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Purpose of Appendix I

The purpose of this appendix is to provide documentation and/or elaboration of information presented in the MSHCP Plan document. For the reader's convenience, the content of the appendix follows the same number system as the Plan. Thus, appendix items referenced in Section 1 of the Plan are found in Section 1 of the appendix, and so on.

Data in this appendix are circa 2003 and have not been updated as part of the Recirculated Plan. This appendix provides background information for certain Plan discussions, but the Recirculated Plan should be relied upon for quantitative information.

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1.0Background, Purpose, Scope, Process, and Regulatory Context

Section 1 of the Plan document describes the background, purpose, scope, and planning process of the Coachella Valley Multiple Species Habitat Conservation Plan/Natural Community Conservation Plan (Plan).

1.1 Public Meetings Held

Development of the Plan has been discussed at a variety of public meetings since 1995. These include Project Advisory Group meetings, CVAG Energy and Environment Committee meetings, CVAG Technical Advisory Committee meetings, CVAG Executive Committee meetings, public forums, Scoping meetings for the EIR/EIS, presentations to individual jurisdictions and entities at public meetings, and public meetings related to trails planning. The Plan, at its various stages of preparation, was discussed at the meetings listed below.

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Project Advisory Group

1997
11-12-97

1998
1-21-98
2-25-98
3-18-98
4-29-98
5-27-98
6-24-98
7-29-98
9-03-98
9-30-98
10-30-98

1999
2-04-99
3-04-99
4-01-99
5-06-99
6-24-99
8-19-99
9-23-99
11-22-99
12-16-99

2000
1-27-00
2-24-00
5-25-00
6-22-00
8-17-00
10-26-00

2001
1-25-01
2-22-01
3-22-01
4-26-01
5-24-01
6-28-01
7-26-01
9-27-01
10-25-01
12-06-01

2002
1-24-02
2-28-02
3-28-02
4-25-02
5-23-02
6-27-02
7-08-02
7-25-02
9-26-02
10-24-02

2003
1-23-03
2-27-03
3-27-03
4-24-03
5-22-03
6-26-03
7-24-03

CVAG Energy and Environment Committee Presentations

1997
12-11-97

1998
2-12-98
3-12-98
5-14-98
7-16-98
9-10-98
11-19-98
12-10-98

1999
1-14-99
3-11-99
9-9-99

2000
1-11-00
1-20-00
2-10-00
3-23-00
5-11-00
6-8-00
7-13-00
9-14-00
11-9-00
12-14-00

2001
1-11-01
2-8-01
3-8-01
4-12-01
6-10-01

2002
3-14-02
9-12-02

2003
1-7-03
7-10-03

CVAG Technical Advisory Committee

1998
5-8-98

1999
1-8-99
3-12-99
4-9-99
9-10-99
11-12-99
12-3-99

2000
1-14-00
1-11-00
4-14-00
5-12-00
6-9-00
7-21-00
10-13-00
11-17-00
12-8-00

2001
3-9-01
4-13-01
5-11-01
6-8-01
9-14-01

2002
2-8-02
5-10-02
6-14-02
9-13-02

2003
1-10-03
4-11-03
6-13-03
7-11-03

CVAG Executive Committee Presentations

1998
9-28-98
10-26-98

1999
1-25-99
9-27-99
12-6-99

2000
1-31-00
2-28-00
4-24-00
6-26-00
7-31-00
9-25-00
10-30-00
12-04-00

2001
3-26-01
4-40-01
9-24-01

2002
2-25-02
7-29-02
9-30-02
1-27-03

2003
2-24-03
6-30-03

EIR/EIS Public Scoping Meetings

7-10-2000 Cathedral City Hall
7-12-2000 La Quinta City Hall

Other Public Meetings

2-20-01	Desert Hot Springs City Council
8-8-01	County of Riverside Planning Commission
9-7-01	BLM Desert Advisory Group
9-26-01	Cathedral City Council
12-01	Riverside County General Plan Advisory Committee
12-01	Santa Rosa San Jacinto National Monument Advisory Committee
4-01-02	Desert Hot Springs City Council
10-10-01	Riverside County Planning Commission
1-16-03	California Resources Agency

Table A3-1: Workshops Held as Part of Trails Planning Process

Public Meetings/Workshops	Date
Trails, Bighorn Sheep and You, Session I Living Desert	January 16, 1997
Trails, Bighorn Sheep & You, Session II Living Desert	June 24, 1999
An Informational Forum: Trails and Bighorn Sheep Palm Springs City Hall	October 26, 1999
Public Scoping Meeting, Notice of Preparation Cathedral City Hall	July 11, 2000
Trails and Bighorn Sheep Working Group Meetings	**Date**
Trails & Bighorn Sheep Working Group	August 19, 1999
Trails & Bighorn Sheep Working Group	September 30, 1999
Trails & Bighorn Sheep Working Group	November 4, 1999
Trails & Bighorn Sheep Working Group	November 23, 1999
Trails & Bighorn Sheep Working Group	December 16, 1999
Trails & Bighorn Sheep Working Group	January 13, 2000
Working Group - New /Perimeter Trails Subcommittee	January 18, 2000
Trails & Bighorn Sheep Working Group	February 10, 2000
Trails & Bighorn Sheep Working Group	March 9, 2000
Working Group - New/Perimeter Trails Subcommittee	March 30, 2000
Trails & Bighorn Sheep Working Group	March 30, 2000
Trails & Bighorn Sheep Working Group	April 20, 2000
Trails & Bighorn Sheep Working Group	October 5, 2000
Trails & Bighorn Sheep Working Group	July 19, 2001
Working Group - New/Perimeter Trails Subcommittee	July 25, 2001
Trails & Bighorn Sheep Working Group	November 8, 2001

The following is a list of experts and participants in the working group and public meetings.

Table A3-2: Participants in the Bighorn Sheep and Trails Working Group

Name	Title	Affiliation
Katie Barrows	Working Group Co-Leader, Associate Director	Coachella Valley Mountains Conservancy
Jim Foote	Working Group Co-Leader, Recreation Specialist	Bureau of Land Management – Palm Springs
Fred Baker	Planning Department	City of La Quinta
Ray Barmore		Coachella Valley Trails Council
Eric Baecht, Ken Church		Coachella Valley Hiking Club
Tom Burks, Nguyen T. Quynh Van		Nellie Coffman School Bicycle Club; Desert Bicycle Club
Paul Campbell		Coachella Valley Trails Council
Kim Clinton	Planning Department	City of Rancho Mirage
Joe Cook	Attendee	Personal use of mountains
John Criste		Terra Nova Planning and Research, Inc.
Melissa Davis		Agua Caliente Band of Cahuilla Indians
David Dawson		City of Palm Springs
Phil Drell	Planning Director	City of Palm Desert
Doug Evans	Planning Director	City of Palm Springs
Diane Freeman	Wildlife Biologist	U.S. Forest Service - Idyllwild
Curtis Galvez		Bureau of Land Management
Carol Gans		Equestrian/Desert Riders
Danella George	Associate Field Manager	Bureau of Land Management – Palm Springs
Wayne Hancock		Building Industry Association – Desert Chapter; KSL Development Corp.
Tom Harney	Member	Riverside County Trails Committee
Jerry Herman	Community Development Director	City of La Quinta
Bill Hillman		Equestrian/Desert Riders
Michael Kellner		Agua Caliente Band of Cahuilla Indians
Jim Kenna	Field Manager	Bureau of Land Management – Palm Springs
Ed Kibbey	Executive Director	Building Industry Association – Desert Chapter
Cynthia Kinser	Planning Director	City of Cathedral City
Bob Leo, Jodi Madigan, Tim Jones		Palm Springs Aerial Tramway
Morgan Levine		Ecotourism/Desert Adventures
Paul Maag	President	Coachella Valley Cycling Association
Matt McDonald	Biologist	U.S. Fish and Wildlife Service – Carlsbad

Table A3-2: Participants in the Bighorn Sheep and Trails Working Group

Name	Title	Affiliation
Steve Nagle	Director of Environ-mental Resources	Coachella Valley Association of Governments
Dan Nove		Riverside County Park and Open Space District
Bruce Poynter		Ecotourism/Desert Adventures
Doug Pumphrey	District Ranger	U.S. Forest Service - Idyllwild
Joel Schultz	Wildlife Biologist	Bureau of Land Management
Joan Taylor	Conservation Chair	Sierra Club
Jeff Winklepleck	Parks Director	City of Palm Desert
Gavin Wright	Wildlife Biologist	Bureau of Land Management – Palm Springs
Michael Young	President	Coachella Valley Hiking Club
Dr. Tim Vail	Attendee	Interested in wildlife and trails
Wildlife Agency Biologists		
Kevin Barry Brennan	Wildlife Biologist	California Department of Fish and Game
Ken Corey	Desert Branch Chief	U.S. Fish and Wildlife Service
Scott McCarthy	Wildlife Biologist	U.S. Fish and Wildlife Service
INVITED EXPERTS PRESENT AT OCTOBER 26, 1999 WORKSHOP		
Dr. Walter Boyce	Faculty member	Department of Veterinary Pathology, Microbiology, and Immunology at University of California, Davis
Tom Davis	Director of Planning	Agua Caliente Band of Cahuilla Indians
Jim DeForge	Executive Director	Bighorn Institute
Mark Jorgensen	Resource Ecologist	California State Parks – Anza Borrego Desert State Park and Mt. San Jacinto State Wilderness
Ray Lee	Wildlife Biologist	Arizona Department of Game and Fish
Stacey Ostermann	Research Biologist	Bighorn Institute
Esther Rubin	PhD candidate	University of California, Davis
Oliver Ryder	Kleberg Chair in Genetics	Center for Reproduction of Endangered Species, San Diego Zoo
Steve Torres	Bighorn Sheep and Mountain Lion Program Coordinator	California Department of Fish and Game

2.0Plan Area Profile

There is no information in this Appendix relevant to Section 2 of the Plan.

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3.0Plan Development

This section of the Plan document describes the development of the Plan, including the conservation planning methodology, the species and natural communities addressed in the Plan, the mapping process used to identify areas of high conservation value, the review by a group of independent scientists, and the alternatives considered. The resulting conservation plan is described in Section 4 of the Plan document.

3.1 Composition and Role of the Scientific Advisory Committee (SAC)

As noted in Section 3.1.1 of the Plan, the development of this Plan placed major emphasis on the integration of defensible science throughout all phases of the planning process. Indeed, recommendations on how to improve the HCP process by various reviewers focus on incorporating state-of-the-art, independent biological expertise (Thomas 2001, Kareiva et al. 1999; Defenders of Wildlife 1998; Anderson and Yaffee 1998). Biological expertise was incorporated in this Plan primarily through the establishment of a Scientific Advisory Committee (SAC) and through continuous liaison with knowledgeable experts. The SAC was established as a subcommittee to the Project Advisory Group (PAG) to provide biological and ecological oversight in the development of the conservation plan. After completion of the Scoping Study and initiation of the formal HCP/NCCP process, the SAC continued as an integral part of Plan development.

The SAC is composed of local biologists with knowledge of the target species and ecological systems within the Plan Area. In particular, biologists from the Center for Natural Lands Management and the University of California Natural Reserve System attended virtually every meeting and effectively functioned as the core of the SAC. In addition, agency biologists from BLM, the National Park Service, U.S. Forest Service, and the Coachella Valley Water District, and one non-biologist who provided liaison with the PAG, participated in the SAC. USFWS and CDFG biologists also attended most SAC meetings. The SAC met on an approximately monthly basis. A list of the core members of the SAC and all others who participated at some time in SAC meetings is given in Table A3-3.

The SAC was charged with developing a recommendation for a biologically based conservation plan for the protection of the Covered Species and conserved natural communities in the Plan. The SAC worked in collaboration with staff from the Coachella Valley Mountains Conservancy, as the consultant drafting the Plan, the agency biologists, and other meeting participants. The SAC ultimately reviewed all aspects of the biological elements of the Plan, but the focus of their efforts was on the following tasks:

1. Compilation of data on all species under consideration for coverage in the Plan.
2. Identification and mapping of natural communities within the Plan Area. In particular, the core SAC members assisted in delineation of sand dune/sand field types.
3. Identification and mapping of ecosystem processes, including sand transport systems.
4. Development and review of species distribution map methodology. Review all species distribution maps (including numerous iterations since initial maps).
5. Assist in design of Site Identification methodology. Once the initial Site Identification Process was established, the SAC reviewed and evaluated iterations of the analysis.
6. Definition and development of key concepts including Core Habitat, corridors and linkages. Consistent with their area of expertise, SAC members assisted with the mapping of Core Habitat for particular species.
7. Development of Reserve Design Criteria.
8. Review and evaluation of iterations of proposed conservation alternatives, using Reserve Design Criteria.
9. Development of and justification for Conservation Alternative 2.
10. Development of and justification for the Preferred Alternative, prior to review by wildlife agencies and jurisdictions.

Table A3-3: Participants in the Scientific Advisory Committee

Name	Title	Affiliation
CORE SCIENTIFIC ADVISORY COMMITTEE MEMBERS		
Cameron Barrows	Regional Director	Center for Natural Lands Management
Mark Fisher	Biologist	University of California, Deep Canyon Desert Research Center
Al Muth	Director	University of California, Deep Canyon Desert Research Center
AGENCY BIOLOGISTS		
Rob Bundy (1998-1999)	Refuge Biologist	U.S. Fish and Wildlife Service CV National Wildlife Refuge
Roland DeGouvenain (1996-1997)	Botanist	Bureau of Land Management Palm Springs Field Office
Diane Freeman (1996 to 12/00)	Wildlife Biologist	U.S. Forest Service Idyllwild Ranger District
Patricia Locke-Dawson (1997)	Wildlife Biologist	Bureau of Land Management Palm Springs Field Office
Rachelle Huddleston - Lorton (1/01 to 7/03)	Wildlife Biologist	Bureau of Land Management Palm Springs Field Office
Don Mitchell (6/00 to 1/03)	Biologist	Coachella Valley Water District

Table A3-3: Participants in the Scientific Advisory Committee

Name	Title	Affiliation
Anne Poopatanapong (As of 1/01)	Wildlife Biologist	U.S. Forest Service Idyllwild Ranger District
Rich Thiery (Prior to 12/99)	Biologist	Coachella Valley Water District
Gavin Wright (through 2000)	Wildlife Biologist	Bureau of Land Management Palm Springs Field Office
REGULATORY WILDLIFE AGENCY STAFF		
Sherry Barrett	Assistant Field Supervisor	U.S. Fish and Wildlife Service Carlsbad Field Office
Caitlin Bean	Staff Environmental Scientist	California Department of Fish and Game
Glenn Black	Senior Environmental Scientist	California Department of Fish & Game
Marina Brand	Environmental Specialist	California Department of Fish & Game
Kevin Barry Brennan	Associate Biologist	California Department of Fish & Game
Ken Corey	Desert Branch Chief	U.S. Fish and Wildlife Service Carlsbad Field Office
Jim Dice (thru 12/00)	Botanist	California Department of Fish and Game
Brenda Johnson	Staff Environmental Scientist	California Department of Fish and Game
Eddy Konno	Associate Biologist	California Department of Fish and Game
Debbie McAller (prior to 8/00)	Botanist	U.S. Fish and Wildlife Service Carlsbad Field Office
Brenda McMillan (1997 only)	Biologist	U.S. Fish and Wildlife Service Carlsbad Field Office
Kim Nicol	Senior Environmental Scientist	California Department of Fish and Game
Alan Pickard	Deputy Regional Manager (Environmental Program Manager)	California Department of Fish and Game
Ron Rempel	Deputy Director, Habitat Conservation	California Department of Fish and Game
Pete Sorensen	Division Chief	U.S. Fish and Wildlife Service Carlsbad Field Office
Dee Sudduth	Deputy Regional Manager	California Department of Fish and Game
PLAN PREPARATION TEAM		
Katie Barrows	Associate Director	Coachella Valley Mountains Conservancy

Table A3-3: Participants in the Scientific Advisory Committee

Name	Title	Affiliation
John Criste	EIR/EIS Consultant	Terra Nova Planning
Bill Havert	Executive Director	Coachella Valley Mountains Conservancy
Ingrid Johnson	GIS Specialist	Bureau of Land Management Palm Springs Field Office
Larry LaPre	Biological Consultant	AMEC Environmental
Jim Sullivan (Steve Nagle before 12/00)	Dir. of Environmental Resources	Coachella Valley Association of Governments
Richard Tull	GIS	Coachella Valley Association of Governments
Brian Vanko, Nathan Mendenhall, Nick Peihl	GIS	Coachella Valley Association of Governments
OTHER OCCASIONAL PARTICIPANTS IN SAC MEETINGS & WORKSHOPS		
Gillian Bowser (1997-1998)	Biologist	Joshua Tree National Park
Dick Crowe	Project Director	BLM – Northern & Eastern Colorado Desert Plan
Doug Evans (prior to 2000)	Planning Director	City of Palm Springs
Kevin Hansen (prior to 12/00)	Dos Palmas Preserve Manager	Bureau of Land Management Palm Springs Field Office
Cheryl Hickam (1996 to 1997)	GIS Specialist	BLM – California Desert District Office
Henry McCutcheon	Resources Chief	Joshua Tree National Park
Kevin O'Connor	Biologist	California Dept. of Fish and Game
Nanette Pratini	GIS Specialist	University of California, Riverside & BLM – Desert District Office
Dr. Laszlo J. Szijj	Professor of Biological Sciences	Cal Poly University – Pomona (for Torres Martinez Indians)
Joan Taylor	Conservation Chair	Sierra Club San Gorgonio Chapter
Genea Warner	Project Assistant	BLM – Northern & Eastern Colorado Desert Plan
BIOLOGISTS CONSULTED DURING PROCESS		
Greg Ballmer	Entomologist	Dept. of Entomology University of California, Riverside
Betsy Bolster	Biologist – Bats	California Department of Fish & Game
Jim Cornett	Natural Science Curator	Palm Springs Desert Museum Palm Springs, CA
Jim DeForge	Executive Director	Bighorn Institute Palm Desert, CA

Table A3-3: Participants in the Scientific Advisory Committee

Name	Title	Affiliation
Shana Dodd	Biological Consultant - PS Pocket Mouse	S.C. Dodd Biological Consulting San Diego, CA
Mark Dodero	Biological Consultant - PS Ground Squirrel	RECON San Diego, CA
Dave Hawks	Biological Consultant - invertebrates	Hawks Biological Consulting
George Helmkamp	Amateur Botanist	Morongo Valley, California
Bob James	Biologist	U.S. Fish and Wildlife Service Carlsbad, CA
Mark Jorgensen	Biologist	Anza Borrego Desert State Park Borrego Springs, CA
Sharon Keeney	Biologist - Desert Pupfish	California Dept. of Fish & Game Indio, CA
Ed LaRue	Biological Consultant	BLM – Northeastern Mojave Desert Plan
Jeff Lovich	Biologist	Biological Resources Division U.S. Geological Service
Chet McGaugh	Biological Consultant - Birds	Tierra Madre Consultants Riverside, CA
Robert McKernan	Curator of Biology	Dept. of Biology San Bernardino County Museum
Steve Myers	Biological Consultant - Birds	Tierra Madre Consultants Riverside, CA
Will Miller	Biologist	U.S. Fish and Wildlife Service Carlsbad, CA
Stacey Ostermann	Biologist	Bighorn Institute Palm Desert, CA
Nanette Pratini	GIS Specialist	Bureau of Land Management Riverside, CA
Gordon Pratt	Entomologist	Dept. of Entomologist University of California, Riverside
Esther Rubin	Researcher - Bighorn Sheep	University of California, Davis
Andrew Sanders	Botanist Herbarium Curator	Herbarium University of California, Riverside
Marcus Speigelberg	Biological Consultant (now with CNLM)	RECON San Diego, CA
INVITED EXPERTS CONSULTED DURING PROCESS		
Nick Lancaster	Research Professor	Desert Research Institute Reno, NV
Reed Noss	Ecologist and Conservation Biologist	Conservation Biology Institute
Howard Snell	Professor of Biology	Department of Biology University of New Mexico

Table A3-3: Participants in the Scientific Advisory Committee

Name	Title	Affiliation
Michael Soule	Conservation Biologist	
C. Richard Tracy	Professor of Biology and Director	Biological Resources Research Ctr. University of Nevada, Reno
John Rotenberry	Professor of Biology	Department of Biology University of California, Riverside
John Willoughby	State Botanist	Bureau of Land Management

In addition to local experts and agency biologists who regularly attended SAC meetings, other scientific experts were consulted at various stages during the Plan development process. Due to the commitment of time necessary to participate regularly in SAC meetings, some of the individuals with expertise on a given species or taxonomic group were not available on an ongoing basis. Efforts to involve these individuals occurred at workshops convened by the SAC throughout the Plan development process. Staff from the Coachella Valley Mountains Conservancy made visits to selected experts at various times throughout the Plan preparation process as well.

In 2000 a team of scientists was engaged to prepare a hydrology report focusing on the sand source/sand transport system for two areas: 1) the Whitewater Floodplain Preserve, and 2) the Willow Hole/Edom Hill and Flat Top Mountain areas. A copy of the resulting report, Long-term Sand Supply to Coachella Valley Fringe-toed Lizard (*Uma inornata*) Habitat in the Northern Coachella Valley, California (United States Geological Survey, 2002), is available for review at CVAG.

During the planning process, a number of workshops were convened to bring in experts to provide review and recommendations for various elements of the conservation plan. A list of workshops held is given in Table A3-4.

Table A3-4: Workshops Held as Part of Planning Process

Workshop Title	Date
Reserve Design and Connectivity Criteria Workshop	November 14-15, 1996
Species Distribution and Conservation Needs Workshop	September 23-25, 30, 1997
Gap Analysis and Reserve Design Workshop	March 25-27, 1998
Reserve Design and Conservation Planning Workshop	April 21-22, 1998
Essential Habitat Boundary for Peninsular bighorn sheep	March 2, 2000
Ecological Monitoring and Adaptive Management Workshop	November 28, 2000

Early in the process, the SAC convened a Reserve Design and Connectivity Criteria Workshop to obtain input from three noted conservation biologists: Reed Noss, Michael Soule, and C. Richard Tracy. This workshop was focused on receiving input and direction from these conservation biologists with respect to the recommended approaches to reserve design, target species selection and habitat modeling, and a wide range of topics related to HCP development. In September 1997, the SAC invited biologists with expertise on a given species or taxonomic group to provide input on the status and distribution of proposed target species; these experts reviewed known location maps and very preliminary species distribution maps. This workshop was very useful in gathering available information on the distribution of proposed target species.

In April 1998, the SAC scheduled another workshop, the Reserve Design and Conservation Planning Workshop, with the three conservation biologists listed above. Prior to this workshop, the SAC met in late March of 1998 to review the results of the Gap Analysis and the preliminary Site Selection and Reserve Design analyses. This workshop, which primarily involved SAC members, wildlife agency biologists, and other interested individuals, provided a review of the reserve design process that would be presented to the conservation biologists in April.

At the April 1998 workshop, a preliminary presentation of the site selection and reserve design program was made. The results of the first run of the quantitative site selection algorithm were presented to the conservation biologists and other workshop participants. The objectives of this workshop were to obtain peer review and input from conservation biologists on the conservation planning methodology, including species habitat modeling, gap analysis, site selection and evaluation, and related reserve design issues. The conservation biologists provided significant input regarding additional data and analyses that would enhance the conservation planning methodology, selection, and design of the proposed reserves.

In March 2000, the CVMC invited city/county planning directors, agency biologists, landowners, and other interested persons to provide input on a map delineating the essential habitat boundary for the Peninsular bighorn sheep. The essential habitat line defines the area within which the recovery plan for bighorn sheep will

In November 2000, the SAC invited individuals with expertise in biological monitoring to an Ecological Monitoring and Adaptive Management Workshop. These experts provided important input and recommendations prior to the development of a Draft Ecological Monitoring and Adaptive Management Plan.

The core members of the SAC demonstrated an exceptional level of commitment to the planning process, devoting their time outside of SAC meetings to make site visits to various locations during the reserve design process, providing assistance in the identification and delineation of species' habitat parameters, ecosystem processes, and other significant features in the GIS mapping effort, and making themselves available to review map products and draft documents whenever necessary. In addition, other scientists listed above, including workshop participants and individuals with particular species expertise, graciously made themselves available whenever their input was requested.

3.2 Conservation Planning Methodology

3.2.1 Best Available Science Standard

From the outset, a goal was established to base the preparation of this Plan on a strong foundation of scientific data and ecological principles. The importance of establishing a baseline of scientifically credible data has been emphasized in several recent reviews of the HCP process (Noss et al. 1997, Hood 1998, Harding et al. 2001). The USFWS addresses the need for use of the "best available" science in their policy documents on HCP preparation, including the Habitat Conservation Planning Handbook (USFWS and NMFS 1996). This handbook calls for the availability of up-to-date biological information on the species being considered within the Plan Area. It also recognizes, however, that for habitat-based HCPs the protection of habitat types for a particular species through an HCP and associated mitigation program may obviate the need for additional distribution studies. The California Natural Communities Conservation Plan (NCCP) guidelines state as a criterion: "The plan provides a conservation strategy that is based on recognized principles of conservation biology, as well as the best available scientific information about species and habitats."

In the initial phases of this Plan's development efforts were focused on gathering all available information on the Covered species and conserved natural communities. The effort to obtain and review up-to-date biological information was ongoing throughout the preparation of the Plan.

The SAC and the Planning Team used the best available scientific data in developing a recommended conservation plan. There were, however, some constraints that had to be acknowledged and dealt with. One constraint was the ability to conduct biological surveys in all desired areas. Two factors combined to pose limits: available funding and lack of permission from some landowners to conduct surveys on their property. Within those limits, surveys were conducted for species for which the existing data were believed by the SAC to be inadequate. Surveys for each of these species were conducted in locations where biologists with expertise in the species believed the habitat was suitable. The locations were also selected to reflect the likely limits of distribution of the species in the Plan Area. A list of these field surveys is given in Section 3.4 of this appendix. An additional constraint was the fact that appropriate conditions for annual plant species occur only in years with appropriate amount and timing of rainfall. In most years there is minimal or no germination of the annual plant species to be covered in the Plan.

Constraints existed for the analytical process as well. Population Viability Analyses (PVAs) did not exist, and the available data would not support preparation of PVAs for the species being covered. Nor did the Plan preparers have the technical expertise or budget to use sophisticated GIS programs or models to assess the biological resource value of each unit of land, regardless of scale, in the Plan Area. As noted below, a coarse filter approach was employed, with emphasis on protecting the Core Habitat areas for target species, the processes that sustain them, and protecting linkages to maintain connectivity. The Plan also provides for natural community conservation.

Notwithstanding the limits on available data and analytical methods, the Plan preparers believe that the expertise of the SAC and other biologists who contributed information, combined with the conservation focus described in the preceding paragraph, have generated a functional Plan that will conserve the Covered Species and conserved natural communities in the Plan. In providing a thorough critique of the Plan, the Independent Science Advisors' Review of the Plan, dated April 13, 2001 (Noss et al. 2001), did "commend the Scientific Advisory Committee (SAC) and others who contributed to the Draft Plan for producing what is sure to be one of the most scientifically defensible and thorough HCPs or NCCPs ever developed." (See Section 3.3 in this appendix for a description of the Independent Science Advisors and their report.)

3.2.2 Planning Objectives and Key Concepts

As noted by Beatley (1994) the HCP process generally involves a central strategy of identifying and protecting certain high value habitat areas. Within this central strategy, greater emphasis has been placed on planning beyond the single-species level to concentrate on ecosystem-based planning (Noss et al. 1997; O'Connell 1997; Margules and Pressey 2000; The Nature Conservancy 2000). Within the framework of HCP and NCCP guidelines, this Plan was designed to emphasize ecosystem-level conservation. Indeed, the ecosystems of the Coachella Valley, including the dynamic sand dunes on the valley floor, essentially required that the participants in this Plan look beyond protection of the habitat for a given suite of species. The character of these dynamic ecosystems required that ecosystem processes, including large-scale disturbance events including flooding and sand transport, be incorporated into the conservation plan. As described below, the Planning Team incorporated planning at various levels of biological organization, using both a coarse and a fine filter approach, and employing certain key concepts described below.

3.2.2.1 Planning at Species, Community, and Ecosystem Levels

The multiple species concept embraces the need to go beyond the habitat needs of a single species to look at other levels of biological organization at which targets for conservation could occur. In their handbook on ecoregional conservation planning, the Nature Conservancy (2000) emphasizes the importance of planning at multiple spatial scales and multiple levels of biological organization. This Plan incorporates these three levels of biological organization: species, terrestrial ecological communities, and ecological systems. The identification of these levels is central to the coarse filter approach discussed below. For this conservation plan, the term natural communities is used to describe terrestrial ecological communities; these natural communities are named based on plant community types defined at the "plant association level" (Nature Conservancy 2000, Sawyer and Keeler-Wolf 1995). The ecological systems, or landscape level, element of this plan is perhaps its most significant feature, in that this is the level at which ecosystem processes are incorporated. The Planning Team identified ecological system elements including both biotic (such as individual species life history characteristics) and abiotic (particularly sand source/sand transport and hydrological processes) components as targets for conservation. This emphasis on natural community and ecosystem-level planning is consistent with the theoretical basis for the NCCP program (Noss et al. 1997), and the NCCP element of this Plan. These levels of biological organization are also used in the Monitoring and Adaptive Management Plan, in which three levels of monitoring are addressed including species-specific, habitat-natural community, and landscape or ecosystem.

3.2.2.2 Coarse Filter and Fine Filter Approach

The Nature Conservancy developed the concept of coarse and fine filters in conservation planning (Noss 1987; Noss and Cooperrider 1994) in response to the sometimes inefficient and ineffective species-by-species approach (Noss et al. 1997). The "coarse-fine filter strategy" is described as a working hypothesis that assumes conservation of multiple, viable examples of all coarse-filter targets (communities and ecological systems) will also conserve the majority of species (The Nature Conservancy 2000). To work as coarse filters, ecological communities and ecosystems must be conserved as part of dynamic, intact landscapes, with some level of connectivity between them, and be represented across environmental gradients to account for ecological and genetic variability. The fine filter approach focuses on those species, such as very rare, extremely localized, or narrowly endemic species, that cannot be reliably conserved with the coarse filter approach (The Nature Conservancy 2000). The SAC adopted this strategy early in the process as part of a general approach for conservation planning. The adoption of this strategy was based on several considerations, notably that the coarse filter would better incorporate the ecological processes and landscape level features that are significant to the target species, and that limitations on data would make it difficult to accomplish fine filter planning for many of the species. The Planning Team recognized that conserving adequate portions of natural communities, including the ecological and physical processes that sustain them, would reduce the need for detailed studies and population viability analyses for individual species.

Some examples of species requiring a fine filter approach include the Palm Springs pocket mouse, Coachella Valley round-tailed ground squirrel, and triple-ribbed milkvetch. Species for which the coarse filter approach is appropriate include the riparian birds, gray vireo, burrowing owl, Coachella Valley Jerusalem cricket, and Le Conte's thrasher.

3.2.2.3 Key Concepts

The process of designating areas of high biological value that were incorporated into the reserve design process, and ultimately into the conservation plan, was based on a number of key concepts identified by the SAC. These key concepts were used to identify and to evaluate potential conservation areas.

The SAC's intention was to preserve multiple Core Habitat areas for each species. Each Core Habitat area was assessed for viability (adequate size, intact natural processes, appropriate corridors) to the extent possible. For those species within the aeolian sand system each site had a discrete sand source. Having multiple, discrete sites provided assurance that catastrophic climatic or environmental events would be unlikely to decimate all populations of target species. Within the multiple-site requirement the SAC also attempted to include the current range of climatic and elevation conditions occupied by each species. Conserved areas in both the cooler, wetter, western end of the Plan Area, and the hotter, drier, central-eastern end of the Plan Area were included to provide the range of conditions a given species inhabits. Therefore the likelihood is increased that some refugia for each of the species will be maintained if climatic conditions change over time. In this section these key concepts will be defined as they pertain to the Plan, especially in the Core Habitat selection and assessment process.

Core Habitat. As defined by the SAC, Core Habitat for a given species is a habitat patch or aggregation of habitat patches that (1) is of sufficient size to support a self-sustaining population of that species, (2) is not fragmented in a way to cause separation into isolated populations, (3) has functional Essential Ecological Processes, and (4) has effective Biological Corridors and/or Linkages to other habitats, where feasible, to allow gene flow among populations and to promote movement of large predators.

Population Viability. Core Habitat must contain enough individuals of a target species to assure a high probability of long-term survival (viability). It must surpass the minimum (effective) population size below which extinction is likely in the short term (Soulé and Simberloff 1986). The scant data available for any of the target species covered in the Plan precluded doing a Population Viability Analysis (PVA; Gilpin and Soulé 1986) because the lack of solid data to establish estimating parameters for the PVA causes uncertainty in extinction predictions (Taylor 1995). Thus the SAC assessed the criterion of viability in the context of habitat patch size. In particular, the SAC assessed whether the habitat patch is of sufficient size to maintain a viable population of the target species. Four factors affect the viability of populations: 1) genetic factors that, through chance events, affect negatively the ability of a population to adapt to a changing environment (founder effect, inbreeding depression, random fixation); 2) demographic factors (e.g., sex ratio, reproductive output, age at sexual maturity); 3) environmental factors, whether relatively short-term (drought or flood) or long-term (climatic change or changes in habitat characteristics); and 4) natural catastrophes such as fire. Genetic and demographic factors are inherent to small populations (Roughgarden 1975; Shaffer 1981, 1985, 1987; Soulé 1980, 1987; Lande and Barrowclough 1987). The SAC attempted to ensure viability by preserving a sufficiently large population in each Core Habitat area to overcome extinctions caused by chance genetic or demographic events, and to negate the chance of extinctions caused by environmental factors or natural catastrophes by creating multiple Core Habitat areas for each target species.

Soulé (1987) proposed that a minimum population size in the low thousands would be needed to support a viable population of vertebrates for several centuries. Thomas (1990) proposed a target of a geometric mean of 5,500 individuals. Insufficient data for nearly all target species allowed calculation of neither geometric mean population sizes nor static population estimates. So the SAC, using the minimum viable population sizes of Soulé (1987) and Thomas (1990) as a guide, decided that the habitat must be of sufficient size to contain at least 5,000 to 10,000 individuals of a target species to satisfy the criterion requiring that Core Habitat be able to support a viable population for that species. This does not mean that Core Habitat was delineated based on this population size range but, instead, potential Core Habitat was first delineated on the basis of habitat size and shape (low perimeter to area ratio) and secondarily assessed to see if it satisfied the viability criteria by supporting 5,000 to 10,000 individuals. Estimating population size involved using the best estimates of experts based on known densities or on short-term trapping or sighting data. In addition to Core Habitat, some small populations of many target species are found in habitat that was preserved for other purposes (e.g., sand source areas, Core Habitat for a different species). Although their ability to persist long term is less certain, these populations may enhance the genetic variability of nearby Core Habitat areas (Gilpin 1987).

Multiple Core Habitat Areas. Management can never foresee catastrophic events and thus assure the survival (probability = 1.0) of any population (Shaffer 1990). A single site may be susceptible to destruction by catastrophic climatic or environmental events (e.g. fire). Protecting multiple unconnected environments is a way of maximizing the likelihood that some populations will persist as not all will be affected, or affected equally, by the event (Soulé 1987). Margules and Pressey (2000) recommend preserving "at least three occurrences of each species." In light of this, the SAC identified multiple, discrete Core Habitat areas for each target species, where practicable. By discrete the SAC implies that the sites are geographically, climatically, or ecologically distinct. Each Core Habitat area has intact ecological processes with discrete sources. With the multiple-site requirement the SAC also attempted to include the current range of climatic and environmental conditions occupied by each species. So to satisfy the population viability criterion, a Core Habitat area must have a large population size, and there must be three or more of these Core Habitat areas whenever possible.

Ecosystem Processes. To be considered Core Habitat according to the SAC's criteria, the habitat must have intact ecological processes. Information about the habitat requirements of each species, and the ecological processes that maintain these habitats, was assembled from literature sources, field studies, and consultation with experts.

Community ecologists focus on the minimum area required for preservation, whereas population biologists focus on the minimum population size or density required for the long-term survival of a species. The two are intimately interrelated; to have long-term viability necessitates protecting a species' habitat, and to protect habitat requires the ecological processes be intact. To best protect ecological processes, as much habitat as possible should be protected, as well as non-habitat areas (for the target species) that directly or indirectly affect that habitat (e.g., watershed areas or sand source areas). To this end, substantial portions of each natural community are to be preserved.

A central goal of this Plan is to ensure the protection of important ecological processes that maintain the natural communities and habitat for target species. Many ecological processes are relevant in this regard but the Plan placed special significance on protection of sand source/sand transport systems for the aeolian sand habitats and of hydrological processes that are significant to many of the natural communities, in particular riparian areas, mesquite hummocks, desert fan palm oases, and desert dry wash woodlands. Sand transport systems and hydrological processes are discussed in greater detail below.

Natural communities ranging in elevation from toe-of-slope up to the upper limit of the bighorn sheep habitat (approximately 4600 feet) will be protected by the Plan. Habitats above this elevation are offered high to moderate protection by the Plan as they occur on primarily public lands. These public land areas, many designated as wilderness, provide the large size and connectivity required to protect communities at the landscape level. Target species that live in habitats encompassed by this mosaic of hillside habitats will likewise be protected (e.g. riparian species: least Bell's vireo, southwestern willow flycatcher, summer tanager, yellow-breasted chat, and yellow warbler).

Below the hillside habitats protected by the Plan lie the aeolian sand habitats, the natural communities most endangered by development and other anthropogenic disturbances in the Coachella Valley. The following natural communities comprise the aeolian sand habitat: active desert dunes, stabilized and partially stabilized desert dunes, active desert sand fields, ephemeral desert sand fields, stabilized and partially stabilized desert sand fields, stabilized shielded desert sand fields, and mesquite hummocks. Those communities categorized as "shielded" have disrupted ecological processes. The aeolian sand system in the Coachella Valley has been described by various studies (Turner et al. 1981; The Nature Conservancy 1985; Lancaster et al. 1993; Meek and Wasklewicz 1993; Wasklewicz and Meek 1995; Barrows 1996, USGS 2002).

Sand Source and Sand Transport Processes. The abiotic ecological processes that drive the aeolian sand habitat extend far beyond the actual habitat and require both a sand source and strong prevailing winds. The source for the blowsand is the erosion of the mountains and hills that surround the valley. Weathering frees sediment and washes it downstream, eventually intersecting an area where fluvial dispersal is replaced by aeolian dispersal. The sediment that arrives on the valley floor contains particle sizes ranging from fine silts and clay through sands and gravels to cobbles and large rocks. High winds sort the sediment; transportability of the differently sized particles is revealed as a positive correlation between wind energy and particle mass. Fine soils like silt and clay are carried aloft and, remaining suspended, are carried away from the region. Sand-sized particles are dispersed downwind during periods of strong winds. Gravels, cobbles, and rocks remain in the sorting area. The San Gorgonio Pass constricts the dominant northwest winds, increasing wind velocity (energy) through the valley and causing the strong, characteristic winds in the vicinity of the pass. Downwind (east and southeast) from the pass, the wind velocities lessen. This means that the stronger winds nearer the pass can carry larger, heavier particles than can winds farther down valley, and larger particles are deposited at the point where the wind no longer has sufficient energy to move them. Thus, average sand particle size decreases with increasing distance from the pass. Downwind from a source area is a transport corridor in which, over the long-term, the wind regime can transport more sand than is normally available to it. Farther downwind, the sand-carrying capability of the wind decreases, and more sand is available than can be transported, resulting in a net accumulation of sand in the depositional area. Periodic influx of new sand in the depositional area maintains an unstable surface.

Any portion of this aeolian sand system can be interrupted. The fluvial portion can be interrupted by flood control structures that impound or divert sediment-laden floodwaters. Barriers in the sand transport corridor can impound sand and block the wind. A barrier creates a leeward wind shadow that extends a distance of roughly ten times the height of the barrier before wind velocities at ground level approach the magnitude of those on the windward side of the barrier. This leads to a gradual depletion of leeward sand, eventually stabilizing the surface.

The blowsand regions in the valley are supplied by myriad sources. The following summary of the aeolian sand habitats, categorized by Conservation Area, describes their primary sand sources and sand transport routes. The Preferred Alternative Conservation Area containing each is named parenthetically, where applicable.

- Snow Creek/Windy Point Conservation Area. This is the westernmost extreme of aeolian habitat in the Coachella Valley. Coastal influence makes this area cooler and wetter than other blowsand habitat, and its proximity to the pass gives it higher velocity winds. The primary sand sources are the San Gorgonio River to the west and the Whitewater River at its confluence with the San Gorgonio River near, Windy Point. Both rivers have their origin in the San Bernardino Mountains; lesser sources occur in smaller canyons in both the San Bernardino and the San Jacinto ranges. Sand that reaches the riverbed from these sources is blown to adjacent habitat by the predominantly west winds, or is carried downstream by floods to supply other habitat areas.

- Whitewater Floodplain Conservation Area. This transport and deposition area is supplied by sediment-laden floodwaters in the Whitewater River that breach the "sugar dikes" at the Coachella Valley Water District settling ponds, just east of Windy Point. These sugar dikes are designed to shunt small flows into the settling ponds, but break away in high volume floods > 500 c.f.s. (Don Mitchell, Coachella Valley Water District, pers. comm.). Floods deposit their sediment load east of the settling ponds, where sand is then transported east onto the Whitewater Floodplain Preserve by the prevailing west winds. In the western portion the wind can transport more sand than is available to it in most years, resulting in sand accumulating only on the lee side of shrubs (accretion dunes or hummocks). To the east, the wind velocity decreases slightly, and these sand accretions periodically coalesce into sand fields (ephemeral sand fields). A secondary sand source for this area is Mission Creek, which transports sediment fluvially from the eastern San Bernardino Mountains. Mission Creek will be protected by the Plan as a sand transport system. The 300-foot total width will allow channel widening, if necessary, albeit with the stipulations that a soft bottom is retained and no debris basins or settling ponds are built. The primary sand transport system, the Whitewater River channel, will be protected as a fluvial sand source from the Snow Creek/Windy Point Conservation Area to where the river channel crosses Indian Avenue on the western edge of the Whitewater Floodplain Preserve.

- The Big Dune. This is the historical terminus for most sand originating from the San Gorgonio and Whitewater River sand sources. Historically, strong episodic winds from the west-northwest transported sand across the Whitewater Floodplain then deposited it where the wind velocity decreased away from the San Gorgonio Pass, forming the large sand pile that comprises the so-called Big Dune. Presently, the sand transport system is permanently blocked by development upwind, so the region is undergoing the slow process of stabilization. The Nature Conservancy (1985, figure II-6) identified it as a "shielded or stabilized area due primarily to urban development (roads, buildings, canals, dikes)." In addition to the lack of an intact sand source, the region is highly fragmented by roads. The largest undeveloped plot that is not divided by two to four-lane roads contains 273 hectares (674 acres). This area is not included in the Preferred Alternative.

- Willow Hole and Edom Hill Conservation Areas. Fault-dammed ground water at the Banning branch of the San Andreas Fault supplies water to honey mesquites. These shrubs impound blowsand, forming hummocks and a portion of the mesquite hummock natural community. The Nature Conservancy (1985) identified three sand source areas for Willow Hole-Edom Hill. The Morongo Wash source supplies sand from the west, and the Willow Hole and Long Canyon watersheds drain through the preserve from north to south. Morongo Creek carries sediment originating in the Little San Bernardino Mountains in Morongo Canyon. Long Canyon also originates in the Little San Bernardino Mountains. The Willow Hole watershed originates in the western Indio Hills and acts to redeposit sand into the Willow Hole area after being carried out by prevailing winds. Additionally, aerial photographs reveal that the Morongo Wash source is augmented by sediment from Mission Creek, which has the San Bernardino Mountains as its source. These sand transport routes, as well as the Willow Hole watershed, are to be protected by the Plan. Mission Creek and Morongo Wash will include 150 feet on each side of the midline of each wash; Long Canyon will be protected with a flood control levee on the west side, along Mountain View Road and without a flood control barrier on the east side. The entire Willow Hole watershed is contained in a portion of the Indio Hills that will be protected.

- Flat Top Mountain—Stebbins Dune (portion of Willow Hole Conservation Area). This area immediately south of Willow Hole had historically three major sand sources. Blowsand that was transported across the northern portion of the Whitewater River floodplain area (just south of Garnet Hill) continued east over the top of Flat Top Mountain. It, along with sand from the other sources, formed a veneer over Flat Top such that it resembled a large dune (Donald Weaver, pers. comm.), with extensive drift deposits on the lee side. But in the early 1960s, the Southern Pacific Railroad planted tamarisk trees to protect their equipment from windblown sand. These trees blocked the sand transport system from this source (Turner et al. 1981, 1983). The two other sources are Mission and Morongo Creeks. These two washes provide sand to the area between I-10 and the Banning branch of the San Andreas Fault, from where prevailing winds transport it around the north end of Flat Top Mountain, then southwest to Stebbins Dune. The fluvial transport routes of Mission and Morongo Creeks, as well as the aeolian transport area south of the fault line, are to be preserved by the Plan.

- Thousand Palms Conservation Area. The dunes within the Thousand Palms Preserve are supplied by two major sources, from Thousand Palms Canyon and from sand-bearing alluvium in the Indio Hills, west of Thousand Palms Canyon. Donald Weaver, in a short-term study for The Nature Conservancy (1985), estimated mean annual supply of sand by the drainages in the Indio Hills and concluded that Thousand Palms Canyon supplies the majority of sediment to the dunes within the Thousand Palms Preserve. However, subsequent studies of aerial photos (Lancaster et al. 1993), geochemical composition (Meek and Wasklewicz 1993; Wasklewicz and Meek 1995), and enhanced satellite imagery (Cameron Barrows, pers. comm.) have determined that drainages west of Thousand Palms Canyon, in the Indio Hills, supplied most of the sand that is present today. These drainages are to be included in the Plan as sand sources, and a proposed flood control structure is designed to direct sediment-laden floodwaters to a sorting area directly upwind of the Preserve. The Thousand Palms Canyon sand source remains intact under the Plan.

- East Indio Hills Conservation Area. The sand source and transport systems to the west of this area (Whitewater River, Mission and Morongo Creeks, Thousand Palms Canyon, etc.) are blocked by development upwind. This leaves only the sand sources in the adjacent Indio Hills and the Little San Bernardino Mountains to supply all the sand for this area (see Independent Science Advisors' Review, Noss et al. 2001). The viability of the remaining aeolian sand habitat here is uncertain.

Habitat Fragmentation. Another criterion that must be satisfied for a Covered Species' habitat to be considered core is that it must not be fragmented: there can be no impervious barriers to target animal movement, or to pollinators or seed dispersal agents of target plants. Effective barriers lead to genetic differentiation among isolated populations, diminish recolonization ability, and decrease the effective size of the population leading to a decrease in viability (Soulé 1986). Habitat can be fragmented by roads or by unsuitable habitat.

The negative effects of roads on species in adjacent communities have been well documented (for review, see Trombulak and Frissell 2000). Roads as barriers are species-specific in their effectiveness to exclude species; this effectiveness as a barrier is linked to road width and traffic volume. Even relatively narrow, lightly traveled roads have been demonstrated to be significant barriers to some arthropods (Mader 1984; Mader et al. 1990; Seibert and Connover 1991), and to some small rodents (Merriam et al. 1989; Oxley et al. 1974; Swihart and Slade 1984). Isolation by roadways has led to significant genetic differentiation between the isolated populations (Reh and Seitz 1990). Oxley et al. (1974) found wide roads to be so effective as barriers to dispersal of small forest mammals that they are equivalent to a body of water twice as wide. In the Coachella Valley there are very few paved roads that are only two-lanes wide and even fewer with light traffic volume. These roads, except perhaps Snow Creek Road, will increase in traffic volume (and will subsequently be widened) as the human population increases locally. Although there is no information available concerning the effectiveness of roads as barriers to the target species, it is the SAC's opinion that wide roads with heavy traffic form effective barriers to all target animal species with the exception of birds and bats.

Linking habitat patches using bridges or culverts has ameliorated the impact of roads as barriers (Reed et al. 1975; Hunt et al. 1987; Woods 1990; Yanes et al. 1995; Romin and Bissonette 1996; Keller and Pfister 1997; Clevenger and Waltho 2000). Efficacy is species-specific, so it is important to know if the target species will use a culvert or bridge and, if so, if the benefit to the population caused by the connection outweighs the impact to the population caused by increased mortality adjacent to the road. A large, landscape-scale preserve is better than smaller preserves linked by narrow corridors (Simberloff et al. 1992). That said, if a potential habitat core is insufficient to meet the criterion of viable population size, but can be connected to nearby habitat via a bridge or culvert so that the area in total is sufficient, then the use of culverts and bridges should be considered. The uncertainties alluded to by Simberloff et al. (1992) prompted the SAC to first select core areas in habitat without roads; but if a potential Core Habitat area satisfied all criteria except size, then the SAC considered linking that habitat to adjacent habitat using a bridge or culvert.

Fragmentation of a Covered Species' habitat patches by intervening unsuitable habitat would prove as detrimental a barrier as are manmade barriers, especially when habitat patches are relatively small within a matrix of unsuitable habitat. An example is the blowsand habitat that is restricted to isolated pockets in the Indio Hills (Barrows 1997). These pockets are surrounded by a non-habitat matrix of rocky alluvium. The SAC did not include these as Core Habitat, even though many contained some of the target species, because the habitat patches were small and widely spaced. Although Ricketts (2001) found that different types of non-habitat matrices differ in their resistance to movement between habitat patches by individuals, there was no attempt to qualitatively analyze the matrix in this way. Instead, this type of fragmentation was filtered out at the species modeling process by the level of resolution used. Habitat was categorized by its predominant constituent, so the habitat patches in Core Habitat were always substantially larger in area than the non-habitat matrix.

Biological Corridors and Linkages. A Linkage is "habitat that permits the movement of organisms between ecological isolates" (Newmark 1993) and that will "enhance or maintain the viability" of target species in those ecological isolates (Beier and Noss 1998). Linkages allow for migration in wide-ranging animals, plant propagation, interchange of genetic material among populations, movement in response to environmental change or natural disasters, and recolonization following extirpation (Beier and Loe 1992). Biological Corridors (wildlife movement areas that are constrained by existing development, freeways, or other impediments) are of particular importance in that they give large predators access to otherwise isolated preserves. Large predators play an important role in controlling populations of mesopredators, which in turn prey upon target species (Crooks and Soulé 1999). Biological Corridors may also aid in the function of ecosystem processes, such as sand transport. Considerable discussion of Biological Corridor and Linkage benefits and disadvantages exists in the literature (for example, Simberloff and Cox 1987; Noss 1987). In essence, Linkages should resemble the habitat they are connecting, they must be wide enough to lessen edge effects, and they must connect habitat that was originally interconnected. The longer a Biological Corridor, the more important that it be wide and that it contain the habitat requirements of a target species. Biological Corridors and Linkages may have disadvantages, as they may serve as the potential avenue for transmitting disease, fire, exotic weeds, and other catastrophes.

Following is a list of Biological Corridors and Linkages addressed by the Plan and the function of each:

> The San Gorgonio Pass separates populations of montane species in the Peninsular Range from Transverse Range populations, which are connected in turn to populations in the Sierra Nevada to the north. A corridor here connects populations in Southern California and Baja California with central and northern California populations (M.E. Soulé, pers. comm.). Large species, especially those that show some migratory behavior, probably used this corridor in the past (mule deer, mountain lions, coyotes, bobcats, etc). The I-10 freeway and Highway 111 form barriers that would be impervious without the bridges and culverts located at the washes. The under crossing at Stubbe Canyon is large and is included in the conservation area. Future development adjacent to other bridges and culverts would further limit their effectiveness.

> The Whitewater River and adjacent floodplain is a sand source corridor primarily, but also serves as a corridor for Coachella Valley milkvetch between Snow Creek/Windy Point Conservation Area and the Whitewater Floodplain Preserve. Heavy traffic volume on Indian Avenue will not affect dispersal of plant seeds, but will stop movements by animals. A bridge or very large culverts, installed at the point where the Whitewater River normally flows across Indian Avenue, would allow animal and sand movement below the road while keeping the road open to traffic during flood events. Although this corridor is many times larger than the home range size of any of these animal species, it contains pockets of habitat and so would function as a conduit for gene flow between the two Conservation Areas.

> Mission Creek is identified as a sand source corridor for the Whitewater Floodplain Preserve and the Willow Hole and Edom Hill Conservation Areas. It may also function as a large-predator corridor, specifically for coyotes, for these preserves.

Morongo Wash The wash is narrow (300 feet) and in some areas is bordered by low-to medium-density residential development. It is identified as a sand source corridor for the Whitewater Floodplain Preserve and the Willow Hole and Edom Hill Conservation Areas. It may also function as a large-predator corridor, specifically for coyotes, for these preserves, and may provide habitat connectivity between the Upper Mission Creek/Big Morongo Canyon Conservation Area and the Willow Hole Conservation Area.

Indio Hills/Joshua Tree National Park Linkage is a corridor connecting the Indio Hills and the Thousand Palms Preserve with the Little San Bernardino Mountains and the protected areas of Joshua Tree National Park. This ensures a source for species that formerly moved freely between the two areas, such as desert bighorn sheep, coyotes, kit foxes, gray foxes, badgers, chuckwallas, desert tortoise, etc.

Desert Tortoise Linkage Conservation Area in the eastern portion of the Plan Area links the Mecca Hills and the Orocopia Mountains with the Little San Bernardino and Eagle Mountains. It is a habitat corridor for the desert tortoise and serves as a movement corridor for many other species.

Climate Change. The 20th century ended with one of the warmest decades since climate data were recorded instrumentally, and probably the warmest since the 1400s (Hulme and Sheard 1999). Globally, the average surface temperature increased 0.6°C in the last century caused, in large part, by increased atmospheric "greenhouse gasses" (Wigley 1999). Recent computer models estimate temperature increases to about 0.5°C by the year 2060 in the southwestern United States (Giorgi et al. 1998; Doherty and Mearns 1999). For a perspective, global temperatures increased only about 0.5°C since the Ice Age 18,000 years ago.

Changes in precipitation are less easy to model because of the diverse topography of the southwestern United States. Coarse-resolution models such as the Canadian Centre for Climate Modeling and Analysis model and the Hadley Centre for Climate Prediction and Research model predict substantial increases in annual precipitation, while a high-resolution, regional model depicts a slight decrease in precipitation relative to present averages (Doherty and Mearns 1999; Mearns et al. 1999). The high-resolution, regional model differs from the others in that the jet stream shifts to the north rather than to the south as in the other two models. None of these models are yet capable of incorporating the effects of El Niño/La Niña or the North Pacific Oscillation and so, could be further refined. Temperature change is positively correlated with the frequency of El Niño events (Hunt 1999a, b) and its complementary, La Niña. El Niño typically results in cooler winters with higher rainfall, while La Niña results in warm, dry winters. Thus the increased variation caused by El Niño/La Niña events may accompany the trend toward an increase in temperatures in the region (Hunt 1999a, b; Timmerman et al. 1999).

The range of climatic conditions in which a species or vegetation type occurs, its climate envelope, has been used to predict how climate change might affect its distribution. It assumes that the geographic range of a species or vegetation type is defined by current climatic conditions in that range. Increases in global temperatures result in poleward shifts (or upward shifts in mountainous areas) of the climatic envelopes, followed by a similar, poleward migration of the species or vegetation types as the climate in their existing locale becomes unsuitable (Box 1981; Emanuel 1985). This type of migration occurred during the Pleistocene in North America as plant species moved north and south in response to intermittent periods of glaciation (Brown and Lomolino 1998). But the rapid pace of the current warming trend is a cause of concern, as it is not known if plant species are capable of migrating that quickly. As climatic conditions warmed following the last Ice Age, trees migrated, on average, about 1 km per decade to keep pace with the changing climate. However, estimates for global warming rates predict a tenfold increase, requiring 10 km per decade migration rates (Davis 1989; Dyer 1995). Fortunately, the steep topography surrounding the Coachella Valley permits a spatial propinquity of life zones so migrations need only be of a few kilometers rather than hundreds of kilometers.

The Preferred Alternative will preserve the majority of land from the toe of slope to the ridgeline of mountains surrounding the Coachella Valley. This landscape-scale protection promotes the upward migration of species and vegetation types in response to global warming. There is a distinct possibility that the highest elevation ecosystems could be reduced or lost entirely, a consequence that cannot be ameliorated by the Plan. Additionally, the climate envelope approach does not account for species and vegetation types that are adapted to specific soil types (Malcolm and Pitelka 2000). The aeolian sand inhabitants, for example, are restricted to blowsand, regardless of climate changes. Part of the rationale for the SAC's criteria of preserving multiple habitat cores for each target species is that the Core Habitat areas will include the current range of climatic and environmental conditions occupied by each species. For example, the Coachella Valley fringe-toed lizard has a Core Habitat at Windy Point (elevation 1000 feet, 305 m); another site 5 miles (8 km) east at Whitewater Floodplain reserve (elevation 600 feet, 180 m); a third site another 3 1/2 miles (5.6 km) east-northeast at Willow Hole (elevation 750 feet, 230m); and the fourth site another 9 miles (14.5 km) from Willow Hole at the Thousand Palms Preserve (elevation 200 feet, 60 m). These sites are spread out over a distance of over 18 miles (29 km), and each has a distinct assemblage of sand sources (see above). There is also a descending gradient in annual precipitation at points increasingly distant (farther east) from the San Gorgonio Pass. Annual rainfall for the following centers, arranged from west to east, is as follows: Palm Springs, 5.31" (134.9 mm); Indio Fire Station, 3.81" (96.8 mm); Thermal F.A.A. Airport, 3.16" (80.3 mm); Mecca Fire Station, 2.94" (74.7 mm) (U.S. Climatological Records 2000). So, by including geographically distinct sites, the multiple sites criterion will include the range of conditions a given species inhabits today. As the climate changes in the future, there is a possibility that the habitat at one or more sites will become unsuitable for a target species. But preserving multiple sites in this manner will increase the likelihood that some refugia for each of the species will be maintained if climatic conditions change over time.

Reserve Size. The theory of island biogeography (MacArthur and Wilson 1963, 1967) was applied early on to habitat preserves (Diamond 1975; Wilson and Willis 1975). In particular, 1) the number of species should be an increasing function of a preserve's area; 2) the extinction rate should be a decreasing function of a preserve's area; and 3) the relationship between area and survival probability differs among species (Diamond 1975). MacArthur and Wilson (1963, 1967) describe the number of species on an island as an equilibrium between immigration rate and extinction rate. The intent of preserves is to prevent extinction for the long term, so extinction rate is of particular importance. A smaller island or preserve will normally contain fewer individuals of a target species making it vulnerable to extinction through stochastic causes: 1) genetic factors that, through chance events, affect negatively the ability of a population to adapt to a changing environment (founder effect, inbreeding depression, random fixation); and 2) demographic factors (e.g., sex ratio, reproductive output, age at sexual maturity) (Shaffer 1981, 1987; Soulé 1980, 1987; Lande and Barrowclough 1987). Richman et al. (1988) found that land-bridge islands had an elevated extinction parameter caused, in part, by species' susceptibility to fluctuations in climate. This elevation of the extinction parameter decreases with increase in island area. Like islands, larger preserves may contain more topographic relief and habitat heterogeneity, providing refuges from which the preserve can be repopulated and thus have lower extinction rates (den Boer 1981).

Preserves identified by the Plan contain Core Habitat for target species. This Core Habitat, as discussed previously, is considered large in that each Core Habitat area alone consists of sufficient area to maintain a viable population. Multiple core areas that are interconnected by corridors or by management practices allow recolonization if climatic fluctuations or environmental catastrophes cause the complete loss of a population.

Edge Effects. A habitat edge is a discontinuity in habitat features that can be perceived by a target species and that, in turn, affects the species' behavior or performance (Lidicker 1999). Conservation biologists refine the definition as it pertains to preserve design to include changes in a natural community caused by the rapid creation of abrupt edges in what were previously undisturbed habitat patches (Lovejoy et al. 1986; Soulé 1986). Of particular interest are the negative effects of edges. Conservation Areas in the Plan Area will, eventually, be nearly surrounded by human-altered habitat that is not suitable for target species within the preserve. Roads, railroads, urban and agricultural developments, greenbelts, etc., will all affect species within the Conservation Areas they surround. Road mortality may depress populations in adjacent habitat; predation from pets and children will increase as urban housing is built to the habitat edge; overspray of pesticides and herbicides can affect some species in habitat adjacent to agriculture. The depth that edge effects penetrate a preserve varies by target species, by habitat type within a preserve, and by type of edge. For example, Winter et al. (2000) found that mesopredators affect nesting success of grassland-nesting sparrows 30 to 50 meters from an edge formed by shrubs, but that roads, agricultural fields, and forests had no effect. But Rosen and Lowe (1994) suggested that snake mortality on roads affected the population well away from the road and into wilderness areas. Studies show that effects diminish with increasing distance into the habitat from the edge

(Gates and Mosher 1981; Wilcove et al. 1986; Andrén and Angelstam 1988; Winter et al. 2000). It is difficult to measure the width of edge effects but Newmark (1993) used a performance measure for the target species across the edge to determine the width of edge effects in a Tanzanian forest by measuring encounter distance of birds from the forest edge. Encounters of the target species increase with distance from the edge to a point where the number of encounters remains constant. This distance was, again, species specific.

Edge effects are directly related to perimeter length. Because area increases geometrically with increase in perimeter length, an increase in area results in a decrease in perimeter-to-area ratio (assuming shape remains unchanged). So a large preserve can minimize edge effects when its area is large enough that the portion affected by proximity to the edge is insignificant relative to the entirety. Thus, a large preserve is internally buffered. Such a large preserve may not be an option because there is either insufficient undeveloped habitat, or the habitat by its nature is small. When this is the case, it may be possible to lessen the edge effects by choosing the type of edge that will impact the target species least. The SAC ranked the common types of edges in increasing order of impact: 1) nonhabitat matrix (a natural habitat that is unsuitable for the survival of the target species); 2) very low-density residential development (one dwelling per 5 or more acres); 3) greenbelt or agricultural development; 4) roads with high traffic volume; 5) high density residential development (one dwelling per less than 1 acre). So, isolating habitat from high-density urban areas with a buffer of nonhabitat matrix will lessen the impacts to the target species dependent on that habitat. High-density residential development affects nearby habitat greater than other edge types because house cats, dogs, and opportunistic mesopredators such as raccoons, opossums, skunks, crows and ravens are subsidized by garbage and pet food (Wilcove 1985; Friesen et al. 1995), especially in the absence of larger predators which act to control numbers of mesopredators (Wilcove 1985; Crooks and Soulé 1999). The SAC considered roads, as edges, to be preferable to high-residential development because the roads would serve as a barrier to mesopredators, a benefit that would outweigh the cost to target species of mortality from vehicles. Additionally, roads can be fenced to prevent mortality if monitoring demonstrates the need.

Preserve shape can also minimize edge effects. A circular preserve, for example, has a much lower perimeter-to-area ratio than does a long, thin preserve. The SAC attempted to minimize perimeter-to-area ratios when delineating preserves that encompass Core Habitat of target species.

Section 3.7 in this appendix explains the Site Identification Process used to develop the Conservation Alternatives.

3.3 Independent Science Advisors

As previously noted, Michael O'Connell of The Nature Conservancy facilitated an outside peer review by a team of independent scientists. This team was provided with a series of questions and asked to respond to the questions in their review. The questions were assembled through suggestions from the SAC, the USFWS, and the Department of Fish and Game. In addition, the CVAG Project Advisor Group provided an opportunity for any interested person to propose a question. In January 2001, documents providing information on the conservation planning process, including copies of a January 2001 revision of the Administrative Review Draft, maps of Conservation Alternatives 1, 2, and 3, species distribution models and known occurrence maps and associated documentation, maps illustrating land ownership, natural features, parcel boundaries, and conserved natural communities within the Plan Area, and a draft Technical Appendix, which included target species and natural community conservation strategies, were distributed to the Independent Science Advisors. A meeting with the science advisors and the SAC was held in early February to provide an opportunity for the independent science advisors to discuss the conservation planning process with the SAC. The Independent Science Advisors (ISA) also met with outside participants to discuss the Plan. In mid-April they submitted a report detailing their findings. The report, "Independent Science Advisors' Review: Coachella Valley Multiple Species Habitat Conservation Plan/Natural Communities Conservation Plan (MSHCP/NCCP)" is included in this section in its entirety.

[NOTE: all references in the ISA report on the following pages to conservation alternatives 1, 2, and 3, refer to the initial alternatives prepared in 2000, not the alternatives contained in the Plan. Section 3.7.2 of this appendix provides additional information on these three alternatives.]

Independent Science Advisors' Review: Coachella Valley Multiple Species Habitat Conservation Plan/ Natural Communities Conservation Plan (MSHCP/NCCP)

Reviewers: Drs. Reed Noss (Editor), Edith Allen, Greg Ballmer, Jay Diffendorfer, Michael Soulé, Richard Tracy, and Robert Webb

Michael O'Connell, Facilitator

April 13, 2001

This report constitutes the peer review of the Coachella Valley Multiple Species Habitat Conservation Plan/Natural Communities Conservation Plan (MSHCP/NCCP) by a group of independent science advisors. Three of the reviewers—Reed Noss, Michael Soulé, and Dick Tracy—participated previously as peer reviewers of early phases of the planning process in the Coachella Valley at two workshops organized by the Coachella Valley Mountains Conservancy, in 1996 and 1998. We otherwise played no role in the development of this plan until being convened for this review. Two additional advisors, Robert Fisher and Robert McKernan, participated in a workshop (described below) on Feb. 12-13, 2001, but did not join in the writing of this review.

We were provided a list of 32 questions under which to organize our review. The questions were developed by the U.S. Fish and Wildlife Service, California Department of Fish and Game, the Coachella Valley Mountains Conservancy, and the Coachella Valley Association of Governments, and grouped into sections considering general habitat and landscape issues, species issues, habitat monitoring and adaptive management, geomorphology, and species modeling (Appendix 1). A draft set of questions was revised in response to comments by Mike O'Connell, Reed Noss, and others. Although we used these questions to organize our comments in this report, in many cases we found that currently available data do not allow us—or probably anyone—to answer the stated question effectively. In several cases we lumped related questions for the sake of efficiency.

In conducting our review we referred to several documents and a substantial series of maps prepared by the Coachella Valley Mountains Conservancy with the assistance of the participating agencies. The primary document was the January 2001 Administrative Review Draft (ARD) of the Coachella Valley MSHCP/NCCP. Supplementary documents included a Technical Appendix, a document on Species Distribution Model Parameters and Known Locations, an Adaptive Management and Monitoring Program, and the Coachella Valley Draft Water Management Plan. Maps included general geographical information, vegetation (including historic for a portion of the study area), plan alternatives, a species richness and ecological diversity model, and species distribution models. We benefited tremendously from a workshop held in Palm Desert on February 12-13, 2001, during which members of the Science Advisory Committee (SAC) which developed the core of the plan, the Coachella Valley Mountains Conservancy, and other participating agencies presented the conceptual approach, major data, and assumptions underlying the plan to our team of reviewers and responded to our questions. Our review team then met separately for the second day of the workshop, discussed our initial responses to the questions, and made assignments to our individual members to take the lead on particular questions.

Although we are technically individual science advisors and reviewers, this review represents a consensus and the collective opinion of our team. This report consists of two sections: 1) a brief overview stating our general impressions of the draft plan and its three biological alternatives; and 2) responses to the specific questions provided to us by the agencies and planners.

We also want to note that we are explicitly aware that the success of the Coachella Valley MSHCP will depend not only on a scientifically-supported conservation program but one that can be implemented successfully given socioeconomic and political constraints. Our comments in this document are made with the knowledge that these other factors may weigh heavily on the final conservation plan. The primary task of the planning team is to weigh the conservation program against these issues. It is our firm belief, however, that the biological conservation program itself – particularly as reflected in the alternatives – should not be compromised in its initial stages based on estimations of the political economy of the planning area. It is essential that a supportable biological alternative be offered that can be evaluated in the context of politics and economics. It is with this perspective in mind that we offer our comments.

General Impressions of the Plan and Its Alternatives

First, we want to commend the Scientific Advisory Committee (SAC) and others who contributed to the Draft Plan for producing what is sure to be one of the most scientifically defensible and thorough HCPs or NCCPs ever developed. Although our comments in this review take the form of a critique, as they must in order to constitute a substantive review, we do not mean to imply failure on the part of the planners. We recognize that substantial effort and analysis have gone into the Draft Plan, and in our view it has no fatal flaws. Our comments are meant instead to point out areas where the plan can be shored up or improved based on our collective knowledge and review of the technical documents.

The main stimulus for the Coachella Valley MCHCP/NCCP is the requirement under Section 10(a) of the U.S. Endangered Species Act for a habitat conservation plan to be approved before "incidental take" of listed species (animal species) on private lands is permitted. The ongoing conversion of natural habitats within the Coachella Valley to other land uses and the consequent reduction in acreage and alteration of the structure and processes of those habitats has placed many species at risk of extinction. To be effective, the Plan must identify the species at risk, their distributions, and the factors necessary to maintain their essential habitats. The Plan must also include a means to preserve and manage those species and their habitats together with the geophysical and biological factors that maintain them. Because the Plan is not just a MSHCP, but also a NCCP, it must provide a means to conserve the natural communities of the Plan Area, not just an assortment of individual species.

On a continental scale, the Coachella Valley is a hot spot of biodiversity, distinguished by high endemism, rarity, and richness of several taxa. For example, researchers with The Nature Conservancy and the Association for Biodiversity Information identified this portion of Southern California as one of six regions in the United States that rank in the top tier of conservation priority based on a rarity-weighted richness index (S. Chaplin et al. 2000, Chapter 6 in *Precious Heritage: The Status of Biodiversity in the United States*, Oxford University Press). Common sense suggests that one should not develop or impact resources in a hot spot, because the chances for conflict with conservation objectives are extremely high. Neither common sense nor a conservation ethic has prevailed in past land-use decisions, however. In the case of the Coachella Valley, the most important habitats for biodiversity are largely private land and very expensive, many have been developed for decades, and the pace of development remains rapid. A credible conservation plan for the Coachella Valley will be difficult to forge but is required to resolve continuing conflicts.

We agree in principle with the general planning paradigm of the SAC, i.e., that any action taken in the Plan, for example, establishment of a conservation area or corridor, must be both sufficient and essential (C. Barrows, pers. comm.). We interpret "sufficient" to mean that it will assure the stated goal or objective (e.g., maintenance of viable populations of covered species) and "essential" to mean that, without the action, the goal or objective will not be attained. Hence, superfluous actions are avoided. In practice, however, the thresholds of sufficiency and necessity are always ill-defined. Estimates of what is sufficient or essential are subjective and highly uncertain, informed as much by individual experience and intuition as by hard data and rigorous analysis. We suspect that much of the apparent disagreement about which biological alternative in the plan should be preferred reflects such individual differences in perspective.

One of the major concerns of our team regarding the planning process and the general content of the biological alternatives in the Draft Plan is that scientific information was often mixed with pragmatism and perceived political reality, without any documentation of how these two classes of knowledge were combined. We believe the credibility of the Plan would be enhanced by addressing ecological issues as objectively and scientifically as possible, free from the constraints of perceived political reality. Socioeconomic and political factors can be considered later as a "cost screen" overlaid on planning alternatives. We address this issue in more detail in some of the responses to our assigned questions.

In cases of high uncertainty and high risk, the precautionary principle suggests that it is better to err on the side of protecting too much habitat than too little, that is, to err on the side of sufficiency rather than necessity. Of course, too great an error in either direction will condemn a plan to political, legal, or economic failure. The best way to minimize the chances of error, and hence meet the sufficiency-necessity standard, is through rigorous science. In practice, however, data, funding, and time are usually insufficient for highly rigorous scientific investigations on the scale of a regional conservation plan. This is the case here. The sufficiency-necessity problem remains, and we would like to see this problem receive more explicit attention in the MSHCP/NCCP.

The Draft Coachella Valley MSHCP/NCCP proposes three conservation design alternatives. Alternative 1 would protect only those lands already in public ownership. We can consider this alternative a null hypothesis that can be easily rejected, as it clearly falls short of meeting the requirements of law (e.g., U.S. Endangered Species Act, California Natural Communities Conservation Planning Act). The Draft Plan properly concludes that Alternative 1 does not contain sufficient natural habitats and associated resources to fulfill essential goals. Alternatives 2 and 3 encompass all lands in Alternative 1 and contain additional private lands. Alternative 3, which was developed based on recommendations from state and federal agencies, is the largest in acreage and subsumes Alternative 2. There is some difference of opinion among the public agencies and other stakeholders regarding the adequacy of Alternative 2 and the need to include some or all of the additional lands identified in Alternative 3. The possibility also exists that even Alternative 3 does not include sufficient habitat and/or other resources to sustain the covered species. Uncertainties remain concerning the minimum habitat areas for particular species, the importance of specific areas as habitat for these species, and the value of potential corridors for flow of individuals and genes and/or maintenance of critical geophysical processes, such as sand and water sources and fluvial and aeolian sand transport.

The Draft Plan should account for the need of covered species to track changes in the distributions of their habitats over time in response to climatic or other environmental changes. In this regard, it is notable that species distributions are often correlated with temperature and moisture gradients, which are likely to shift in response to climatic change. Thus, a warmer, drier climate is likely to cause species associated with higher moisture and/or cooler temperature regimes to be reduced in numbers or eliminated from existing occupied habitat lands where climatic conditions are currently marginal. Such species could become more restricted to the western portion of the Plan Area (Whitewater-Snow Creek-Windy Point areas). Conversely, in the event of climatic cooling, which is a probable successor to the current warming phase, species associated with warmer and drier habitats may become more restricted to the valley floor and southeastern portions of the Plan Area. Maintaining well-connected, heterogeneous landscapes with multiple microhabitats and potential refugia is a sensible strategy in the face of climate change in any direction (R. Noss, 2001, *Conservation Biology* 15: in press). Thus, long-term conservation planning for the Coachella Valley must consider maintenance of physical linkages over a range of existing temperature-moisture regimes and elevations. We note that the Draft Plan gives scant attention to such long-term issues.

The Plan, especially Alternative 3, maintains considerable landscape connectivity around the margins of the valley, which are mostly mountainous terrain, but much more tenuous linkage opportunities across or longitudinally through the valley. To a large extent the opportunities for such linkages are precluded by agricultural and, to a greater extent, urban land uses. Nevertheless, some opportunity exists to use the Whitewater River channel, the railroad right-of-way, and even highway rights-of-way to maintain some level of connectivity through the length of the valley. The Whitewater River in particular seems to be a good candidate for maintaining a linkage for a number of habitats. Serious discussion of this option should be included in the Plan. Of course, regulatory agencies must consider the costs and benefits of conserving particular areas relative to other potential sites in the planning area before they enter negotiations with stakeholders.

Responses to Specific Questions Posed to Science Advisors

The general reaction of our team to the questions provided is that many of them are questions best addressed to the planners, not to reviewers. In many cases data that would allow us, or anyone, to answer the questions are not available. The four geomorphology questions are a case in point: Answering any of these questions would require substantial new research. Nevertheless, in all cases we have provided our best answers, given the best available information. In some cases we suggest the kinds of field studies and analyses that would be necessary to answer the questions definitively.

I. Habitat/Landscape Level Questions:

1. *Evaluate each Conservation Alternative using the attached "Criteria for Evaluating Site Identification Maps." (Conservation Alternatives are described on pages 90-105 of Administrative Review Draft).*

Choosing among alternatives boils down to an exercise in best professional estimation. High quality data sufficient to make a defensible choice of an alternative are simply not available. This lack of data is par for the course in conservation planning. As noted earlier, we believe that in the face of poor data, the precautionary principle should hold. In all of the 11 specific areas of contention (i.e., areas of land included in Alternative 3 but not Alternative 2), and all else being equal, we can be sure that the Plan would be improved by the inclusion of additional habitat. Thus, the burden of proof should rest on showing that excluding the additional areas in Alternative 3 will not jeopardize the ability of the plan to sustain viable populations of the covered species. Because the SAC included their estimation of socioeconomic and political criteria in decisions that, at this point in the process, should have been made purely on biological/ecological grounds, we do not believe they placed the burden of proof on the correct side in developing Alternative 2. This is particularly important given that precisely how socioeconomic and political criteria influenced their decisions is not documented in the Draft Plan.

The SAC's general approach in developing Alternative 2 was to suggest that adding extra habitat would not increase the Plan's ability to sustain populations. They appeared to be influenced more by necessity than sufficiency. In several cases we believe the SAC overemphasized potential negative aspects of sites suggested by the agencies in Alternative 3, or at least did not provide adequate documentation for these assumed negative aspects. For example, in arguing against the inclusion of the "Flat-top Mountain and Dune Area North of I-10" (p. 106 of the Administrative Review Draft [ARD] and in comments during the February workshop), the SAC's argument for not including the area was that the dunes were no longer active, and this, combined with the high per-acre value of property in the dunes meant that the area was not necessary for protection of the species on the proposed covered species list. The idea that the area, though sub-optimal, might serve as a buffer for the more intact areas to the north was not considered or documented explicitly, nor were potential management practices apparently considered, such as active disturbance to reactivate dunes or human-assisted movement of sand into the system. Such procedures, while expensive and intensive, might be necessary for the conservation of some species or natural communities.

In another case, "the area between Date Palm and the extension of Duval Road" (pg 110 ARD) Alternative 2 appears to exaggerate the potential negative effects of human structures on the conservation value of the site, or at least does not provide adequate documentation to support the conclusion that these structures eliminate the area for conservation purposes. During the workshop the SAC indicated that the primary reason they did not include this area in Alternative 2 was the presence of a road that bisects it. In the ARD the SAC also discusses the small size of the area. Aerial photographs of the site indicate that large portions of the area are not bisected by roads and that the area, while small, could sustain large populations of some of the endemic insects and plants covered in the Plan. This area may have been dismissed too quickly and the presence of a road weighed too heavily in the decision-making process. Although substantial scientific literature suggests that roads have negative effects on many taxa, making the presence of a single, two-lane road the primary reason for rejecting a site overextends the scientific evidence for negative effects of roads. Many assumed barriers are better seen as filters, as some movement of organisms occurs across them. We understand that plans to widen this road exist, but the Alternative did not consider the possibility of designing a road to include underpasses for animals.

Moreover, it is not enough to do conservation on maps. As pointed out later in our comments, especially with regard to adaptive management, the Plan must specify the ways in which mistakes or omissions in the Plan will be corrected in the future. Ideally, each conservation sub-area requires its own plan with explicit biological objectives and management approaches identified.

As suggested earlier, the documents seem to have taken a largely static view of the ecosystems of the Coachella Valley. In some cases they are perhaps too narrowly focused on the notion of a pristine, self-managing system as the only kind of habitat that should be included in a reserve. The documents appear to have given little attention to options such as maintaining habitat for the covered species via active management. The plan also does not explicitly consider the possibility that habitats disturbed by human activities may recover over time or be restored to provide suitable habitat in the future (see R. Webb et al., 1988, The effects of disturbance on desert vegetation in Death Valley National Monument, Cal. *USGS Bulletin* 1793). Recovery from soil compaction requires about 80-120 years in the Mojave Desert (R. Webb et al., 1986, *Soil Science Society of America Journal* 5): 1341-1344).

The inclusion or deletion of lands proposed for conservation in Alternatives 2 and 3 must be based on sound principles of conservation biology and factual evidence or strong inference of conservation value. Because the additional lands proposed for inclusion in Alternative 3 are scattered throughout the Plan Area and because their proposed inclusion is based on diverse factors, each must be considered separately. We do this briefly below for several of the areas under discussion.

Expanded Snow Creek Area between Interstate 10 and California Highway 111, west of the Whitewater River.

This area is located within an important transient sand source and sand transport area and provides habitat for sand endemics such as the Coachella Valley Jerusalem cricket, Coachella Valley Giant Sand-treader cricket, and Palm Springs pocket mouse. Although this land currently may not be crucial to the protection of these species, it offers a refugium during major flood events that could affect the adjacent Snow Creek/San Gorgonio Wash habitat area and provides a broader contact zone between that area and Whitewater Canyon. Additionally, it should be noted that many sand endemic species (including those mentioned above) are distributed primarily in the northwestern end of the Coachella Valley and are probably limited by moisture and temperature gradients. Ongoing climate change will alter the existing temperature/moisture gradient and, thus, the distribution of suitable habitats for many species. Some species already concentrated in the northwestern portion of the Plan Area are likely to become more confined to it, as they are eliminated from areas further east. Use of this land for wind-generated electric power might be compatible with both the conservation of covered species that persist under this form of land use and perhaps for the conservation of natural communities.

Although Alternative 2 concludes that natural ecological processes for this land have been compromised by the railroad and by Highway 111, the habitat in this area has similar value to that in the adjacent areas of Snow Creek/San Gorgonio River Wash, and Windy Point. In Greg Ballmer's experience, the arthropods are the same and may even be more abundant in the proposed expansion area of Alternative 3. Highway 111 and the railroad are not absolute barriers to movement of either the sand-inhabiting arthropods or the sand in this area.

This triangular-shaped parcel, bounded by major highways to the north and south and the Whitewater River to the east, could be a major refugia for animals dependent on local aeolian systems. The San Gorgonio River is isolated from this parcel owing to the barrier formed by California 111, and the Whitewater River is channelized as it passes north to south along its east end. Small, relatively active areas of sand exist in this parcel, suggesting that it might be marginal habitat for sand-preferring organisms covered under the MSHCP. In addition, several species have known distributions in this area, which is relatively pristine in comparison to similar areas towards the northeast. The assumption that the natural ecological processes for this parcel have been compromised is not entirely correct, but public agencies are regularly bulldozing the Whitewater River channel in this area with the apparent goal of eliminating riparian vegetation that uses Colorado River aqueduct water destined for the recharge galleries downstream. Because this practice effectively eliminates cover that might provide a wildlife-migration corridor, the MSHCP should explicitly suggest that the practice be eliminated. If it is eliminated, the value of the triangular parcel would be greatly increased.

Expanded Mission Creek Area

This area may provide low-density habitat for a few vertebrate species, such as desert tortoise. Its inclusion in the reserve system would also provide a more defensible perimeter and buffer for the adjacent Mission Creek conservation area. It would be useful to have more information on the biological resources of this expansion area and an analysis of potential damage to the Mission Creek area if it were urbanized or converted to other uses. Additionally, it should be noted that a recent finding of the Coachella Valley Jerusalem cricket in a patch of aeolian sand atop the bluffs on the north side of Whitewater Canyon (wind farm area) indicates that this species is somewhat more widespread than previously thought and may occur in the expanded Mission Creek area. Further surveys for this species are probably warranted in this area.

One of the major rationales for including this expansion in Alternative 3 is the belief from previous reports that the area provides a significant source of fluvial sand that could be entrained and moved downstream to the aeolian source area. This belief is incorrect; most of the sand supply transported in Mission and Morongo Creeks comes from areas upslope from this parcel, which mostly serves as a zone of transport from mountain front to depositional area. Channelization of Mission Creek in this area could improve sand delivery from the sources in the San Bernardino Mountains to the depositional area south of the Banning fault by improving hydraulic conveyance across the alluvial fan (which is built from sedimentation from Mission Creek and Morongo Wash) to the depositional plain west of Willow Hole and minimize within-channel storage of sand that is unavailable for aeolian transport.

Expanded Whitewater Preserve Area

The water recharge basins along the Whitewater River south of I-10 and north of Highway 111 are in the middle of a potential sand transport area. However, the configuration of the basins greatly impedes sand transport—dunes are present on the downwind sides of the basins and are effectively trapped until released by dredging. The river floodway is routed around the basins and, thus, does not interdict much of the sediment flow. It may become possible to reorient the basins at some time in the future to increase the rate of aeolian sand transport, while also reducing basin maintenance costs. As the basins are designed to wash out in a major flood event, there seems to be no urgency in altering their orientation at this time. It would be appropriate to discuss such matters with the water district staff to determine the feasibility of future alterations.

Also, the presence of the basins serves as a wind shadow for significant areas downwind of the basins but upwind of the Preserve that could be viable habitat for several species covered under the MSHCP. The presence of wind generators on this land, plus its prime location as depositional area for Whitewater River, plus the potential for aeolian transport across it makes it a prime candidate for restoration. One potential means would be to alter the configuration of the main northern dike that protects the recharge galleries from the Whitewater River at flood stage by shortening it (not adding dredged material as is done currently). This would allow large floods to spread out sooner, dropping their sand loads upwind from the Whitewater Preserve instead of enhancing the probability that floodwaters will pass down river toward Palm Springs.

Expanded Willow Hole and Sand Source Area and Flat-top Mountain and dune area north of I-10

Alternative 2 envisions protection of a relatively narrow pair of active stream channels (Mission Creek and Morongo Wash) east of Highway 62 to maintain sediment transport to the valley floor where it can be redistributed by aeolian processes to feed the active dunes in the Willow Hole area. Expanded protection of this area, as proposed in Alternative 3, may increase protected habitat for a few vertebrate species and improve the value of this corridor for animal movement over a range of elevations. More data is needed to determine the real value of this area to the Palm Springs pocket mouse and other species, which may use it as Core Habitat or as a movement corridor.

Expansion of this conservation area could potentially give greater protection from potential future flood control alterations. Observations in late February, after the February 12-13 storm, indicates that much of the depositional area for Mission and Morongo Creeks north of I-10 is inundated even during relatively light runoff events. Channelization of this area would be devastating to the Willow Hole sand-delivery system.

On the other hand, Mission Creek is already channelized between the San Andreas (Banning) fault and about California 62. It performs the desired function: it delivers sand with minimal storage on the alluvial fan west of Desert Hot Springs. Morongo Wash, however, is not channelized and does store sediment in that same area. The channelization of Mission Creek also retains sand from being lost owing to aeolian activity, while the unchannelized Morongo Creek is losing sand, which is stored in aeolian dunes east of its channel. (This, of course, suggests management just east of Morongo Wash for species dependent on aeolian habitat.) Channelization is beneficial in certain circumstances related strictly to fluvial sand delivery systems. Most floods already are caused by rainfall (the most severe rain on snow), so climatic change—unless it shifts storms from winter to summer—may not be a major issue for this area. We expect such floods to cause degradation in the channels upslope, which means more sand is moved into the depositional plain that is the target of the MSHCP. What is most needed is a ban on channelization south of the San Andreas (Banning) fault, either north or south of I-10 and the railroad. Deposition south of I-10 benefits the Whitewater River Preserve, so this is a case where preservation of the entire system greatly benefits the aeolian-dependent species.

In addition, recent field work of Robert Webb and colleagues suggests a more direct source for aeolian sand to Willow Hole than Mission/Morongo. There are several canyons in the Little San Bernardino Mountains due north of Willow Hole—Long Canyon, West End Canyon, and East End Canyon—as well as a drainage in the Indio Hills due east of Willow Hole that appear to be potential major contributors of fluvial sand. West End and East End Canyons are blocked by a long dike system that effectively stores all sediment at the mountain front while releasing water through a long, mostly underground culvert that flows to the southwest and away from Willow Hole. Active management of undeveloped parts of the Seven Palms Valley, particularly related to channelization of distributary flow channels from Long Canyon, could be helpful to the Willow Hole sand-delivery system while allowing development upslope.

Big Dune South of I-10

The major controversy for this site seems to be economic cost versus biological benefit. It may very well be too costly in terms of money and/or political capital to protect. Nevertheless, the biological value of this site should determine whether to include it within the scope of the conservation program in the Draft Plan. Much of the rationale for excluding it seems to be a presumption that it is a "dead" dune, cut off from the sand source that is needed to maintain it as an active dune. However, some of the covered species do quite well in stabilized dunes and may inhabit the Big Dune. Further survey work is needed to determine if it is an important site for Coachella Valley Jerusalem cricket, for example. This area is very near the easternmost record for this species (adjacent to I-10 at the Thousand Palms off-ramp. See also our response to Question #1, Species Level, All Species.

East End of the Indio Hills

The dunes in this area are well separated from others to the west, and land use changes have all but eliminated sandy habitat connections between them. The formerly robust sand delivery system from the Whitewater River - Mission Creek - Morongo Wash has been completely truncated, leaving only sand sources in the Indio Hills and the Little San Bernardino Mountains. The biotic community of the eastern dunes is somewhat different from those of dunes further west; this difference provides an argument for their inclusion in the Draft Plan in order to cover all habitat types and natural communities. It seems that there is not enough survey information currently to determine the value of this area for a number of covered species that may use it. Again, it is worth mentioning that climate change may result in the geographic range of this community type, or at least of some of its components, either expanding or contracting in the future. Under a warmer, drier climate this community is likely to expand or shift to the west; while a cooler, moister climate could result in its displacement by other species, which currently have a more western distribution within the valley (if landscape linkages are maintained). The isolation of this area from other dunes argues against its value in contributing in a major way to genetic or demographic interchange with populations elsewhere. However, given the abundance of dune endemics (especially plants and insects) throughout the Southwest, one cannot dismiss the possibility that a number of species could survive and maintain their evolutionary potential even if this dune area becomes increasingly isolated.

Conclusion:

In considering how to distribute conservation areas in the Coachella Valley, two opposing considerations should be kept in mind: 1) the need to distribute reserves throughout the planning area in order to provide for multiple populations (redundancy) of the covered species and to represent communities across their natural range of variation; and 2) the need to concentrate conservation areas in portions of the Valley that are biologically richest (i.e., hot spots) or where habitat quality if highest and persistence of populations over time is most probable. These two considerations need to be balanced in the Plan. The argument for concentrating reserves in the western portion of the planning area, where precipitation is higher and population densities of covered species are generally higher, is attractive, and makes even more sense in the context of global warming. Nevertheless, such a strategy could be counterproductive if it results in loss of population redundancy and reduced representation of natural communities across the Valley. Moreover, a reserve system concentrated in any one portion of the Valley would be more vulnerable to “contagious catastrophes” (i.e., disease, extreme weather episodes, geomorphic change) and other synchronized environmental events that could extinguish local populations.

Alternative 1 does not provide for the sand delivery systems that affect major habitat in the northern Coachella Valley. Alternative 2, while much better, relies too heavily on terrain and climatic features (e.g., windy area won’t be developed into housing units) to preserve the integrity of the sand delivery systems. Alternative 3 may go too far in some areas by assuming that significant sand is generated on alluvial fans instead of upslope in the San Bernardino and Little San Bernardino Mountains and the Indio Hills.

We have not undertaken a thorough analysis of the potential effects of the three planning alternatives on covered species and natural communities, which we believe is outside the scope of a peer review. This topic is reasonably well covered in the Draft Plan, given the limitations of available data. In any case, these limitations prevent us from saying much more about the potential population viability of any of these species under the Plan alternatives. Some notes on the covered invertebrate species, prepared by Greg Ballmer, are in Appendix 1. In addition, the team botanist and restoration ecologist, Edith Allen, provides some comments on the plant species and natural communities:

Overall, Alternative 1 is unacceptable for two of the five plant species, but Alternative 2 is acceptable for all five, with reasoning as follows:

Alternative 1 is clearly unacceptable for the little San Bernardino Mountains linanthus, which has only three known locations that lie in lands protected by Alternative 1. Only 18% of the modeled habitat for the Coachella Valley milkvetch lies in Alternative 1 protected lands. Of the five plant species, only the triple ribbed milkvetch would be unaffected if Alternative 1 is chosen.

The difference between Alternatives 2 and 3 is relatively small or not different for LSBM linanthus, triple ribbed milkvetch, and Orocopia sage. The Mecca aster would lose about 20% of its habitat if Alternative 2 is chosen, which is probably not a threat to its existence. The C.V. milkvetch is the most extensive of the five plant species, and will lose the most acreage if alternative 2 rather than 3 is chosen. However, protection under Alternative 2 will probably not threaten its persistence. Of the 5 plant species, the C.V. milkvetch is the only one known to occur on the Big Dune. The C.V. milkvetch occurs on stabilized as well as active dunes, and would likely survive on Big Dune even though the geomorphic processes of dune building are no longer active. The other four species are in river washes, dry fans, creosote scrub, and other communities, but are not sand-obligate species.

Eleven of the 26 natural communities have only about 1300 acres or less in the planning area. Alternative 1 gives insufficient protection to at least 8 of the natural communities (under a 50% protection criterion for the communities of limited area). At least seven of these small communities are wetland ecosystems that should be conserved as much as possible because of the critical habitat they provide for target and non-target species. Losing wetlands and springs would obviously endanger additional species not currently covered. Under Alternative 2 all these small community types would achieve up to 98% protection, except for mesquite hummocks. Mesquite hummocks would be protected up to 50% under Alternative 3.

Two larger community types deserving special protection are the active sand fields that provide sand for other sites as well as habitat for sand-requiring species, and the dry wash woodlands that are habitat for many target species. The active sand receives 75% and 93% protection under Alternatives 2 and 3, respectively, but deserves as much protection as possible to preserve other sand-dependent habitats downwind. The dry wash woodland is quite extensive (some 40,000 acres) but is important habitat for desert tortoise, bighorn sheep, several target bird species, other migratory birds, and is the only habitat for the LSBM linanthus. Preservation of dry wash woodland on the northeast Salton Sea (under Alternative 3) may be important for animal movement. Some of this woodland has been converted to exotic tamarisk, but would still be valuable habitat and corridor if restored.

In summary, we offer the following brief responses to the "criteria for evaluating site identification maps" as a way of comparing alternatives 1,2, and 3, emphasizing that such a comparison is more appropriately made by the planners (i.e., the SAC) than by reviewers.

1. **Are the habitat patches within the sites large enough to sustain the species/natural community?** It is important to recognize that patch size cannot be considered independently from patch configuration; these qualities interact to influence population viability. Two or more small patches within dispersal distance and not separated by movement barriers may be treated as one larger patch by a species. This question is also highly species-specific. As we have noted, data are generally insufficient to answer this question, and no PVAs have been conducted. Nevertheless, Alternative 1 seems to be insufficient for many species. Alternative 2 would provide patches large enough for many or most of the covered invertebrates and plants, barring major environmental change. The larger, better connected patches in Alternative 3 would offer higher probabilities of persistence for most species, but especially the vertebrates.

2. **How many of the existing sites where the species or natural community occurs in the Plan Area would be protected under this Site Identification Alternative? Is this considered to be sufficient by biologists with expertise on this species or natural community?** Please refer to our discussion above. This is not really an appropriate question for reviewers.

3. **Are connections to other sites essential? If so, do meaningful connections exist, and can they be maintained?** For many or most covered species, and speaking generally, we can say with confidence that connections to other sites are essential, especially in the long term and considering the inevitability of environmental change. Some meaningful connections certainly exist, but exactly how meaningful needs to be determined by research. Alternative 3 provides more connectivity than Alternative 2. Whether that additional connectivity is essential has yet to be established, but the precautionary principle suggests maintaining existing connections where possible, until the necessary research has been conducted. As noted elsewhere, connectivity across highways and other potential barriers could be improved through engineering approaches.

4. **Is the site large enough to sustain any keystone species, such as large predators**

necessary to maintain essential ecological processes? There is insufficient attention to large predators (e.g., mountain lion, bobcat, coyote) in the Plan. These are not considered covered species, for good reason, but could serve as focal species for designing the reserve network. For these species, no single site is large enough to sustain a population, so connectivity is the key issue.

5. **Are the sites representative of the range of environmental conditions...under which the species or natural community occurs in a viable population?** Insufficient data are provided to answer this question. As discussed above, a network of conservation areas well distributed across the Valley would be preferred for this purpose over a design concentrated in one portion of the Valley.

6. **Can necessary physical and ecological processes be maintained?** This question is highly site-specific, and is addressed elsewhere (to the extent possible, given data limitations) in this report.

7. **Is there a significant potential for adverse edge effects from adjacent land uses? Could these be so severe as to jeopardize the viability of the site? Could these edge effects be successfully managed?** Edge effects are virtually unstudied in the Valley. Research elsewhere suggests that edge effects could be pervasive, but are manageable to some extent by such means as constructing "hard edges" (e.g., fences impermeable to opportunistic predators such as house cats and raccoons) around small isolated reserves, managing invasive species, and maximizing reserve size generally. In addition to the probability of biological edge effects, aeolian areas have strong edge effects related to stability and mobility of sand sheets. In effect, this is a natural edge effect comparable to that of habitat fragmentation. Because of this, we believe it is better to err on the side of too much conservation than too little when it comes to the aeolian-dependent species.

8. **Is there a significant potential for impacts from deleterious activities on the site, such as illegal dumping, off road vehicle activity, shooting, or illegal collecting? Could these be so severe as to jeopardize the viability of the site? Could these edge effects be successfully managed?** As in our response to question #7 (above), these kinds

   of edge effects are probable. Although they have not been studied in the Valley, efforts to reduce their potential impacts should be taken.

9. **Is there a potential for exotic species to adversely impact the site? Could these be so severe as to jeopardize the viability of the site? Could these edge effects be successfully managed?**

Same response as above.

2. *Did the site identification process and development of conservation areas follow a systematic, stepwise process, including the appropriate use of species models?*

Of fundamental concern in any conservation plan is whether the process of identifying sites and designing conservation areas was systematic and rigorous. Chris Margules and Bob Pressey (2000, *Nature* 405:243-253) note that systematic conservation planning is highly superior to opportunistic or politically-biased planning and has several key attributes: 1) it requires clear choices about the features to be used as surrogates for overall biodiversity, 2) it is based on explicit goals, preferably translated into quantitative, operational targets, 3) it recognizes the extent to which conservation goals have been met in existing reserves, 4) it uses simple, explicit methods for locating and designing new reserves to complement existing ones in achieving goals, 5) it applies explicit criteria for implementing conservation action on the ground, and 6) it adopts explicit objectives and mechanisms for maintaining the conditions within reserves that are required to foster the persistence of key natural features, together with an effective monitoring and adaptive management program.

The approach taken in development of the conservation alternatives meets most of the criteria of systematic conservation planning in a general sense. For example, clear choices were made about the species and communities to be used as surrogates; the conservation goals are reasonably explicit; the limitations of the current reserve network are recognized; and the methods and site selection criteria are fairly explicit. We are concerned, however, that modern, quantitative tools were not employed to accomplish the required tasks. Hence, the process of site selection was more subjective and less transparent than it would have been if more rigorous methods had been applied. For example, there was no use of sophisticated habitat suitability models, PVAs, or site selection algorithms (e.g., SITES, a program developed by The Nature Conservancy for ecoregional conservation planning; S. Andelman et al., 1999. *SITES V 1.0: an analytical toolbox for designing ecoregional conservation portfolios*, The Nature Conservancy). Rather, selection of sites was based on GIS overlays and expert opinion. The failure to apply rigorous models reflects, in large part, the paucity of data on the species and communities concerned. Nevertheless, we feel that a more technically rigorous and sophisticated site evaluation process could have been applied and would result in a more defensible Plan. (See our response to question #6 in this section, below, and response to question #4 under Species Modeling.)

The site-identification process involved both scientific and non-scientific analyses. The scientific analyses are reasonably well documented for most species, but the non-scientific analyses, which involve issues such as monetary value of property as an inhibition to purchase, and prior land-use history, are not well documented. These two analyses need to be clearly separated, and the separation could explain, in part, the reason for the differences between Alternatives 2 and 3 and make the choice between the two – or, alternatively, a hybrid of the two – more objective.

The justification for the site-identification process appears in the ARD (p. 65-67). It is somewhat unusual that this plan uses GIS analysis with definite equations between data layers, yet no equations are presented in the documentation and the descriptions are somewhat vague. For example, multipliers are discussed but the final values are not given or referenced in the text. The "Relative Conservation Value" ranges from 0-25, yet there is no conversion equation given to combine "Covered Species Richness" (number of target species, ranges 0-31); "Covered Natural Communities Richness" (number of natural communities, possible range of 1-46 but probably never greater than 2-5); "Habitat Heterogeneity" (number of natural communities plus landform types, possible range given as 1 to >10); and "Habitat Fragmentation" (explicitly defined, 0-100%). It would appear that "Covered Species Richness" is double weighted, the combination of "Covered Natural Communities Richness" and "Habitat Heterogeneity" represents a double weight, and "Habitat Fragmentation" is a single weight, but it would be valuable to see this in equation form, for example:

RCV = f5*(2*f1*CSR + (f2*CNCR+f3*HH) + f4*HF)
where the f's are conversion factors to obtain the units of RCV. This would help the scientific credibility of the document as well as provide the more technically inclined audience to understand the basis for the plan.

The species models appear to be derived from considerable information, both in terms of mapped habitat information in GIS formats and the long experience and personal observations of the members of the SAC. As noted in the ARD (p. 64), species such as the ones covered in this MSHCP are difficult to map because of highly specific habitat requirements (which map require map units far larger in scale than the quarter section analysis used in the ARD) or the habitat requirements may only be vaguely known.

Most of the maps depicting current and/or historical distributions of species and the corresponding habitat model appear to be consistent and credible. For some species, like the desert slender salamander, the ARD leaves absolutely no doubt what is required for management of the species. However, some of the credibility of the ARD is damaged by seemingly incongruous information presented in map form or omissions from the documentation. For the Coachella Valley fringe-toed lizard, all the documentation is presented in the 1985 HCP and none of the information is repeated, even in summary form in the Technical Appendix. This needs to be corrected by providing a good summary that references the previous work. The only real information on this species appears on the map depicting the species distribution model, and this has semantics problems that beg explicit documentation in the ARD or the Technical Appendix. For example, distributions pre- and post-1979 appear to be issues on this map—why? If pre-1979 distributions are irrelevant, as appears to be implied by the "Potential Distribution" model, then why are they included? Should "Potential Distribution" be renamed "Potential Distribution, Post-1979"? How is it that some "Known Locations, Post-1979" fall outside the potential distribution? These issues need to be dealt with on the map and in the documentation.

Other maps appear to be contradictory, although that appearance may arise solely from inadequate documentation or insufficient labels on the maps. For example, for the Yuma Clapper Rail, at least three "Known Locations" are outside of the "Potential Distribution," which would raise questions about the validity of the potential distribution and the expert opinion model on which it is based. It is possible that those dots hide mapped potential distribution and therefore cannot be seen at the scale of this map, but that should be explained in the caption. For certain species—particularly the Coachella Valley giant sand treader cricket, the Palm Springs pocket mouse, the Coachella Valley milk vetch, the Crissal thrasher, the Palm Springs ground squirrel, the flat-tailed horned lizard, and the Mecca aster -- significant differences are depicted between "Known Locations," "Potential Distribution," and "Core Habitat." How can a known location be outside a potential distribution? If this isn't simply a semantics problem, this needs to be explained in detail or the credibility of the species model is seriously jeopardized. How is it that in many cases (see Palm Springs pocket mouse) the number of "Known Locations" is much higher outside of the "Core Habitat" than inside? Does the "Core Habitat" imply that points are not depicted within its boundaries because of the number of observations? Some of these maps show known locations in urban areas—does this mean that these species can adapt to urban environments and do not require specific areas to be set aside for special habitat management? For many bird species, the potential migratory areas and potential breeding areas are different from the observed locations of the species, in some cases with little or no overlap, and this <u>appears</u> to be a problem. Some species do not have potential distribution models, and, although this is discussed in the Technical Appendix, it should be noted on the map caption.

As these questions might indicate, the maps leave open alternative interpretations which may undermine the credibility of the MSHCP. For example, one might interpret the depictions of some Core Habitats as extremely conservative to the point of potential jeopardy for the species being managed, and therefore criticize the plan as insufficient to protect that species. Alternatively, given certain species' occurrence in highly urbanized areas, one might question the need for management of those species by setting aside lands or limiting development when they appear to tolerate existing developments. The point is that the species models appear to require much more documentation, particularly on the maps and their captions since they are separated from the

Technical Appendix. Our general conclusion is that the species models are probably adequate but their documentation falls short. This shortfall affects the perceived credibility of the plan in general and must be rectified.

Certain non-scientific issues appear to be presented as scientific issues, such as habitat fragmentation (ARD, p. 66). However, data on fragmentation are never presented in map form to allow the readers to evaluate for themselves the amount of fragmentation that exists on areas adjacent to alternative 2 areas, or whether alternative 2 areas themselves are already fragmented. Also, certain species may not be affected by habitat fragmentation as depicted in the ARD, and this interaction may be desirable as a way of differentiating habitats as favorable for some species but unfavorable for others. As discussed during our February 12 meeting, land valuation had a major influence on exclusion of certain potential habitats from alternative 2. We believe that some form of land valuation should be depicted in map form for the ARD if this alternative is to be included.

3. Is thorough documentation provided for the methodology and the data used to identify Core Habitat areas?

Regarding documentation, please refer to our response to the previous, related question (#2). For many species, core-habitat areas are not depicted and the reasons appear to be documented in the Technical Appendix. In general, no documentation of core-habitat delineation for species in general is presented either in the ARD or the Technical Appendix. As noted under question 2, the documentation for certain species models with core-habitat areas is inadequate as presented in map form, which is the only way it is shown in the documentation we were given. In many cases, the documentation for the methodology and the data used to identify core-habitat areas are sufficient even in the absence of an overall description of how core areas were delineated, particularly for a number of bird species. In some very noteworthy cases (*e.g.,* the Coachella Valley fringe-toed lizard), the methodology and data used are nearly all contained in an old (1985) habitat conservation plan which may be unavailable to someone reviewing this document. A summary of this HCP needs to be provided.

Because of the lack of an explicit scientific discussion of delineation of core-habitat areas, one is left to speculate as to how these areas were delineated. That such speculation is possible, of course, undermines somewhat the scientific credibility of the MSHCP. One possibility that explains the discrepancy between mapped Core Habitat and known distributions is that a political filter, such as cost of land acquisition or known opposition from developers or land owners, may have been overlain on the known distribution. The core-habitat areas for some species appear to broadly follow the outlines of known distributions of aeolian sand, particularly given historical development patterns, and if so, this should be simply stated. As this discussion indicates, thorough documentation has not been provided concerning the delineation of core-habitat areas and this problem needs to be rectified.

4. What are the limitations in the site identification process?

A significant limitation is that the methods (see pages 64-70 of the ARD) fail to recognize that the 31 focal species have very different spatial and temporal scales at which their population dynamics play out across the planning area. As such, the ranking criteria used may be inappropriate for some of the larger species. For many of the 31 species (those where population dynamics play out a smaller spatial scales), the methods described may be appropriate because many, if not all of the factors driving viability in the planning area will be driven by local processes that determine births and deaths within habitats. However, for larger bodied species, whose population dynamics occur at larger spatial scales, the spatial patterns of how reserves are configured, the size of the core areas, and the pattern and effectiveness of linkages between these cores become critical to maintaining viable populations. Thus, for these species, the issue of reserve design becomes one of dealing with dispersal and other demographic processes within and between core areas. The methods described on pages 64-67 demonstrate little awareness of the importance of patch size and configuration on viability for such species.

Another major limitation is the discrepancy between mapped points of "Known Distribution" versus the "Potential Distribution" outlines derived from GIS analysis. Either 1) very few observations have been made on many of these species, lowering the information content needed to depict potential distribution, or 2) not all known distribution points are included on the maps. As discussed in the Technical Appendix, some of these species have highly specific habitat preferences that are difficult to plot at the 1/4 section level in map form, much less at the scale given on the oversize map sheets.

Furthermore, there does not appear to be much if any discussion on adaptive plasticity, where species may adapt to different habitat conditions if ones they previously occupied are degraded. In the case of the Coachella Valley fringe-toed lizard, there was some discussion that as active sand area decreased in natural habitats, the lizards may have switched to habitats created artificially by berms and a landfill. Other species appear to have adapted already to urban environments; we suggest the documents should discuss the implications of this potential adaptation. The site-identification process is in some ways hindered by the assumption that conditions at the time of the plan are representative of the full adaptation of the species without consideration of the potential full range in habitat variability.

We are also concerned that the "site identification mapping" methodology (section 3.6.1, pp. 65-67 of the ARD) is inadequate for conservation of natural communities. Because the Plan is also a NCCP, not just a MSHCP, adequate representation and conservation measures for natural communities are essential. As noted on p. 89 of the ARD, natural communities are considered in the Plan only in terms of providing habitat for covered species. This purpose is obviously redundant with the accompanying goal of protecting habitat of covered species. Instead, natural community conservation might be seen as a coarse filter that complements the fine filter of species conservation. The coarse filter is predicted to capture species about which little is known (e.g., poorly surveyed taxa such as many invertebrates, fungi, bryophytes, and bacteria) and serves to protect a higher level of biological organization—the community or ecosystem—which may be considered valuable in its own right.

The selection algorithm also may have been applied at an inappropriate spatial scale. Applying this simplistic algorithm to quarter-sections selects for a fine-grained, as opposed to coarse-grained, environment. High beta diversity (turnover of species along gradients, as reflected in "covered species richness," "covered natural community richness," and "habitat heterogeneity") is selected at the expense of larger, potentially more intact, blocks of particular habitats or communities. Considerable redundancy exists in these criteria, particularly between natural community richness and habitat heterogeneity. It would have been preferable to set separate targets for representation of viable occurrences of each covered species and natural community, rather than using simple richness criteria.

We suggest the planners refer to The Nature Conservancy's ecoregional planning materials (e.g., C. Groves et al., 2000, *Designing a Geography of Hope: A Practitioner's Guide to Ecoregional Conservation Planning,* 2nd ed.) and consider using more sophisticated selection algorithms (e.g., SITES, cited above), which would provide more quantifiable results than the methodology represented in the Draft Plan. SITES has been used as an aid for designing and analyzing alternative portfolios in a number of TNC ecoregional plans, including the Northern Gulf of Mexico, Cook Inlet, Klamath Mountains, Sierra Nevada, Middle Rocky Mountains-Blue Mountains, Utah-Wyoming Rocky Mountains, and Southern Rocky Mountains ecoregions. SITES utilizes an algorithm called "simulated annealing with iterative improvement" as a heuristic method for efficiently selecting regionally representative sets of areas for biodiversity conservation. It is not guaranteed to find "the best" solution. Nevertheless, the algorithm attempts to minimize conservation "cost" while maximizing attainment of conservation goals in a compact set of sites. It has been used effectively in study areas with poorer data availability than the Coachella Valley.

5. *Have information gaps been identified and does each alternative adequately consider uncertainty in the design of the conservation areas?*

When three of us (Noss, Soulé, and Tracy) were empanelled as early reviewers five years ago, we suggested that alternative reserve designs be set up as a hierarchy along a gradient of ignorance. Specifically, it can be argued that the highest probability of success in conserving the species in Coachella Valley is to protect all historic habitat, and the advisors recommended presentation of many alternative reserve designs including that mentioned above without regard to the difficulty of implementation. Thus, the designs would be considered on their biological basis alone at first, then later within a socio-political context (i.e., a cost screen would be applied to plan alternatives).

Even a reserve design based upon all historic habitat provides no certainty of success in preserving the covered species. This is especially the case because habitat is only one element necessary to protect species from extinctions. For example, noxious exotic species are now considered the second most important threat to species worldwide, next to loss of habitat. Thus, protection of habitat needs to be put into a context of the needs to manage species vis-a-vis manifold needs within the protected habitats.

The drafters of the MSHCP reserve design have, in some cases, not considered the uncertainties of identified stressors to the covered species. Moreover, as discussed earlier, it appears that financial and political implementation impediments were folded into the conservation program in addition to biological requirements. This means that the biological needs of species may have been considered by the SAC only through the filter of their personal understanding of implementation constraints which have not been addressed explicitly in the document. As noted earlier, we detect an implicit concern with the necessity requirement that threatens to overwhelm the sufficiency requirement. This became particularly obvious in the presentations to our team as the concepts of new viaducts (e.g., underpasses for wildlife) were discussed as a means to mitigate the negative effects of roads as barriers. Members of the SAC expressed doubt that such mitigation was possible, hence their preference for Alternative 2, which considered habitat areas separated by major roads as essentially permanently isolated. A more precautionary approach would have left open options for restoring lost connectivity. This in fact may become a viable alternative if other habitat areas are lost due to political or economic factors.

An important principle in developing reserve designs is to admit ignorance of biological properties and processes and consider the consequence of that ignorance as alternative designs are proposed. Our assessment based on the documentation and discussions is that ignorance and uncertainty have not been considered explicitly in the comparison of any of the alternative designs.

6. Are adequate buffers provided for conservation, assuming full build-out under each jurisdiction's general plan?

There are no buffer zones *per se* or other transitional areas around reserves identified in the design alternatives. Any buffer function is implicitly assumed to be provided by the outer zone of each reserve. Given the well-documented problem of edge effects (physical, biological, human, etc.), we believe the buffer zone issue should be addressed in the final plan. Evidence from several studies suggests that agricultural or low-density residential development around reserves results in less severe edge effects (e.g., nest predation on birds) than when reserves are surrounded by high-density residential development. This is probably due to higher densities of house cats and opportunistic mesopredators, such as raccoons and opossums, subsidized by garbage and pet food, in high-density residential areas (D. Wilcove, 1985, *Ecology* 66:1211-1214; L. Friesen et al., 1995, *Conservation Biology* 9:1408-1414; R. Blair, 1996, *Ecological Applications* 6:506-519). On the other hand, buffers sometimes can be population sinks, potentially draining a source population in a reserve (R. Noss and A. Cooperrider, 1994, *Saving Nature's Legacy*, Island Press). In such cases it may be preferable to surround a reserve with a "hard edge," such as a tall fence, impervious to mesopredators (M. Groom et al., 1999, Pages 171-197 in M. Soulé and J. Terborgh, eds., *Continental Conservation*, Island Press). We suggest hard edges may be most appropriate for isolated reserves, where the potential for restoring connectivity for native species is low but the probability of severe edge effect is high.

7. What are the limitations in the site identification process?

See above (grouped with #2 and #3)

8. Are sufficient data provided to determine the effects of roads on population viability for target species?

Roads, especially major ones, are assumed in the Draft Plan to represent strong fragmenting factors. A habitat fragmentation value was assigned to each mapping unit based on the extent of fragmentation by roads, with roads divided into three categories of width and each road "buffered" to include an additional area one-half the width of the road on each side. Habitat areas separated by major roads are generally assumed to be functionally isolated from one another (although, paradoxically, some of the corridors proposed in the Plan alternatives cross several major roads). We agree that many studies support the assumption that roads are major threats to biodiversity. Potential effects of roads include barriers to movement of organisms and sand, sources of direct mortality (road kill), access to disruptive human activities (e.g., poaching, collecting, ORV use), and spread of invasive exotic species.

No data are provided, however, on the effects roads may have on the covered species and natural communities in the Plan Area. Apparently no studies have been conducted. Nor are potential mitigation measures (e.g., road closures, tunnels, overpasses, fences) considered in any detail. We recommend that the adaptive management and monitoring plan include research on the effects of roads. Moreover, we recommend that specific mitigation measures to reduce the likely impacts of roads be considered in the planning alternatives.

9. Can the target species be grouped into categories that reflect general area requirements related to viability? What are those categories and general area requirements?

The ability to group species into "conservation guilds" should be taken as a testable hypothesis to be considered as part of the monitoring and adaptive management program. Possible answers to the first question posed above are "yes," "yes, under certain circumstances," or even "no."

However, it is likely that some lumping of species into conservation guilds is possible. This question needs to be investigated as one of the first implementation programs of the HCP insofar as it could make considerably more efficacious the management prescriptions in preserved habitat. It certainly seems that the sand-dependent species may have needs in common allowing some lumping, but this should be taken as an hypothesis. Whether area requirements alone would serve as a basis for grouping species into categories is questionable. A more fruitful approach may be one suggested by R. Lambeck (1997, *Conservation Biology* 11: 849-856), which is to group species into vulnerability guilds (e.g., area-limited, dispersal-limited, resource-limited, process-limited) and then identify the species in each guild that is most demanding. These species would then serve as potential umbrella species for the others in their guild. This process would need to be repeated for each major habitat type in the planning area, as well as for the area as a whole.

Asking "what are the categories and what are the general area requirements?" is outside of the scope of a peer review. As reviewers, we suggest that planners make an attempt to lump species based upon hypothesized common needs and vulnerabilities. Outside reviewers could review the evidence for lumping, but the process of testing the efficacy of lumping should be proposed as an activity in the adaptive management program of the HCP.

10. Does the prescribed CVWD groundwater management plan provide adequate water table levels to sustain the target natural communities and species? If not, what additional data are needed?

Several natural communities that affect the species covered under the MSHCP are strongly affected by groundwater levels: mesquite hummocks, Sonoran cottonwood-willow riparian forest, southern arroyo willow riparian forest, southern sycamore-alder riparian woodland, mesquite bosque, and coastal and valley freshwater marsh. Of these, the freshwater marsh is probably most strongly affected by agricultural drainage, wastewater effluent, and urban runoff; those ecosystems used by bird species adjacent to the head of the Salton Sea are more affected by its water levels than groundwater; and the Sonoran cottonwood-willow riparian forest, southern arroyo willow riparian forest, southern sycamore-alder riparian woodland, and mesquite bosque appear to be mostly out of the area of active groundwater management. Therefore, the natural community type most affected by groundwater withdrawals are mesquite hummocks.

The CVWD water management plan calls for a preferred Alternative 4, which differentially affects the "Upper Valley" from the "Lower Valley" (division line at approximately perpendicular to the valley at La Quinta). The distinction between the two areas is that the Upper Valley is mainly a tourism based economy with water used for urban environments, domestic and resort usage, and golf courses, whereas the Lower Valley is heavily dominated by agricultural usage. Alternative 4 calls for elimination of groundwater overdraft throughout the basin by importing and recharging water from the Colorado River, eliminating the decline in groundwater levels in the Upper Valley, increasing groundwater levels in the Lower Valley, and promoting water conservation. All the alternatives are compared using a groundwater flow model that excludes the Desert Hot Springs area, which is one of the key areas with respect to the MSHCP.

Mesquite hummocks are found in two distinct places with regards to groundwater: on or near active faults, such as the San Andreas, and scattered among stabilized dunes on the valley floor. The former habitat is not directly addressed by the CVWD plan and may be the most threatened of the two types owing to pumpage for the rapidly enlarging cities of Desert Hot Springs, Cathedral City, and Indio. Alternative 4 calls for eliminating the decline in groundwater in the Upper Valley, which would include most of the mesquite hummock habitat along the faults, but the modeling may be insufficient to consider flow upslope from the faults. Despite urbanization upslope from the faults at Desert Hot Springs, the flow model doesn't cover this part of the aquifer and therefore the possibility exists that the flow system feeding the mesquite hummocks in Willow Hole may be neglected in the planning process.

Alternative 4 as stated will likely positively affect the remaining mesquite hummocks scattered around the floor of the Coachella Valley in the Lower Valley. Although groundwater overdraft has been extensive, restoration of groundwater levels (as stated in the preferred alternative) could save these unique habitats and possibly aid many of the target species in the MSHCP.

We suggest that monitoring wells be installed at selected areas in the preserves, ACECs, and other areas with significant riparian vegetation as a part of the adaptive management plan. These are relatively cheap and objective ways of evaluating whether or not groundwater levels are declining and may affect riparian ecosystems.

II. Species Level Questions:

All Species

1. *If the conservation areas for sand dependent species are concentrated in the dune systems north of Interstate 10, will this be sufficient for those species over the long term if the dune systems south of Interstate 10 are eliminated?*

Regarding the sufficiency of the dunes conserved north of I-10 for long-term needs of sand dependent species, the short answer is not for all species. Although some species have relatively broad tolerances for temperature and moisture regimes, others have much more narrow tolerances. For the latter species (especially those unable to fly), it is critical to maintain landscape linkages to allow them to track the changing limits of their essential habitat parameters. Historically, the largest contiguous dune system was south of I-10; it linked dune habitats in the center of the Valley with sandy habitats and sand sources extending to the western limits of the Plan Area. This dune system spanned a relatively broad and dynamic gradient of temperature and moisture conditions, permitting similarly dynamic range adjustments for many species. The central dune system is now fragmented and can no longer support such species range adjustments. Dunes north of I-10 are much less extensive and less connected to one-another; they are also cut off from the remnant southern dunes by I-10 and by the railroad. Thus, linkages among the dunes north of I-10 are tenuous and the ability of their flightless inhabitants to track climate-related changes in habitat distribution are impaired. The physical isolation of dunes north of I-10 makes their sand-dependent inhabitants more vulnerable to extirpation when climatic or other external conditions change, than would the same species in the southern dune system prior to its fragmentation

Only one covered plant species is known to occur on the Big Dune south of I-10, the CV milkvetch. This species occurs in active and stabile sand and has a high probability of persistence on the Big Dune even though it is no longer geomorphically active. Alternatively, CV milkvetch distribution is extensive enough elsewhere that it will survive even without protection of Big Dune.

A more definitive answer to the question proposed here is strongly desirable, but it will require—as a start—biological surveys of the Big Dune. In the interim, we suggest that the Big Dune be protected from development. Although it seems certain that the Big Dune is limited on process (i.e., sand movement), this does not entirely negate its habitat values. Whether or not to include the Big Dune in the proposed reserve system should be decided on the basis of adequate biological data. While data may eventually confirm the availability of the Big Dune for economic development, we believe it should not be eliminated up front simply on the basis of high land values and little or no biological information.

2. *If full build-out were to occur under each jurisdiction's general plan up to the boundary of the conservation areas, and 10% of each parcel inside the conservation areas could be developed, which target species might be affected and how; particularly in areas with multiple small parcels?*

Again, this is a question that peer reviewers cannot answer acceptably. It is impossible to answer this question without knowledge of the exact pattern and nature of each development project. At this point in time, data do not exist to understand the mechanisms by which this level of build-out will affect the Coachella Valley ecosystem. Nevertheless, the notion of 10% build-out on each parcel inside the conservation areas is one of the most troubling aspects of the Draft Plan. It is certain to lead to habitat fragmentation within reserves unless the development process can be intelligently regulated such that habitat destruction is limited to marginal areas. Clustering, especially on reserve margins rather than centrally, is a much less disruptive pattern of development than scattered build-out. Roads would increase greatly under a scattered vs. a clustered pattern, perhaps to the point that the total surface area occupied by roads constitutes a substantial loss of habitat reserve-wide. Unfortunately, we do not find a rigorous assessment of this problem in the Draft Plan.

A number of covered species can be expected to decline unless the 10% build-out allowance is eliminated or confined to reserve areas with low habitat values. For example, given the probable increase in a highly subsidized cat population in the vicinity of residential subdivisions, the two small mammals covered in the Plan (Palm Springs ground squirrel, Palm Springs pocket mouse) will be negatively affected. Fire frequency also can be expected to increase, with uncertain effects on covered species. With regard to the covered sand-inhabiting orthopteroid insects (CVJC, CVG, CVGSC), simply taking out 10% of the habitat on each parcel (e.g. paving over 10%) would probably cause a simple 10% reduction in population size. However, the loss could be much greater depending on how the land is modified. For example, landscape trees and shrubs could alter sand deposition, introduce invasive weedy plants, and alter insolation by shading. This uncertainty might be overcome by implementing strict land use guidelines for landscaping, such as prohibiting certain invasive species and prohibiting or limiting the height of ornamental trees and shrubs. It would be helpful if only native plants were used in landscaping.

3. *Were area requirements, habitat and connectivity needs and life histories adequately addressed and documented for each species in the development of conservation areas?*

Our general answer to this question is "apparently not," but we acknowledge that data to consider area requirements, habitat affinities, and connectivity requirements from the standpoint of each species' autecology were sparse. The Draft Plan gave general consideration to autecological requirements in constructing the species-specific habitat models. Nevertheless, the Plan should have considered connectivity issues, in particular, more thoroughly. See our response to question #4 under Species-Specific for some suggestions concerning connectivity.

4. *Were appropriate biological parameters and/or landscape features used to estimate a minimum patch size of suitable habitat for inclusion in the conservation area design for each species?*

This question has two basic components. First, "Were appropriate biological parameters . . . used to estimate a minimum patch size of suitable habitat for inclusion in the conservation area design for each species?" Many people use the term "parameter" (meaning a value or state of a variable) as a synonym for "variable." Because the context does not help in figuring out which concept was meant, we assume both were meant. In general, we believe the planners used reasonable factors (variables) in the conservation area design. In many cases, of course, data were not available, so surrogate variables were used. We are impressed by the knowledge and skill of the biologists working on this project (i.e., the SAC) and have no reason to doubt that reasonable (best available) variables were used.

With regard to "parameter" selection, the models used to determine suitable habitat for the various covered species are not formal population viability (PVA) models (see our response to Species Modeling questions); in other words, they do not involve the use of precise parameter estimation and testing. Therefore, although this question is interesting, it is not relevant at this stage. It might become relevant, however, as time goes by and PVAs are carried out as part of implementation, monitoring, and adaptive management.

Second, "Were appropriate . . . landscape features used to estimate a minimum patch size of suitable habitat for inclusion in the conservation area design for each species?" In most cases, this question is the same as the question above assuming that "landscape variables" and "variable" mean the same thing. Where adequate knowledge of particular species is available, we support the choice of landscape variables used in the models.

The more important issue, perhaps, is that of "minimum patch size." We assume that the questioner has in mind some minimum (critical) area necessary for the persistence of the species population over a reasonable length of time. It is impossible, however, to engage in a serious discussion of this question unless the issues of "how long" and "probability of persistence" are specified for each covered species individually. To do this, of course, requires many years of demographic information and a formal PVA. At best, these data are available for one or two species, so the question, on its face, could be described as academic.

To be fair, however, we should address the underlying issue, which is "does the minimum patch size (or overall area protected) for each covered species make sense based on the intuition of conservation biologists?" Unfortunately, though, even this question requires some information about the annual variability of the relevant ecological variables, knowledge of existing or potential edge effects, consideration of demographic stochasticity, degree of connectivity for each species, etc. For example, a small patch that can sustain a mean population of 10 individuals of an animals species with an average lifetime movement distance from the natal site of 300 meters and located several kilometers from other patches would fail to pass the "laugh test." On the other hand, such a patch located between 200 and 400 meters from a larger site might constitute a reasonable conservation site in a metapopulation model, assuming there were no impassable barriers to dispersal.

As noted elsewhere, we are concerned that the suite of potential reserves in Alternative 2 is potentially insufficient from a biological standpoint. Yet how much of Alternative 3 is beyond the necessary amount of habitat to sustain the covered species and natural communities is highly uncertain, largely because of data limitations. Most importantly, the question of how much habitat is needed cannot be answered without considering details of management. Hence the importance of having an adequate adaptive management plan. Without ecological management, much larger areas of habitat are usually necessary to sustain a suite of target species. Conversely, smaller areas can be adequate given sufficient management.

Insufficiency is an almost inevitable result of considering non-biological factors, such as cost of purchasing private property, in the initial selection of conservation areas. If one were less concerned with land costs and availability, it would be prudent and ethical to give the benefit of the doubt to the species—to employ the precautionary principle with regard to rejecting possible sites. This is particularly reasonable when little is known about the critical factors that determine long-term persistence, which is generally the case for the covered species in the Coachella Valley. Certainly non-biological factors, such as economics, must inform the final selection of conservation areas and the mechanisms by which these areas are protected and managed. Our concern is that when economic and political factors are brought into consideration early in the design and planning process, they constrain biological options and make the choice of conservation areas less defensible scientifically. As we have stated earlier, it may be that the final plan must balance the economic and political feasibility of some of the proposed biological conservation areas with their necessity as protected areas. But to make that judgment at the selection stage, particularly in the absence of documentation about what those non-biological factors are, undermines the defensibility of the proposed conservation program.

To the best of our knowledge, the best available information was used to determine the habitat needs of the covered insect species. Unfortunately, there are no definitive values for minimum habitat patch size for any of these species. Furthermore, the rapid pace of habitat conversion to other uses, together with habitat fragmentation and other environmental changes, does not permit an accurate assessment of long-term effects on species viability with respect to habitat patch size. This information can only come from future studies. This is why an effective adaptive management plan is so important.

5. Are the data provided on the habitat requirements and ecology of narrowly distributed endemics sufficient to design conservation alternatives and management methods?

This question has two parts. First, one must understand what a “narrowly distributed endemic” is. Second, one must decide if the understanding of these species’ life histories, population dynamics, and habitat requirements is sufficient to design conservation alternatives.

Based on species descriptions in the Technical Appendix, the following species are found only in Coachella Valley and might be considered narrowly distributed endemics: CV Jerusalem cricket, Casey’s June beetle, Coachella Valley giant sand-treader cricket, triple-ribbed milkvetch, and the CV fringe-toed lizard. Additional species are found primarily in the planning area, with some populations located outside: CV milkvetch, little San Bernardino Mountains linanthus, Mecca aster, Orocopia sage, Palm Springs ground Squirrel, and the Palm Springs pocket mouse.

In general, knowledge of the above species consists primarily of distributional data and perhaps estimates of abundance in each location. (Obviously, the level of information varies across species, with the perhaps the best data being available for the Fringe-toed lizard.) Virtually nothing is known about the demographic or genetic patterns and processes in most of these species. Thus, designing conservation alternatives for these species cannot, at present, be based on high quality, rigorously collected data.

Specifically, understanding how alternatives 2 and 3 will differentially change the ability of the Plan to conserve viable populations of the above species is fraught with high levels of uncertainty. The primary method of comparison is to overlay Alternatives 2 and 3 on the predicted distribution for each species and determine which alternative covers a sufficient amount of the predicted distribution for each species.

There are a number of reasons why this method may contain substantial error. First, the predicted species distribution maps may not be correct. In rare cases, so little is known about a species that a predicted distribution was not created (i.e. Jerusalem cricket). In cases where the species distributions were predicted using GIS overlays, there is no information regarding the validity of these distributions. Validation could be achieved by surveying randomly selected locations within and outside the predicted distribution of each species, then determining how frequently the GIS model correctly classified a location in terms of presence or absence.

Second, errors of omission could lead to substantial uncertainty when designing or choosing between alternatives. The current comparative method does not include information regarding how population dynamics and genetic structure will interact with each of the alternatives to determine overall viability of the narrow endemics. This is not a fault of the SAC, but merely a limitation of the data available. Nevertheless, the simplistic methods used create uncertainty in the design and selection process that should be acknowledged.

Species-Specific

1. *Is it critical to maintain the habitat at the east end of the Indio Hills to sustain populations of the Palm Springs ground squirrel and the Palm Springs pocket mouse rangewide?*

Information provided on the biology of this species and the spatial configuration of the Plan is not adequate to answer this question with a high level of certainty. The ability of the Plan (or any given alternative) to cover the squirrel will depend on the interaction between the spatial ecology of the squirrel (i.e. how population dynamics occur across space) and the final spatial configuration of the Plan. The following types of information would increase our ability to understand how habitat in the east end of Indio Hills affects the ability of an alternative to sustain the squirrel:

A) Higher quality distribution maps. Currently, the distribution map for this species consists of 103 locations across a predicted 103,207 acres, or 1 point per 1,000 acres. Data on habitat requirements consists of descriptions of habitats in which the species was found. Detailed, longer-term studies of spatial variation in density, reproductive success, survivorship, and other demographic parameters across habitat gradients are lacking. Thus, there is the potential for error in the identification of the Core Habitat for this species.

B) Understanding how the species responds to habitat fragmentation. Given the relatively low density of this species reported in the technical appendix, large areas may be required to maintain viable populations within any given area of the Plan. How habitat fragmentation, including low levels of development within conservation areas, affects population dynamics and dispersal is critical to understanding the contribution of habitat east of Indio Hills toward overall viability.

C) Factors regulating population size. Generalizing points 1 and 2 above, little is known about the factors that regulate population size in this species. Preferred habitat seems somewhat identifiable, but having a detailed understanding of those factors influencing density at a given locality would increase our ability to identify suitable habitat and determine management strategies.

D) The dispersal ability of the species/historic patterns of gene flow. One argument against including habitat east of Indio hills in the Plan is that it represents a disjunctive population and hence adds little to the overall population throughout the reserve. However, we know nothing about the dispersal biology of this species, average dispersal distances and how connected populations were prior to the current urbanization of the Valley. Given such a dearth of information, we do not know if populations in eastern part of the reserve were always disjunctive from more western populations or were recently isolated. Indeed, we do not know if the habitat connections between the core areas found in both alternatives in the western part of the reserve are even necessary to maintain demographically critical dispersal or gene flow.

Understanding the dispersal biology of the species would allow one to understand the spatial distances at which populations of ground squirrels become demographically isolated and what habitat types make corridors functional for this species. In addition, many small mammal species show sex and age biases in dispersal. This information may be critical in designing translocation programs, if they are needed. Genetic data would greatly assist the decision making process by describing the historic patterns of gene flow, and hence historic connections between populations, prior to urbanization. This information would improve substantially the identification of core areas and critical habitat linkages. In addition, the data would be useful in adaptive management because they may suggest specific translocation scenarios in situations where creating or maintaining habitat corridors is impossible.

E) A better understanding of how build-out will take place within the planning area. Despite the focus on Alternatives 2 and 3, both represent general "outlines" of the ultimate hard boundaries of the Plan. Particular pieces of land designated as reserve in the Alternatives may be considered critical for development by stakeholders or too expensive to add to public ownership. As such, we cannot be certain of the final spatial configuration of the plan or the densities of urbanization in particular areas of build-out. Hence, the east end of Indio Hills may end up supporting a key population(s) of the squirrel depending on how areas to west are ultimately delineated during the negotiation process between stakeholders and the wildlife agencies.

2. Is the proposed corridor between the east end of the Indio Hills and Dos Palmas sufficient to maintain potential for demographic interchange for the Palm Springs ground squirrel and the Palm Springs pocket mouse?

In short, there is insufficient information to answer this question. The data needed to answer this question are described in the response to the previous question regarding the dispersal ability of the species and historic patterns of gene flow.

Nevertheless, given the large distances involved and documented dispersal distances of similarly sized small mammals, it is unlikely that populations separated by the distances between Indio Hills and Dos Palmas were ever "demographically" connected in the sense that dispersal from Indio Hills populations had regular (annual or within a generation), demographic impacts on populations in Dos Palmas or vice-versa. Metapopulation-like colonization events probably took place between the two areas in the past (or even now), which would have connected the populations genetically as multiple generations of dispersing individuals moved genes between the areas, but there is no evidence of such connection.

3. *Is a linkage between Willow Hole and the upper Mission Creek necessary for the long term persistence of the Palm Springs pocket mouse?*

This question boils down to whether or not the different levels of connection between Willow Hole and Upper Mission Creek proposed in the alternatives will differentially impact the long-term persistence of the pocket mouse. There are two critical biological issues that must be resolved to answer the question. The first is basically the question asked of the review panel, is immigration between the populations on either side of the proposed corridor necessary for persistence? However, another question is critical as well: Will the corridor function differently (or at all) under the two alternatives?

Insufficient data exists to answer either question adequately. The following types of information would help determine the role of immigration to overall persistence.

A) The population demography of pocket mice. If populations show large fluctuations in numbers and local extinctions, then immigration between locations will become critical for recolonizing sites. If populations are more stable and rarely go extinct, immigration between sites is demographically less important. What role immigration plays in overall population persistence in this species is not known.

B) Estimates of gene flow between pocket mouse populations on either side of the proposed corridor. If these populations are genetically distinct with little gene flow, then historical immigration between the populations was rare. In this case, immigration may not be critical to long-term persistence. The alternative is that the populations are genetically indistinguishable and gene flow did occur. Analyses using mitochondrial DNA would be appropriate given the distances between populations.

In order to determine the difference between the two alternatives in their ability to promote movement of pocket mice between populations, information is needed on the spatial distribution of pocket mice in the area. If pocket mice are found in the two drainage canals, then it may be possible that they would continue to use these features in the future. This assumes that use of the drainages by pocket mice will not change as development takes place or if the design of the drainages is altered. Detailed demographic studies in these canals could determine if they are used for dispersal (short persistence times and no reproductive activity), or actually support populations of mice (longer persistence times, newly weaned offspring occurring seasonally, reproductive activity).

If surveys indicate the mouse is found in the contested area (i.e. Alt. 3), but not in the drainage systems (Alt. 2), then Alternative 3 would be preferred, assuming additional build-out of the current low density urbanization in the Alt. 3 area does not continue.

It is obviously desirable to maintain suitable habitat wherever possible. The area in question, however, already is partially developed and disturbed and could even be (or shortly become) a demographic sink for this species. Moreover, there is an approved specific plan for development in the future. This raises many questions. Would restrictions on off-road-vehicle use in the area be reasonable, practical, and beneficial? Also, given increasing density of housing and the vast increase in subsidized house cats that this implies, is survival of the mouse likely in this area? (Even low-density housing in the area could restrict opportunities for the survival of a viable population.) Would it be possible to design and protect a linkage zone connecting these two localities? Would fencing of such a linkage keep out cats and human recreational use that would compromise the biological utility of the linkage?

Ultimately, whether or not a linkage between Willow Hole and Upper Mission Creek is needed is unknown given all the uncertainties of current and future distribution of the mouse, not to mention the absence of reasonably good PVA for the species; such a PVA is probably not a realistic expectation given the level of information now available. If funding were to become available, however, such a PVA should be performed. Because the mouse is known to exist at several localities between Willow Hole and the Salton Sea along the eastern side of the Coachella Valley (a distance of about 50 miles), a barrier to movement between Willow Hole and Upper Mission Creek is not likely to jeopardize persistence during the next century or so, depending, of course, on the development pattern in the planning area as a whole.

4. Have adequate connections been maintained within the Plan Area and to populations outside of the Plan Area for target species?

Connectivity for genetic exchange and to assure repopulation of depleted populations (the "rescue effect") are important features of any conservation plan. Although an argument has been made (for example, by Dan Simberloff and colleagues) that corridors without proven values for species are ill-considered, this suggestion poses a high risk of Type II error. Natural landscapes are fundamentally connected, but this connectivity is often broken by human activities. Conservation strategies do not attempt to create corridors between habitats that were naturally isolated, but rather to maintain, and where possible restore, natural connections (R. Noss, 1987, *Conservation Biology* 1:159-164). The precautionary principle suggests that the appropriate null hypothesis is that severing natural connections has no ill effects on biodiversity. Accepting this null hypothesis, if it is incorrect, would have serious consequences. Hence, the burden of proof should be placed on those who would reduce natural levels of connectivity (P. Beier and R. Noss, 1998, *Conservation Biology* 12:1241-1252). Again, we urge more consideration to assuring sufficiency and less to proving necessity.

The Coachella Valley Plan has one major connection across the Valley in the north, crossing Rt. 111, I-10, and Dillon Road. It consists of Alternative 2 and 3 patches. In some areas Alternative 2 forms a narrow corridor, and addition of Alternative 3 lands would increase the width and possibly the security of the corridor. Target animals such as desert bighorn sheep may not necessarily use this corridor, as they usually will not cross highways, but the corridor may provide connectivity for other large mammals not covered by the Plan, as well as potentially

many smaller-bodied animals, especially if modifications of roads (wildlife crossings) can be made.

A second potential major connection not addressed in the Plan is the Whitewater River channel. It runs east-west across the Valley through Palm Desert and Indio, then south to the Salton Sea. It is not currently a viable connector for many species, as it has been channelized. However, it is not fenced, and might be a connection for species not highly sensitive to urbanization such as coyotes. Coyotes, in turn, can help maintain populations of native birds through their top-down regulation of opportunistic mesopredators (K. Crooks and M. Soulé, 1999, *Nature* 400:563-566). The possibility of preserving lands to increase animal movement via the Whitewater River should be pursued, as well as potential restoration of the river channel that might make it a corridor for additional animal species. A north-south linkage could be restored by stopping dredging and clearing the Whitewater River upstream from its juncture with the San Gorgonio River and the triangular area were added, as proposed under Alternative 3.
Other potential wildlife corridors running east-west through the Valley are railroad and highway rights-of-way, which might also be restored. Furthermore, canals are likely barriers to movement of a number of species. Land bridge (i.e., running the canal below ground) in strategic places could significantly reduce the barrier effects. The potential of these options to improve connectivity for covered and uncovered species should be addressed in the Plan.

A third major connection across the Valley is on the north end of the Salton Sea. This is currently mapped as agricultural, but salinization is increasingly causing abandonment of farmland adjacent to the sea. Native saltbush and exotic tamarisk are colonizing this land. Even though it is not pristine habitat, it may be a useful dispersal corridor. Although much of the land in this area is Indian-owned and therefore outside the jurisdiction of the Plan, other lands that are not yet developed should be considered in the Plan. Again, restoration is a major issue in considering these lands.

Several additional smaller-scale connections occur in the Valley. The unexpected development plans between Dillon road and Joshua Tree National Park need to be countered by preservation of additional adjacent lands to improve connectivity to the Park. Desert washes should be preserved as corridors where they may provide for animal movement, for instance in the Alternative 3 lands on the northeast of the Salton Sea. The "sand channels" north of I-10 may also be corridors for animal movement, especially if the adjacent lands are not developed any more densely than at present.

We emphasize, again, that while a corridor is often a hypothesis rather than proven fact, the option for keeping corridors should not be closed until the function of the purported corridor is known. Corridors may be especially important for movement of organisms during times of environmental stress. Global change may bring warmer temperatures and possibly higher rainfall to the Coachella Valley, and may necessitate animal dispersal as natural habitats change. The future of vegetation change in the Coachella Valley is uncertain, but allowing natural movement is one way to allow organisms to search out suitable habitat. Maintaining as much connectivity as possible is a safeguard against future extinctions.

Species that require connectivity at very broad spatial scales in the planning area include large mammals that are not covered by the plan (e.g., mountain lion). Bighorn sheep are thought not to move across freeway underpasses, so the opportunity for movement of this species may already be lost. (On the other hand, it is not unlikely that very wide underpasses, or better yet, land bridges, would be used for movement.) Historically genetic exchange occurred mainly when individual rams would move between populations, as has been documented for Rocky Mountain bighorn sheep. The existing and potential corridors outlined in our response to the previous question will be more useful to vagile non-target mammals, mainly predators.

In the event of climate change, it is almost certain that some populations of species dependent on narrow environmental parameters will dwindle in size and may be extirpated, while others may flourish. Populations of flightless sand-dependent organisms are now largely fragmented by transportation corridors and other anthropogenic habitat alteration activities which have carved up the once-contiguous large dune systems. To a large extent species persistence will depend on whether habitat linkages to potential refugia are maintained. The insect most likely to be adversely affected is Casey's June beetle. Because the females are flightless, this species cannot adjust its range rapidly. This species is already essentially locked into a few small enclaves surrounded by urban barriers to dispersal.

Connections between the Coachella Valley planning area and other landscapes are potentially important for several species. Again, adequate data are lacking, but a precautionary approach dictates conservation of existing linkages. Species in this category include large mammals (e.g., bighorn sheep and such uncovered species as mountain lion, coyote, bobcat, and kit fox), the desert tortoise, and the CV milk vetch, little San Bernardino Mountains linanthus, Mecca aster, Orocopia sage, Palm Springs ground squirrel, and Palm Springs pocket mouse. Research is needed on the dispersal behaviors of these species in order to identify plausible corridors.

III. Habitat Monitoring and Management Questions.

1. What basic principles and testable hypotheses for monitoring and adaptive management would be appropriate in the Plan Area? Are these included in the proposed management program?

Please refer to Appendix B for a summary of what our team feels a defensible science-based adaptive management program might look like. The current proposal for monitoring and adaptive management in the Coachella Valley MSHCP is based entirely upon a one-species-at-a-time process, which we do not believe is the most efficient or auspicious approach. The Adaptive Management and Monitoring Program document we reviewed is confusing and statistically difficult to defend. Moreover, it is probably not an optimal use of the limited funds likely available for management.

The essence of the currently proposed program consists of gathering count data on various species while simultaneously measuring a host of independent, potentially explanatory variables, then using multivariate analyses to partition the variation in numbers of individuals across the suite of explanatory variables. Unfortunately, the population dynamics of desert species are typically so dramatic and precipitous (in response to natural fluctuations in the environment) that it is nearly impossible discern anthropogenic causes of change. Hence, the data derived from a monitoring program of this sort is unlikely to provide information to managers that will be useful for adaptive management, that is, for changing management practices to better serve the goals of the conservation plan.

The proposed Coachella Valley monitoring program suggests using a less volatile measure of populations such as reproductive output. However, this method has been hypothesized to work for fringed-toed lizards only because there are 1.5 decades of data upon which the approach has been evaluated. The method would be much less appropriate for other covered species in the HCP, for which data are considerably more limited. Considering each covered species individually also has considerable drawbacks (R. Noss, M. O'Connell, and D. Murphy, 1997, *The Science of Conservation Planning*, Island Press). As discussed earlier, a more promising approach would be to classify species into conservation guilds (for example, vulnerability guilds or habitat guilds). In such an approach, similarities in habitat affinities, life histories, and responses to habitat alteration and management would need to be identified quantitatively enough that the wildlife agencies would be convinced that conservation of some species, through habitat protection and management, will also conserve other species in the covered list.

The most promising kind of monitoring currently proposed for the CV-MSHCP appears to be that used to assess the extent of various kinds of sand using digital IR and GIS. For some species, this method measures the extent, and potentially the fragmentation, of suitable habitat. Hence, this approach could be used to assess trends in habitat patterns quickly and effectively. We suggest that this approach be pursued at the initiation of the adaptive management program.

At the very least, the monitoring and adaptive management program should develop process models of how the systems work. Validation monitoring (see Appendix B) should be an important aspect of the program from the outset. It will be necessary to establish a record of implementation of management prescriptions and devise a plan to assess the efficacy of those prescriptions. This requires hypothesis testing and validation research as well as effectiveness monitoring.

We recommend using Appendix B as a template of how to structure a monitoring and adaptive management program in the Coachella Valley. Furthermore, two issues not directly addressed by the Plan, but which will affect future management, are global warming and air pollution. In addition to becoming warmer in response to elevated CO_2, the Southern California deserts will receive more moisture under one global warming scenario (R. Nielson, 1998, Pp. 439-456 in R.

Watson et al., eds. The Regional Impacts of Climate Change. An Assessment of Vulnerability. *Special Report of Intergovernmental Panel on Climate Change Working Group II.* Cambridge University Press). The net impact to flora and fauna is impossible to predict, but monitoring is needed to detect vegetation change. Invasions of exotic plant and animal species are occurring rapidly and may be exacerbated by climate change. Exotic *Bromus rubens* responds to elevated CO_2 by increased growth more than native species, which may in part explain its increasing abundance in recent decades (Smith et al. 2000, *Nature* 408:79-82.). The monitoring in this Plan will not detect the causes of vegetation change, but will point to the need for research to determine the causes of plant and animal invasions.

Air pollution is of increasing concern in the desert as coastal urban areas grow and as local growth in the desert creates its own air pollution. The main concerns for vegetation are nitrogen oxides and ozone that originate from automobile exhaust. Ozone levels are likely not high enough to cause acute physiological damage in vegetation, although effects of long-term, low levels are more difficult to predict (E. Allen et al., in press, *Air Pollution and Vegetation Change in* Southern California *Shrublands. Proceedings of the Symposium on "Planning for Biodiversity: Bringing Research and Management Together" Feb. 29-Mar. 3, 2000*). Nitrate deposits on plant and soil surfaces and accumulates in the soil, unlike ozone, which dissipates. The Coachella Valley may also experience ammonium deposition from agricultural fertilization and possibly emissions from the Salton Sea. Nitrogen deposition is known to cause vegetation change in ecosystem types globally. It may enhance invasions of exotic species by differentially increasing their productivity compared to native species. There is evidence for this in Southern California coastal sage scrub (E. Allen et al., 1998, *Proceedings of the International Symposium on Air Pollution and Climate Change Effects on Forest Ecosystems, Riverside, CA February 5-9, 1996;* E. Allen et al., in press, *Ibid*).

Nitrogen fertilization in the desert caused an increase in the exotics Mediterranean split grass and storksbill* (M. Brooks, 1998, *Ecology of a Biological Invasion: Alien Annual Plants in the Mojave Desert. Ph.D. Dissertation, University of California, Riverside;* M. Brooks, 2000, *American Midland Naturalist* 144:92-108). Increased productivity is expected only in wet years, which may be followed by fire in the next dry season. Thus nitrogen deposition may be enhancing the fire cycle, which was previously virtually unknown in the desert. Remote sensing methods need to be calibrated to detect these invasions. The intensive density counts of exotics proposed in the monitoring plan are probably not required. Air pollution is monitored by the California Air Quality Management District in stations in Palm Springs, Indio, Joshua Tree NP, and other desert locations (http://www.arb.ca.gov/aqd/namslams/map_all.pdf), so data will be readily available to local land managers. Again, the cause of vegetation change is a research question. Nevertheless, nitrogen deposition and global change should be listed in the models as potential drivers of weed invasion, along with fragmentation and land disturbance.

*Mediterranean split grass (*Schismus barbatus*) and storksbill (*Erodium* spp.) are not listed in the text as two of the major invasive species. As they increase, they may be responsible for a decrease in native plant species richness.

2. What management actions can be taken to minimize the impacts of roads on species and habitats?

This topic is essentially unexplored in the Draft Plan. As noted earlier, the Plan implicitly assumes that the barrier and other effects of roads cannot be modified to reduce their impacts. Experience in many regions, however, has demonstrated that wildlife crossings, ranging from culverts to overpasses to land bridges, can be effective in reducing the barrier effects of roads, as well as roadkill. Responses are highly species-specific, however, so mitigation measures must be carefully tailored to the species in question (e.g., V. Keller and H. Pfister, 1997, Pp. 70-80 in K. Canters, ed. *Habitat Fragmentation and Infrastructure*; A. Clevenger and N. Waltho, 2000, *Conservation Biology* 14:47-56). We recommend that this topic receive increased attention in the final draft of the Plan.

Insofar as ground-dwelling sand-dependent arthropods are concerned, minimizing the number of roads would have a salutary effect. Where roads cannot be avoided it may be better to pave them than to leave them unpaved. At least some ground-dwelling beetles avoid non-habitat substrates. Thus, a hard paved surface could create a minor barrier to such insects while a soil-surface road might not. The benefit of the former depends on how frequently the road is traveled. Frequent traffic on an unpaved road might cause more road-kills than on a paved road. This hypothesis has been tested in Europe but needs confirmation with regard to the local fauna and habitat conditions.

3. As part of the monitoring program, is a set, quantitative Trigger Number the best method to detect declines in populations and to initiate management responses, or can deleterious trends be separated from expected fluctuations to more accurately trigger a management response?

This issue is addressed in Appendix B. Although some form of monitoring to provide a measure of a species population status over time is often desirable, it is often not possible to set any particular trigger number to initiate management responses. This is especially true for short-lived species, such as annual plants and most insects. Normal annual or seasonal fluctuations in populations of such short-lived organisms usually cannot be distinguished from declines based on habitat degradation. Instead, management decisions should be based on other measurable factors, such as changes in sand deposition patterns and habitat invasion by exotic weedy plants and animals. For long-lived plants and animals (e.g. desert bighorn sheep, Orocopia sage), real deleterious trends in population size are more easily detected and a quantitative trigger might be appropriate to initiate corrective management practices. Nevertheless, trends analysis can often be more useful than the setting of simplistic management thresholds.

Regarding the Coachella Valley giant sand-treader cricket and Coachella Valley Jerusalem cricket, population monitoring, if desired, can be accomplished by oatmeal baiting as an alternative to pit-fall trapping. The use of oatmeal bait trails for surveying crickets of many types is commonplace and can be superior to pit-fall trapping. The oatmeal bait method generally produces quicker results with greater probability of locating crickets during a given evening (when they are active) than does pit-fall trapping. The bait survey also eliminates the possibility of unwanted cricket mortality; they desiccate rapidly and are also more prone to predation if rodents or scorpions end up with them in the pit-fall trap. The main drawback to oatmeal trapping is that it requires intensive labor.

IV. Geomorphology:

In general, the four questions posed here are too specific for the advisory committee to respond to in a quantitative fashion, as is implied by the specifics of the questions. For the most part, these are questions to guide future research, not questions for peer reviewers. Nevertheless, we offer preliminary responses to these questions below.

1. *What is the relative contribution of sediment from each canyon in the Little San Bernardino Mountains to the Thousand Palms dune system?*

This is a question that would require a research project to answer accurately, but a rough estimation could be gleaned from sediment-yield estimation techniques developed from other desert regions. There are numerous ways for estimating fluvial sediment yield, separated in part by approach. Some methods are purely empirical, fitting statistical functions (typically power functions) to empirical data (K. Renard, 1972, Sediment problems in the arid and semi-arid southwest, in *Proceedings, 27th Annual Meeting, Soil Conservation Society of America: Portland, Oregon*, p. 225-232). Other approaches include more-intensive statistical modeling (E. Flaxman,1972, Predicting sediment yield in Western United States, *Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers*, HY 12, p. 2073-2085) and deterministic sediment-yield models that are highly data intensive (e.g., J. Gilley et al., 1988, USDA Water erosion prediction project. Symposium proceedings, pub. 07-88). In the Coachella Valley, where little sediment data has been collected, the best technique is to apply an empirical function from another region. For example, from the Colorado Plateau, one estimator is of the form:

$$Q_s = 193 \cdot A^{1.04}$$

where Q_s = sediment yield (Mg/yr) and A = drainage area (km^2) (R. Webb et al., 2000, *Geological Survey Water Resources Investigations Report* 00-4055, 67 p.). The point is that sediment yield generally is a strong power function of drainage area, although often the relation is nearly linear (exponent about equal to 1). Therefore, sediment yield (and therefore the sediment contribution) can be estimated primarily from the drainage area. Several canyons then become important, particularly Long Canyon upslope from Desert Hot Springs and Fan Hill Canyon, upslope from Thousand Palms Canyon. West Wide and East Wide Canyons are blocked by a dike that effectively removes sediment from floodwaters, eliminating these canyons as sediment sources.

At this time, canyons from the Little San Bernardino Mountains and the Indio Hills are the only significant sources of sediment available for aeolian entrainment and transport. The significance of the sediment yield from these canyons is better evaluated in terms of areas of deposition, which generally are higher on the alluvial fans of Seven Palms Valley and Fun Valley than would be useful for aeolian replenishment of the Thousand Palms Preserve. The major sand source for this preserve was once the Whitewater River system (including Mission Creek and Morongo Wash), but freeway and railroad construction have effectively eliminated this source except during extremely high windstorms.

From a casual examination, it would appear that the Thousand Palms dune system receives sand in several ways: 1) direct sand input from Whitewater River system (now closed off); 2) direct sand input from drainages of the Little San Bernardino Mountains and the Indio Hills (partial closure owing to development of depositional plains); 3) indirect sand input from fluvial sand originating in the Whitewater River system, mobilized into aeolian sand, deposited in the Indio Hills, remobilized in the fluvial system of the Indio Hills, deposited upwind from Thousand Palms Canyon, and mobilized into aeolian sand (see 2); and 4) aeolian sand from Mission Creek, Morongo Wash, and other small valleys north of the Indio Hills that is mobilized into aeolian sand, crosses the divide between Seven Palms Valley to Fun Valley, is mobilized in the distributary flow system on the alluvial fans, and is aeolian entrained and transported into the Thousand Palms Preserve (disrupted by development). Historically, the Whitewater River system was probably the most important source. Now, it would appear that the most important sources are from the Indio Hills and Fun Valley.

2. *Is the sand transport system to the east end of the Indio Hills intact? How does agricultural development affect the sand transport system in that area? To what extent did the developed areas on the south side of the Indio Hills provide sand to the east end historically?*

As mentioned in response to question #1, above, historically the major source of aeolian sands to the east end of the Indio Hills probably was the Whitewater River system. This source is completely cut off with the exception of sand recycled from the Indio Hills or transported directly during rare, extreme windstorms. Agricultural development will impede the sand transport system in that area or any area upwind of aeolian dunes in the Coachella Valley. The developed areas on the south side of the Indio Hills probably provided little sand but instead were minor fluvial deposition areas from drainages emanating from the Indio Hills. Instead, the major function of this area probably was as an aeolian transport zone where sand originating from the Whitewater River system moved across an aeolian plain and into the Thousand Palms dune system. Freeway and railroad construction have effectively ended this source, so those developed lands probably would have little influence on the aeolian dunes in the Thousand Palms Preserve.

3. Does the Willis Palms drainage supply sediment to the Thousand Palms sand corridor?

This question is too specific given the overall context of the MSHCP; the Willis Palms drainage does not appear on any maps and does not appear to be mentioned in the ARD. However, SAC members have told us the canyon is on the southeast corner of the Indio Hills and deposits fluvial sediments just upwind from the Thousand Palms Preserve. Therefore, it likely is a significant source of aeolian sands for this preserve, given the closure of other major historical sources.

4. How stable are the dunes south of Interstate 10, even if sand sources are reduced or eliminated?

The stability of dunes may be evaluated on several levels. The dunes themselves appear to be very stable, unlike the unidirectional sand-transport systems that characterize the sources for the Whitewater River and Thousand Palms preserves. These dunes appear to be stopped from east-southeastward movement owing to the presence of railroad and freeway berms. Unlike other dune systems in the vicinity, some perennial vegetation has colonized these dunes, further causing stability. However, within the area of dunes, active sand movement is undoubtedly occurring, which potentially creates habitat for both animals that simply require aeolian sand as well as animals that require active, loose aeolian sand.

The stability of Big Dune is unknown in geomorphic terms, with the exception of information from Lancaster (1993). Stability has two connotations: whether the dune has an active surface layer, which may promote some endemic animals and plants, or whether the sand supply has been cut off. The answer to the latter question is a decided yes. As to the former question, deflation of the dune with no addition of sand may continue to provide habitat for some endemics, particularly insects, and therefore this habitat should not be discarded without significant consideration in the MSHCP.

The true level of stability of this dune system must be evaluated by a combination of historical analysis (using aerial photography and other techniques) as well as monitoring under the Adaptive Management Plan. We suggest that aeolian sand-transport monitors be installed in this area, in addition to sand depth monitoring and photographic monitoring, to determine just how stable this dune system is over the long term.

V. Species Modeling

1. Was enough information on habitat quantity and quality, and species distribution and abundance, available to create accurate models?

This question is impossible to answer until the models have been validated by new survey data or other independent data sets. An accurate model would be one that successfully predicts the location of new data points.

2. Are the assumptions in the species models supported by literature?

Although the "Species Distribution Model Parameters and Known Locations" report documents the decision-making process for including or rejecting GIS layers for the individual species models, we found no detailed discussion of the modeling process or its assumptions and limitations. Except for a couple general references on modeling, no literature is cited to support the use of these particular models or their limitations.

3. Was the process for creating the species models scientifically reasonable and defensible based on available data?

The species models in the Draft Plan are simple GIS overlays and can be described as spatially-explicit conceptual models. Such models are superior to abstract or spatially non-explicit models and they are arguably the best that could be produced, given the limited available data. For some of the better-studied taxa, however, particularly the CV fringe-toed lizard but also perhaps several other species with relatively abundant data points, more rigorous models with better predictive power could be developed.

Examples of more rigorous predictive models are several recent approaches based on resource selection functions (M. Boyce and L. MacDonald, 1999, *Trends in Ecology and Evolution* 14:268-272). Using multiple logistic regression, occurrences of a given species are graphed against a series of potential predictor variables. When the relationships are statistically significant (tighter than expected by chance), those variables enter into the habitat suitability model for that species, which is displayed in GIS. An advantage of this approach is that predictions of habitat suitability can be extended geographically beyond the areas for which sightings exist, but within the documented range of the species. For example, C. Carroll et al. (1999, *Conservation Biology* 13:1344-1359) developed a spatial habitat model for the fisher in northwestern California and adjacent Oregon, based on 682 previously surveyed locations, satellite imagery, and derived indices of vegetation composition. The model was validated with new data from 468 survey stations with sooted track plates, at which vegetation measurements also were taken. Habitat quality, measured by number of fisher detections at each station was successfully predicted by the model, with nearly 80% correct classification. The importance of field validation cannot be overstated. Just because a habitat appears suitable—and even if that suitability has been well validated in other landscapes—does not mean it is being used by the species in question.

The next step beyond such static habitat suitability models are dynamic, spatially-explicit population models (SEPM), a class of individual-based simulation models that incorporate additional biological realism as habitat-specific demographic parameters. Because both static and dynamic models have strengths and weaknesses, a combined approach offers a unified population viability analysis framework. In SEPMs, individuals not only move between cells, but grow, reproduce or not, and die. Model output from SEPMs may include the mean population size, mean time to extinction, or the percentage of suitable habitat occupied. The development of SEPMs has allowed data gathered from intensive demographic studies to be combined with GIS maps of landscape composition and pattern. These models permit analysis of both equilibrium behavior (i.e., can current habitat sustain the current species distribution for 100 years?) and transient behavior (e.g., can a species recolonize from current refugia or would active reintroduction be necessary?). Analysis of relaxation times, i.e. the time to and pattern of loss of a population after habitat change occurs, allows estimates of the "extinction debt" in the region due to past habitat change. We urge development of these combined models in the Coachella Valley for those species for which adequate distributional data and estimates of demographic parameters are available or become so during the adaptive management and monitoring process.

4. What limitations in the species modeling process may result in inadequate or erroneous maps of potential habitat for any of the target species? What might those errors be?

Small sample sizes (few records) and limited knowledge of autecology are obvious limitations for many of the covered species. The potential for errors of omission (failing to predict the actual occurrence of a species) or commission (predicting occurrence where the species is not found) are correspondingly high. The magnitude of these errors can be determined only through intensive field validation.

5. *Does an analysis of "known locations conserved" provide enough information to make decisions about the adequacy of conservation for species without models? Should any other factors be considered? What are the potential risks of basing conservation of a species solely on known locations?*

Species distribution models should be dynamic, as distributions change over time. Historic distribution records can yield clues about possible future changes in distributions. There are inherent risks in basing a long-term conservation plan solely on known locations. One must also consider likely future changes in the distribution of essential habitat parameters. Furthermore, records for some species (especially insects) are largely artifacts of convenient accessibility. Insect collectors and bird watchers (as opposed to researchers) often return to the same known locations year after year while ignoring many other sites where a given species may occur, but simply has not been reported. There is no substitute for systematic on-the-ground surveys covering all likely or possible locations for a species within a region.

6. *To what extent is historical location information useful in creating models and proposing conservation areas?*

See previous response.

7. *Are there any sources of information not on the list of Source of Biological Data in Table 3.2 that should be consulted?*

We are not aware of specific sources of information. This question is best addressed to local biologists.

Appendix A (by Greg Ballmer, Ph.D.)

NOTES ON COVERED INVERTEBRATES

Casey's June Beetle (*Dinacoma caseyi*)
Most records of this species are from the edge of the desert floor where it meets the boundary of the San Jacinto Mountains. Recent records are from a very few locations on the Agua Caliente Indian Reservation at the mouth of Palm Canyon and from private land within the Smoke Tree Ranch residential community. Historic records from elsewhere in Palm Springs and nearby communities pertain to areas that have been thoroughly developed or otherwise altered and presumably no longer have appropriate habitat. Other potential habitat identified by Frank Hovore seems to have a low likelihood of occupancy, but needs to be surveyed to determine whether the species is present. If this species were found to occur within the Plan Area further west (Snow Creek/San Gorgonio River Wash is perhaps the most likely place to look), one would be warranted in expressing greater optimism about its chances of long-term persistence. In the absence of evidence that it occurs elsewhere, preservation of this species may depend entirely on the good will and conservation efforts of the Agua Caliente Indians (not included in the Plan) and other private landowners. The Draft Plan contains no guarantees that either the Indians or other private landowners will take steps to preserve this species.

Furthermore, in the event of a significant climate shift it seems unlikely that this species will be able to track the likely changes in the distribution of its habitat, as it is probably already cut off from that option. One must question the premise that the Draft Plan offers long-term protection for this species. In order to offer realistic coverage for this species it will be necessary to determine more accurately the extent of its occupied habitat both in known locations and at other sites where potential habitat has been identified. Another possible conservation measure could be active management, including captive breeding and re-release into other suitable areas within the Plan Area. Success of such measures is speculative and not recommended at this time.

Coachella Valley Giant Sand-treader Cricket (CVGSC) (*Macrobaenetes valgum*)
This species is a sand endemic restricted to the western portion of the Plan Area from Fingal's Finger to the Coachella Valley Fringe-toed Lizard Preserve. Its range is probably determined by the presence of aeolian sand and a suitable temperature/moisture regime. Plan Alternatives 2 and 3 preserve 39% and 66%, respectively, of this species' current habitat. It should be noted that significant climatic warming is likely to shift the range of this species toward the western (cooler, moister) portion of its range and, thus, reduce the useful extent of its protected habitat. In that event the additional western lands identified in Alternative 3 might provide significantly more useful habitat and commensurately greater protection from decline and extinction. It seems likely that sufficient habitat will be protected for this species in both Alternatives 2 and 3 if its current range does not shift greatly.

Coachella Valley Jerusalem Cricket (CVJC) (*Stenopelmatus cahuilaensis*)

The range of this sand endemic is skewed toward the western end of the Coachella Valley, with known locations primarily from Palm Springs Airport westward to Fingal's Finger. This correlates with winter precipitation patterns, which are generally higher and more stable in the west than elsewhere in the valley. Only two records for this species are known from north of I-10. The westernmost of these was reported just this season from a windmill farm on the bluff along the north side of Whitewater Canyon. The extent of this population is unknown but could extend through scattered patches of aeolian sand at the base of the bluffs, as well as further to the north and east toward Mission Creek. The easternmost record for this species is at the Thousand Palms off-ramp from the I-10 freeway. This record is probably an outlier, as surveys elsewhere within the community of Thousand Palms and further to north and east have failed to find it. This species could occur nearby on the south side of I-10 in the vicinity of the Big Dune. In view of predicted climatic shift toward warmer and drier conditions, it seems most important for this species to protect habitat at the western end of its range (especially along the Whitewater River wash from Palm Springs westward to Fingal's Finger), including the expanded lands included in Alternative 3.

Coachella Valley Grasshopper (CVG) (*Spaniacris deserticola*)

This species is a hot desert endemic which does well at elevations around sea level (primarily the valley floor and adjacent bajadas) where its host-plant, *Tiquilia palmeri*, occurs. Several historic sites for this species in the Coachella Valley no longer support habitat. It may now be restricted to sites north of I-10, including portions of the CVFTL Preserve and Willow Hole areas. The distribution of this species further to the south and east needs to be determined. As for the records of this species reported by Matt McDonald from Dos Palmas, near the Salton Sea, and the east end of the Indio Hills, at least some are misidentifications. If historic populations in Imperial County have been extirpated, then those remaining in the Coachella Valley should be considered far more important. Alternative 3 would protect considerably more of the few known sites for this species than would Alternative 2, although there is some question as to whether some of the reported sites covered by Alternative 3 are for misidentified specimens.

Pratt's blue (*Euphilotes enoptes cryptorufes*)

Pratt's blue is confined to the higher elevation chaparral belt in the San Jacinto-Santa Rosa Mountains range. This is a rarely encountered taxon with perhaps no more than three adult individuals having been found in the wild. Most museum specimens were reared from larvae found on the host-plant, Eriogonum davidsonii, which grows in openings in the chaparral and along trails. Because all known habitat occupied by this species lies within the Santa Rosa Mountains National Monument and/or National Forest land, the main responsibility for protecting it lies with federal agencies. Protection should entail proper land management to ensure that the habitat is maintained to conserve the host plant. This would logically entail a more-or-less natural fire regime and exclusion of activities which could destroy the habitat. It seems likely that the management plan for this species is adequate.

Appendix B (by Dick Tracy, Ph.D.)

ADAPTIVE MANAGEMENT/MONITORING PROGRAM

Background

The initial conservation measures under the MSHCP start a process of accumulating experience and knowledge. That is, the MSHCP contains a programmatic core feature that is “adaptive management". The initial MSHCP management actions are those hypothesized to be necessary to mitigate threats to all covered species. However, it is important for the permit holders to admit that:

1. Currently identified threats are **hypotheses** about threats rather than certain knowledge.
2. Initial management actions emanate from **hypotheses** about what is needed to militate against identified threats.

Proposed management actions thus are guesses as to what is needed to militate against guessed-at threats. These guesses (or hypotheses) must be replaced by better knowledge as part of the “management actions” of the MSHCP. This additional knowledge will only come from a science-based adaptive management program (SBAMP). The work of this program must be entrusted only to those who normally test hypotheses using scientific methods to generate new knowledge.

Those in charge of the Adaptive Management Program must recognize that environmental conditions for species will change, and potentially change dramatically, with time. This is especially true in Coachella Valley where new species will invade the system (e.g., exotic invader species like salt cedar, red brome, argentine ants, etc.). Moreover, physical/chemical changes will occur at high rates (e.g., roads are created or expanded, urban development is created or expanded, fertilizer and/or pesticides are blown into to spring, etc.). New, or modified, management actions will be necessary to respond to continued changes in the environment.

In addition, even after “correct” management actions are identified and implemented, the effectiveness of these actions must be assessed. The process of acquiring and using new knowledge to prescribe changes in management represents the science-based adaptive management necessary to assuage Service concerns about the efficacy of the plan behind the 10A permit.

Adaptive management is a flexible, iterative approach to long-term management of biological resources. Adaptive management is directed over time by the results of ongoing monitoring activities and other information. This means that biological management techniques and specific objectives are regularly evaluated in light of monitoring results and new information on species needs, land use, and a variety of other considerations. These periodic evaluations are used to adapt both management objectives and techniques to achieve overall management goals better. In the case of the MSHCP, these goals broadly include maintenance of the long-term net habitat values of the ecological communities in project area with a particular emphasis on covered species. This includes recovery of listed species, conservation of unlisted covered species, and evaluation of other species for status as covered under the Section 10(a) permit to the Permittees.

Science-Based Adaptive Management

Science-based adaptive management is the approach preferred by many resource managers when scientific resources and funding are available. Adaptive management provides resource managers with objective scientific data and analysis upon which to base management decisions. Adaptive management provides those who fund resource management and conservation actions with objective and scientifically valid evaluations of the needs for various actions and a basis for assessing the effectiveness of those actions.

A critical element of a science-based adaptive management program is the database upon which management decisions are made. Such a database can provide the basis for evaluating species, ecosystem, and/or landscape status and trends, and it can be used to evaluate management actions directed at conservation of biological resources. Adaptive management requires a scientifically valid program for collecting scientific data, coupled with supervision of an accessible database by a competent scientific authority and quantitative evaluation of emerging data.

Biological recommendations emanating from the SBAMP for inventory, monitoring, and research ordinarily would be used to establish funding, management, and monitoring priorities.

The primary focus of a SBAMP should be the evaluation of the status of species and ecosystems within the project areas to bear on land-use decisions potentially affecting biological resources in these areas. Specifically, the SBAMP must develop methods to monitor the effectiveness of management actions in meeting MSHCP objectives. For the service, this also requires tracking how the status of each element of the project (e.g., each species) can be assessed under the monitoring scheme.

The SBAMP must establish a geographic information system database for all inventory, monitoring, and research data, and a reliable entity must be invested with authority to keep the database and make it available to all agencies, municipal and county authorities, scientists, and NGOs involved with the project. This entity must ensure long-term maintenance of the database and review of the validity and reliability of the database.

Elements of SBAMP

The inventory and monitoring component of the SBAMP ordinarily would include six steps which, when appropriately linked to decision making, would maximize the collection and integration of objective, reliable data into the decision-making process and help in making decisions about management actions.

A. Identification of Explicit (Quantifiable) Scientific Goals and Objectives

The goals of the scientific program should include "targets" of study at a variety of spatial scales and levels of ecological complexity. Targets of study should range from highly restricted spatial scales for species such as narrow endemics found only in individual desert springs to broad spatial scales for species ranging over most of the Valley in multiple habitat types. Targets of study may range from individual populations to entire ecosystems and landscapes and the physical processes upon which those ecosystems and species depend. Among those targets of study should be specific population characteristics of select species of concern, including federally listed threatened and endangered species, "candidate" species and/or sensitive species, and other species of special conservation concern. Targets of study for ecological communities and ecosystems may include variables associated with composition (which species are present), structure (characteristics like shrub sizes and shapes), and function (such as presence of pollinators, nitrogen fixers, keystone species, and physical processes required by the system). Landscape-level studies will identify targets of study that can be remotely sensed from aerial photography and/or data logging systems. The scientific goals and objectives ordinarily have to be dynamically optimized to incorporate the most current scientific information and respond to changes in goals and direction from those in charge of managing the project.

B. Identification of Likely Environmental Stressors

The SBAMP will identify likely sources of ecological disturbance that can compromise ecosystems and their constituent species. Environmental stressors include both natural and anthropogenic phenomena including climate change, fire, loss of habitat due to fire, toxic pollutants, flood, water diversions, wind breaks, invasions of exotic species, overharvest of species, and so on. Identification and verification of stressors will be the product of research to establish mechanistic links between environmental phenomena and stress to populations, species, and ecosystems.

C. Construction of Conceptual Models Describing Crucial Ecosystem Interactions

Models will outline interconnections (linkages) among physico-chemical ecosystem processes, among ecological communities, and among species and processes within communities. Models are important in developing an understanding of the key ecosystem processes and properties and in developing an understanding of how environmental stressors affect processes predicting extinction events. The models will be important in delimiting the boundaries of what constitutes natural variation in population and ecosystem processes and describing the role of humans in stressing natural processes. Models will incorporate the latest scientific concepts and paradigms, the application of which can contribute to keeping conservation costs low and scientific understanding high.

D. Identification of Indicators

Indicators serve as surrogates and allow inference to be drawn regarding population or ecosystem processes of concern. They can be species or ecosystem components, or characteristics that are easy to measure and exhibit dynamics and responses that parallel more difficult to measure population or ecosystem processes of concern. Indicators are selected because they demonstrate low natural variability but respond measurably to environmental change. Indicators will include population sizes and distributions of select species, physical and biotic variables associated with ecological communities and vegetation types readily assessed by remote methods. Establishing an indicators program requires research into correlative relationships among focal populations and ecosystem and habitat properties and processes. The cost, relative efficacy, and anticipated benefits of such research should be regularly evaluated (along with other alternative conservation measures, alternatives, and proposals) by those implementing the HCP as well as the FWS.

E. Development of Sampling Design to Estimate Status and Trends of Indicators

Hypothesis testing, trend analyses, model development, and statistical inference are elements of a scientific program that will be subjected to independent scientific review. Monitoring exercises must be statistically rigorous so that the program will have the highest probability of detecting ecologically important trends. Sampling design, hypothesis testing, and trend analyses are all scientific processes that continually become more efficient as scientific knowledge increases; thus, experimental design requires continuous evaluation.

F. Determination of Threshold Values That Will Trigger Proposals for Management Changes

Status and trends of species and communities must be used to trigger proposals for adjusting land management and policy. Such data provide the basis for establishing dynamic policies and management aimed at producing the desired ecological condition and the conditions required by the U.S. Fish and Wildlife Service.

Appropriately integrated, an adaptive management program will use direct measurements and surrogate variables (indirect measures of the status of ecosystem processes or species) to determine the status and trends of ecosystems and their constituent species. Resulting data and analyses can lead to recommendations for adaptive management. It is critical to this process that the integrity of inventory, monitoring, and research be assured using the highest standards of scientific accountability and peer review in order for any adaptive management program to promote change to management in the project area, the USFWS, resource managers, and regulatory agencies with reliable and objective.

Adaptive Management Decision Making

An adaptive management framework can allow information to be transferred directly to decision makers and land and resource planners (e.g., BLM, USFS, USPS, Boulder City, etc.) for integration into MSHCP implementation. This information transfer could follow that proposed for effectiveness monitoring for the Northwest forests (see Effectiveness Monitoring for the Northwest Forest Plan - Draft 7 August 1997). The process involves four steps:

- Provide a range of possible management responses
- Determine the potential alternative ecological outcomes associated with specific phenomena being monitored
- Assess the probabilities associated with each possible interpretation of monitoring data
- Identify the management decision that maximizes the overall "utility" of each decision and outcome (involving considerations of the costs of misinterpretations of monitoring data and/or costs of wrong decisions)

To the extent feasible, species and habitat linkages will be addressed to produce proposals for management that maximize the conservation of ecosystems upon which “covered” species depend and that minimize financial costs and disruption of public activities. By linking statistically validated sampling designs with explicit consideration of environmental stressors, any MSHCP would move beyond traditional census approaches that document trends but rarely explain phenomena causes. This will allow the SBAMP process to provide land managers with the scopes of work to support defensible land management decisions.

Inventory, Research, and Monitoring

Inventory, research, and monitoring (IRM) are necessary and important activities for long-term, multiple species HCPs (Fig. 1). Nevertheless, there is confusion about incorporating these activities into conservation planning. The lines separating monitoring and research are not sharp. Indeed, apposite monitoring requires research methods to provide more than anecdotal information; and anecdotal information will be inadequate for both economy-seeking permit holders and for regulatory agencies. Additionally, where monitoring methods do not yet exist, research must be conducted to develop efficacious means to assess the effectiveness of the MSHCP.

Definitions

Inventory, according to Webster's New International Dictionary (Merriam-Webster 1986), is an itemized list of current assets; as a survey of natural resources such as a survey of wildlife of a region.

Monitoring, according to Webster's New International Dictionary (Merriam-Webster 1986), is to watch, observe, or check especially for a purpose.

Research, according to Webster's New International Dictionary (Merriam-Webster 1986), is to search or to investigate exhaustively.

Inventory

A conservation plan designed to protect sensitive populations of wildlife and plants must be based upon knowledge of the status of those populations. The size and spatial distribution of populations are critically important pieces of information upon which management prescriptions can be made. If the status of any population is not known, then aspects of that status can be assessed through an inventory of biological resources, and that inventory should be conducted at the earliest possible time in the planning process. If knowledge about the status of populations is not known before the 10(a) permit is requested, then that inventory should be performed as one of the first actions under the HCP.

Monitoring

A monitoring program without a goal might be viewed as more dangerous than no program at all. Monitoring without goals can consume valuable resources that may be used in other conservation actions and incorrect information from improper monitoring can mislead and direct dangerous management decisions. Monitoring must be conducted with adequate sampling and scientifically defensible sampling protocols. Data must be replicable and have determinable probability of being correct.

There are numerous purposes for monitoring plans, and different kinds of monitoring are necessary and important to a successful HCP. Monitoring is important to validate management actions, to provide better data for adaptive management, and to obtain advanced capacity to respond unforeseen circumstances that. Monitoring can be categorized as implementation monitoring, effectiveness monitoring, or validation monitoring (USFWS 1994). The first two of these forms of monitoring meet the traditional definition of monitoring, but the validation monitoring may be viewed as a form of research (see below).

Implementation Monitoring: Implementation monitoring provides a permanent record of the mitigation and *management actions* under the MSHCP. Implementation monitoring should assess conservation actions such as fencing along roads, recreation restrictions within reserves, prescribed burns or floods, stream and range improvements, pollution regulation, vegetation restoration, and grazing management. Implementation monitoring should also assess the impacts of "natural implementations" such as occurrences of drought, natural fires, invasion of exotic species.

Effectiveness Monitoring: Effectiveness monitoring is used to record *responses* of biological resources to management actions and other important natural and anthropogenic events as well as random, year-to-year changes. With sufficient data from different sites through time analyses should be able to separate out non-random changes from a background of random changes. For example, analyses of data from effectiveness monitoring could be used to assess the efficacy of off-highway vehicle restrictions on vegetation or dune systems. They could be used to estimate the impacts of natural and anthropogenic fires or floods. They can be used to assess the growth in animal populations freed from mortality caused by vehicles on roads passing through semi-natural areas. Importantly, analyses from effectiveness monitoring also can be used to assess the loss of biological resources due to aggressive competition, predation, or parasitism by exotic species.

Validation Monitoring: Validation monitoring (USFWS 1994) is actually a form of research. Its purpose is to determine if a "conceptual model" of ecological systems is valid. If the conceptual model is correct, then correct prescriptions for adaptive management can be made. Validation monitoring determines if the predictions and assumptions of adaptive management are appropriate to attain the desired objectives. Validation monitoring generally requires experimentation and long-term tracking of ecosystem responses to create a database necessary to validate results from the effectiveness monitoring. Validation monitoring/research thus can be used to assure that the benefits from management actions are not wrongly attributed.

Relationships among Monitoring, Research and Adaptive Management

Adaptive management in the context of a conservation plan requires assessment of the effectiveness of management actions. That assessment occurs through monitoring. Importantly, some monitoring cannot be implemented without preliminary research. The efficacy of a conservation plan requires evaluation of the effects of management in light of hypothesized responses to that management. Different kinds of monitoring are required to make a decision to alter current management practices to reach the desired objectives of the Clark County HCP (see Fig. 1).

"Short cuts" in monitoring

The information necessary to alert managers to conservation challenges of destructive, non-random ecosystem changes must come from monitoring and research. In complex multiple species HCPs, it is rarely possible to measure all populations covered by the Section 10(a) permit. Time and money are usually inadequate to allow such extensive monitoring; therefore, "short cuts" are necessary to evaluate the efficacy of the plan. Several possible categorizations of MSHCP elements can be helpful in meeting MSHCP goals. These include surrogate species, which can convey substantial information about the status of other ecosystem elements. All species covered under the MSHCP may not be equal in terms of their importance to or influence on other species in the MSHCP, and some species may not correlate in their reaction to environmental events. Below are possible categories of species that can be helpful in assessing the efficacy of the conservation planning.

Indicators: Indicators are those ecosystem elements (populations, habitat, other) are correlated with populations of covered species or ecosystem elements targeted for conservation. This correlation allows us to measure the dynamics of one population and infer the dynamics of others. Correlations among species generally come from similar reactions by species to similar stressors. For example, if several species are sensitive to drought and all decline in population numbers in the presence of drought, then documented declines in one species allows us to infer that other correlated populations also will decline. Debate over the efficacy of indicator species exists, particularly regarding ecological communities dominated by density-dependent dynamics. It is not possible to identify indicators without research documenting the correlated responsiveness of populations.

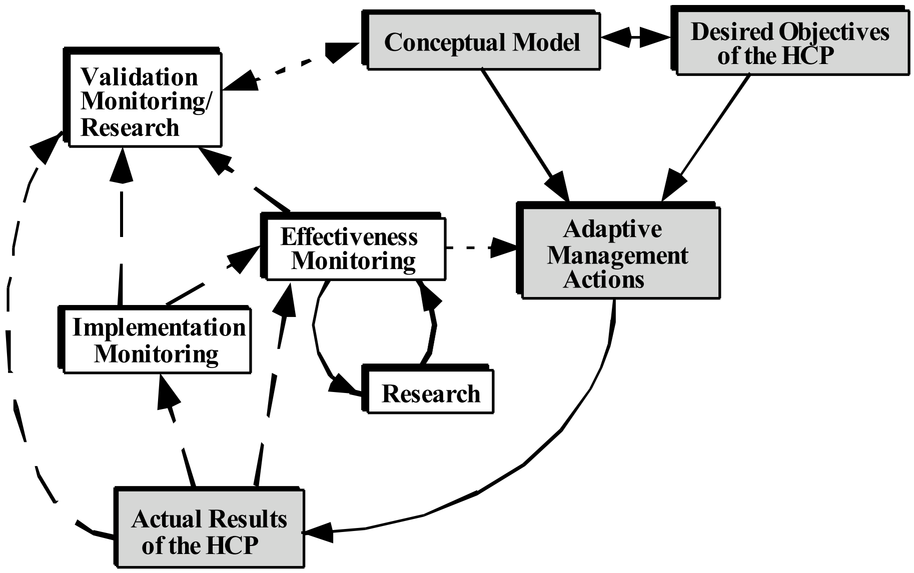

Fig. 1. Relationships among the desired objectives of the HCP, a conceptual model of the functional relationships among species, and monitoring activities in the adaptive management of the HCP.

Keystone species: Keystone species are those species that have an influence on the population dynamics (and even presence) of a number of other species, often far out of proportion to their own numbers or biomass. For example, the absence of a keystone predator might release prey species from population control that can result in competitive exclusion among other species. The presence of keystone species often promotes species richness in an ecosystem.

Umbrella species: Umbrella species are species with very large home ranges, comparatively small population densities, and narrow habitat requirements (e.g., northern spotted owl, desert tortoise). Protection of the habitats that support such ostensibly can confer protection the habitats of many other species.

Flagship species: Flagship species are large and/or charismatic species (e.g., pandas, lions, bison, bald eagles) that "represent" the habitat protected. Protection of such species may not protect other species, but it may create support for conservation efforts among voters or financial donors.

Focal species: Focal species are simply species to which particular attention is paid in conservation efforts. Species like the marbled murrelet are neither charismatic nor are they keystones. However, they are the focus of attention in conservation efforts because they are sensitive species within the Northwestern temperate rainforest ecosystem.

Invader species: Invader or exotic species are species that have not evolved within the ecosystem in which they are now found. Some invader species are dangerously aggressive competitors or predators and can cause the extirpation of native species. Invader species include salt cedar, which threatens persistence of native willows, or bullfrogs which threatens persistence of many true frogs in the western United States.

The Role of Research

Research is essential to effective monitoring. Selecting indicators requires research to identify ecosystem elements that correlate in their responses to changes in environmental conditions. Establishing statistically defensible correlations among species or other elements in their responses to the environment is the only effective method for establishing indicators.

Research is necessary for the development, and amendment of conceptual ecosystem models. An incorrect conceptual model can lead to inappropriate adaptive management action. A conceptual model might posit for example, that paved roads are damaging to nocturnal snake populations because individual snakes seek warm places at night to thermoregulate. This hypothesis requires testing. The test would not simply count the number of snakes that become road kills on paved roads. It would assess threats to the persistence of snakes with known population dynamics given that certain numbers of individual snakes will die on roads.

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3.4 Field Surveys Completed during Plan Preparation

Throughout the Plan preparation, field surveys were conducted to assess the occurrence and distribution of target species of plants and animals. These surveys were conducted by members of the Scientific Advisory Committee, staff from the Bureau of Land Management, California Department of Fish and Game, Coachella Valley Mountains Conservancy, U.S Fish and Wildlife Service, and consultants hired by CVAG. Surveys completed specifically for this Plan are shown in the following Table A3-5.

Table A3-5: MSHCP Biological Surveys

Survey Title/Target Species	Conducted by	Date(s)
Surveys for Palm Springs pocket mouse	Shana Dodd S.C. Dodd Biological Consulting	1995 1999
Surveys for Palm Springs ground squirrel (on potential conservation areas)	Mark Dodero RECON	1995
Survey for five rare plants at selected locations in the Coachella Valley	Andy Sanders, UCR Thomas Olsen Associates	Spring 1995
Surveys for Palm Springs ground squirrel (on existing preserves)	Katie Barrows, CVMC (with Jennifer Purcell)	1995
Surveys for Coachella Valley milkvetch (on existing preserves)	Katie Barrows, CVMC (with Jennifer Purcell)	1995
Surveys for riparian birds along Whitewater Channel, Salton Sea/Delta area	Patricia Locke-Dawson BLM	Spring 1995
Surveys for sensitive insects of concern to the CVMSHCP	Dave Hawks Hawks Biological Consulting	1995
Surveys for flat-tailed horned lizards	Kim Nicol, CDFG; Patricia Locke-Dawson, BLM; Sharon Keeney, CDFG	October 1995
Surveys for flat-tailed horned lizards: East end of Indio Hills	Will Miller, USFWS; Kim Nicol, CDFG; Katie Barrows, CVMC	May 1997
Survey for riparian birds	Peter Beck (contract with USFWS)	Spring 1997
Survey for flat-tailed horned lizard habitat: E. of Coachella Canal (Gravel Pit) to Box Canyon	Kim Nicol, CDFG; Gavin Wright, Ingrid Johnson, Karen Dortweiler, BLM	Spring 1997
Survey for flat-tailed horned lizard habitat: Indio Hills to Dos Palmas	Mark Fisher UCNRS, Deep Canyon Reserve	March 1997
Survey for flat-tailed horned lizard habitat/linkage: East of Coachella Canal	Will Miller, USFWS Katie Barrows, CVMC	June 20, 1997
Survey for Palm Springs ground squirrel: Snow Creek	Kim Nicol, CDFG; Ingrid Eleck, BLM; Cam Barrows, CNLM; Katie Barrows	June 1997
Survey of Mission Creek and Big Morongo Wash	Katie Barrows, CVMC; Ingrid Eleck, BLM; Cam Barrows, CNLM	July 29, 1997

Table A3-5: MSHCP Biological Surveys (continued)

Survey Title/Target Species	Conducted by	Date(s)
Surveys for Coachella Valley round-tailed ground squirrel and Palm Springs pocket mouse	Bob James, USFWS	1997
Survey for triple-ribbed milkvetch	Will Miller, USFWS	April 1997
Surveys for Little San Bernardino Mountains linanthus	Will Miller, USFWS	March-April 1997
Surveys for Coachella Valley giant sand treader cricket and Jerusalem cricket	Cameron Barrows CNLM	Jan-April 1998
Surveys for various bat species	Kim Nicol, CDFG and other SAC members	May 1998
Surveys for Casey's June beetle	Cameron Barrows CNLM	1998
Rare Plant Survey: East End of Indio Hills	Jim Dice, CDFG; Will Miller, USFWS; Walt Sniegowski, CVMC Volunteer	April 1998
Survey for Coachella Valley milkvetch: East of Washington St. (Fleming Ranch) & East Indio Hills (West of gravel pit)	Will Miller, USFWS Dennis Hebert, UCNRS	April 14, 1998
Survey for triple-ribbed milkvetch: Mission Creek	Will Miller, USFWS; Ingrid Eleck, BLM; Katie Barrows, CVMC; Jennifer Purcell, CVMC Volunteer	May 1998
Survey for triple-ribbed milkvetch: Agua Alta Canyon	Will Miller, USFWS Pete Sorensen, USFWS	April 15, 1998
Surveys for flat-tailed horned lizard: East Indio Hills	Gavin Wright, BLM	1998-1999
Surveys for Coachella Valley round-tailed ground squirrel	Matt McDonald, USFWS.	April – Aug. 1999
Surveys for Casey's June beetle	Cameron Barrows, CNLM Mark Fisher, UCNRS	Summer 2000
Survey for Little San Bernardino Mountains linanthus, Coachella Valley milkvetch	Ken Corey, Gary Wallace, Pete Sorensen, USFWS; Mark Porter, Rancho Santa Ana Botanic Garden	May 2001
Surveys for soil conditions in habitat for Little San Bernardino Mountains linanthus and triple-ribbed milkvetch	Peter Fahnestock, USGS; Robin Kobaly, BLM; George Helmkamp; Katie Barrows; Gary Wallace, Matt McDonald, USFWS; Mark Porter,	November 2001
Surveys for Coachella Valley round-tailed ground squirrel	Paul Beattie, Matt McDonald, Lianne Ball, USFWS, to test monitoring protocol	April – July 2002
Surveys for Covered Species as part of initial evaluation of Monitoring protocols. See Table 8-7a in Plan for species included in surveys	UC Riverside, Center for Conserv. Biology staff; Cam Barrows, CNLM; Angela Gatto, CDFG	2003 – 2007

3.5 Natural Communities Mapping

3.5.1 Natural Communities Map

The natural communities map found in Section 3.2.2 of the Plan delineates the occurrence and distribution of natural communities or vegetation types in the Plan Area. The land-cover map (vegetation layer) for the Sonoran Desert Region from the Gap Analysis of Mainland California (CA-GAP) (1994) was used as a baseline. This gap map was produced by the University of California Santa Barbara (UCSB) using a minimum mapping unit of 100 ha (1 km^2) and a scale of 1:100,000. Details of the CA-GAP mapping process are provided in Davis et al. (1995). To better describe and map the distribution of natural communities within the Plan Area, including threatened or rare natural communities, the GIS Team (Conservancy, BLM, and County GIS staff) refined this gap map as described below.

The names of the natural community types are based on the natural communities classification system of Holland (1986), the classification system that has been widely used by the California Natural Diversity Data Base (CNDDB), and other regional, state and federal resource managers. Recently, the CNDDB has adopted the natural communities classification system developed by Sawyer and Keeler-Wolf (1995) for the California Native Plant Society; it is intended that a cross-walk of the Holland classes with the CNPS system will be developed for the natural communities map.

Five new community types were added to the Holland system to enhance the ability to characterize the sand dune communities, in particular with respect to their habitat features. These community types include Active Desert Sand Fields, Active Shielded Desert Dunes, Ephemeral Desert Sand Fields, Stabilized Shielded Desert Sand Fields, and Mesquite Hummocks. The "mesquite hummock" type was added to describe this once common community type that is distinguished from the Mesquite Bosque of Holland (1986). Scientific Advisory Committee members Dr. Alan Muth and Mark Fisher from the University of California Boyd Deep Canyon Natural Reserve (UCNRS), and Cameron Barrows from the Center for Natural Lands Management assisted us in developing the classification of seven sand dune community types, including three previously described by Holland (Active Desert Dunes, Stabilized and Partially Stabilized Desert Dunes, and Stabilized and Partially Stabilized Desert Sand Fields). In addition to vegetation features, these seven types reflect temporal (e.g. ephemeral) and other characteristics (e.g. active, stabilized) of each major sand-dominated community. Descriptions of these community types are given in Section 4.2.3, Conservation Strategies for Natural Communities. The classes for non-vegetated surfaces and human dominated land uses follows that of the CA-GAP map (1994), with the addition of the following types: 1) Rural, very low density, rural residential areas; 2) Landfill, for landfill/waste disposal facilities; 3) Wind Energy, for wind energy parks, which retain some native vegetation cover.

The GIS Team refined the UCSB Gap Analysis Map using a combination of source data: 1) geo-referenced June 1992 Landsat (Thematic Mapper or TM) satellite imagery; 2) 1996 and 1998 1:1000-scale blue-line copies of black and white aerial photographs supplied by the Coachella Valley Water District (CVWD); 2) color infrared aerial photographs at various scales; 3) USGS 7.5 minute (1:24000) topographic quad maps; and 4) field surveys and ground-truthing between 1995 and 2000. The steps involved in the map preparation are:

1. The GIS Team imported the CA-GAP map to the BLM-Palm Springs GIS system and amended it to include only the area within the Plan boundary. It was also necessary to correct some obvious labeling errors of the natural community types. Other necessary baseline data, such as Landsat (TM) satellite imagery and color infrared aerial photographs, were obtained from USGS/EROS Data Center. A reference document (data dictionary) that identifies all map elements and associated data has been prepared.

2. Initially, the GIS Team attempted to assign the natural community types unique to the Plan Area based on a supervised classification process (as in Dorweiler 1997) done in the ARC/INFO GRID module (ESRI). An active sand dune located on the Thousand Palms Preserve was used as a test case, with the assumption that the Landsat image cell values representing the dune would be very clear-cut, and the formula used in GRID would easily select other like cells. The process, however, selected other types of sand formations, such as Stabilized and Partially Stabilized Desert Dunes. Computer selection by the GRID classification process was not adequate to distinguish between very similar natural community types, given the available software. The team chose not to use supervised classification, as it did not provide the necessary accuracy for this mapping process.

3. As an alternate method, the GIS Team digitized natural community information directly on-screen using the Landsat satellite imagery as a frame of reference. Natural community boundaries were mapped using photo interpretation of patterns in the satellite imagery, supplemented by 1:1000 blue line copies of black and white aerial photographs and color infrared aerial photographs. Typically, review of CVWD aerial photographs, other available aerial photographs, and field reconnaissance, in an iterative process, followed digital delineation of a given natural community on the satellite imagery. The refinement of the CA-GAP map, through the addition of more detailed mapping of the target natural communities, was produced using a minimum mapping unit of 30 meters. This minimum mapping unit was determined based on the average size of a mesquite hummock, the smallest natural community. After each community was digitized, the team updated the CA-GAP map with the new vegetation layer coverages to produce the natural communities map for the Plan Area.

4. Before the mapping process began, surveys of selected natural community types, in particular those proposed for inclusion in the Plan, were conducted. Due to the sparse cover

in desert ecosystems and limits of time and personnel, the GIS Team used the releve method (Mueller-Dombois and Ellenberg 1974) to describe plant species composition and estimate plant cover. These surveys were used to establish baseline descriptions of the natural community types.

3.5.2 Accuracy Assessment

Because the natural communities map of the Plan Area is an important component of the species distribution modeling process, and will also contribute to decisions about land acquisition and preserve design, it was deemed essential that adequate accuracy assessment and ground-truthing of the map be done. Based on an initial evaluation of the level of accuracy for the natural communities mapped, stratified random points were identified in the Plan area. Biologists from the CDFG, CVMC, UC Deep Canyon Desert Research Center, and volunteers visited these points to complete a vegetation sample using a releve (Mueller-Dombois and Ellenberg 1974). The individuals doing the field sampling did not know how the point had been classified in the natural communities map. A releve was completed at each of 250 random points. Not all random points were visited due to constraints of available staff and volunteers. The results of the releves were entered in a data base to permit an objective classification of the vegetation sampled. The releve data were evaluated in a community analysis using PC-ORD, which incorporates the TWINSPAN (two-way indicator species analysis) program (Hill 1994), to classify the samples. The results of this analysis are available upon request. In addition to the releves, biologists, GIS personnel, and volunteers have used field reconnaissance, walking or driving to check the accuracy of the natural communities map. The results of these field inspections were used to update and increase the accuracy of the map.

As another means of evaluating the natural communities map accuracy, personnel from the Center for Conservation Biology at University of California, Riverside completed a field assessment. The results of this analysis were provided to CVAG in an unpublished report, “Report to the Coachella Valley Association of Governments: I – Assessment of Vegetation Map Boundaries” (Allen et al. 2002). They found the map to be accurate and noted that discrepancies were primarily due to the difficulty of identifying boundaries between sand types. They also noted that the 30 meter pixel satellite images used for the map affect the accuracy and recommended the application of newer satellite images.

3.5.3 Historical Natural Communities Map

A historical natural communities map (see Figure A3-1) was prepared by digitizing natural communities information from 1939 (U.S. Engineer 1939) aerial photos. A limited set of aerial photos from the 1930s was also obtained for the Palm Springs area only. The 1939 photos were used as the basis for a historical vegetation map; these 1939 photos (scale 1:2000) were only available for the valley floor of the Coachella Valley from approximately Cathedral City east to the Salton Sea. Historical photo coverage for other parts of the Plan Area was either unavailable or incomplete, such that too much interpretation would be necessary to piece together a map of the natural vegetation. Ultimately, the 1930s photos for the Palm Springs area were not used for the present version of the historical natural communities map because of time limitations and difficulty incorporating this area within the area represented by the Coachella Valley Water District photos. Please note that, even within the historical natural communities boundary, there are some natural community types, such as desert dry wash woodland, that are not mapped completely. This is due to the inability to discern, in some cases, boundaries between types of communities.

The historical natural communities map was used to generate statistics regarding the relative distribution of natural communities on the floor of the Coachella Valley in 1939 compared with today; many of these natural communities have been most impacted by land use changes in the Plan Area in the last 60 years. The historical natural communities map statistics are presented in Table A3-6. The steps involved in the preparation of the historical natural communities map are:

1. For reference purposes, the GIS team visited the Coachella Valley Water District office and photocopied the 1939 photos described above. In addition, the team traced the major features and natural communities as shown on the original photos onto Mylar for scanning into a digital format.

2. The GIS team intended to scan the photos, and then use a software program that would convert each scanned image to a GIS coverage. This process was partially successful and coverages were produced. However, excessive 'noise' (unnecessary lines, etc.) appeared in the coverages, which would have required extensive clean up. Because technology that may have reduced some of this 'noise' was not available, the team decided that it would be more efficient to digitize on-screen using the GIS coverage as a back image for reference purposes.

3. The GIS team digitized as many of the natural communities as described by Holland (1996) that could be distinguished on the photos. The team decided that the historical information was not adequate to accurately map some natural communities such as coastal and valley freshwater marsh, desert fan palm oasis woodland, tamarisk scrub (introduced in the 1950s), lake (Salton Sea), and Sonoran cottonwood willow riparian forest. These communities were likely present in 1939 but not discernable in photographs.

   The GIS team also followed the general guidelines described below:

   a. The team digitized the extant desert dry wash woodland of the Santa Rosa and San Jacinto Mountain "cove" areas that could be distinguished in the 1939 photos.
   b. All reservoirs and quarries represented in the current natural communities coverage

were deleted in the historical natural communities coverage since they did not exist in 1939.

c. The team made the general assumption that natural communities in the surrounding mountains of the Plan Area (Santa Rosa and San Jacinto Mountains to the south and Little San Bernardino Mountains to the north) had not significantly changed other than at the urban interface areas. The fire regime of the mountain areas over the past 7 decades has possibly impacted the natural communities, but no data were available for representing this possible change. The team digitized natural communities at the urban interface to the extent that they could be distinguished on the 1939 photos.
d. The currently developed area of Desert Hot Springs and surrounding rural areas were labeled as Sonoran creosote bush scrub for the historical natural communities map. The city of Banning was labeled as rural, Cathedral City Cove was labeled as urban, and the northern part of Palm Springs where development had occurred was labeled as urban.
e. Because it was difficult to differentiate between desert saltbush scrub and desert sink scrub on the photos, the GIS team determined a line separating the two communities based upon current distribution.
f. An additional classification called Mission Creek Floodplain was added, based upon an extensive area evident in the 1939 photo. Apparently, this was debris deposited by the hurricane event in 1938.

4. Because the 1939 aerial photographs were not georeferenced (georeferencing establishes the relationship between objects on a planar map and known real-world coordinates), the coverages were transformed into a 'real-world' view. This was accomplished by digitizing tic marks representing coordinates for the UTM projection (Universal Transverse Mercator) for each photo in its corresponding GIS coverage. In order to produce the most accurate transformation, a minimum of four tics were used. The tics were established by marking known locations, such as intersections of roads that existed in 1939. Then the UTM coordinates were identified on the current roads GIS coverage. When roads were not available, the GIS team used the intersection of section lines where the photos clearly showed the delineation of these lines. When possible, the tics were placed in four opposite corners in order to achieve the maximum dimensionality possible. When this was not possible, a rubber sheeting process was applied to bring a known area that was skewed back into alignment. For example, this process was used in the Deep Canyon area to correct the alignment of the desert dry wash woodland. Because the configuration of the canyon has not changed significantly since the 1930s, the GIS team was confident that they could make this correction with reasonable accuracy.

5. After the GIS coverages representing each photo had been transformed, the coverages were joined together into one seamless coverage. The GIS team ensured that all natural communities were labeled. The team then digitized a boundary coverage indicating the

extent of the 1939 photos and incorporated this boundary into the historical natural communities coverage. The GIS team added an explanatory note to the map emphasizing historical natural community information applies only within this boundary. The statistics comparing the historical natural communities of 1939 with the natural communities present today are only for the area within this boundary in both cases.

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Table A3-6: Comparison of Historical and Current Distribution of Conserved Natural Communities[1]

NATURAL COMMUNITY	HISTORICAL DISTRIBUTION 1939 (Acres)	CURRENT DISTRIBUTION 1998 (Acres)[2]
ACTIVE DESERT DUNES	8,710	429
ACTIVE SHIELDED DESERT DUNES	0	94
ACTIVE DESERT SAND FIELDS	12,492	4,762
STABILIZED & PARTIALLY STABILIZED SAND FIELDS	23,849	3
STABILIZED SHIELDED DESERT SAND FIELDS	3,221	11,752
MESQUITE HUMMOCKS	8,309	870
SONORAN CREOSOTE BUSH SCRUB	48,955	20,259
SONORAN MIXED WOODY & SUCCULENT SCRUB	18,756	17,235
DESERT SALTBUSH SCRUB	47,910	8,373
DESERT SINK SCRUB	8,209	3,948
DESERT DRY WASH WOODLAND	5,102	3,714
TAMARISK SCRUB	0	1,924
URBAN	1,642	53,160
AGRICULTURE	26,277	84,480
LAKE	14,682	16,458
QUARRY	0	369
RESERVOIR	0	168
LANDFILL	0	8
MISSION CREEK FLOODPLAIN[3]	710	0

1 For a limited area as defined by the historical natural communities boundary, based on availability of 1939 aerial photos.

2 Additional natural communities not delineated on the historical natural communities map include desert fan palm oasis woodland, Sonoran cottonwood willow riparian forest, and freshwater marsh. These communities were likely present in 1939 but not discernable in photographs.

3 An extensive area evident in 1939 photo; apparently debris deposited by the hurricane event in 1938.

3.6 Species Habitat Distribution Modeling

3.6.1 Overview of the Modeling Process

The conservation planning methodology outlined for this Plan required the preparation of maps that indicate the occurrence and distribution of known locations, occupied habitat, and potential habitat for each covered species. These species distribution maps are predictions, based on the assumption that a species has a high probability of occurrence in appropriate habitats within its known range (Csuti 1994). The process of developing a species distribution model is considerably influenced by the available data for a given species.

There are inherent limitations in the use of ecological modeling. The processes that are being modeled are typically highly variable, and there is usually an incomplete understanding of these processes. Further, changing climatic conditions, difficulties in estimating abundance and movement rates, and lack of knowledge about the nature of functional relationships makes it difficult to accurately describe a particular system, such as a population of Palm Springs ground squirrels, or to predict its condition into the future. It is important to treat the model as a hypothesis or as a mathematical expression of one's provisional understanding of how a system might work, instead of as a prescription determining how it will look. Further verification, or testing, of the model needs to be done to gather more knowledge of the system being modeled and to gauge if it is an accurate predictor. Management, integrated with research and monitoring, assures that the information gathered is relevant to decision making. Used in this manner, models can be an important part of conservation planning (Conroy, 1997).

The species distribution models developed for this Plan can be described as spatially explicit conceptual models (Independent Science Advisors' Review, Noss et al. 2001). The models attempt to provide a picture of the connection between landscape patterns and species viability (Ruckelshaus et al. 1997). They are simple GIS overlays, based upon known occurrences of the species, literature surveys of habitat variables, and expert knowledge. The various accuracies and scales of the data that were incorporated into each model are also important to recognize.

The modeling process is not without shortcomings. One difficulty associated with this kind of model is that it usually predicts habitat 'potential' rather than occupancy or other observable phenomenon, so that verification of habitat may be problematic (Conroy, 1997). More sophisticated modeling techniques are available, each with their limitations. One example is the spatially explicit population model which can represent realistic behavior with parameters that reflect the mechanisms thought to be responsible for a species' being at risk in fragmented habitats. This type of model allows a landscape to be described in as much detail as a GIS database can support. However, it requires data that may not be available or that can be difficult to obtain, and there is a strong possibility that errors can be made in estimating parameters. These errors may be so severe that the models become compromised as management tools (Ruckelshaus et al. 1997).

For most of the target species in this Plan, the data necessary for a more complex modeling effort with any degree of accuracy have not been collected. Data, such as population numbers necessary to maintain viability, the effects of roads as barriers, and other baseline habitat variables, were simply not available for many of the species. Given the limited available data, time, and funding provided for this Plan, the models developed are the best that could be produced, to satisfy an important component of the overall conservation planning effort. In keeping with the theory that each model is a 'hypothesis,' each needs to be tested for further knowledge and validity, and is subject to update. It is recognized that the adaptive management and monitoring process will play an integral role in the validation of the models. It may become possible, with the additional data, to move to a more complex modeling process and be able to combine this process into a unified population viability analysis framework, as recommended in the Independent Science Advisors' Review (Noss et al. 2001).

The habitat distribution maps were prepared in a stepwise process that involved continual input and feedback from the members of the SAC and other individuals with expertise or knowledge of a given species or taxonomic group.

For each covered species, a map indicating the location of known occurrences of the species was prepared. The sources used for these data, including CNDDB records, biological surveys completed for the Plan, environmental documents, museum records, published records, and consultation with biologists knowledgeable about a given species, are described in section 3.2. Known occurrences were mapped using the standards established by the California Natural Diversity Data Base (CNDDB). Each known occurrence is represented in the GIS database by a point. As the exact location of an observation or occurrence may not be known, some inaccuracies may be found on point maps. These points have varying degrees of mapping precision based on the original source of location information; they may include a circular area surrounding the point with a radius of 451.5 m (1,505 feet) for more precise locations, to 1,584 m (5,280 feet) for less precise locations (CNDDB 1992). The known occurrences describe locations where a given covered species has been observed or collected. These data do not, however, represent a systematic survey of all areas within the Plan boundary where a given species could be expected to occur. The absence of a record for a species in a given location does not necessarily indicate that the species does not occur there.

Maps of the known occurrences for each covered species were used to prepare models of the occupied and potential habitat for these species. The distribution of each covered species for which adequate information was available was delineated using known occurrences and habitat associations available from field survey data compiled for the Plan, literature review, other field surveys, and consultation with outside experts and the SAC.

Just as the absence of a record for a species in a given location does not necessarily indicate that the species does not occur there, conversely, the location of a species in an area that has not been identified as modeled habitat for that species does not necessarily negate the accuracy or credibility of that model. First, it is important to remember that all of the models reflect available data. Second, various situations may exist to account for the occurrence of known locations outside the modeled habitat.

The species that appear to be associated with sandy habitats, such as the Palm Springs pocket mouse and Coachella Valley giant sand treader cricket, each have a few known locations that do not occur on modeled habitat. A possible explanation is that there are additional sandy areas that were not mapped due to the minimum mapping unit, or were not visible on the aerial photography or the Landsat satellite imagery. In some cases soil data were not available for areas within the Plan boundary. So for example, the Palm Springs pocket mouse model shows some known locations in the vicinity of Thermal Canyon for which no soil data were available. All of the known locations for riparian birds may not be found on modeled habitat. Again, seeps or other riparian areas may not have been mapped due to minimum mapping limitations or because they were not visible on source documents. In the case of the Crissal thrasher, two known locations are documented where the habitat is now dominated by tamarisk, not the selected natural communities for this bird. However, the sightings may have been in the channel where the birds were dispersing in the saltbush areas between the dikes.

Other occurrences of species on apparently developed areas and not on modeled habitat may be accounted for by the fact that small patches of habitat may still persist in these areas, but due to the minimum mapping unit or lack of visibility on the source document, these areas were not mapped.

There are a few cases where it is recognized that the model needs to be refined. An example is the Mecca aster; however, due to a lack of necessary information, the model will need to stay 'as is' for now. In some modeled species, field checks may need to be done to confirm suitability of questioned habitat.

Known locations of species are an important part of the planning database, but it is also recognized that there are limitations associated with the use of these data. To prevent basing the long-range conservation plan on known locations alone, further systematic surveys will be done to identify all potential locations for a given species. As noted by the Independent Science Advisors (Noss et al. 2001) there is no substitute for systematic surveys to evaluate all likely locations for a species within a region. The species models are dynamic, subject to distribution changes over time, and as more data are gathered on given species, the models can be updated.

3.6.2 Parameters for Each Species Distribution Model

For each species, as much information as available was gathered on the following list of habitat parameters. At the same time individual data layers on each of these habitat parameters were incorporated in the GIS database:

Natural community associations. The natural communities map was used as the basis for the distribution of natural community associations used by each species. The list of natural communities included in a given species model was developed through consultation with individual experts and literature review.

Soils. The maps of the soils in the Soil Survey of Riverside County California, Coachella Valley Area, published by the USDA Soil Conservation Service and the University of California Agricultural Experiment Station (1974) were used. For the valley floor areas where species are strongly associated with sandy substrates, the soil survey maps were digitized from 7.5 minute quadrangles (1:24000) into a GIS data layer, which was used in the habitat models. For those species for which soil character was known to be significant, the mapped known locations were used to identify the relevant soil types. In some cases, recommendations from knowledgeable biologists on soil types for a given species model were used.

Sand source associations. Sand source and sand transport areas were digitized in a natural features GIS layer based on photo interpretation of satellite imagery, aerial photos, and field reconnaissance. These ecological process areas were shown as an overlay on models for those species for which they were deemed essential by knowledgeable biologists. In some cases, sand source maps were used in part to predict the occurrence of species associated with washes, as the washes often coincide with sand source areas.

Landforms associations. A map indicating the common landforms within the Coachella Valley area, prepared by the BLM-Desert District, was available to select landforms that would be utilized as habitat for a given species.

Topographic characteristics. Topographic characteristics of habitat, primarily occurrence above or below the toe of the slope, were also delineated. Habitat distribution models for species not known to occur in hillside or mountainous areas were limited by a GIS layer delineating the toe of slope.

<u>Specific boundary/range limits</u>. For some species whose known range was limited such that there was an absence of occurrences in areas initially modeled as habitat, range limits (east, west, north, south or other non-topographic limits) were imposed. These limits were imposed as boundaries delineated on topographic maps and digitized as part of the habitat model, or merely described and digitized by using known features already present in other GIS coverages.

<u>Elevation limits</u>. A review of the literature and supporting data from the species accounts and known occurrences was used to assign an elevation range for each species. Actual elevations were derived from Digital Elevation Model (DEM) data.

<u>Other factors</u>. Specific factors that were relevant to a given species were also incorporated in the model.

<u>Field observations</u>. Where review of the models by CDFG, USFWS, and the SAC resulted in questions about aspects of a model, field visits were made to assess the model's accuracy, and adjustments were made as necessary.

The habitat parameters were organized in table format for each species to prepare for the completion of the habitat distribution models. Once all of the appropriate habitat parameters were identified for a given species, a stepwise process of compiling GIS data layers was used to prepare the models. This process involved the selection of relevant data from GIS layers and the elimination of data that did not correspond to the model parameters (for example, elimination of areas above a prescribed elevation limit).

3.6.3 Species for Which No Model Was Developed

Insufficient data on its habitat parameters made it difficult to develop an acceptable model for the burrowing owl. This is a widely distributed species and occurs in a variety of habitat types below toe of slope. The habitat distribution map for this species shows known occurrences only.

3.6.4 Review and Validation of Species Distribution Models

At each step of the model development process, members of the SAC and other biologists with knowledge of a given species were consulted. Draft species distribution maps were prepared and reviewed by these individuals in a series of workshops hosted by the SAC. In September 1997, a workshop was held to receive input on draft species distribution models. The species habitat distribution maps used in the Site Identification process were developed to represent both the known and potential habitat for the covered species. In some cases, modifications were made to the models based on the recommendations of an individual scientist with expertise on a given species. Updates and corrections to the models continued to be made. In November 1999, modifications to the models were made, based on input received from USFWS and CDFG biologists and the SAC. These updated models were submitted to the USFWS and CDFG as part of a review process in a report entitled “A Biological Analysis of Three Conservation Alternatives” (CVAG 2000). Additional recommendations for final modifications to the habitat distribution models were received in October 2000 from USFWS and CDFG biologists; habitat distribution models were revised again in January 2001. These modifications were made only after careful research and documentation was completed to support each recommendation.

To incorporate independent peer review of the species distribution models, knowledgeable individuals with expertise on one or more target species have been asked to review, critique, and sign a written endorsement of habitat distribution models for these species.

3.7 Site Identification Process

The Site Identification Mapping process entailed mapping and analyzing the biological data gathered for the planning process. The process involved creating a series of layers using GIS, assigning values to the mapped elements, and aggregating the values to identify sites of the highest conservation value in the Plan Area, emphasizing the Covered Species and conserved natural communities. These sites are the focal point for conservation measures to protect the Covered Species and conserved natural communities. Initially three iterations of mapping occurred at the SAC level, before presentation to the Project Advisory Group.

3.7.1 Iterative Site Identification Process

The Site Identification Process developed for this Plan was the result of an iterative process, including “test runs” to evaluate the effects of incorporating various ecological features in the analysis. As indicated previously, a “Reserve Design and Conservation Planning Workshop” was held in April 1998 to present a preliminary site selection and reserve design program to invited conservation biologists (Dr. Reed Noss, Dr. Michael Soulé, and Dr. Richard Tracy). At the workshop, the preliminary results of the first iteration site identification analysis described below were presented for review, discussion, and recommendations by conservation biology advisors and other attendees.

3.7.1.1 First Iteration of Site Identification Mapping: Quantitative GIS Analysis

The first iteration of Site Identification Mapping entailed a quantitative evaluation of the entire Plan Area using GIS. This GIS analysis was based on selection algorithms developed for this and other regional planning efforts, such as Northern and Eastern Colorado Desert Plan, at the BLM

Desert District office in Riverside, California (Zmudka 1998). For comparative purposes, the mapping was initially conducted with two different units of analysis. The units were: (1) a section (approximately 1 square mile or 640 acres), and (2) a quarter section (approximately 160 acres). After comparing the two sets of maps, the SAC determined that the quarter section analysis was more useful as it represented a higher degree of resolution. Further mapping was conducted only at the quarter section level, and only that level of mapping is described here.

In the development of this initial analysis, "test runs" were completed using mapped information on other ecological features, such as perennial water sources. The layers ultimately agreed upon by the SAC to prepare the first iteration Site Identification Maps are described below.

Covered Species Richness. This layer measures the relative importance of each mapping unit (quarter section) as habitat for the species for which coverage is sought in the Plan. A species richness value was assigned to each mapping unit based on the number of target species present in the unit as delineated by the species habitat distribution models and points of known occurrences for each species for which coverage is being sought. When aggregating the scores for the site identification map, a multiplier of two was applied to the scores in this layer to emphasize the relative importance of covered species richness as compared with other layers.

Conserved Natural Communities Richness. This layer measures the relative importance of each mapping unit for the conserved natural communities in the Plan. A natural community richness value was assigned to each mapping unit based on the number of natural communities present in the unit as delineated by the natural communities map. When aggregating the scores for the site identification map, it was intended that a multiplier of two be applied to the scores in this layer to emphasize its relative importance over the habitat heterogeneity and habitat fragmentation layers. A multiplier was not applied as the natural communities were effectively scored twice by virtue of adding in the habitat heterogeneity layer, which includes all natural community types.

Habitat Heterogeneity. This layer provides a measure of the relative value of each mapping unit in terms of overall biological diversity. A value for habitat heterogeneity was assigned to each mapping unit based on the number of natural communities and landform types in each mapping unit. The Scientific Advisory Committee recognized that these are but two elements of habitat heterogeneity, and that habitat heterogeneity may not be a good indicator of high quality habitat diversity, especially with small patch size. The scale values ranged from low (one to three natural community and landform "types") to high (more than 10 "types").

Habitat Fragmentation. This layer provides a measure of the degree to which the habitat value of each mapping unit may have been impacted by fragmentation. A value was assigned to each mapping unit based on the extent of habitat fragmentation from roads. Roads were divided into three categories based primarily on their width, including interstate highways (300 feet wide), major roads (50 feet wide), and minor roads (30 feet wide or less), including some dirt roads (fourwheel drive roads, power-line roads). Each separate road was buffered to include an additional area of one-half the width of the road, on both sides of the road. Within each sample section (1/4 section) the percent of undisturbed habitat was used to assign a "fragmentation value", ranging from high (0 to 20% undisturbed) to low (81 to 100% undisturbed).

Each quarter section was assigned a value for each of the layers described above. Several different versions of this analysis were conducted for comparison purposes. One version was run with multipliers applied to the Covered Species Richness and Natural Communities Richness layers, and one without, to comparatively assess the effect of the multiplier. The SAC determined that the multipliers added due emphasis to the species and natural communities layers since these reflect a primary goal of the Plan, which is to provide for long-term conservation of the species and the natural communities conserved by the Plan. Another version was run with higher values, based on a vulnerability score assigned to endemic species, disjunct populations, highly vulnerable species (based on the level of existing protection for a given species), and highly vulnerable natural communities applied to the Covered Species Richness and Natural Communities Richness layers for comparative purposes. The SAC determined that these weightings should not be used since coverage was sought for species regardless of whether they were endemic, disjunct, or highly vulnerable.

To establish a standard classification system for each data layer in the site identification analysis, a program was written to classify the data by standard deviation from the mean (Zmudka 1998). Each quarter section was classified using a standard deviation multiplier of 0.35 (thirty-five one-hundredths of a standard deviation) to establish six classes: high, medium-high, medium, low medium, low, and N (little or no effect). Thus, for example, the medium (M) class includes values 0.35 of a standard deviation above and below the mean. Values were classified as having little or no effect if they were less than 100 meters for line features, 25 acres for area features, and 0 for point features.

Aggregation of the values from each of the above layers resulted in a map color-shaded to depict the relative conservation value of each mapping unit in the Plan Area. Relative conservation values were sorted into five categories from highest to lowest, with 25 as the maximum score. Mapping units with a score from 21 to 25 are shaded the darkest hue, deep red, and so on down to mapping units with the lowest scores from one to five, shaded a pale, dotted yellow. A "little or no effect" level, N, includes the mapping units that had no score or a statistically insignificant score. Habitat, based on known locations only, for endemic and near endemic species, and disjunct populations, was identified with diagonal line shading. This did not affect the score for any quarter section, but served to emphasize that these habitats were important even if they did not score high in overall species richness.

The layers and the aggregate value maps described in this section were used to develop the set of first iteration Site Identification Maps described in Section 3.7.1.2. An aggregate value map was developed for each of the site identification alternatives described in the following section.

3.7.1.2 First Iteration Site Identification Alternatives

The following set of first iteration Site Identification Maps was prepared to identify areas of high biological resource values based on an array of parameters. Some of the alternatives were included based on input from the Project Advisory Group for the Plan.

Site Identification Alternative 1. This alternative was created by selecting the highest three categories (aggregate scores 11-25) identified through the Initial Site Identification Mapping process. The lands selected through this process have the highest biological value for all Covered Species and conserved natural communities under the Plan.

Site Identification Alternative 2. This alternative was created by selecting all lands in the highest two categories (aggregate scores 16-25) identified through the Initial Site Identification Mapping process. As compared to Alternative 1, the lands selected for this alternative reflect a further narrowing of the lands with highest biological value for all the Covered Species and conserved natural communities under the Plan. The species and natural communities included in this alternative are the same as for *Site Identification Alternative 1*.

Site Identification Alternatives 3a and 3b. These alternatives were designed to cover only currently listed species, disjunct populations, and endemic and near endemic species, i.e. species whose complete range or the majority of whose range occurs in the Plan Area. Only the habitats of currently listed species, disjunct populations, and endemic and near endemic species, and the natural communities in which they occur, were considered in developing and assessing the Species Richness and Natural Communities Richness layers for the Initial Site Identification Mapping process. From the resulting map, the highest three categories were selected to comprise Alternative 3a, and the highest two categories comprise Alternative 3b.

Site Identification Alternatives 4a and 4b. These alternatives were designed to cover only currently listed species and the natural communities in which they are found. Only the habitats of currently listed species and the natural communities in which they occur were considered in developing and assessing the Species Richness and Natural Communities Richness layers for the Initial Site Identification Mapping process. From the resulting map, the highest three categories were selected to comprise Alternative 4a, and the highest two categories comprise Alternative 4b.

Site Identification Alternatives 5a and 5b. These alternatives were designed to cover only animal species. Plant species were not considered in that they do not always have the same status under the Endangered Species Act. Only the habitats of all animal species and the natural communities in which they occur were considered in developing and assessing the Species Richness and Natural Communities Richness layers for the Initial Site Identification Mapping process. From the resulting map, the highest three categories were selected to comprise Alternative 5a, and the highest two categories comprise Alternative 5b.

Site Identification Alternative 6. This alternative included only lands with conservation management status 1, 2, and 3. No new lands would be acquired, but existing public lands not now managed for species protection purposes would have new management prescriptions adopted to provide species and habitat protection. Coverage would be sought only for those species that would be adequately protected on public and private lands (e.g., the Center for Natural Lands Management) with active conservation management or on which agreements could be made with the management entities to include additional management prescriptions.

Site Identification Alternative 7. This alternative included only those lands that currently have conservation management status 1 and 2. Areas with conservation management status 1 and 2 include only those where a primary management goal is the protection of habitat values. Coverage would be sought only for those species that would be adequately protected on these public and private lands (e.g., the Center for Natural Lands Management). This alternative reflects the level of protection that would be afforded to the species and natural communities if no changes were made in existing management of public lands.

A map for each of the first iteration site identification alternatives is available for inspection at CVAG.

3.7.1.3 Second Iteration of Site Identification Mapping: Incorporation of Ecosystem Processes, Endemic Species, and Conservation Status

The first iteration Site Identification Maps were modified to incorporate significant features that could not readily be assigned a quantitative value or score. The first iteration maps were refined by the following process to produce a second iteration of maps:

1. For each alternative, an overlay of vital ecological and physical processes, such as sand source areas, was used to identify areas not identified in the Initial Site Identification Mapping process that are necessary to maintain the long-term viability of the high conservation value areas. This overlay was added to the map to indicate that maintaining these processes intact is essential in order to maintain the viability of the habitat areas for the species to be covered under the Plan. Two of the natural communities where ecological processes are no longer intact, active shielded desert dunes and stabilized shielded sand

fields, were excluded.

2. To ensure they receive adequate consideration in the Plan, known occurrences of endemic and near endemic species, and disjunct populations that did not occur within the areas identified by the Initial Site Identification Mapping process as having high overall biological value were highlighted on the map, with the color green. This was done to emphasize these species and populations even though their habitat may not score high using the general criteria of species richness, natural community richness, habitat heterogeneity, and lack of fragmentation.

3. All public and private lands with conservation management status 1, 2, and 3 were added, as these lands already have some conservation purpose and add to the Plan's overall conservation value.

4. All currently developed areas were removed, including areas mapped as urban, agricultural, rural, reservoir, quarry, and landfill.

The resulting second iteration Site Identification Maps represented a range of conservation alternatives based on a quantitative biological analysis conducted using GIS and modified by the addition of ecological and physical process areas and the inclusion of all public and private lands with a degree of conservation management. Statistics regarding the acres of land identified for each species and natural community on each map were also prepared to provide gross quantitative information about potential conservation of the species and communities.

At this point, the SAC compared all of the alternatives and determined that several were sufficiently similar as to warrant elimination of some of the alternatives. Alternatives 1, 2, 4b, 6, and 7 were retained. A map for each of the second iteration site identification alternatives is available for inspection at CVAG.

3.7.1.4 Third Iteration of Site Identification Mapping: Identification of Highest Conservation Value Areas

The second iteration of alternatives displayed on the preceding maps represented a range of approaches to conservation, from public lands only to various configurations of high value conservation lands. The purpose of the third iteration was to develop alternatives that were further refined to focus on the highest conservation value areas that would conserve all the target species and natural communities and reflect the actual "on the ground" situation in terms of topography, and other pertinent features such as roads, canals, and existing development. These alternatives combine the quantitative analysis of the first two iterations with a qualitative analysis by the SAC. The alternatives were developed as follows:

On the habitat distribution map for each species, the SAC identified Core Habitat areas, defined as "areas where natural processes that maintain habitat mosaic are still intact, and there is a lack of fragmentation such that populations are of sufficient size to allow long-term viability." For some species where the SAC was uncertain of the long-term viability of the habitat in some areas, the areas were identified as possible Core Habitat areas. Core Habitat areas for each species were prepared on Mylar overlays; these overlays were combined in a single Mylar overlay which included a perimeter incorporating all the areas identified as Core Habitat for each target species for which it was defined. The identification of Core Habitat was later refined by the SAC using the standards described in the key concepts discussion in Section 3.2.2.3. This Core Habitat process is addressed in the individual species conservation strategies in Section 9 in the Plan document.

The second iteration Site Identification map for each alternative listed in Section 3.7.1.2 was compared with the Mylar overlay of Core Habitat areas for all the species. The closest match was Site Identification Alternative 2, with the two highest aggregate scores from the first iteration. Areas on this Alternative that did not have value as either Core Habitat for the species included in the Plan, linkage and connecting corridor, or ecological and physical processes were deleted.

Aerial photos (primarily CVWD 1:1000 photos from 1998) were used to describe boundaries for the high conservation value areas identified in Alternative 2 that conformed to natural features such as ridges, alluvial fans, toe of slope, stream courses, etc., rather than the ¼-section line boundaries from the GIS analysis. In this process, the SAC and biologists from USFWS and CDFG made numerous field visits to various potential reserve sites to better evaluate and map these boundaries. The sand source and sand transport areas were more completely mapped after the initial mapping identified in the second iteration process described in Section 3.7.1.3; this revised ecological process mapping, including identification of important watershed features, was incorporated into the third iteration map. Through field visits and aerial photo analysis, potential habitat linkage and corridor areas were more accurately mapped and incorporated into the third iteration Site Identification map. The map was evaluated for adequate buffers to habitat and linkage areas; these buffer areas were included within all proposed conservation areas, where adequate undeveloped land was available for this purpose. Aerial photos were also used to exclude existing land uses, such as roads, levees, and developed areas.

During this phase of the site identification process, the Plan Area was divided into “subunits” to allow for evaluation at a finer scale; these subunits, including western, central, eastern, and Santa Rosa/San Jacinto Mountains portions of the Plan Area, were for discussion purposes only. The use of these subunits allowed the SAC, and the Project Advisory Committee, to focus on specific areas within the Plan boundary.

The SAC reviewed, made some adjustments to, and approved the third iteration Site Identification map, which was designed to include a low acreage conservation alternative and a high acreage conservation alternative. The third iteration map identifies high value conservation areas that include: (1) Core Habitat areas that would be protected under a low acreage conservation alternative only; (2) additional habitat areas that would be protected under a high acreage conservation alternative; (3) essential ecological process areas; and (4) linkage areas. It should be noted that these categories describe the primary, rather than the exclusive, function of the land. For example, land in an ecological process area or a corridor may still have habitat value, but the primary value of the land is ecological process or connectivity rather than Core Habitat.

A map for each of the first iteration site identification alternatives is available for inspection at CVAG.

The high and low acreage conservation alternatives and the Existing Conservation Lands alternative were submitted to USFWS and CDFG for review along with a conservation analysis for each species and natural community (CVAG 1999). This reference document, titled "A Biological Analysis of Three Conservation Alternatives" is available at CVAG for inspection.

3.7.2 Development of Initial Conservation Alternatives

In their response to the alternatives and conservation analyses submitted to them for review in the "Biological Analysis of Three Conservation Alternatives" (CVAG 1999), USFWS and CDFG identified additional areas that they believed should be considered by the SAC for inclusion in Conservation Areas. The SAC subsequently evaluated the additional areas suggested for consideration by USFWS and CDFG. The SAC's evaluation led to the development of a new alternative, referred to as the Core Habitat, Essential Ecological Processes, and Linkages alternative. In Section 3.7.2.2, this is presented as Initial Alternative 2. Initial Alternative 1 includes the existing public lands and private conservation lands alternative. Initial Alternative 3 is the former high conservation acreage alternative with the addition of those areas that USFWS and CDFG recommended to the SAC for consideration.

3.7.2.1 Initial Conservation Alternative 1

This alternative would include all local, state, private conservation, and federal agency lands in the Plan Area with conservation management status 1, 2, and 3 (see Section 2.4 in the Plan document for a description of these categories). This alternative would also include private conservation lands that have habitat for the species included in the Plan or have one of the conserved natural communities included in the Plan. No new areas would be acquired for Plan purposes. The local jurisdictions would contribute to the management of the existing conservation areas as mitigation for the habitat loss allowed under the Plan.

This alternative is depicted in Figure A3-2. Substantial areas would be protected in the mountainous portions of the Plan Area: the San Gorgonio wilderness and Whitewater Canyon

ACEC in the San Bernardino Mountains; Mission Creek west of Highway 62, Morongo Canyon ACEC, and Joshua Tree National Park, in the Little San Bernardino Mountains; the Coachella Valley Fringe-toed Lizard Preserve in the Indio Hills; the Mecca Hills wilderness in the Mecca Hills; the Orocopia Mountains wilderness in the Orocopia Mountains; the Santa Rosa Mountains wilderness, Deep Canyon Desert Research Center, Hidden Palms Ecological Reserve, Carrizo Canyon Ecological Reserve, Magnesia Springs Ecological Reserve and portions of the new Santa Rosa and San Jacinto Mountains National Monument in the Santa Rosa Mountains; and portions of the Santa Rosa and San Jacinto Mountains National Monument, the San Jacinto wilderness, Mount San Jacinto State Park, and Oasis de los Osos in the San Jacinto Mountains. Some of these areas are well protected, but habitat fragmentation is a problem in other areas where considerable private lands still exist. On the valley floor, the only significant conservation areas would be the three existing Coachella Valley fringe-toed lizard preserves and Dos Palmas ACEC. The sand sources for the Coachella Valley fringe-toed lizard preserves are not adequately protected, and, collectively, the valley floor preserves do not provide adequate habitat for most of the species proposed for coverage.

Tables 3-7 and 3-8 identify the number of acres that would be protected for each species and natural community under this alternative. Because this alternative entails no land acquisition, only Core Habitats, essential ecological processes, and linkages that happen to be on existing public lands or private conservation lands would be protected. As a result, sand transport, watershed, and other ecological processes are not well protected and linkages are not maintained between major habitat areas. Core Habitat is often fragmented or occurs in small blocks. As a result, it is not expected that USFWS and CDFG would issue incidental take permits for most of the Covered Species proposed for inclusion in the Plan. By not securing incidental take permits for the majority of the species proposed for coverage, this alternative would not be expected to achieve the Plan objectives.

Table A3-7: Conservation of Species, Initial Alternative 1

SPECIES	**TOTAL ACRES OF HABITAT IN PLAN AREA**	**INITIAL ALTERNATIVE 1: EXISTING CONSERVATION LANDS**		
		LEVELS[1] 1 & 2 (%[2])	LEVEL [1] 3 (%[2])	TOTAL ALTERNATIVE 1[3]
ARROYO TOAD [4,5]	1	0 (0%)	0 (0%)	0 (0%)
BURROWING OWL [4,5]	40	10 (25%)	8 (20%)	18 (45%)
CALIFORNIA BLACK RAIL	1,331	384 (29%)	140 (11%)	524 (40%)
CASEY'S JUNE BEETLE	797	21 (3%)	0 (0%)	21 (3%)
COACHELLA VALLEY GIANT SAND TREADER CRICKET	23,015	3,813 (17%)	1,926 (8%)	5,739 (25%)
COACHELLA VALLEY GRASSHOPPER [4,5]	17	7 (41%)	0 (0%)	7 (41%)
COACHELLA VALLEY JERUSALEM CRICKET [4,5]	14	0 (0%)	4 (29%)	4 (29%)
COACHELLA VALLEY MILK VETCH	57,212	5,950 (10%)	3,930 (7%)	9,880 (17%)
CRISSAL THRASHER	8,932	746 (8%)	108 (1%)	854 (9%)
DESERT PUPFISH	0.15	0.04 (27%)	0.01 (7%)	0.05 (34%)
DESERT SLENDER SALAMANDER	325	325 (100%)	0	325 (100%)
DESERT TORTOISE	489,815	249,970 (51%)	69,008 (14%)	318,978 (65%)
FLAT-TAILED HORNED LIZARD	28,907	5,804 (20%)	1,185 (4%)	6,989 (24%)
GRAY VIREO	104,112	70,057 (67%)	22,764 (22%)	92,821 (79%)
LEAST BELL'S VIREO	63,551	13,981 (22%)	13,827 (22%)	27,808 (44%)
LE CONTE'S THRASHER [4,5]	26	5 (19%)	3 (12%)	8 (31%)
LITTLE SAN BERNARDINO MOUNTAINS GILIA [4,5]	52	3 (6%)	0 (0%)	3 (6%)
MECCA ASTER	29,531	15,245 (52%)	4,367 (15%)	19,612 (67%)
OROCOPIA SAGE	79,024	34,147 (43%)	16,597 (21%)	50,744 (64%)
PALM SPRINGS (CV) ROUND-TAILED GROUND SQUIRREL	106,636	10,697 (10%)	9,009 (8%)	19,706 (18%)
PALM SPRINGS POCKET MOUSE	145,173	15,154 (10%)	14,572 (10%)	29,726 (20%)

Table A3-7: (cont.) Conservation of Species, Initial Alternative 1

SPECIES	TOTAL ACRES OF HABITAT IN PLAN AREA	INITIAL ALTERNATIVE 1: EXISTING CONSERVATION LANDS		
		LEVELS[1] 1 & 2 (%[2])	LEVEL [1] 3 (%[2])	TOTAL ALTERNATIVE 1[3]
PENINSULAR BIGHORN SHEEP	127,767	80,046 (63%)	3,579 (3%)	83,625 (66%)
PRATT'S BLUE BUTTERFLY [4,5]	1	0 (0%)	1	1 (100%)
SOUTHERN YELLOW BAT	1,356	540 (40%)	123 (9%)	663 (49%)
SOUTHWESTERN WILLOW FLYCATCHER	62,992	13,731 (22%)	13,814 (22%)	27,545 (44%)
SUMMER TANAGER	62,072	13,138 (21%)	13,679 (22%)	26,817 (43%)
TRIPLE-RIBBED MILK VETCH [4,5]	34	25 (74%)	4 (12%)	29 (86%)
YELLOW-BREASTED CHAT	63,145	13,196 (21%)	13,687 (22%)	26,883 (43%)
YELLOW WARBLER	63,388	13,801 (22%)	13,821 (22%)	27,622 (44%)
YUMA CLAPPER RAIL	2,375	449 (19%)	57 (2%)	506 (21%)

[1] Indicates number of acres for conservation management levels, as described in Section 2.5, on public and private conservation lands. Levels one and two are combined and level three is shown separately.

[2] Numbers given in parentheses indicate acres within each conservation level, or combination of conservation levels, as a percentage of total acres of habitat for each species in the Plan area.

[3] Indicates total of levels one, two and three; the numbers in parenthesis indicates the acres in Alternative 1 as a percentage of the total acres of habitat for each species in the Plan area.

[4] No species distribution model was prepared for this species. The number given is the total number of known locations within the entire Plan area or within the boundaries of each alternative. For each species and alternative, the number of known locations is underlined.

[5] Percentages given indicate known locations conserved as a percentage of total known locations in the Plan Area.

Table A3-8: Conservation of Natural Communities, Initial Alternative 1

NATURAL COMMUNITY	TOTAL ACRES IN PLAN AREA	INITIAL ALTERNATIVE 1: EXISTING CONSERVATION LANDS		
		LEVELS[1] 1 & 2 (%[2])	LEVEL[1] 3 (%[2])	TOTAL ALTERNATIVE 1[3]
ACTIVE DESERT DUNES	561	434 (77%)	52 (9%)	486 (86%)
STABILIZED & PARTIALLY STABILIZED DESERT DUNES	192	21 (11%)	0	21 (11%)
ACTIVE DESERT SAND FIELDS	5,016	2,306 (46%)	57 (1%)	2,363 (47%)
STABILIZED & PARTIALLY STABILIZED SAND FIELDS	1,332	112 (8%)	183 (14%)	295 (22%)
EPHEMERAL DESERT SAND FIELDS	4,598	884 (19%)	1,110 (24%)	1,994 (43%)
STABILIZED SHIELDED SAND FIELDS	14,528	434 (3%)	867 (6%)	1,301 (9%)
MESQUITE HUMMOCKS	1,035	122 (12%)	3 (0.3%)	125 (12%)
SONORAN CREOSOTE BUSH SCRUB	405,785	191,050 (47%)	60,471 (15%)	251,521 (62%)
SONORAN MIXED WOODY & SUCCULENT SCRUB	136,017	71,995 (53%)	5,282 (4%)	77,277 (57%)
MOJAVE MIXED WOODY SCRUB	104,214	67,335 (65%)	9,073 (9%)	76,408 (74%)
DESERT SALTBUSH SCRUB	5,572	80 (1%)	0	80 (1%)
DESERT SINK SCRUB	9,740	2,257 (23%)	546 (6%)	2,803 (29%)
SOUTHERN ARROYO WILLOW RIPARIAN FOREST	117	101 (86%)	0	101 (86%)
SONORAN COTTONWOOD WILLOW RIPARIAN FOREST	1,180	394 (33%)	28 (2%)	422 (35%)
SOUTHERN SYCAMORE-ALDER RIPARIAN WOODLAND	669	498 (74%)	15 (2%)	513 (86%)
COASTAL AND VALLEY FRESHWATER MARSH	64	0	1 (2%)	1 (2%)
CISMONTANE ALKALI MARSH	321	247 (77%)	11 (3%)	258 (80%
DESERT DRY WASH WOODLAND	40,551	8,245 (20%)	12,936 (32%)	21,181 (52%)
DESERT FAN PALM OASIS	1,355	539 (40%)	123 (9%)	662 (49%)
ARROWWEED SCRUB	277	137 (49%)	7 (3%)	144 (52%)
MESQUITE BOSQUE	481	154 (32%)	0	154 (32%)
SEMI-DESERT CHAPARRAL	22,619	15,377 (68%)	5,031 (22%)	20,408 (90%)
CHAMISE CHAPARRAL	2,794	2,229 (80%)	0	2,229 (80%)
REDSHANK CHAPARRAL	13,282	279 (2%)	9,760 (73%)	10,039 (75%)
PENINSULAR JUNIPER WOODLAND & SCRUB	37,545	24,022 (64%)	7,973 (21%)	31,995 (85%)
MOJAVEAN PINYON-JUNIPER WOODLAND	30,666	30,380 (99%)	0	30,380 (99%)

[1] Indicates number of acres for conservation management levels, as described in Section 2.5, on public and private conservation lands. Levels one and two are combined and level three is shown separately.

[2] Numbers given in parentheses indicate acres within each conservation level, or combination of conservation levels, as a percentage of total acres of each natural community in the Plan Area.

[3] Indicates total of levels one, two and three; the numbers in parenthesis indicates the acres in Alternative 1 as a percentage of the total acres of each natural community in the Plan Area.

3.7.2.2 Initial Conservation Alternative 2

This alternative would establish conservation areas that protect Core Habitat for the Covered Species and conserved natural communities included in the Plan, ecological processes necessary to sustain these habitats, and linkages. The conservation areas include the Alternative 1 lands as well as private lands essential for Core Habitat, ecological processes, and linkages. New management prescriptions are proposed for the existing public and private conservation lands where needed. Private lands would be protected through the implementation program, by means of acquisition, general plan policies, ordinances, and other planning tools. Conservation biology principles were used in preserve design to assure long-term viability and adequate conservation for the Covered Species and conserved natural communities. These principles are:

1. Species well distributed across their native range are less susceptible to extinction than species confined to small portions of their range.
2. Large blocks of habitat, containing large populations, are better than small blocks with small populations.
3. Blocks of habitat close together are better than blocks far apart.
4. Habitat in contiguous blocks is better than fragmented habitat.
5. Interconnected blocks of habitat are better than isolated blocks.
6. Blocks of habitat that are roadless or less accessible to humans are better than roaded and accessible habitat blocks.

This conservation area alternative is depicted in Figure A3-3. This alternative would protect private lands in the mountains necessary to avoid habitat fragmentation, protect essential ecological processes, and maintain linkages. On the valley floor, this alternative would build on the existing Coachella Valley fringe-toed lizard preserves and Dos Palmas ACEC by adding adjacent habitat for the Covered Species and conserved natural communities included in the Plan, protecting the essential ecological processes that maintain the habitat areas, and protecting linkages between the major mountains ranges. In addition, this alternative would create new preserve areas in the Snow Creek area, east of Highway 62 along Mission Creek and Morongo Wash, and at the Whitewater River delta at the northwest end of the Salton Sea.

Tables 3-9 and 3-10 identify the number of acres that would be protected for each species and natural community under this alternative.

Table A3-9: Conservation of Species, Initial Alternative 2

SPECIES	**TOTAL ACRES OF HABITAT IN PLAN AREA**	**INITIAL ALTERNATIVE 2: CORE HABITAT, ECOSYSTEM PROCESSES & LINKAGES**	
		ACRES[1]	% OF TOTAL[2]
ARROYO TOAD [3,4]	1	1	100
BURROWING OWL [3,4]	40	28	70
CALIFORNIA BLACK RAIL	1,331	1,221	92
CASEY'S JUNE BEETLE	797	328	41
COACHELLA VALLEY GIANT SAND TREADER CRICKET	23,015	8,904	39
COACHELLA VALLEY GRASSHOPPER [3,4]	17	11	65
COACHELLA VALLEY JERUSALEM CRICKET [3,4]	14	9	64
COACHELLA VALLEY MILK VETCH	57,212	21,979	38
CRISSAL THRASHER	8,932	3,173	36
DESERT PUPFISH	0.15	0.06	40
DESERT SLENDER SALAMANDER	325	325	100
DESERT TORTOISE	489,815	432,413	88
FLAT-TAILED HORNED LIZARD	28,907	12,729	44
GRAY VIREO	104,112	91,092	87
LEAST BELL'S VIREO	63,551	48,238	76
LE CONTE'S THRASHER [3,4]	26	14	54
LITTLE SAN BERNARDINO MOUNTAINS GILIA [3,4]	52	51	98
MECCA ASTER	29,531	21,060	71
OROCOPIA SAGE	79,024	69,811	88
PALM SPRINGS (CV) ROUND-TAILED GROUND SQUIRREL	106,636	36,513	34
PALM SPRINGS POCKET MOUSE	145,173	58,194	40

Table A3-9: (cont.) Conservation of Species, Initial Alternative 2

SPECIES	**TOTAL ACRES OF HABITAT IN PLAN AREA**	**INITIAL ALTERNATIVE 2: CORE HABITAT, ECOSYSTEM PROCESSES & LINKAGES**	
		ACRES [1]	% OF TOTAL[2]
PENINSULAR BIGHORN SHEEP	127,767	126,978	99
PRATT'S BLUE BUTTERFLY [3,4]	2	2	100
SOUTHERN YELLOW BAT	1,356	1,330	98
SOUTHWESTERN WILLOW FLYCATCHER	62,992	47,852	76
SUMMER TANAGER	62,072	46,919	76
TRIPLE-RIBBED MILK VETCH [3,4]	34	25	74
YELLOW-BREASTED CHAT	63,145	47,980	76
YELLOW WARBLER	63,388	47,248	76
YUMA CLAPPER RAIL	2,375	1,552	65

[1] Indicates number of acres of habitat for each species within the boundaries of Alternative 2, or number of known locations (underlined) for species with no habitat distribution model.

[2] Numbers given indicate acres of habitat within Alternative 2, as a percentage of total acres of habitat for each species in the Plan Area.

[3] No species distribution model was prepared for this species. The number given is the total number of known locations within the entire Plan area or within the boundaries of each alternative. For each species and alternative, the number of known locations is underlined.

[4] Percentages given indicate known locations conserved as a percentage of total known locations in the Plan Area.

Table A3-10: Conservation of Natural Communities, Initial Alternative 2

NATURAL COMMUNITY	TOTAL ACRES OF COMMUNITY IN PLAN AREA	INITIAL ALTERNATIVE 2: CORE HABITAT, ECOSYSTEM PROCESSES & LINKAGES	
		ACRES[1]	% OF TOTAL[2]
ACTIVE DESERT DUNES	561	547	98
STABILIZED & PARTIALLY STABILIZED DESERT DUNES	192	192	100
ACTIVE DESERT SAND FIELDS	5,016	3,749	75
STABILIZED & PARTIALLY STABILIZED SAND FIELDS	1,332	415	31
EPHEMERAL DESERT SAND FIELDS	4,598	3,806	83
STABILIZED SHIELDED DESERT SAND FIELDS	14,528	1,573	11
MESQUITE HUMMOCKS	1,035	327	32
SONORAN CREOSOTE BUSH SCRUB	405,785	319,031	79
SONORAN MIXED WOODY & SUCCULENT SCRUB	136,017	99,798	73
MOJAVE MIXED WOODY SCRUB	104,214	86,005	83
DESERT SALTBUSH SCRUB	5,572	1,370	25
DESERT SINK SCRUB	9,740	8,876	91
SOUTHERN ARROYO WILLOW RIPARIAN FOREST	117	117	100
SONORAN COTTONWOOD WILLOW RIPARIAN FOREST	1,180	1,166	99
SOUTHERN SYCAMORE-ALDER RIPARIAN WOODLAND	669	669	100
COASTAL AND VALLEY FRESHWATER	64	61	95
CISMONTANE ALKALI MARSH	321	321	100
DESERT DRY WASH WOODLAND	40,551	31,530	78
DESERT FAN PALM OASIS WOODLAND	1,355	1,329	98
ARROWWEED SCRUB	277	267	96
MESQUITE BOSQUE	481	481	100
SEMI-DESERT CHAPARRAL	22,619	9,785	43
CHAMISE CHAPARRAL	2,794	2,376	85
REDSHANK CHAPARRAL	13,282	13,230	99.6
PENINSULAR JUNIPER WOODLAND & SCRUB	37,545	37,411	99.7
MOJAVEAN PINYON-JUNIPER WOODLAND	30,666	30,666	100

[1] Indicates number of acres of each natural community within the boundaries of Alternative 2.

[2] Numbers given indicate acres within Alternative 2, as a percentage of total acres of each natural community in the Plan Area.

3.7.2.2 Initial Conservation Alternative 3

This alternative would expand Alternative 2 by including the high conservation acreage alternative areas and additional areas that were recommended for further consideration by USFWS and CDFG in their response to the third iteration of Site Identification Maps. Figure A3-3 depicts this alternative.

Tables 3-11 and 3-12 identify the number of acres that would be protected for each species and natural community under this alternative.

Table A3-11: Conservation of Species, Initial Alternative 3

SPECIES	**TOTAL ACRES OF HABITAT IN PLAN AREA**	**INITIAL ALTERNATIVE 3: ENHANCED CONSERVATION**	
		ACRES [1]	**% OF TOTAL[2]**
ARROYO TOAD [3,4]	1	1	100
BURROWING OWL [3,4]	40	30	75
CALIFORNIA BLACK RAIL	1,331	1,221	92
CASEY'S JUNE BEETLE	797	328	41
COACHELLA VALLEY GIANT SAND TREADER CRICKET	23,015	15,149	66
COACHELLA VALLEY GRASSHOPPER [3,4]	17	15	88
COACHELLA VALLEY JERUSALEM CRICKET [3,4]	14	13	93
COACHELLA VALLEY MILK VETCH	57,212	35,926	63
CRISSAL THRASHER	8,932	3,382	38
DESERT PUPFISH	0.15	0.06	40
DESERT SLENDER SALAMANDER	325	325	100
DESERT TORTOISE	489,815	445,169	91
FLAT-TAILED HORNED LIZARD	28,907	18,888	65
GRAY VIREO	104,112	91,234	88
LEAST BELL'S VIREO	63,551	53,673	84
LE CONTE'S THRASHER [3,4]	26	16	62
LITTLE SAN BERNARDINO MOUNTAINS GILIA [3,4]	52	52	100
MECCA ASTER	29,531	28,548	97
OROCOPIA SAGE	79,024	78,364	99
PALM SPRINGS (CV) ROUND-TAILED GROUND SQUIRREL	106,636	65,500	61
PALM SPRINGS POCKET MOUSE	145,173	97,001	67

Table A3-11: (Cont.) Conservation of Species, Initial Alternative 3

SPECIES	**TOTAL ACRES OF HABITAT IN PLAN AREA**	**INITIAL ALTERNATIVE 3: ENHANCED CONSERVATION**	
		ACRES [1]	% OF TOTAL[2]
PENINSULAR BIGHORN SHEEP	127,767	126,978	100
PRATT'S BLUE BUTTERFLY [3,4]	<u>2</u>	<u>2</u>	100
SOUTHERN YELLOW BAT	1,356	1,330	100
SOUTHWESTERN WILLOW FLYCATCHER	62,992	47,852	85
SUMMER TANAGER	62,072	46,919	84
TRIPLE-RIBBED MILK VETCH [3,4]	<u>34</u>	<u>25</u>	74
YELLOW-BREASTED CHAT	63,145	47,980	83
YELLOW WARBLER	63,388	47,248	85
YUMA CLAPPER RAIL	2,375	1,552	65

[1] Indicates number of acres of habitat for each species, or the number of known locations, within the boundaries of Alternative 3.

[2] Numbers given indicate acres within Alternative 3, as a percentage of total acres of habitat for each species in the Plan Area.

[3] No species distribution model was prepared for this species. The number given is the total number of known locations within the entire Plan area or within the boundaries of each alternative. For each species and alternative, the number of known locations is underlined.

[4] Percentages given indicate known locations conserved as a percentage of total known locations in the Plan Area.

Table A3-12: Conservation of Natural Communities, Initial Alternative 3

NATURAL COMMUNITY	TOTAL ACRES OF COMMUNITY IN PLAN AREA	INITIAL ALTERNATIVE 3: ENHANCED CONSERVATION	
		ACRES[1]	% OF TOTAL[2]
ACTIVE DESERT DUNES	561	552	98
STABILIZED & PARTIALLY STABILIZED DESERT DUNES	192	192	100
ACTIVE DESERT SAND FIELDS	5,016	4,670	93
STABILIZED & PARTIALLY STABILIZED SAND FIELDS	1,332	1,319	99
EPHEMERAL DESERT SAND FIELDS	4,598	4,225	92
STABILIZED SHIELDED SAND FIELDS	14,528	6,466	45
MESQUITE HUMMOCKS	1,035	520	50
SONORAN CREOSOTE BUSH SCRUB	405,785	349,938	86
SONORAN MIXED WOODY & SUCCULENT SCRUB	136,017	109,955	81
MOJAVE MIXED WOODY SCRUB	104,214	88,740	85
DESERT SALTBUSH SCRUB	5,572	1,386	25
DESERT SINK SCRUB	9,740	8,876	91
SOUTHERN ARROYO WILLOW RIPARIAN FOREST	117	117	100
SONORAN COTTONWOOD WILLOW RIPARIAN FOREST	1,180	1,171	99
SOUTHERN SYCAMORE-ALDER RIPARIAN WOODLAND	669	669	100
COASTAL AND VALLEY FRESHWATER MARSH	64	61	95
CISMONTANE ALKALI MARSH	321	321	100
DESERT DRY WASH WOODLAND	40,551	36,681	90
DESERT FAN PALM OASIS WOODLAND	1,355	1,352	99.8
ARROWWEED SCRUB	277	267	96
MESQUITE BOSQUE	481	481	100
SEMI-DESERT CHAPARRAL	22,619	9,785	43
CHAMISE CHAPARRAL	2,794	2,376	85
REDSHANK CHAPARRAL	13,282	13,239	100
PENINSULAR JUNIPER WOODLAND & SCRUB	37,545	37,545	100
MOJAVEAN PINYON-JUNIPER WOODLAND	30,666	30,666	100

[1] Indicates number of acres of each natural community within the boundaries of Alternative 3.

[2] Numbers given indicate acres within Alternative 3, as a percentage of total acres of each natural community in the Plan Area.

3.7.3 Evaluation of Initial Conservation Alternatives

The SAC evaluated the three conservation alternatives described in Section 3.7.2 using the following measures of adequacy.

1. **Size of habitat patches**. For each Covered Species, the SAC assessed whether a Conservation Area provided Core Habitat. The Core Habitat concept was not applied to species that were considered to occur as metapopulations; these are burrowing owl, Le Conte's thrasher, Yuma clapper rail, California black rail, the riparian bird species, and southern yellow bat. A Conservation Area was not deemed inadequate because of the lack of Core Habitat for these species. The concept of Core Habitat was not used with natural communities.

2. **The number of Core Habitat areas protected in Conservation Areas for each Covered Species**. Where possible, the SAC sought to conserve a minimum of three Core Habitat areas for each Covered Species. In some cases, more than three Core Habitat areas for a Covered Species occurred in the Conservation Areas. In other instances, fewer than three Core Habitat areas for a Covered Species occurred in the Plan Area.

3. **Representative range of environmental conditions, including temperature, moisture, and elevation gradients, under which the species or natural community occurs in a viable population**. For each Covered Species, the SAC assessed whether the Conservation Areas included Other Conserved Habitat that provided for the conservation of the range of environmental conditions in which the species occurs in the Plan Area.

4. **Essential Ecological Processes**. These could include hydrological processes (both subsurface and surface), blowsand movement, erosion, deposition, substrate development, soil formation, and biological processes such as reproduction, pollination, dispersal, and migration. The SAC assessed the Conservation Areas to evaluate whether the Essential Ecological Processes necessary to sustain the Covered Species' habitats and conserved natural communities present were included in the Conservation Areas.

5. **Biological Corridors and Linkages**. For each Covered Species, the SAC assessed whether connectivity of the population in each Conservation Area was maintained with populations in other Conservation Areas and to populations outside the Plan Area to the maximum extent feasible.

The tables in Section 9 in the Plan document show the extent to which the Conservation Areas in the Preferred Alternative, which evolved from the Conservation Alternative 2 developed by the SAC at this stage of the process, contain Core Habitat (and how many Core Habitat areas) and

Other Conserved Habitat. The Conservation Analysis for each Covered Species in Section 9 in the Plan document describes the protection of Essential Ecological Processes in the Conservation Areas and the Biological Corridors and Linkages between Conservation Areas that are protected.

The SAC concluded that Conservation Alternative 1 did not satisfy the above criteria for the Covered Species and conserved natural communities because of the degree of fragmentation in the Existing Covered Lands and the lack of protection of Essential Ecological Processes and Biological Corridors and Linkages. The SAC also concluded that Conservation Alternative 3 provided the same benefits as Conservation Alternative 2, included some potentially useful additional areas, and included some additional areas that did not appear to meet the criteria. Section 3.7.4 describes the process used to develop the Preferred Alternative.

3.7.3.1 Statistical Analysis of Alternatives

The basic steps in the statistical analysis involved the preparation of various map layers including the natural communities (vegetation) map and species habitat distribution maps, and comparison of these maps with additional map layers that contain land management and ownership information. This process essentially creates the opportunity for comparison between the habitat distribution map for a given species or each natural community and the map for a given Site Identification Alternative or conservation alternative in order to evaluate the amount of area where they coincide. This information is used to identify the relative level of conservation for each Covered Species and natural community under the different alternatives.

Initially, a statistical analysis was carried out to evaluate the level of protection afforded each Covered Species and natural community for each of the site identification alternatives identified in Section 3.7.1 (site identification alternatives 1, 2, 4b, 6, 7). Subsequently, a statistical analysis was conducted of Alternatives 1, 2, and 3 as described in Section 3.7.2. For each alternative, the number of acres included within it for each species and natural community is expressed as a percent of the total acres of habitat. The results of the statistical analyses for the three Conservation Alternatives considered in the Plan are shown in the tables in Sections 3.7.2.1, 3.7.2.2, and 3.7.2.3.

3.7.3.2 Administrative Review Draft

An Administrative Review Draft was distributed to the Wildlife Agencies and all other signatories to the Planning Agreement in August 2000. This Administrative Review Draft, while not a complete MSHCP, included a discussion of the site identification and reserve design process, the three initial conservation alternatives described in Section 3.7.2, the proposed conservation plan, summary conservation strategies for all Covered Species and conserved natural communities, and a preliminary discussion of the implementation program. This draft provided an additional opportunity for the jurisdictions and the Wildlife Agencies to provide input into the development of the Plan. This reference document is available for review at CVAG's office.

3.7.3.3 SITES Model

Based on the recommendations of the ISA after their review of the January 2001 Administrative Review Draft, the SITES model (SITES V.1.0: An Analytical Toolbox for Designing Ecoregional Conservation Portfolios, The Nature Conservancy) was used to complete an analysis of the reserve design for the MSHCP. SITES V.1.0 runs on an Arcview GIS 3.2 platform. It uses a heuristic method to choose a reserve system or "conservation portfolio" from a larger set of "planning units" within an ecoregion. Given a set of goals (number of species or amount of habitat to protect) for an ecoregion, it uses a process termed Simulated Annealing to choose an optimal reserve design. In all cases the "optimum" reserve is the solution that protects the greatest number of species/habitats using the smallest land area. The simulated annealing process chooses an initial random selection of planning units and then determines how well they accomplish the stated conservation goals in the form of model parameters. The program then randomly adds and subtracts planning units for 1,000,000 iterations, checking each solution against specified parameters. Planning units that add to the goals are retained while planning units that detract are removed. The strength of this program is its non-linear structure, which prevents formation of local optima, intermediate solutions that contribute greatly early in the iterative process but force a less than optimal final solution. As the program runs, it becomes more and more selective, incorporating only those planning units that add to the designated goals. Because the program randomly selects a different group of planning units at the beginning of each run, it could choose somewhat different results for the same data set. SITES V. 1.0 is designed to run the same data set 10 times and presents the solution that comes closest to the provided goals; how often a particular parcel of land is chosen provides a good indication of its value within the preserve's design constraints. Using the SITES V. 1.0 program, a reserve design very similar to the Preferred Alternative was selected. Observed differences were minor, and primarily appeared related to the scale the program chose for planning units; high-priority vegetation types were selected preferentially even if they were only a small portion of the planning unit; i.e. an entire section (640 acres) was chosen when only a few acres of the desired vegetation type occurred in the section. This evaluation is described in a report from the University of California, Riverside, Center for Conservation Biology (Allen et al. 2002) which is available from CVAG.

3.7.4 Development of Draft Preferred Alternative

The three conservation alternatives were reviewed by the ISA in 2001, resulting in preparation of a report titled "Independent Science Advisors' Review: Coachella Valley Multiple Species Habitat Conservation Plan/Natural Communities Conservation Plan (MSHCP/NCCP)". In addition, in 2002 a preliminary draft of a study titled Long-term Sand Supply to Coachella Valley Fringe-toed Lizard (*Uma inornata*) Habitat in the Northern Coachella Valley, California (United States

Geological Survey, 2002) was made available to the SAC. In response to the ISA report and additional information provided by the USGS study, the SAC analyzed additional areas for potential inclusion in the Conservation Areas. This analysis included review of the additional information provided, field visits, and meetings with other biologists. Based on this analysis, the SAC recommended addition of some areas to Conservation Alternative 2 and a new conservation alternative was developed for further discussion. This alternative was discussed in a series of meetings among CDFG, USFWS, CVAG staff, and local jurisdictions to obtain additional information, including biological and land use information. Through this process, the SAC's revised conservation alternative was further revised. In no case were the resulting Conservation Area boundaries less than those recommended by the SAC. The result was the preferred conservation alternative presented in Section 4 of the Plan document.

3.8 Species Considered but Not Included in the Plan

3.8.1 Review of Species Identified in the Original MOU

The original Planning Agreement among the local, state, and federal agencies comprising the Plan participants identified 52 species to be considered for inclusion in the Plan and identified all the natural communities in the Plan Area. This original list was compiled by requesting input from biologists with expertise in the Coachella Valley area, agency biologists, and consulting other lists (e.g. California Native Plant Society, CDFG, USFWS, NDDB, etc.). As information was gathered through the planning process, the Planning Team continuously reviewed the list. Other experts on individual species were also consulted. A number of species were subsequently deleted from consideration. Table A3-13 identifies the species from the original Planning Agreement that are not proposed for coverage and the reasons why not.

Table A3-13: Species Not Proposed for Coverage under the Plan

Species	Status	Reasons for not Including in Plan	Potential Future Actions
California leaf-nosed bat *Macrotus californicus*	CSC	Insufficient information is available at this time. The species is known to occur in one natural cave in the Santa Rosa Mountains. This species formerly occurred at Bat Cave Buttes also, but this site has been heavily vandalized and no longer has any California leaf-nosed bats. Surveys were not conducted as part of this planning effort due to funding constraints.	Before it would be feasible to include the species in the Plan, it would be necessary to determine if they utilize any of the desert dry wash woodlands within the Plan Area by mist netting. If the California leaf-nosed bat is foraging in an area, the nearby areas should be surveyed for potential caves, and these should be inspected to determine if the bats are roosting there.
Yuma myotis *Myotis yumanensis*	CSC	A literature search has indicated no known occurrences in the Plan Area. If it does occur, it will likely be in the upper, forested elevations. Localities within the Plan Area would be at the edge of its range. Surveys were not conducted as part of this planning effort due to funding constraints.	If it is later discovered that the species occurs in the Plan Area, the species could be considered for inclusion in the Plan through an amendment. Surveys would be needed to determine the distribution and status of the species.
Long-eared myotis *Myotis evotis*	CSC	A literature search has indicated no known occurrences in the Plan Area. If it does occur, it would be expected only in the forested zones of the Plan Area, at the eastern edge of its range. Surveys were not conducted as part of this planning effort due to funding constraints.	If it is later discovered that the species occurs in the Plan Area, the species could be considered for inclusion in the Plan through an amendment. Surveys would be needed to determine the distribution and status of the species.
Long-legged myotis *Myotis volans*	CSC	A literature search has indicated no known occurrences in the Plan Area. If this species occurs in the Plan Area, it would be expected only in the forested zones. Localities in the Plan Area would be at the eastern edge of its range. Surveys were not conducted as part of this planning effort due to funding constraints.	If it is later discovered that the species occurs in the Plan Area, the species could be considered for inclusion in the Plan through an amendment. Surveys would be needed to determine the distribution and status of the species.

Table A3-13: Species Not Proposed for Coverage under the Plan (cont.)

Species	Status	Reasons for not Including in Plan	Potential Future Actions
Western small-footed myotis *Myotis ciliolabrum*	CSC	A literature search has indicated no known occurrences in the Plan Area. If this species occurs in the Plan Area, it would be expected only in the forested zones of the Plan Area, at the eastern edge of its range. Surveys were not conducted as part of this planning effort due to funding constraints.	If it is later discovered that the species occurs in the Plan Area, the species could be considered for inclusion in the Plan through an amendment. Surveys would be needed to determine the distribution and status of the species.
Fringed myotis *Myotis thysanodes*	CSC	A literature search has indicated no known occurrences in the Plan Area. The nearest known locality is one record from 1992 listed as Joshua Tree National Monument. Surveys were not conducted as part of this planning effort due to funding constraints.	If it is later discovered that the species occurs in the Plan Area, the species could be considered for inclusion in the Plan through an amendment. Surveys would be needed to determine the distribution and status of the species.
Townsend's (Western) big-eared bat *Corynorhinus townsendii pallescens*	CSC	There is one record of this species in the Plan Area in Whitewater Canyon from 1915. It is unknown if the locality where the species was found in Whitewater Canyon is still viable. Surveys were not conducted as part of this planning effort due to funding constraints.	If it is later discovered that the species occurs in the Plan Area, the species could be considered for inclusion in the Plan through an amendment. Surveys would be needed to determine the distribution and status of the species.
Pallid bat *Antrozous pallidus*	CSC	Pallid bats are known to occur in the vicinity of Bat Cave Buttes, Painted Canyon, the Eagle Mountains, and Cottonwood Spring (Joshua Tree National Park). The population at Bat Cave Buttes has been severely impacted by recreational use of the caves (P. Brown, pers. comm.). The population at Painted Canyon could also be impacted by recreational use. Surveys were not conducted as part of this planning effort due to funding constraints.	Before specific conservation measures could be formulated for this species in the Plan Area, more information is needed on the status of the populations. Survey needs include determining their status at Bat Cave Buttes, Painted Canyon, and other comparable habitat using netting and acoustic surveys. Because this is a species that is commonly found under bridges, it would be worthwhile to check bridges for guano and staining.

Table A3-13: Species Not Proposed for Coverage under the Plan (cont.)

Species	Status	Reasons for not Including in Plan	Potential Future Actions
Pocketed free-tailed bat *Nyctinomops femorosaccus*	CSC	There is little information available on this species. The type locality is from Palm Springs. It is also known to occur in Painted Canyon in the Mecca Hills. It is not known whether these are roosting colonies or not. The population in Painted Canyon could be impacted by recreational use. Surveys were not conducted as part of this planning effort due to funding constraints.	To add this species to the Plan, additional surveys would be needed in the Mecca Hills area and throughout the Plan Area in appropriate habitat to determine the distribution and status of this species.
California (Western) mastiff bat *Eumops perotis californicus*	CSC	There are two records for this species within the Plan Area. One is from Cottonwood Spring in Joshua Tree National Park and the other is from Painted Canyon in the Mecca Hills. The Joshua Tree National Park population is probably fairly secure. The locality in Painted Canyon is subject to disturbance from recreation. Surveys were not done for this species due to funding constraints.	To add this species to the Plan, additional surveys would be needed in the Mecca Hills area and throughout the Plan Area in appropriate habitat to determine the distribution and status of this species.
Desert slender salamander *Batrachoseps aridus*	FE/SE	There are only two known occurrences of this species, both of which are protected on Existing Conservation Lands. There is no need for additional protection.	Should a need arise in the future, this species could be become a Covered Species through Plan and Permit Amendments.
California red-legged frog *Rana aurora draytonii*	FE	There is an historic record for one location in the Plan Area. The species is believed to have been extirpated from that location, which is on Indian Reservation land.	If it is later discovered that the species occurs in the Plan Area, the species could be considered for inclusion in the Plan through an amendment. Surveys would be needed to determine the distribution and status of the species.
Mountain yellow-legged frog *Rana muscosa*	no official status	There are two records, in Andreas Canyon (Indian land) (1979) and Snow Creek (1979-1980). The species is thought to be extirpated from these locations. Potential habitat is mostly on public land. Surveys were not done due to funding constraints.	If it is later discovered that the species occurs in the Plan Area, the species could be considered for inclusion in the Plan through an amendment. Surveys would be needed to determine the distribution and status of the species.

Table A3-13: Species Not Proposed for Coverage under the Plan (cont.)

Species	Status	Reasons for not Including in Plan	Potential Future Actions
California legless lizard *Anniella pulchra pulchra*	CSC	The species is known from the Santa Rosa Mountains, but there is little information on its distribution there. This would be near the edge of its overall range. There is insufficient information to include the species in the Plan and no perceived threat to warrant inclusion.	If it is later determined that inclusion of the species is warranted, the species could be considered for inclusion in the Plan through an amendment. Surveys would be needed to determine the distribution and status of the species.
San Diego horned lizard *Phrynosoma coronatum blainvillei*	No official status	The species is known to occur in the westernmost portion of the Plan Area. It is primarily, however, a species of the coastal plains and mountains. Its distribution in the Plan Area is not regarded as significant to the survival of the species.	If it is later determined that inclusion of the species is warranted, the species could be considered for inclusion in the Plan through an amendment. Surveys would be needed to determine the distribution and status of the species.
Lowland leopard frog *Rana yavapiensis*	CSC	There are no records for this species in the Plan Area. The closest known location is an isolated population in the San Felipe Creek area in Imperial County.	If it is later discovered that the species occurs in the Plan Area, the species could be considered for inclusion in the Plan through an amendment. Surveys would be needed to determine the distribution and status of the species.
Casey’s June beetle *Dinacoma caseyi*	No official status	While it has no official status, this species is a narrow endemic, known to occur only in the Plan Area in an area of approximately 160 acres. More than half of this is controlled by a single landowner. Efforts to work with this landowner to develop a conservation strategy have not yet come to fruition. Therefore, the species could not be included as a Covered Species. Efforts to work with this landowner are ongoing.	At such time as a conservation strategy that can be implemented can be developed, this species may be added as a Covered Species through Plan and Permit Amendments.
Coachella Valley grasshopper *Spaniacris deserticola*	No official status	This species is known from several locations in the Coachella Valley, and is widespread in the desert beyond the Plan Area. Its existence in the wild does not appear to be threatened.	To add this species to the Plan, field surveys would be needed in appropriate habitat to determine the distribution and status of this species.

Table A3-13: Species Not Proposed for Coverage under the Plan (cont.)

Species	Status	Reasons for not including in Plan	Potential future actions
Pratt's dark aurora blue butterfly *Euphilotes enoptes cryptorufes*	No official status	This species is known from two locations in the national forest in the San Jacinto and Santa Rosa Mountains. Insufficient information makes it currently infeasible to develop a conservation strategy such that the species could be a Covered Species.	To add this species to the Plan, field surveys would be needed in appropriate habitat to determine the distribution and status of this species.
Morongo desert snail *Eremarionta morongoana*	No official status	A report was prepared on this species based on aerial photo analysis and literature searches. The species is known to occur in or immediately adjacent to the Plan Area. There is potential habitat in the Plan Area; however, no field surveys have been conducted to verify known locations and identify other potential occurrences.	To add this species to the Plan, field surveys would be needed in appropriate habitat to determine the distribution and status of this species.
Thousand Palms desert snail *Eremarionta millepalmarum*	No official status	A report was prepared on this species based on aerial photo analysis and literature searches. The species is known to occur in the Plan Area north and northeast of Thousand Palms in the Little San Bernardino Mountains; however, no field surveys have been conducted to verify known locations and identify other potential occurrences.	To add this species to the Plan, field surveys would be needed in appropriate habitat to determine the distribution and status of this species.
Glandular ditaxis *Ditaxis clariana*	CNPS List 2	According to the Jepson Manual, this species is rare in California, but occurs in the Coachella Valley. Surveys did not locate any individuals, but fall surveys in a favorable weather year were not conducted.	To add this species to the Plan, field surveys would be needed in appropriate habitat under favorable conditions to determine the distribution and status of this species.
California ditaxis *Ditaxis californica*	CNPS List 2	USFWS and CDFG recommended deletion because of uncertainty about its taxonomic status and a lack of knowledge of its distribution and ecological requirements. Most known locations occur on public land.	If it were determined in the future that this species should be covered, the Plan would serve as a good base for seeking coverage as its known occurrences in the Plan Area are within areas to be conserved by the Plan.

Table A3-13: Species Not Proposed for Coverage under the Plan (cont.)

Species	Status	Reasons for not including in Plan	Potential future actions
Robison's monardella *Monardella robisonii*	No oficial status	There is one record northwest of Desert Hot Springs near the border with San Bernardino County. It is also known to occur in the Morongo Valley area and in Joshua Tree National Park in San Bernardino County. Surveys to determine its potential occurrence in the Plan Area have not been conducted. Given its habitat preferences, if it does occur more widely in the Plan Area, it would be expected to be found primarily on protected lands in the Morongo Canyon ACEC and in the National Park.	To add this species to the Plan, field surveys would be needed in appropriate habitat to determine the distribution and status of this species.
Cliff spurge *Euphorbia misera*	CNPS List 2	There is one historic record for this shrub in the Plan Area. It appears that this was a relict population. The species is otherwise known from coastal bluffs and rocky slopes in coastal California, the Channel Islands, and Baja California. Surveys in 1995 did not locate any occurrences in the Plan Area.	If it is later discovered that the species occurs in the Plan Area, the species could be considered for inclusion in the Plan through an amendment.
Flat-seeded spurge *Chamaesyce platysperma*	No official status	The historic range of this annual is the Sonoran Desert in the Coachella Valley, southwestern Arizona, and Sonora, Mexico. It occurs in sandy soils. It has generally not been seen in California since the early 1900's. There is a possible recent record from the Palm Springs area, but 1995 surveys did not locate any occurrences in the Plan Area.	If the species still does occur in the Plan Area, it is likely that it would be found in areas that would be protected for other sandy soil-associated species.

3.9 Natural Communities Not Included in the Plan

The original Planning Agreement listed 23 natural communities believed to occur in the Plan Area. Through the planning process a total of 46 natural communities were identified in the Plan Area. Of these, 26 natural communities provide habitat for the covered species and are the focal point for establishment of conservation areas. The other natural communities were not included in the reserve design process and development of conservation areas established under this Plan. However, with two exceptions, these other natural communities are adequately protected in the Plan Area on public and private conservation lands. This existing protection adds to the overall conservation value of the Plan in protecting watersheds, providing habitat for large predators, protecting overall biological diversity in the Plan Area, providing buffers for conservation areas established under this Plan, and providing areas that could become important to covered species with potential future changes in environmental conditions (including climatic change). The two exceptions that are not either currently protected or proposed for protection under this Plan are Active Shielded Desert Dunes and Tamarisk Scrub. All of the natural communities that are not specifically included in the Plan are described in Table A3-14, along with the reason why these communities are not included.

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Table A3-14: Natural Communities Not Included in the Plan

Natural Community	Description	Reasons for not Including in the Plan
Active Shielded Desert Dunes	Areas of actively moving sand, but with one or more physical processes (wind corridor, sand source) interrupted (shielded) by roads, buildings, trees, or other barriers to sand transport and ecological processes.	Only one small dune system of less than 124 acres, surrounded by urbanization, exists south of Hovley Lane on Portola Avenue in Palm Desert. It is not included in the Plan because it is a habitat fragment, the essential ecological processes for which are not intact.
Tamarisk Scrub	This is a weedy, virtual monoculture of any of several Tamarix species, usually supplanting native vegetation and using large amounts of water. About 3,365 acres occur in the Plan Area, primarily near the Salton Sea. It is considered to have significantly lower habitat values than the native communities it displaces.	In some instances restoration efforts to restore the displaced native community could be beneficial, but the tamarisk scrub community itself is not desirable to protect.
Riversidean Sage Scrub (Desert)	This is the most xeric expression of coastal sage scrub. Typical stands are fairly open and dominated by sagebrush (*Artemisia californica*), California buckwheat (*Eriogonum fasciculatum*), and Foxtail chess (*Bromus madritensis* ssp. *rubens)*.	This community is restricted to the San Gorgonio Pass in the Plan Area, where about 8,279 acres are found. It is more common in the western part of the County, where it is addressed in the Western Riverside County MSHCP.
Mojave Mixed Steppe	A fairly dense grassland dominated by big galleta grass (*Pleuraphis rigida*), with several shrubby species from Mojave mixed woody scrub scattered throughout. It is found in dry, sandy or gravelly places from 2,000' to 7,000' elevation.	Just over 400 acres occur on some of the upper bajadas and lower slopes of the Little San Bernardino Mountains, where it is 100% protected in Joshua Tree National Park.
Blackbrush Scrub	This community consists of low, often intricately branched shrubs, 0.5 to 1 meter tall, with crowns usually not touching and with bare ground between plants, typically occurring between 4,000' to 7,000' elevation.	Nearly 8,500 acres occur in the Little San Bernardino Mountains, where 100% of it is protected in Joshua Tree National Park.

Table A3-14: Natural Communities Not Included in the Plan (cont.)

Natural Community	Description	Reasons for not Including in the Plan
Upper Sonoran Mixed Chaparral	This is a dense chaparral community lacking dominance by any one species or shrub group. Typical species include chamise (*Adenostoma fasciculatum*), manzanitas (*Arctostaphylos* spp.), *Ceanothus* species, and live oaks (*Quercus* spp.). It may intergrade with other chaparral types. This community occurs on the slopes of Cottonwood and Stubbe Canyons in the San Bernardino Mountains at the western edge of the Plan Area, where the coastal influence results in higher available moisture.	Of the approximately 2,600 acres in the Plan Area, 100% is protected on public lands.
Upper Sonoran Manzanita Chaparral	A dense chaparral to 5 meters (15 feet) in which dominance is shared by chamise and various species of manzanita. Most stands appear to be disturbance followers, establishing after fire or other disturbance.	Only 3 acres occur in the Plan Area, on existing public land.
Mixed Montane Chaparral	This community is characterized by 1 to 3 meters tall, mostly sclerophyllous chaparral dominated by *Ceanothus* and manzanita (*Arctostaphylos* spp.) species. Understories are typically very sparse. Most plants are less than 2 meters (5 feet) tall.	The less than 200 acres occurring in the Plan Area in the San Jacinto Mountains are protected on public land.
Northern Mixed Chaparral	This is a type of chaparral dominated by broad-leaved sclerophyll shrubs, 2 to 4 meters (6 to 12 feet) tall, forming dense often nearly impenetrable stands of vegetation dominated by chamise (*Adenostoma fasciculatum*), scrub oak (*Quercus dumosa*), manzanita (*Arctostaphylos* spp.*)* and *Ceanothus* species. It is found in the San Jacinto Mountains and, to a lesser extent, in the San Bernardino Mountains.	Approximately 40% of this community, of which just over 8,500 acres occur in the Plan Area, is protected on public lands.

Table A3-14: Natural Communities Not Included in the Plan (cont.)

Natural Community	Description	Reasons for not Including in the Plan
Scrub Oak Chaparral	A dense evergreen chaparral to 7 meters (20 feet) tall, dominated by scrub oak (*Quercus dumosa*) with considerable mountain mahogany (*Cercocarpus betuloides*). It occurs in two locations in the San Bernardino and San Jacinto Mountains.	Approximately 96% of the roughly 2,550 acres in the Plan Area is protected on public lands.
Canyon Live Oak Forest	This is a dense forest dominated by Canyon live oak (*Quercus chrysolepis*), and with little understory. Trees may reach up to 20 meters (60 feet) in height in canyons or on north-facing slopes. Trees may have multiple trunks.	In the Plan Area, less than 200 acres occur in one area of the San Jacinto Mountains west of Palm Canyon. 100% of it occurs on San Bernardino National Forest lands in steep, rather inaccessible terrain.
Black Oak Forest	This is a persistent subclimax forest dominated by black oak (*Quercus kelloggii*), with scattered emergent ponderosa pine (*Pinus ponderosa*) or Jeffrey pine (*Pinus jeffreyi*). Most stands are even-aged, reflecting past disturbances.	This community has one occurrence in the Plan Area of about 3,400 acres in the San Jacinto Mountains. About 71% of this is in the San Bernardino National Forest, with 25% in wilderness.
Coulter Pine Forest	This is an open forest of scattered Coulter pines (*Pinus coulteri*) and black oak (*Quercus kelloggii*), with an understory of shrubs typically associated with Upper Sonoran Mixed Chaparral. Some stands are dense enough to suppress the shrubby layer.	About 5,000 acres occur in scattered locations in the San Jacinto Mountains in the Plan Area; 89% of this is in the San Bernardino National Forest, with 55% of the total in wilderness.
Big Cone Spruce-Canyon Live Oak Forest	This community is an open (on steep slopes) to dense (on flats) forest dominated by big cone spruce (*Pseudotsuga macrocarpa*), 17 to 27 m (50 to 80 feet) tall, over a dense canopy of canyon live oak (*Quercus chrysolepis*), and a very sparse herb layer. It is usually found in a chaparral matrix.	A large stand occurs in the San Bernardino Mountains, and a small stand in the San Jacinto Mountains, together totaling less than 2,700 acres, with 100% in wilderness.

Table A3-14: Natural Communities Not Included in the Plan (cont.)

Natural Community	Description	Reasons for not Including in the Plan
Westside Ponderosa Pine Forest	This is an open park-like forest of coniferous evergreens to 70 meters tall, dominated by ponderosa pine (*Pinus ponderosa*). The understory is typically sparse, consisting of scattered chaparral shrubs and young trees.	In the Plan Area, about 8,500 acres occur at higher elevations in the San Jacinto Mountains, where 99% of it is in either the San National Forest or the state park, with 59% of the total in wilderness.
Sierran Mixed Coniferous Forest	This is similar to Westside Ponderosa Pine Forest, but denser with the crowns often touching, and often slightly taller (to 75 meters), and with several dominant species, including white fir (*Abies concolor*), ponderosa pine (*Pinus ponderosa*), Jeffrey pine (*Pinus jeffreyi*), and sugar pine (*Pinus lambertiana*).	In the Plan Area, roughly 3,300 acres occur in several locations above 7,000 feet in the San Jacinto Mountains, where 84% of it is in either the San Bernardino National Forest or the state park, with 66% of the total in wilderness.
Jeffrey Pine Forest	This community is a tall, open forest dominated by Jeffrey pine (*Pinus jeffreyi*), with a sparse understory of species from the Mixed Montane Chaparral or Sagebrush Scrub communities. It is similar in aspect to the Westside Ponderosa Pine forest.	In the Plan Area, nearly 4,500 acres occur at up to 9,000 feet elevation in the San Jacinto Mountains, with 100% of it in wilderness.
Jeffrey Pine-Fir Forest	This is similar to Sierran Mixed Coniferous Forest, but not quite so tall (up to 60 meters). The understory is open, consisting primarily of scattered Mixed Montane Chaparral and small trees. Dominant species are white fir (*Abies concolor*) and Jeffrey pine (*Pinus jeffreyi*).	In the Plan Area, this community is adequately protected; approximately 3,200 acres occur at up to 9,000 feet elevation in the San Jacinto Mountains, with 70% of it either in the San Bernardino National Forest or the State Park.
Southern California Subalpine Forest	This is an open or clumped timberline forest dominated by Lodgepole pine (*Pinus contorta murrayana*) and Limber pine (*Pinus flexilis*). The understory is typically very sparse	In the Plan Area, less than 2,000 acres occur on San Jacinto Peak, where 99% of it is in the wilderness.

3.10 Sources of Biological Data

Biological data for the Plan were obtained from a wide variety of sources. The management and storage of the information collected was designed to follow existing data collection and storage protocols. For example, species location data are stored according to the standards of the California Natural Diversity Data Base. To the extent possible, all data were compiled in a GIS ARC/INFO database associated with GIS coverages. The center for collection and storage of these data was at the Bureau of Land Management Palm Springs Field Office. Particular attention was paid to the clear and complete documentation of all data used, all sources of information, and all updates and changes made to data layers and GIS coverages. The data were compiled, analyzed, and stored to support various components of the Plan preparation and implementation process. The sources of data used in this Plan include:

I. **Known location information for Covered Species and conserved natural communities**. These data are maintained in GIS (digital) coverages and on GIS maps that can be identified by area based on jurisdiction boundaries, township/range information or other map parameters. These data were compiled from various sources:

1. Field data collected during surveys for the CVMSHCP in 1995, 1997, 1998, and 1999. These surveys were conducted by participating agency biologists and biologists working under contract to conduct focused surveys for some of the covered species. Surveys were generally conducted during the spring months. Survey protocol were developed and approved by USFWS and CDFG. Information on location, habitat characteristics, range and other variables for species surveyed were described in written reports submitted to the SAC.
2. Environmental Impact Reports (EIRs), Biological Assessments, and other environmental documents prepared throughout the Plan Area since 1979.
3. California Natural Diversity Data Base (NDDB) records. Data from the NDDB were from 1992 and 1997. Additionally, some older records obtained from this source were archived if the known habitat for a given species was no longer extant at the location described in the record.
4. California Department of Fish and Game, Bureau of Land Management, National Park Service (Joshua Tree National Park), California State Parks, and U.S. Fish and Wildlife Service data.
5. Data collected from biologists knowledgeable about the Plan Area and/or a given species. Data from individual biologists were obtained in meetings and workshops hosted by the SAC. Records provided by individuals were carefully documented; records were mapped on 7.5 minute topographic quads and later digitized into a GIS data layer. Relevant information was obtained on each record before it was included in the database.

6. A September 1997 workshop held to gather known locations and information about the distribution of target species. Biologists and other individuals with expertise on one or more of the species participated in the workshop.
7. Location data from voucher specimens held in museums, herbaria, and public-trust institutions. In the spring of 2001, museums were contacted directly to request information on their records of target species (see Section 3.3.1.3).
8. Published records and species distribution information from peer-reviewed journal articles, where information on species or natural community distribution has been described at an appropriate scale.
9. Data gathered by University of California, Riverside, Center for Conservation Biology from 2003 - 2007 as part of the initial evaluation of Monitoring protocols.

II. **Species Information Summaries on each species included in the Plan**. These summaries, prepared by members of the SAC or Coachella Valley Mountains Conservancy staff, give general status, habitat, and life history information for each species, including general descriptions of the known distribution of each species within the Plan Area. These were augmented by literature searches. These species information summaries have been incorporated in the Conservation Strategies for Covered Species included in the Section 4.2.2.

3.10.1 List of Reports Consulted for Species Distribution Information

When the process of gathering information on the target species began, a thorough review of environmental documents, including biological assessments and environmental impact reports, was completed. As new information became available in subsequent environmental documents it was added to the database. Reports consulted to date are included in the following list. A review of more recent environmental documents was completed in April 2003. Additional records for target species derived from this review were added to the database; these records will be used to assess, in part, the accuracy of species distribution models.

AMEC Earth and Environmental. 2001. WECS Section 12 Sites Biological Survey. Prepared for Whitewater Energy Corporation.

Baxter Consulting Services. 1996. Jurisdictional Wetlands Delineation for the 62nd Avenue at Whitewater Stormwater Channel Bridge Channel Bridge Project. Prepared for the County of Riverside Transportation Department.

BonTerra Consulting. 2000. Draft Initial Study and Mitigated Negative Declaration for Rio Vista Village. Prepared for Burnett Companies.

BonTerra Consulting, 2001. Biological Constraints Survey for the Bob Hope Drive/ Dinah Shore Drive Widening Project. Prepared for RBF Consulting. Located as Appendix 6.4 of The Initial Study/ Environmental Checklist Bob Hope Drive/ Dinah Shore Drive Widening Project.

Brandman, Michael, Associates. 1994. Draft Environmental Impact Report. Mid-Valley Parkway Project. Prepared for the Coachella Valley Association of Governments, the City of Palm Springs, the City of Cathedral City, the City of Rancho Mirage, the City of Palm Desert, and the County of Riverside.

Brandman, Michael, Associates. 1994. Draft Environmental Impact Report. Mid-Valley Parkway Project. Volume 2 Technical Appendices. Prepared for the Coachella Valley Association of Governments, the City of Palm Springs, the City of Cathedral City, the City of Rancho Mirage, the City of Palm Desert, and the County of Riverside.

Brandman, Michael, Associates. 1999. Biological Assessment. Commercial WECS Permit No. 99. Christensen/Lazar Project. Riverside County, California. Prepared for Enron Wind Development Corporation.

Brandman, Michael, Associates. 2001. Coachella Valley Milk-Vetch Focused Survey Report for the Agua Caliente Band of Cahuilla Indians, Riverside County, California. Prepared for Agua Caliente Band of Cahuilla Indians.

BRW, Inc. 1992. City of La Quinta Draft General Plan. Prepared for the City of La Quinta.

BRW, Inc. 1992. Draft Environmental Impact Report. City of La Quinta 1992 General Plan Update. Prepared for the City of La Quinta.

BRW, Inc. 1992. Final Environmental Impact Report. City of La Quinta 1992 General Plan Update. Prepared for the City of La Quinta.

BRW, Inc. and Natelson Company, Inc. 1992. Master Environmental Assessment. City of La Quinta 1992 General Plan Update. Prepared for the City of La Quinta.

Bureau of Land Management, U.S. Department of the Interior. 2000. Environmental Assessment (CA-660-00-39) for Mineral Material Contract, Crawford Project.

California Department of Parks and Recreation. 2001. Mount San Jacinto State Park Preliminary General Plan.

Cathedral City Redevelopment Agency. 1997. Initial Study and Mitigated Negative Declaration.

The Downtown Core Project. Prepared for CEQA Clearance for Disposition and Development Agreements, Entitlements, Construction Clearances.

Chambers Group, Inc. 1991. Biological Survey of the Proposed Rancho Morongo Site, Tentative Tract No. 26617. Prepared for Associated Engineers, Inc.

Chambers Group, Inc. 2000. Draft Biological Assessment for Construction at Two I-10 Interchanges Gene Autry Trail/Palm Drive and Date Palm Drive Riverside County, California. Prepared for Parsons Brinckerhoff Quade and Douglas, Inc.

CH2M Hill. 2001. Teayawa Energy Center Draft Environmental Impact Statement/ Environmental Impact Report. Prepared for the United States Department of the Interior Bureau of Indian Affairs and the County of Riverside Transportation and Land Management Agency.

Circle Mountain Biological Consultants. 1995. Eagle Mtn. Landfill Special-Status Species. Special-Status Plants and Plant Communities Reported from the Eagle Mountain Region. Unpublished report to U.S. Fish and Wildlife Service.

Circle Mountain Biological Consultants. 1997. California State University, San Bernardino, Coachella Valley Center: Biological Resource Inventory and Impacts Assessment. Prepared for Terra Nova Planning and Research, Inc. Draft EIR for the California State University San Bernardino, Coachella Valley Campus Master Plan.

Circle Mountain Biological Consultants. 2000. General Biota Study and Focused Survey for Desert Tortoise for the Chiriaco Summit Water System Replacement Project, Riverside County, California. Prepared for Krieger and Stewart, Inc.

City of La Quinta. 2000. Environmental Checklist Form for La Quinta Arts Foundation, Specific Plan 2000-042, Conditional Use Permit 2000-048.

City of Rancho Mirage. 2001. Ramon Widening between Da Vall Drive and Los Alamos Road, Draft Initial Study, Environmental Checklist, and Mitigated Negative Declaration.

Comarc Design Systems and Eisner-Smith Planners. 1979. Coachella Valley Master Environmental Assessment Final MEA Document.

Cornett and Associates. 1989. Biological Assessment and Impact Analysis. The Seven Palms Ranch Project. Prepared for Terra Nova Planning & Research, Inc.

Cornett, James W., Ecological Consultants. 1992. Biological Inventory and Impact Analysis of the Proposed Shadowrock Resort. Prepared for Shadowrock Ventures.

Cornett, James W. Ecological Consultants. 1994. Biological Assessment and Impact Analysis of the Proposed Palm Springs Airport Expansion. Located within the City of Palm Springs, California. Prepared for Coffman Associates Airport Consultants.

Cornett, James W., Ecological Consultants. 1994. Biological Assessment and Impact Analysis of the Proposed Palm Springs Classic Resort. Prepared for Smith, Peroni & Fox Planning Consultants, Inc.

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3.10.2 Museums Contacted for Specimens from Target Species List

In May and June of 2001, the following museums were contacted to request any recorded data on the target species within their collection. Responses from many of these museums have been received and are currently being processed. Ultimately, these data will be compared with existing records for each of the target species and new information will be added to the database. As noted by Margules and Pressey (2000) however, "museum and herbarium data on the locations of taxa are notoriously biased, having been collected for a different purpose (systematics), and often in an opportunistic manner." The museum records, particularly older records based on collections, are often very imprecise in terms of the location and may not be as useful for that reason. Nevertheless, every effort is being made to completely assess the records from the following museums:

Arboretum, University of California, Santa Cruz
Western Foundation of Vertebrate Zoology
The Living Desert
San Francisco Zoological Gardens
Hi-Desert Nature Museum
The Academy Of Natural Sciences
Field Museum of Natural History
Peabody Museum of Natural History
Louisiana State University Herbarium
Arboretum, University of California Davis
Santa Barbara Museum of Natural History
Anza-Borrego Desert State Park
World Museum of Natural History
Santa Ana Zoo
Oregon Museum of Science and Industry
American Museum of Natural History
Carnegie Museum of Natural History

Harvard Museum of Natural History, Harvard University
Natural History Museum and Biodiversity Research Center, University of Kansas
Museum of Vertebrate Zoology, University of California Berkeley
California Academy of Sciences
Oakland Museum of California
Riverside Municipal Museum
Mousley Museum of Natural History
Burke Museum of Natural History
National Museum of History
The Cornell Plantations
Museum of Natural History, Princeton University
Science Museum of Minnesota
James Ford Bell Museum of Natural History
Museum of Southwestern Biology, University of New Mexico
Museum of Zoology, University of Michigan
Natural History Museum of Los Angeles
Oklahoma Museum of Natural History, University of Oklahoma
Arizona State Museum, University of Arizona
University of Wisconsin Zoological Hall
San Bernardino County Museum
Texas Natural History Collections, University of Texas
Barrick Museum, University of Nevada
San Diego Natural History Museum

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4.0Establishment of the MSHCP Reserve System

4.1 Analysis of Other Conserved Habitat for Covered Species and Broadly Distributed Natural Communities Conserved through Other Conservation Objectives

Specific Conservation Objectives for Other Conserved Habitat are generally not delineated in the Plan because Other Conserved Habitat overlaps with and will be protected in conjunction with attaining other Conservation Objectives such as conserving Essential Ecological Process areas, Biological Corridors and Linkages, or Core Habitat for other Covered Species. Similarly, specific Conservation Objectives are not articulated in the Plan for the more broadly distributed conserved natural communities because sufficient amounts of these communities are conserved in conjunction with attaining other Conservation Objectives.

Table A4-1 summarizes the extent to which conservation of Other Conserved Habitat and the more broadly distributed conserved natural communities is achieved in each Conservation Area through other Conservation Objectives. As shown in the table, in most Conservation Areas, the entire Conservation Area is covered by one or more Conservation Objectives. As a result, Other Conserved Habitat and the more broadly distributed conserved natural communities are protected in these Conservation Areas, and no additional analysis is needed. In those Conservation Areas where the entire Conservation Area is not covered by one or more Conservation Objectives, additional explanation is provided in Tables 4-2 through 4-7b of how conservation is achieved for Other Conserved Habitat for various species and known Occurrences, and for the more broadly distributed conserved natural communities through other Conservation Objectives.

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Table A4-1: Identification of Conservation Objectives That Cover 100% of Other Conserved Habitat and Broadly Distributed Natural Communities in the Conservation Areas

Conservation Area	*The Conservation Objective or Combination of Conservation Objectives that Cover 100% of Other Conserved Habitat and Broadly Distributed Natural Communities in the Conservation Area*					
	Core Habitat	***Other Conserved Habitat***	***Sand Source***	***Sand Transport***	***Linkage***	***Natural Community***
Cabazon[1]				X		
Stubbe & Cottonwood Cyns.			X	X		
Snow Creek				X		
Whitewater Canyon			X	X		
Highway 111/I-10[2]		X				
Whitewater Floodplain Preserve				X		
Upper Mission Creek/Big Morongo Canyon	See Table A4-2					
Willow Hole			X	X		
Long Canyon[3]						
Edom Hill			X	X		
Thousand Palms						
West Deception[1]			X			
Indio Hills/Joshua Tree National Park Linkage			X	X		
Indio Hills Palms					X	
East Indio Hills	See Table A4-3					
Joshua Tree National Park	See Table A4-4					
Desert Tortoise & Linkage	X	X			X	
Mecca Hills/Orocopia Mtns.	X	X			X	X
Dos Palmas	See Tables 4-5a and 4-5b					
CV Stormwater Channel & Delta	See Tables 4-6a and 4-6b					
Santa Rosa/San Jacinto Mountains	See Tables 4-7a and 4-7b					

[1] A portion of the Conservation Areas has a Conservation Objective to maintain fluvial sand transport only; there is no specific Conservation Objective for species or natural communities in these areas. This table applies only to the portion of the Conservation Area in which there are species or natural communities related Conservation Objectives.

[2] Modeled habitat for desert tortoise, Coachella Valley round-tailed ground squirrel, Le Conte's thrasher, and Palm Springs pocket mouse each cover 100% of this Conservation Area.

[3] The only Conservation Objective in this Conservation Area is to maintain fluvial sand transport.

Table A4-2: Acres Covered by Other Conservation Objectives

Upper Mission Creek/Big Morongo Canyon Conservation Area

Conservation Area ***Natural Community***	***Total Acres in Conservation Area***	***Acres Covered by Conservation Objectives***	***Acres Not Covered by a Conservation Objective***	***Land Ownership of Acres Not Covered by a Conservation Objective***
Upper Mission Creek/Big Morongo Canyon	29,317	29,310	7[1]	Private – 6; BLM - 1

[1] All of these acres are in Blind Canyon which USGS indicates does not contribute to sand source or sand transport. They were included for reserve design purposes.

Table A4-3: Analysis of Certain Conserved Natural Communities Covered by Other Conservation Objectives East Indio Hills Conservation Area

Conservation Area ***Natural Community***	***Total Acres in Conservation Area***	***Acres Covered by a Conservation Objective***	***Acres Not Covered by a Conservation Objective***	***Land Ownership of Acres Not Covered by a Conservation Objective***
East Indio Hills	4,225	4,027	198	Private – 129; CVWD – 50; BLM - 19
Sonoran creosote bush scrub	*3,002*	*2,969*	*33*[1]	--
Tamarisk scrub	*N/A*	--	*64*[1,2]	--
Agriculture/Urban/Quarry	*N/A*	--	*52/35/14*[1,2]	--

[1] Occurs within the 198 acres not protected by a Conservation Objective.

[2] Tamarisk scrub is not on the list of conserved natural communities included in the Plan; agriculture, urban and quarry are developed areas.

Table A4-4: Analysis of Certain Conserved Natural Communities Covered by Other Conservation Objectives Joshua Tree National Park Conservation Area

Conservation Area Natural Community	*Total Acres in Conservation Area*	*Acres Covered by a Conservation Objective*	*Acres Not Covered by a Conservation Objective*	*Land Ownership of Acres Not Covered by a Conservation Objective*
Joshua Tree National Park	161,927	161,102	825	NPS – 825
Sonoran creosote bush scrub	*N/A*	--	*92*[1]	*NPS - 92*
Blackbrush scrub	*N/A*	--	*730*[1,2]	*NPS - 730*
Mojave mixed steppe	*N/A*	--	*3*[1,2]	*NPS - 3*

[1] Natural communities are within the 825 acres not protected by a Conservation Objective; all of these acres are protected as part of Joshua Tree National Park. They are included in the Conservation Area for reserve design purposes.

[2] These natural communities are not on the list of conserved natural communities in the Plan because they are already adequately conserved in the Plan Area.

Table A4-5a: Analysis of Other Conserved Habitat Covered by Other Conservation Objectives Dos Palmas Conservation Area

Species	*Total Acres of Habitat in Conservation Area*	*Acres Covered by Another Conservation Objective*	*Additional Acres Protected by Existing Conservation Lands*	*Total Acres Covered*	*Total Acres Not Covered by a Conservation Objective*	*Land Ownership of Acres Not Covered by a Conservation Objective*
Coachella Valley round-tailed ground squirrel	4,287	4,209	54	4,263	24	Private - 19 SLC - 5
Desert tortoise	334	199	135	334	0	N/A
Flat-tailed horned lizard	5,450	5,387	30	5,417	33	Private - 33
Least Bell's vireo (Breed./Migratory)	10,338 (181/10,157)	10,338	0	10,338	0	N/A
Orocopia sage	3,743	3,608	135	3,743	0	N/A

Table A4-5a (cont.)

Species	*Total Acres of Habitat in Conservation Area*	*Acres Covered by Another Conservation Objective*	*Additional Acres Protected by Existing Conservation Lands*	*Total Acres Covered*	*Total Acres Not Covered by a Conservation Objective*	*Land Ownership of Acres Not Covered by a Conservation Objective*
Palm Springs pocket mouse	7,832	7,733	65	7,798	34	Private - 29 SLC - 5
Southern yellow bat	126	126	0	126	0	N/A
Southwestern willow flycatcher (breed./migratory)[1]	10,338 (126/10,212)	10,338	0	10,338	0	N/A
Yellow-breasted chat	10,338 (403/9,935)	10,338	0	10,338	0	N/A

[1] The same statistics also apply for summer tanager and yellow warbler

Table A4-5b: Analysis of Certain Conserved Natural Communities Covered by Other Conservation Objectives Dos Palmas Conservation Area

Natural Community	*Total Acres of Natural Community in Conservation Area*	*Acres Covered by Another Conservation Objective*	*Additional Acres Protected by Existing Conservation Lands*	*Total Acres Covered*	*Total Acres Not Covered by a Conservation Objective*	*Total Acres of Natural Community Not Covered by a Conservation Objective*
Sonoran creosote bush scrub	11,854	11,712	142	11,854	0	N/A
Tamarisk scrub	2,700	357	937	1,294	1,406	Private - 1,385; SLC - 21

Table A4-6a: Analysis of Other Conserved Habitat for Covered Species Covered by Other Conservation Objectives Coachella Valley Stormwater Channel and Delta Conservation Area

Species	*Total Acres of Habitat in Conservation Area*	*Acres Covered by Another Conservation Objective*	*Additional Acres Protected by Existing Conservation Lands*	*Total Acres Covered*	*Total Acres Not Covered by a Conservation Objective*	*Land Ownership of Acres Not Covered by a Conservation Objective*
Least Bell's vireo[1] Breeding/ Migratory	2517 (82/2435)	2517	0	2517	0	N/A
Southwestern willow flycatcher[1] Breeding/ Migratory	2517	2517	0	2517	0	N/A
Summer tanager[1] Breeding/ Migratory	2517	2517	0	2517	0	N/A
Yellow warbler[1] Breeding/ Migratory	2517	2517	0	2517	0	N/A
Yellow-breasted chat[1] Breeding/ Migratory	2517	2517	0	2517	0	N/A
Le Conte's Thrasher	928	928	0	928	0	N/A
Palm Springs pocket mouse	172	172	0	172	0	N/A

[1] Total acres are the same; breeding and migratory habitat acres may differ

Table A4-6b: Analysis of Certain Conserved Natural Communities Covered by Other Conservation Objectives - Coachella Valley Stormwater Channel and Delta Conservation Area

Natural Community	*Total Acres of Natural Community in Conservation Area*	*Acres Covered by Another Conservation Objective*	*Additional Acres Protected by Existing Conservation Lands*	*Total Acres Covered*	*Total Acres Not Covered by a Conservation Objective*	*Land Ownership of Acres Not Covered by a Conservation Objective*
Tamarisk scrub	163	58	5	63	100	Private - 88; IID – 12

Table A4-7a: Analysis of Other Conserved Habitat for Covered Species Covered by Other Conservation Objectives Santa Rosa and San Jacinto Mountains Conservation Area

Species	*Total Acres of Habitat in Conservation Area*	*Acres Covered by Another Conservation Objective*	*Additional Acres Protected by Existing Conservation Lands*	*Total Acres Covered*	*Total Acres Not Covered by a Conservation Objective*	*Land Ownership of Acres Not Covered by a Conservation Objective*
Coachella Valley fringe-toed lizard	120	110	2	112	8	Private – 8
Coachella Valley giant sand-treader cricket	120	110	2	112	8	Private – 8
Coachella Valley Jerusalem cricket	200	183	3	186	14	Private – 14
Coachella Valley milkvetch	292	278	3	281	11	Private – 11
Coachella Valley round-tailed ground squirrel	1.330	1,230	34	1,264	66	Private - 52; DWA - 4; CVWD – 10
Flat-tailed horned lizard	81 (Pred - 66; Pot - 15)	67	0	67	14	Private – 14 (Pred - 11; Pot - 3)
Gray vireo	67,407	67,407	0	67,407	0	N/A
Least Bell's vireo (breed./migratory)	5,554 (1,597/3,957)	5,554	0	5,554	0	N/A
Palm Springs pocket mouse	5,562	4,357	363	4,720	842	Private - 823; DWA - 4; CVWD – 15
Peninsular bighorn sheep	169,479	169,479	0	169,479	0	N/A
Southern yellow bat	953	953	0	953	0	N/A
Southwestern willow flycatcher (breed./migratory)[1]	5,554 (1,597/3,957)	5,554	0	5,554	0	N/A
Yellow-breasted chat (breed./migratory)[1]	5,554 (1,597/3,957)	5,554	0	5,554	0	N/A

[1] The same statistics also apply for summer tanager and yellow warbler. The total modeled habitat for the riparian birds is the same; only breeding and migratory habitat differs.

Table A4-7b: Analysis of Certain Conserved Natural Communities Covered by Other Conservation Objectives Santa Rosa and San Jacinto Mountains Conservation Area

Natural Community	*Total Acres of Natural Community in Conservation Area*	*Acres Covered by Another Conservation Objective*	*Additional Acres Protected by Existing Conservation Lands*	*Total Acres Covered*	*Total Acres Not Covered by a Conservation Objective*	*Land Ownership of Acres Not Covered by a Conservation Objective*
Ephemeral desert sand fields	37	27	5	32	5	Private – 5
Sonoran creosote bush scrub	44,287	40,051	589	40,640	3,647	Private-3,075; DWA - 1; CVWD – 571
Stabilized sand fields	20	20	0	20	0	N/A
Mesquite hummocks	5	5	0	5	0	N/A
Sonoran mixed woody and succulent scrub	90,537	90,107	404	90,511	26	Private - 20; DWA - 3; Indian - 2; CPS – 1
Active desert dunes	56	56	0	56	0	N/A
Interior live oak chaparral	2,738	2,738	0	2,738	0	N/A
Northern mixed chaparral	3	3	0	3	0	N/A
Stabilized shielded sand fields	7	7	0	7	0	N/A

4.2 Acquisitions since the Planning Agreement

Acquisitions resulting on land in the Conservation Areas being conserved since the 1996 Planning Agreement are credited to Complementary Conservation, the state and federal contribution to Plan implementation, or the Permittees obligations. Table A4-8 shows the acquisitions since 1996 and how they have been credited.

Table A4-8: Acquisitions and Credit Since 1996

Agency/Entity	Acres Acquired	Credit		
		Complementary Conservation	State/Federal	Local Permittees
American Land Conservancy	496	496		
Bureau of Land Management[2]	9,763	8,721	1,042	
Center for Natural Lands Management[3]	2,679	812	1,355	512
Coachella Valley Mountains Conservancy[2]	1,752	1,103	649	
Department of Fish and Game (Wildlife Conservation Board)	3,158		3,158	
Friends of the Desert Mountains[4]	6,033	3,630	2,403	
Living Desert	641	641		
Local Permittees	1,988			1,988
National Park Service	918	918		
The Nature Conservancy	2,300	2,300		
U.S. Forest Service	927	927		
Wildlands Conservancy	21,592	21,592		
TOTAL	52,247	41,140	8,607	2,500

[1] .

[2] Acquisitions in the Santa Rosa and San Jacinto Mountains National Monument were considered Complementary Conservation. Othert acquisitions were credited to the state/federal commitment to Plan implementation.

[3] Acquisitions with grant funds from CVMC were credited to the state/federal commitment to Plan implementation. Acquisitions with CVFTL HCP fees were credited to the Local Permittees. Acquisitions with other funding sources were credited to Complementary Conservation.

[4] Acquisitions with grant funds from CVMC were credited to the state/federal commitment to Plan implementation. Acquisitions with other funding sources were credited to Complementary Conservation.

4.3 Model MOU

The Local Permittees will commit existing identified Local Permittee owned land to conservation in perpetuity in the MSHCP Reserve System. Local Permittee lands in the MSHCP Reserve System that are currently conserved and which will be managed for Plan purposes include identified lands owned by the Cities and CVWD. CVCC will enter into agreements to ensure the permanent conservation and management of the above identified lands pursuant to the Plan, including providing access to the property for biological monitoring and management purposes. The model MOU developed for this purpose is shown below.

MEMORANDUM OF UNDERSTANDING
REGARDING CONSERVATION MANAGEMENT
BY AND BETWEEN
COACHELLA VALLEY CONSERVATION COMMISSION
AND ____

This Memorandum of Understanding ("Memorandum") is made and entered into this ___ day of _______________, 200__, by and between the Coachella Valley Conservation Commission and the ___________________________________ .

WHEREAS, the Coachella Valley Conservation Commission ("Commission"), was established to implement the Coachella Valley Multiple Species Habitat Conservation Plan ("MSHCP") and ensure the conservation of landing the MSHCP Reserve System to ensure the conservation of Covered Species and conserved natural communities; and

WHEREAS, the ___________________________(" ____") is a California nonprofit corporation whose mission includes acquisition and protection of natural open space areas; and

WHEREAS, the ______________________owns land within the MSHCP Reserve System; and

WHEREAS, the ________________________ desires to cooperate with the Commission in the conservation of these lands in perpetuity in a manner consistent with the Conservation Goals and Conservation Objectives of the MSHCP

NOW, THEREFORE, it is mutually agreed and understood that:

1. The ________will manage the Land in a manner consistent with the Conservation Goals and Conservation Objectives of the MSHCP.

2. The ________will, upon request, provide access to the Commission and its agents, the Biological Monitoring Administrator and the Administrator's designees, the Reserve Management Oversight Committee, the Reserve Unit Management Committee, the California Department of Fish and Game, and the U.S. Fish and Wildlife Service for purposes of biological monitoring.

3. The ________will cooperate with the Commission and its agents, the Land Manager and the Land Manager's designees, the Reserve Management Oversight Committee, the Reserve Unit Management Committee, the California Department of Fish and Game, and the U.S. Fish and Wildlife Service for purposes in management and adaptive management actions required to implement the MSHCP.

4. The Commission, its member entities, and/or the California Department of Fish and Game, and/or the U.S. Fish and Wildlife Service will fund the biological monitoring activities and the management and adaptive management activities on the ________________________ land.

5. The Commission and the ____________ mutually agree that the _____________ may

dispose of its land by sale or gift to any government agency cooperating in the implementation of the MSHCP to ensure conservation of the land in perpetuity, or to a nonprofit conservation organization that agrees to enter into a Memorandum for conservation management on the land with the Commission.

6. The Commission and the ____________ further mutually agree that the _____________ may dispose of its land by sale for other than a conservation purpose only after providing the Commission with the opportunity to acquire the land at market value as determined by appraisal.

7. (Name), (Title) ______________________________, or his successor, is designated as the ____________' official contact with the Commission for the purpose of this Memorandum. (Name), (Title) ________________________________ of the Coachella Valley Conservation Commission, or his successor, is designated as the Commission's official contact with the ______ for the purposes of this Memorandum.

8. The Commission shall indemnify and hold _____________________ its directors, officials, officers, agents, consultants, employees and volunteers free and harmless from any and all claims, demands, causes of action, liabilities, obligations, judgments or damages, in law or in equity, to property or persons, in any manner arising out of or incident to alleged negligent acts or willful misconduct of the Commission, its officials, officers, employees, agents, consultants, and contractors arising out of or in connection with the performance of this MOU.

9. This Memorandum will commence on the date this Memorandum is last signed by the parties hereto and may be terminated only by written agreement of both parties.

10. This Memorandum may be executed in counterpart. The counterparts together shall constitute a single agreement.

______________________________ ______________________________

__________________ __________________

Date Date

Note: The Model Conservation Easement has been moved from Appendix I; it is now found as Exhibit H to the Final IA.

4.4 Dimensions of Culverts and Bridges that Function as Biological Corridors

4.4.1 Stubbe Canyon Wash Biological Corridor under I-10

The Biological Corridor centers on the Stubbe Canyon Wash bridges over the I-10 freeway in Section 8, T3S R3E. This Biological Corridor connects Stubbe/Cottonwood Canyons Conservation Area and the Snow Creek/Windy Point Conservation Area.

Two undercrossings exist side by side, separated by 0.06 miles. The Stubbe West undercrossing is 11.3 meters wide, 5.1 meters high, and the total distance from the north side of the freeway to the south side of the freeway is 70.0 meters. It is open across the center median of the freeway, such that it is well lit by natural light and there is direct line of sight from one side of the freeway to the other. It has a natural bottom of rocks and sandy soils. On the north side of the freeway, Stubbe West wash slopes gradually up to the frontage road approximately 35 meters to the north. The Stubbe East undercrossing is 16.7 meters wide, 4.5 meters high, and the total distance from the north side of the freeway to the south side of the freeway is 74.0 meters. It is open across the center median of the freeway, such that the it is well lit by natural light and there is direct line of sight from one side of the freeway to the other. It also has a natural bottom of rocks and sandy soils. On the north side, the undercrossing slopes up gradually to the two-lane frontage road, approximately 40 meters north of I-10. This road dead ends approximately one mile to the west and serves only a small rural residential area. The corridor north of the freeway then expands in width from the frontage road to the San Bernardino Mountains, where the corridor is over 1 1/2 miles wide at the mouths of Stubbe and Cottonwood Canyons. On the south side of the freeway is a railroad track approximately 20 meters south of the undercrossings. The track is elevated on trestles and affords no physical obstacle to wildlife movement. The toe of slope of the San Jacinto Mountains is approximately 0.5 miles from the freeway at this point.

4.4.2 Whitewater River and San Gorgonio River Biological Corridors under Highway 111

Portions of the Whitewater River Floodplain Conservation Area and the Highway 111/I-10 Conservation Area function as a Linkage south from the I-10 bridge to Highway 111, where a bridge over the San Gorgonio River just before it joins the Whitewater River completes the Biological Corridor. The Snow Creek bridge over Highway 111 is 148.5 meters wide, 4.5 meters high and 67.3 meters long. This bridge has seven divisions that are each 4.5 meters high and 11.8 meters long; the second through sixth divisions are each 23.0 meters wide while the first and seventh divisions are 17.0 and 16.5 meters wide, respectively. There is also a Whitewater River undercrossing under Highway 111 approximately 0.5 miles west of the Snow Creek bridge. It provides an additional Biological Corridor. The Whitewater River bridge over Highway 111 is 63.0 meters wide, 2.6 meters high, and 37.2 meters long and links the Snow Creek/Windy Point Conservation Area with the Highway 111/I-10 Conservation Area. This bridge has seven divisions that are each 9.0 meters wide, 2.6 meters high and 12.9 meters long. It is sandy-bottomed and devoid of vegetation.

4.4.3 Whitewater River Biological Corridor under the I-10

Whitewater Canyon serves as part of a Linkage and Biological Corridor connecting the San Bernardino Mountains portion of the Transverse Ranges with the Peninsular Ranges (San Jacinto and Santa Rosa Mountains) through the Snow Creek/Windy Point Conservation Area. The corridor provides for movement along the Whitewater River, which crosses under the I-10 freeway beneath a high bridge, the approximate dimensions of which are 112.8 meters wide, 7.2 meters high, and 48.0 meters long. This bridge has six divisions or spans of equal dimensions. Each division is 18.8 meters wide, 7.2 meters high and 48.0 meters long. The bridge is divided into two sections to accommodate east and westbound lanes of I-10. It straddles a large wash with gravel, rocks, and large boulders. There is a frontage road approximately 0.3 miles to the north and wind turbines approximately 0.3 miles to the south.

4.4.4 Mission Creek Biological Corridors under Hwy 62

A Biological Corridor exists in the Upper Mission Creek/Big Morongo Canyon Conservation Area where two bridges span Highway 62 over Mission Creek. The Mission Creek south bridge is 8.6 meters wide, 3.4 meters high, and 11.3 meters long on the northbound two lanes of Highway 62. This bridge is 8.7 meters wide, 2.5 meters high, and 11.3 meters long on the southbound side of Highway 62. Mission Creek is not spanned for a distance of 21.0 meters between the northbound and southbound lanes.

The northern Mission Creek bridge is 9.5 meters wide, 6.2 meters high, and 11.4 meters long on the northbound side of Highway 62. It is 9.5 meters wide, 6.2 meters high, and 11.4 meters long on the southbound side of Highway 62. Mission Creek is not spanned for a distance of 21.0 meters between the north and southbound lanes.

4.4.5 Mission Creek and Willow Wash Biological Corridors under I-10

The Plan maintains two Biological Corridors between the Willow Hole Conservation Area and the Whitewater Floodplain Conservation Area via the Mission Creek culvert and the Willow Wash culvert which both cross under the I-10 Freeway. The Mission Creek culvert has a natural bottom and measures 17.5 meters wide, 3.2 meters high, and 55.6 meters long. The Willow Wash culvert measures 20.7 meters wide, 1.9 meters high, and 50.0 meters long and also has a natural bottom.

4.4.6 Biological Corridors under the I-10 Freeway in the Desert Tortoise and Linkage Conservation Area

A bridge over and several culverts under I-10 in the Desert Tortoise and Linkage Conservation Area form Biological Corridors that are part of larger Linkages connecting the Joshua Tree National Park Conservation Area with the Mecca Hills/Orocopia Mountains Conservation Area. The dimensions of the bridge and the culverts are as follows:

a. Corridor 1, centered on Thermal Canyon: 8.7 meters high, 19.0 meters wide, and 83.8 meters long. There is a 55.3 meter gap between the eastbound and westbound lanes of the freeway.
b. Corridor 2 centered on the E. Cactus City Wash and Hazy Gulch culverts. The E. Cactus City Wash undercrossing is 15.0 meters long on the westbound side of I-10, 14.9 meters long on the eastbound side of I-10, with a 39.0 meter gap in between for a total of 68.9 meters. The corridor is 2.7 meters high and 19.6 meters wide. The Hazy Gulch undercrossing is 12.6 meters long on the westbound side of I-10 and 12.6 meters long on the eastbound side of I-10, with a 32.9 meter gap in between for a total of 58.1 meters. The corridor is 4.2 meters high and 12.8 meters wide. Both have a natural, sandy wash bottom.
c. Corridor 3 centered on the Happy Gulch culvert is 1.2 meters high, 11.0 meters wide. It is 12.7 meters long on the westbound side of I-10 and 12.7 meters long on the eastbound side of I-10, with a 32.8 meter gap in between for a total of 58.2 meters.
d. Corridor 4 centered on the Desperation Arroyo culvert is 2.8 meters high and 5.4 meters wide. It is 12.5 meters long on the westbound side of I-10 and 12.5 meters long on the eastbound side of I-10, with a 33.0 meter gap in between for a total of 58.0 meters.
e. Corridor 5 centered on the Desperation Arroyo, West Buried Mountain Wash, Buried Mountain Wash, Resurrection Wash, West Saddle Gulch, Saddle Gulch, West Cotton Gulch, Cotton Gulch, East Cotton Gulch, and Paul Gulch culverts, west of Cottonwood Canyon.

5.0Costs of and Funding for Plan Implementation

5.1 Land Costs

A copy of *A Market Study of Land Values, Related to Several Areas of Prospective Acquisition, Associated with the Coachella Valley Multiple Species Habitat Conservation Plan* (Scarcella, July 2005) is available for review at CVAG. This study was based on the author's review of current sales and listings of comparable properties Table A5-1 summarizes projected purchase price in the Conservation Areas based on the Market Study with the above-described modifications. The table includes the Permittees' share of private land in the Conservation Areas that could have to be acquired, except the fluvial sand transport processes Essential Ecological Processes in the Cabazon, Long Canyon, and West Deception Conservation Areas where the Plan provides that the Conservation Objectives can be met without land acquisition. The table assumes acquisition of all the non-conservation land shown in the table. In practice, this may not occur because planning tools such as density transfer, and dedication of land through conditions of approval for projects in the Conservation Areas may make it unnecessary to purchase all the land. The table may, therefore, overstate the amount of land that might need to be acquired.

Table A5-1 Projected Acquisition Costs in Conservation Areas[1]

MSHCP Designation	Low-Range Per Acre	Mid-Range Per Acre	High-Range Per Acre	Total Acres[2]	Low Range %	Mid Range %	High Range %	Low-Range Totals	Mid-Range Totals	High-Range Totals	Total Value Estimate	Avg. $ Per Acre
Cabazon[3]	$ 500	$ 7,000	$ 13,500	2,140	70%	20%	10%	$ 749,000	$ 2,996,000	$ 2,889,000	$ 6,634,000	$ 3,100
Stubbe & Cottonwood Canyons	$ 500	$ 6,950	$ 13,400	1,830	40%	45%	15%	$ 366,000	$ 5,723,325	$ 3,678,300	$ 9,767,625	$ 5,338
Whitewater Canyon	$ 400	$ 4,000	$ 6,500	740	20%	80%	0%	$ 59,200	$ 2,368,000	$ -	$ 2,427,200	$ 3,280
Snow Creek / Windy Point	$ 500	$ 1,850	$ 3,200	1,340	40%	20%	40%	$ 268,000	$ 495,800	$ 1,715,200	$ 2,479,000	$ 1,850
Highway 111 / I-10	$ 2,500	$ 10,625	$ 18,750	360	20%	60%	20%	$ 180,000	$ 2,295,000	$ 1,350,000	$ 3,825,000	$ 10,625
Upper Mission Creek / Big Morongo Cyn	$ 1,500	$ 25,750	$ 50,000	6,970	65%	30%	5%	$ 6,795,750	$ 53,843,250	$ 17,425,000	$ 78,064,000	$ 11,200
Whitewater Floodplain	$ 500	$ 5,250	$ 10,000	3,940	50%	30%	20%	$ 985,000	$ 6,205,500	$ 7,880,000	$ 15,070,500	$ 3,825
Willow Hole	$ 2,500	$ 21,250	$ 40,000	1,960	25%	55%	20%	$ 1,225,000	$ 22,907,500	$ 15,680,000	$ 39,812,500	$ 20,313
Thousand Palms	$ 5,000	$ 37,500	$ 70,000	5,480	40%	45%	15%	$ 10,960,000	$ 92,475,000	$ 57,540,000	$ 160,975,000	$ 29,375
Edom Hill	$ 5,000	$ 12,500	$ 20,000	1,860	85%	10%	5%	$ 7,905,000	$ 2,325,000	$ 1,860,000	$ 12,090,000	$ 6,500
Indio Hills / Joshua Tree NP Linkage	$ 1,000	$ 15,500	$ 30,000	1,830	75%	20%	5%	$ 1,372,500	$ 5,673,000	$ 2,745,000	$ 9,790,500	$ 5,350
Indio Hills Palms	$ 500	$ 1,000	$ 1,500	1,250	55%	30%	15%	$ 343,750	$ 375,000	$ 281,250	$ 1,000,000	$ 800
East Indio Hills	$ 1,000	$ 4,250	$ 7,500	2,690	30%	55%	15%	$ 807,000	$ 6,287,875	$ 3,026,250	$ 10,121,125	$ 3,763
Santa Rosa & San Jacinto Mtns	$ 350	$ 4,000	$ 50,000	31,390	50%	48%	2%	$ 5,493,250	$ 60,268,800	$ 31,390,000	$ 97,152,050	$ 3,095
Dos Palmas	$ 350	$ 1,425	$ 2,500	10,570	90%	5%	5%	$ 3,329,550	$ 753,113	$ 1,321,250	$ 5,403,913	$ 511
Desert Tortoise and Linkage	$ 225	$ 1,113	$ 2,000	45,250	65%	25%	10%	$ 6,617,813	$ 12,585,156	$ 9,050,000	$ 28,252,969	$ 624
Joshua Tree National Park	$ 150	$ 225	$ 300	26,400	25%	25%	50%	$ 990,000	$ 1,485,000	$ 3,960,000	$ 6,435,000	$ 244
Mecca Hills / Orocopia Mountains	$ 250	$ 1,125	$ 2,000	21,970	60%	30%	10%	$ 3,295,500	$ 7,414,875	$ 4,394,000	$ 15,104,375	$ 688
CV Stormwater Channel & Delta	$ 10,000	$ 20,000	$ 30,000	3,770	30%	30%	40%	$ 11,310,000	$ 22,620,000	$ 45,240,000	$ 79,170,000	$ 21,000
West Deception Canyon[3]	$ 300	$ 300	$ 300	400	100%	0%	0%	$ 120,000	$ -	$ -	$ 120,000	$ 300
				172,140.00				**$ 63,172,313**	**$ 309,097,194**	**$ 211,425,250**	**$ 583,694,756**	**$ 3,391**

[1] This table includes the estimated costs of the Local Permittees' share of acquisitions. Land values are based on *A Market Study of Land Values, Related to Areas of Prospective Acquisition, Associated with the Coachella Valley Multiple Species Habitat Conservation Plan* (Scarcella, September 2006).

[2] Indicates the maximum acres of private non-conservation land that could need to be acquired to achieve Conservation Objectives. The acreages are lower than in the Market Study because it included projected acquisitions through Complementary Conservation and Additional Conservation lands to be acquired by state and federal agencies.

[3] Acres for which the only Conservation Objective is conserving the fluvial sand transport Essential Ecological Process are not included as meeting this Conservation Objective does not require any acquisition.

5.2 Land Improvement Costs

Land improvement refers to capital costs that occur when land is acquired in the Conservation Areas in order to render the land usable for the intended conservation purposes. These costs include but are not limited to fencing as necessary (but not ongoing maintenance of fencing), signage, and removal of trash and exotic species. In the first year of the acquisition program, $182,000 is allocated to land improvement. This cost is subject to 3% annual inflation. Over the 30 year term of the acquisition program, the total projected for land improvement is $8,683,000.

In 2005 dollars, i.e., without taking inflation into account, the projected costs are:

Fencing	$ 1,427,884
Gates	30,000
Clean-up	53,000
Saharan mustard removal	$3,943,961
Signage	3,240
TOTAL	$ 5,458,085

5.3 CVCC Administrative Costs

Table A5-2 shows the cost projections for CVCC administrative costs.

Table A5-2: CVCC Administrative Cost Projections

Position	***% time CVCC***	***Annual Salary+Benefits***	***CVCC charge***
Exec Director	0.1	$166,254	$16,625
Director of Environmental Resources	0.8	$119,538	$95,630
Program Assistant II	0.8	$68,931	$55,145
Technician	0.75	$60,403	$45,302
IT Manager	0.25	$85,176	$21,294
Accounting Technician	0.5	$57,158	$28,579
Director Administrative Services	0.1	$152,485	$15,248
Acquisitions Manager (contract)			$100,000
Subtotal			$377,824
Overhead at 20%			$75,565
Total			$453,389

These costs are apportioned between administration of the acquisition program and general administration during the thirty years period of the acquisition program. In addition to the $120,000 for an Acquisition Manager and 20% overhead, CVAG will provide staff support to the acquisition program, including GIS analysis and mapping, funding disbursement, and staff support for the Acquisition and Funding Coordinating Committee and CVCC Executive Committee regarding decisions on acquisitions. In all, in addition to the $120,000 for an Acquisition Manager and 20% overhead, $291,000 of CVAG staff time is allocated to the acquisition program, for a total of $411,000 in the first year. That amount is projected to increase 3% annually during the 30 year acquisition program.

6.0 Plan Implementation

6.1 Conservation Areas Conservation Objectives for Use in Rough Step Analysis

The annual Rough Step analysis conducted by the Permittees for each Conservation Area will verify that sufficient progress is being made toward achieving the Conservation Objectives for Core Habitats, Essential Ecological Process areas, Biological Corridors and Linkage, and conserved natural communities for each Conservation Area.

Cabazon Conservation Area Conservation Objectives.

1. In total, 2,340 acres of the Cabazon Conservation Area shall be conserved. (This may be less than the sum of acres indicated in the following objectives because there can be overlap among areas covered by the objectives. For example, Core Habitat for two or more species may overlap, or Core Habitat and an Essential Ecological Process area may overlap. The individual acreage figures will be used in compliance monitoring.)
2. Conserve at least 1,629 acres of the sand source areas.
3. Conserve at least 12 acres of mesquite hummocks natural community and 9 acres of southern sycamore-alder riparian woodland natural community, which provide Habitat for riparian birds and other Covered Species.
4. Conserve at least 83 acres of Essential Habitat for the Peninsular bighorn sheep.
5. Maintain the current capacity for fluvial (water-borne) sand transport along 4,496 acres of the San Gorgonio River and its tributaries.
6. Maintain functional Biological Corridors under I-10 by conserving at least 631 acres in the Fornat Wash Biological Corridor to maintain ecosystem function for Covered Species. Aside from the freeway culvert, which is an unavoidably narrow segment, the Biological Corridor shall be one mile wide, except where Existing Uses or Indian reservation lands not subject to the Plan preclude this width, to minimize edge effects. It should also be noted that portions of the corridor cross Indian reservation land, which is not a part of the Plan and over which the Plan exerts no control.
7. Coordinate with the Western Riverside County MSHCP Regional Conservation Authority to ensure that fluvial sand transport along the San Gorgonio River west of the Cabazon Conservation Area and functionality of the San Gorgonio River as a Biological Corridor are maintained.

Stubbe and Cottonwood Canyons Conservation Area Conservation Objectives.

1. In total, 2,430 acres of the Stubbe and Cottonwood Canyons Conservation Area shall be conserved. (This may be less than the sum of acres indicated in the following objectives because there can be overlap among areas covered by the objectives. For example, Core Habitat for two or more species may overlap, or Core Habitat and an Essential Ecological Process area may overlap. The individual acreage figures will be used in compliance monitoring.)
2. Conserve at least 2,276 acres of Core Habitat for desert tortoise, allowing evolutionary processes and natural population fluctuations to occur. Minimize fragmentation, human-caused disturbance, and edge effects to Core Habitat by conserving contiguous Habitat and effective Linkages between patches of Core Habitat. Protect individual tortoises within the area when allowed Development does occur.
3. Conserve at least 1,111 acres of Other Conserved Habitat for Le Conte's thrasher. Conserve Le Conte's thrasher nesting sites as described in Section 4.4 for avoidance, minimization, and mitigation measures.
4. Conserve at least 1,241 acres of the sand source area in the San Bernardino Mountains to maintain the natural erosion processes that provide sediment for the blowsand ecosystem.
5. Conserve at least 1,129 acres in the fluvial (water-borne) sand transport area. Maintain the current capacity for fluvial sand transport in Stubbe Canyon Wash.
6. Conserve occupied burrowing owl burrows as described in Section 4.4 for burrowing owl avoidance, minimization, and mitigation measures.
7. Conserve at least 25 acres of Sonoran cottonwood-willow riparian forest and at least 229 acres of desert dry wash woodland natural communities, which provide Habitat for riparian birds and other Covered Species. For the remaining acreage of the Sonoran cottonwood-willow riparian forest natural community where disturbance is authorized by the Plan, ensure no net loss.
8. Maintain functional Biological Corridors under I-10 by conserving at least 1,058 acres in the Stubbe Canyon Wash Biological Corridor north of the freeway to maintain potential Habitat connectivity for desert tortoise, Coachella Valley round-tailed ground squirrel, and Palm Springs pocket mouse, and a wildlife movement corridor to maintain ecosystem function for Covered Species. Aside from the freeway culverts and any Existing Use areas, which are unavoidably narrow segments, the Biological Corridor shall expand to one mile wide to minimize edge effects.

<u>Snow Creek/Windy Point Conservation Area Conservation Objectives</u>.

1. In total, 2,340 acres of the Snow Creek/Windy Point Conservation Area shall be conserved. (This may be less than the sum of acres indicated in the following objectives because there can be overlap among areas covered by the objectives. For example, Core Habitat for two or more species may overlap, or Core Habitat and an Essential Ecological Process area may overlap. The individual acreage figures will be used in compliance monitoring.)
2. Conserve Core Habitat and associated Essential Ecological Processes (as set forth below) for Coachella Valley milkvetch, Coachella Valley giant sand-treader cricket, Coachella Valley Jerusalem cricket, Coachella Valley fringe-toed lizard, Coachella Valley round-tailed ground squirrel, and Palm Springs pocket mouse, allowing evolutionary processes and natural population fluctuations to occur. Minimize fragmentation, human-caused disturbance, and edge effects to Core Habitat by conserving contiguous Habitat and effective Linkages between patches of Core Habitat.
    a. Conserve at least 816 acres of Core Habitat for the Coachella Valley milkvetch in the City of Palm Springs portion of the area and at least 1,210 acres of Core Habitat in the unincorporated portion of the area.
    b. Conserve at least 672 acres of Core Habitat for the Coachella Valley giant sand-treader cricket in the City of Palm Springs portion of the area and at least 501 acres of Core Habitat in the unincorporated portion of the area.
    c. Conserve at least 815 acres of Core Habitat for the Coachella Valley Jerusalem cricket in the City of Palm Springs and at least 538 acres in the unincorporated portion of the area.
    d. Conserve at least 672 acres of Core Habitat for the Coachella Valley fringe-toed lizard in the City of Palm Springs portion of the area and at least 501 acres of Core Habitat in the unincorporated portion of the area.
    e. Conserve at least 838 acres of Core Habitat for the Coachella Valley round-tailed ground squirrel in the City of Palm Springs portion of the area and at least 1,371 acres of Core Habitat in the unincorporated portion of the area.
    f. Conserve at least 838 acres of Core Habitat for the Palm Springs pocket mouse in the City of Palm Springs portion of the area and at least 1,331 acres of Core Habitat in the unincorporated portion of the area.
    g. Conserve at least 838 acres of the fluvial and aeolian sand transport area in the City of Palm Springs portion of the area and at least 1,482 acres in the unincorporated portion of the area. Maintain the current capacity for fluvial sand transport in the San Gorgonio River floodplain
3. Conserve at least 775 acres of Other Conserved Habitat for Le Conte's thrasher in the City of Palm Springs portion of the area and at least 1,453 acres of Other Conserved Habitat in the unincorporated portion of the area. Conserve Le Conte's thrasher nesting sites as described in Section 4.4 for avoidance, minimization, and mitigation measures.

4. Conserve at least 144 acres of Essential Habitat for the Peninsular bighorn sheep in the City of Palm Springs portion of the area, and at least 443 acres in the unincorporated portion of the area.
5. Conserve individual desert tortoises as described in Section 4.4 for desert tortoise avoidance, minimization, and mitigation measures.
6. Conserve occupied burrowing owl burrows as described in Section 4.4 for burrowing owl avoidance, minimization, and mitigation measures.
7. Conserve at least 62 acres of the active desert dunes and at least 610 acres of the ephemeral desert sand fields in the City of Palm Springs portion of the area, and at least 409 acres of the ephemeral desert sand fields and at least 93 acres of the stabilized and partially stabilized desert sand fields in the unincorporated portion of the area to provide for the conservation of these natural communities. As these conserved natural communities are all part of the Core Habitat areas identified in Conservation Objective 2 for this area, attainment of that objective will also achieve this objective.
8. Maintain functional Biological Corridors and Linkages under I-10 and Highway 111 by conserving at least 415 acres of identified Biological Corridor in the unincorporated portion of the Conservation Area and at least 247 acres identified Biological Corridor in the City of Palm Springs' portion, such that the functionality of each individual Biological Corridor listed below is not compromised:
    a. Conserve the Stubbe Canyon Wash Biological Corridor south of the I-10 to maintain potential Habitat connectivity for desert tortoise, Coachella Valley round-tailed ground squirrel, and Palm Springs pocket mouse, and to maintain ecosystem function for Covered Species. Aside from the freeway culverts and any Existing Use areas, which are unavoidably narrow segments, the Biological Corridor shall expand to one mile wide to minimize edge effects.
    b. Conserve the Whitewater Floodplain Biological Corridor south of Highway 111 to maintain potential Habitat connectivity for Coachella Valley Jerusalem cricket, Coachella Valley round-tailed ground squirrel, and Palm Springs pocket mouse, and to maintain ecosystem function for Covered Species. Aside from the highway culverts and any Existing Use areas, which are unavoidably narrow segments, the Biological Corridor shall expand to one mile wide to minimize edge effects.

<u>Whitewater Canyon Conservation Area Conservation Objectives</u>.

1. In total, 1,440 acres of the Whitewater Canyon Conservation Area shall be conserved. (This may be less than the sum of acres indicated in the following objectives because there can be overlap among areas covered by the objectives. For example, Core Habitat for two or more species may overlap, or Core Habitat and an Essential Ecological Process area may overlap. The individual acreage figures will be used in compliance monitoring.)
2. Conserve at least 1,084 acres of Core Habitat for desert tortoise in the unincorporated

portion of the area, allowing evolutionary processes and natural population fluctuations to occur. Minimize fragmentation, human-caused disturbance, and edge effects to Core Habitat by conserving contiguous Habitat and effective Linkages between patches of Core Habitat. Protect individual tortoises within the area if allowed Development does occur.

3. Conserve at least 850 acres of the sand source area in the San Bernardino Mountains in the unincorporated portion of the area to maintain the natural erosion processes that provide sediment for the blowsand ecosystem.
4. Conserve at least 435 acres in the fluvial (water-borne) sand transport area in the Riverside County portion of the area. Maintain the current capacity for fluvial sand transport in the Whitewater River.
5. Conserve at least 348 acres of Other Conserved Habitat for the Little San Bernardino Mountains linanthus in the Riverside County portion of the area.
6. Conserve at least 368 acres of Core Habitat for the triple-ribbed milkvetch in the Riverside County portion of the area.
7. Conserve at least 706 acres of modeled Habitat for the arroyo toad in the Riverside County portion of the area.
8. In the Riverside County portion of the area, conserve at least 107 acres of existing Sonoran cottonwood-willow riparian forest natural community, which provides Habitat for riparian birds and other Covered Species. For the remaining acreage of this natural community where disturbance is authorized by the Plan, ensure no net loss.
9. In the Riverside County portion of the area, maintain functional Biological Corridors under I-10 by conserving at least 201 acres in the Whitewater River Biological Corridor north of the freeway to maintain potential Habitat connectivity for desert tortoise, Coachella Valley round-tailed ground squirrel, and Palm Springs pocket mouse, and to maintain ecosystem function for Covered Species. Aside from the freeway bridge and any Existing Use areas, which are unavoidably narrow segments, the Biological Corridor shall expand to one mile wide to minimize edge effects.

Highway 111/I-10 Conservation Area Conservation Objectives.

1. Conserve 350 acres in this Conservation Area. This will protect Other Conserved Habitat for the Coachella Valley milkvetch, Coachella Valley Jerusalem cricket, Coachella Valley round-tailed ground squirrel, Palm Springs pocket mouse, and Le Conte's thrasher, allowing evolutionary processes and natural population fluctuations to occur. Minimize fragmentation, human-caused disturbance, and edge effects to Habitat by conserving contiguous Habitat patches and effective Linkages between them.

Whitewater Floodplain Conservation Area Conservation Objectives.

1. In total, 4,140 acres of the Whitewater Floodplain Conservation Area shall be conserved.

(This may be less than the sum of acres indicated in the following objectives because there can be overlap among areas covered by the objectives. For example, Core Habitat for two or more species may overlap, or Core Habitat and an Essential Ecological Process area may overlap. The individual acreage figures will be used in compliance monitoring.)

2. Conserve Core Habitat and associated ecological processes (as set forth below) for Coachella Valley milkvetch, Coachella Valley giant sand-treader cricket, Coachella Valley fringe-toed lizard, Coachella Valley round-tailed ground squirrel, and Palm Springs pocket mouse, allowing evolutionary processes and natural population fluctuations to occur. Minimize fragmentation, human-caused disturbance, and edge effects to Core Habitat by conserving contiguous Habitat and effective Linkages between patches of Core Habitat.
    a. Conserve at least 2,671 acres of Core Habitat for the Coachella Valley milkvetch in the Palm Springs portion of the area, at least 61 acres in the Cathedral City portion of the area, and at least 58 acres in the unincorporated Riverside County portion of the area.
    b. Conserve at least 2,659 acres of Core Habitat for the Coachella Valley giant sand-treader cricket in the Palm Springs portion of the area, at least 61 acres in the Cathedral City portion of the area, and at least 57 acres in the unincorporated Riverside County portion of the area.
    c. Conserve at least 2,659 acres of Core Habitat for the Coachella Valley fringe-toed lizard in the Palm Springs portion of the area, at least 61 acres in the Cathedral City portion of the area, and at least 57 acres in the unincorporated Riverside County portion of the area.
    d. Conserve at least 2,955 acres of Core Habitat for the Coachella Valley round-tailed ground squirrel in the Palm Springs portion of the area, at least 59 acres in the Cathedral City portion of the area, and at least 100 acres in the unincorporated Riverside County portion of the area.
    e. Conserve at least 3,122 acres of Core Habitat for the Palm Springs pocket mouse in the Palm Springs portion of the area, at least 61 acres in the Cathedral City portion of the area, and at least 477 acres in the unincorporated Riverside County portion of the area.
    f. Conserve at least 3,484 acres of the fluvial and aeolian sand transport area in the Palm Springs portion of the area, at least 61 acres in the Cathedral City portion of the area, and at least 481 acres in the unincorporated Riverside County portion of the area. Maintain the current capacity for fluvial sand transport in the Whitewater River floodplain.
3. Conserve occupied burrowing owl burrows as described in Section 4.4 for burrowing owl avoidance, minimization, and mitigation measures.
4. Conserve at least 3,433 acres of Other Conserved Habitat for Le Conte's thrasher in the Palm Springs portion of the area, at least 61 acres in the Cathedral City portion of the area, and at least 480 acres in the unincorporated Riverside County portion of the area. Conserve

Le Conte's thrasher nesting sites as described in Section 4.4 for avoidance, minimization, and mitigation measures.

5. Conserve at least 392 acres of the active desert sand fields in the Palm Springs portion of the area; at least 43 acres of the active desert sand fields in the Cathedral City portion of the area; at least 1,185 acres of the ephemeral desert sand fields in the Palm Springs portion of the area and at least 52 acres in the unincorporated Riverside County portion of the area for the conservation of these natural communities; at least 394 acres of the stabilized and partially stabilized desert sand fields in the Palm Springs portion of the area and at least 4 acres of the stabilized and partially stabilized desert sand fields in the unincorporated Riverside County portion of the area. As these conserved natural communities are all part of the Core Habitat areas identified in Conservation Objective 2 for this area, attainment of that objective will also achieve this objective.
6. Maintain functional Biological Corridors and Linkages by conserving at least 475 acres of identified Biological Corridor in the unincorporated portion of the Conservation Area, at least 809 acres of identified Biological Corridor in the City of Palm Springs' portion, and at least 18 acres of identified Biological Corridor in the City of Cathedral City portion, such that the functionality of each individual Biological Corridor listed below is not compromised:
    a. Conserve the Whitewater River Biological Corridor south of I-10 in the unincorporated area to maintain potential Habitat connectivity for desert tortoise, Coachella Valley round-tailed ground squirrel, and Palm Springs pocket mouse, and to maintain ecosystem function for Covered Species. Aside from the freeway bridge and any Existing Use areas, which are unavoidably narrow segments, the Biological Corridor shall expand to one mile wide to minimize edge effects.
    b. Conserve the Mission Creek Biological Corridor south of the freeway in the Palm Springs portion of the Conservation Area to maintain potential Habitat connectivity for Coachella Valley round-tailed ground squirrel, and Palm Springs pocket mouse, and to maintain ecosystem function for Covered Species. Aside from the freeway culvert and any Existing Use areas, which are unavoidably narrow segments, the Biological Corridor shall expand to one mile wide to minimize edge effects.
    c. Conserve the Willow wash area south of the I-10 in Palm Springs and in Cathedral City to maintain potential Habitat connectivity for Coachella Valley round-tailed ground squirrel, and Palm Springs pocket mouse, and to maintain ecosystem function for Covered Species. Aside from the freeway culverts and any Existing Use areas, which are unavoidably narrow segments, the Biological Corridor shall expand to one mile wide to minimize edge effects.
    d. Maintain the ability of wildlife to cross Indian Avenue and Gene Autry Trail by providing undercrossings for Coachella Valley fringe-toed lizard, flat-tailed horned lizard, Coachella Valley round-tailed ground squirrel, and Palm Springs pocket mouse if these roads are widened to six lanes or more.

<u>Upper Mission Creek/Big Morongo Canyon Conservation Area Conservation Objectives.</u>

1. In total, 10,810 acres of the Upper Mission Creek/Big Morongo Canyon Conservation Area shall be conserved. (This may be less than the sum of acres indicated in the following objectives because there can be overlap among areas covered by the objectives. For example, Core Habitat for two or more species may overlap, or Core Habitat and an Essential Ecological Process area may overlap. The individual acreage figures will be used in compliance monitoring.) If through means not under the control of the Permittees this Conservation Objective cannot be achieved within the Desert Hot Springs or Riverside County portions of the Conservation Area, the acreage not conserved per this Conservation Objective shall be conserved in or adjacent to this Conservation Area or the Willow Hole, Whitewater Canyon, Desert Tortoise Linkage, Stubbe and Cottonwood Canyons, Indio Hills/Joshua Tree National Park Linkage, Joshua Tree National Park, Mecca Hills/Orocopia Mountains, or Snow Creek/Windy Point Conservation Areas as described below for the individual species. The Wildlife Agencies shall review impacts and conservation pursuant to the requirements above annually during the Rough Step review. If, as described below, the maximum impacts are exceeded or the minimum required conservation is not occurring, coverage for Palm Springs pocket mouse and/or Little San Bernardino Mountains linanthus shall automatically terminate and the CVCC and Permittees will be given written notice acknowledging the termination of coverage for the above-referenced species 30 days prior to coverage terminating.

2. Conserve Core Habitat and associated ecological processes (as set forth below) for Little San Bernardino Mountains linanthus, triple-ribbed milkvetch, desert tortoise, and Palm Springs pocket mouse, allowing evolutionary processes and natural population fluctuations to occur. Minimize fragmentation, human-caused disturbance, and edge effects to Core Habitat by conserving contiguous Habitat and effective Linkages between patches of Core Habitat.

   b. a. Conserve at least 966 acres of Core Habitat for the Little San Bernardino Mountains linanthus in the Desert Hot Springs portion of the area and at least ~~1,~~1,052 acres in the Riverside County portion, including the hydrologic processes upon which the plant depends. Conserve at least 426 acres of Core Habitat for the triple-ribbed milkvetch in the Riverside County portion of the area.

   c. Conserve at least 2,271 acres of Core Habitat for desert tortoise in the Desert Hot Springs portion of the area and at least 7,936 acres in the Riverside County portion. Protect individual tortoises within the area when allowed Development does occur.

   d. Conserve at least 1,865 acres of Core Habitat for the Palm Springs pocket mouse in the Desert Hot Springs portion of the area, at least 22 acres of Other Conserved Habitat for the Palm Springs pocket mouse in the Palm Springs portion of the area and at least 1,112 acres of Core Habitat in the Riverside County portion. Maintain potential Habitat connectivity between Core Habitat in the Upper Mission Creek/Big Morongo Canyon Conservation Area and the Willow Hole Conservation Area. Minimize fragmentation and human-disturbance of, and edge effects to, the Habitat connectivity area along Morongo Wash from any Development allowed within the Conservation Area.

Conserve at least 141 acres of the sand source areas in the Desert Hot Springs portion of the area and at least 6,488 acres in the Riverside County portion subject to natural erosion processes.

f. Conserve at least 1,949 acres of the fluvial sand transport areas in the Desert Hot Springs portion of the area, at least 22 acres in the Palm Springs portion, and at least 1,259 acres in the Riverside County portion. Maintain the current capacity for fluvial sand transport in Mission Creek and Morongo Wash.

3. Conserve at least 1,931 acres of Other Conserved Habitat for Le Conte's thrasher in the Desert Hot Springs portion of the area, at least 22 acres in the Palm Springs portion, and at least 1,072 acres in the Riverside County portion of the area. Conserve Le Conte's thrasher nesting sites as described in Section 4.4 for avoidance, minimization, and mitigation measures.

4. Conserve at least 90 acres of Coachella Valley Jerusalem cricket Habitat in the Desert Hot Springs portion of the area, and at least 419 acres of Coachella Valley Jerusalem cricket Habitat in the Riverside County portion of the area.

5. Conserve occupied burrowing owl burrows as described in Section 4.4 for burrowing owl avoidance, minimization, and mitigation measures.

6. Conserve at least 76 acres of Sonoran cottonwood-willow riparian forest and at least 58 acres of Southern sycamore-alder riparian woodland in the Riverside County portion of the area; and at least 76 acres of desert dry wash woodland natural communities in the Desert Hot Springs portion, and at least 76 acres in the Riverside County portion, which provide Habitat for riparian birds and other Covered Species. For the remaining acreage of these conserved natural communities where disturbance is authorized by the Plan, ensure no net loss.

7. Maintain the two bridges on Highway 62 over Mission Creek so as not to affect the existing sediment transport and Biological Corridor. Maintain functional Biological Corridors under Highway 62 by conserving at least 88 acres in the Desert Hot Springs portion and at least 688 acres in the Riverside County portion to maintain potential Habitat connectivity for desert tortoise and Palm Springs pocket mouse, and to maintain ecosystem function for Covered Species. Aside from the highway bridges and any Existing Use areas, which are unavoidably narrow segments, the Biological Corridor shall expand to one mile wide to minimize edge effects.

8. Maintain the fluvial sand transport along the existing Mission Creek Channel.

Willow Hole Conservation Area Conservation Objectives.

1. In total, 4,920 acres of the Willow Hole Conservation Area shall be conserved. (This may be less than the sum of acres indicated in the following objectives because there can be overlap among areas covered by the objectives. For example, Core Habitat for two or more species may overlap, or Core Habitat and an Essential Ecological Process area may overlap. The individual acreage figures will be used in compliance monitoring.)

2. Conserve Core Habitat and associated ecological processes (as set forth below) for Coachella Valley milkvetch, Coachella Valley fringe-toed lizard, Coachella Valley round-tailed ground squirrel, and Palm Springs pocket mouse, allowing evolutionary processes and natural population fluctuations to occur. Minimize fragmentation, human-caused disturbance, and edge effects to Core Habitat by conserving contiguous Habitat patches and effective Linkages between patches of Core Habitat.

    a. Conserve at least 782 acres of Core Habitat for the Coachella Valley milkvetch in the Cathedral City portion of the area, at least 863 acres in the Desert Hot Springs portion of the area, and at least 888 acres in the Riverside County portion.

    b. Conserve at least 211 acres of Core Habitat for the Coachella Valley fringe-toed lizard in the Cathedral City portion of the area, at least 3 acres in the Desert Hot Springs portion of the area, and at least 452 acres in the Riverside County portion.

    c. Conserve at least 1,256 acres of Core Habitat for the Coachella Valley round-tailed ground squirrel in the Cathedral City portion of the area, at least 3 acres in the Desert Hot Springs portion of the area, and at least 1,078 acres in the Riverside County portion.

    d. Conserve at least 959 acres of Core Habitat for the Palm Springs pocket mouse in the Cathedral City portion of the area, at least 1,542 acres in the Desert Hot Springs portion of the area, and at least 1,142 acres in the Riverside County portion of the area. Maintain potential Habitat connectivity between Core Habitat in the Willow Hole Conservation Area and Upper Mission Creek/Big Morongo Canyon Conservation Area. Minimize fragmentation and human-disturbance of, and edge effects to, the Habitat connectivity area along Morongo Wash from any Development allowed within the Conservation Area.

    e. Conserve at least 710 acres of the sand source area in the Cathedral City portion of the area and at least 17 acres in the Riverside County portion to maintain the natural erosion processes that provide sediment for the blowsand ecosystem.

3. Conserve at least 798 acres in the fluvial (water-borne) and aeolian (air-borne) sand transport area in the Cathedral City portion of the area, at least 1,542 acres in the Desert Hot Springs portion of the area, and at least 1,192 acres in the Riverside County portion. Maintain the current capacity for fluvial sand transport in Mission Creek and Morongo Wash for sand transport to the Willow Hole/Edom Hill Reserve.

4. Conserve at least 1,508 acres of Other Conserved Habitat for Le Conte's thrasher in the Cathedral City portion of the area, at least 1,499 acres in the Desert Hot Springs portion of the area, and at least 1,178 acres in the Riverside County portion. Conserve Le Conte's thrasher nesting sites as described in See Section 4.4 avoidance, minimization, and mitigation measures.

5. Conserve at least 71 acres of mesquite hummocks natural community in the Riverside County portion of the area, and at least 27 acres in the Desert Hot Springs portion of the area, which provides Habitat for riparian birds and other Covered Species.

6. Conserve at least 194 acres of stabilized & partially stabilized desert dunes in the Riverside County portion and at least 125 acres in the Desert Hot Springs portion; at least 33 acres of active desert sand fields in the Cathedral City portion of the area; at least 178 acres of

ephemeral desert sand fields in the Cathedral City portion of the area, at least 549 acres in the Desert Hot Springs portion, and at least 179 acres in the Riverside County portion; at least 51 acres of stabilized and partially stabilized desert sand fields in the Cathedral City portion of the area, at least 49 acres in the Desert Hot Springs portion, and at least 79 acres in the Riverside County portion; and at least 152 acres of desert saltbush scrub in the Riverside County portion of the area to conserve these natural communities.

7. Maintain functional Biological Corridors between this area and the Whitewater Floodplain Conservation Area by maintaining the culverts conveying Mission Creek and Willow Wash under I-10 at no less than their current size and character. Maintain functional Biological Corridors under I-10 by conserving at least 120 acres in the Riverside County portion and at least 277 acres in the Desert Hot Springs portion, such that the functionality of each individual Biological Corridor listed below is not compromised:

   a. Conserve the Mission Creek Biological Corridor north of the freeway to maintain potential Habitat connectivity for Coachella Valley round-tailed ground squirrel, and Palm Springs pocket mouse, and to maintain ecosystem function for Covered Species. Aside from the freeway culvert and any Existing Use areas, which are unavoidably narrow segments, the Biological Corridor shall expand to one mile wide to minimize edge effects.

   b. Conserve the Willow Wash area north of the freeway in the City of Desert Hot Springs to maintain potential Habitat connectivity for Coachella Valley round-tailed ground squirrel, and Palm Springs pocket mouse, and to maintain ecosystem function for Covered Species. Aside from the freeway culverts and any Existing Use areas, which are unavoidably narrow segments, the Biological Corridor shall expand to one mile wide to minimize edge effects.

8. Maintain the ability of wildlife to cross Mountain View Road, Varner Road, 18th Avenue, and Dillon Road by providing culverts or undercrossings for Coachella Valley fringe-toed lizard, Coachella Valley giant sand-treader cricket, Coachella Valley round-tailed ground squirrel, Palm Springs pocket mouse, and other species if these roads are widened beyond two lanes.

9. Maintain the fluvial sand transport along the existing Mission Creek Channel.

10. Conserve occupied burrowing owl burrows as described in Section 4.4 for burrowing owl avoidance, minimization, and mitigation measures.

11. Remove tamarisk to improve water availability for mesquite hummocks.

Long Canyon Conservation Area Conservation Objectives.

1. Maintain the fluvial (water-borne) transport of sediment through the Long Canyon floodplain area. Maintain the current capacity for fluvial sand transport in Long Canyon wash.

Edom Hill Conservation Area Conservation Objectives.

1. In total, 3,060 acres of the Edom Hill Conservation Area shall be conserved. (This may be less than the sum of acres indicated in the following objectives because there can be overlap among areas covered by the objectives. For example, Core Habitat for two or more species may overlap, or Core Habitat and an Essential Ecological Process area may overlap. The individual acreage figures will be used in compliance monitoring.)
2. To maintain connectivity, conserve the Other Conserved Habitat patches for the Coachella Valley milkvetch, Coachella Valley giant sand-treader cricket, Coachella Valley fringe-toed lizard, Coachella Valley round-tailed ground squirrel, and Palm Springs pocket mouse between the Thousand Palms Conservation Area and the Willow Hole Conservation Area. Maintain the Other Conserved Habitat patches, allowing evolutionary processes and natural population fluctuations to occur. Minimize fragmentation, human-caused disturbance, and edge effects to the Habitat by conserving effective Linkages between patches of Core Habitat.
3. Conserve ecological processes (as set forth below) for the Willow Hole Conservation Area and the Thousand Palms Conservation Area.
    a. Conserve at least 310 acres of the sand source area for the Willow Hole Conservation Area in the Cathedral City portion of the area and at least 1,770 acres in the Riverside County portion to maintain the natural erosion processes that provide sediment for the blowsand ecosystem.
    b. Conserve at least 565 acres in the fluvial sand transport area in the Riverside County portion of the area for the Willow Hole Conservation Area. Maintain the current capacity for fluvial sand transport in the washes emanating from the Indio Hills that carry sand to the Willow Hole Conservation Area.
    c. Conserve that portion of the sand source area for the Thousand Palms Conservation Area in the Riverside County portion of the Conservation Area to maintain the natural erosion processes that provide sediment for the blowsand ecosystem.
4. Conserve occupied burrowing owl burrows as described in Section 4.4 avoidance, minimization, and mitigation measures.
5. Conserve at least 310 acres of Other Conserved Habitat for Le Conte's thrasher in the Cathedral City portion of the area and at least 1,745 acres in the Riverside County portion. Conserve individual Le Conte's thrasher nesting sites as described in Section 4.4 avoidance, minimization, and mitigation measures.
6. Conserve at least 3 acres of the stabilized and partially stabilized desert sand fields, and at least 37 acres of active desert sand fields in the Riverside County portion of the area to ensure the conservation of these conserved natural communities.

Thousand Palms Conservation Area Conservation Objectives.

1. In total, 8,040 additional acres of the Thousand Palms Conservation Area shall be conserved. (This may be less than the sum of acres indicated in the following objectives because there can be overlap among areas covered by the objectives. For example, Core Habitat for two or more species may overlap, or Core Habitat and an Essential Ecological

Process area may overlap. The individual acreage figures will be used in compliance monitoring.)

2. Conserve Core Habitat and associated ecological processes (as set forth below) for Coachella Valley milkvetch, Mecca aster, Coachella Valley giant sand-treader cricket, Coachella Valley fringe-toed lizard, flat-tailed horned lizard, Coachella Valley round-tailed ground squirrel, and Palm Springs pocket mouse, allowing evolutionary processes and natural population fluctuations to occur. Minimize fragmentation, human-caused disturbance, and edge effects to Core Habitat by conserving contiguous Habitat patches and effective Linkages between patches of Core Habitat. This will also help maintain connectivity with Habitat at Willow Hole through the Edom Hill Conservation Area.

    a. Conserve at least 985 acres of Core Habitat for the Coachella Valley milkvetch.

    b. Conserve at least 2,676 acres of Core Habitat for the Mecca aster.

    c. Conserve at least 818 acres of Core Habitat for the Coachella Valley giant sand-treader cricket.

    d. Conserve at least 818 acres of Core Habitat for the Coachella Valley fringe-toed lizard.

    e. Conserve at least 860 acres of Core Habitat for the flat-tailed horned lizard. Conserve individual flat-tailed horned lizards as described in Section 4.4 avoidance, minimization, and mitigation measures.

    f. Conserve at least 3,082 acres of Core Habitat for the Coachella Valley round-tailed ground squirrel.

    g. Conserve at least 3,679 acres of Core Habitat for the Palm Springs pocket mouse.

    h. Conserve at least 3,712 acres of the sand source area to maintain the natural erosion processes that provide sediment for the blowsand ecosystem. This also maintains Linkages for wildlife to the Edom Hill Conservation Area.

    i. Conserve at least 4,206 acres in the fluvial and aeolian sand transport area to maintain the sand transport system. Maintain the current capacity for fluvial sand transport in the washes emanating from the Indio Hills that provide sand for the Thousand Palms Conservation Area. This also maintains Linkages for wildlife to the Edom Hill Conservation Area.

3. Conserve occupied burrowing owl burrows as described in Section 4.4 burrowing owl avoidance, minimization, and mitigation measures.

4. Conserve the refugia locations for the desert pupfish in accordance with the Desert Pupfish Recovery Plan.

5. Conserve at least 3,972 acres of Other Conserved Habitat for Le Conte's thrasher. Conserve Le Conte's thrasher nesting sites as described in Section 4.4 avoidance, minimization, and mitigation measures.

6. Conserve at least 34 acres of the desert dry wash woodland natural community, which provides Habitat for riparian birds and other Covered Species. For the remaining acreage of this natural community where disturbance is authorized by the Plan, ensure no net loss.

7. Conserve at least 14 acres of active desert dunes and at least 804 acres of active desert sand

fields to provide for the Conservation of these conserved natural communities. This goal will be attained through attaining Goal 2 for the species that inhabit these conserved natural communities.

8. Maintain the hydrologic groundwater regime necessary to maintain the pupfish refugium and the mesquite hummocks, Sonoran cottonwood-willow riparian woodland, desert dry wash woodland, and desert fan palm oasis woodland natural communities in this Conservation Area.

9. Maintain the ability of wildlife to cross Ramon Road, Washington Street, and Thousand Palms Canyon Road by providing undercrossings for Coachella Valley fringe-toed lizard, flat-tailed horned lizard, Coachella Valley round-tailed ground squirrel, and Palm Springs pocket mouse if these roads are widened. These undercrossings should also provide for seed dispersal.

West Deception Canyon Conservation Area Conservation Objectives.

1. Conserve at least 1,063 acres of the sand source area to maintain the natural erosion processes that provide sediment for the blowsand ecosystem.

2. Maintain the current capacity for fluvial sand transport in the West Deception Canyon fluvial sand transport system.

Indio Hills/Joshua Tree National Park Linkage Conservation Area Conservation Objectives.

1. In total, 10,530 acres of the Indio Hills/Joshua Tree National Park Linkage Conservation Area shall be conserved. (This may be less than the sum of acres indicated in the following objectives because there can be overlap among areas covered by the objectives. For example, Core Habitat for two or more species may overlap, or Core Habitat and an Essential Ecological Process area may overlap. The individual acreage figures will be used in compliance monitoring.)

2. Conserve ecological processes for the Thousand Palms Conservation Area that occur in the Indio Hills/Joshua Tree National Park Linkage Conservation Area and Core Habitat for the desert tortoise as set forth below:

    a. Conserve at least 7,735 acres of Core Habitat for desert tortoise, allowing evolutionary processes and natural population fluctuations to occur. Minimize fragmentation, human-caused disturbance, and edge effects to Core Habitat by conserving contiguous Habitat and effective Linkages between patches of Core Habitat. Protect individual tortoises within the area when allowed Development does occur.

    b. Conserve at least 4,135 acres of the sand source area to maintain the natural erosion processes that provide sediment for the blowsand ecosystem.

    c. Conserve at least 6,132 acres in the fluvial sand transport area. Maintain the current capacity for fluvial sand transport in the washes emanating from the Little San Bernardino Mountains that flow into Thousand Palms Canyon.

3. Maintain functional Biological Corridors and Linkages as set forth below.
   a. Conserve at least 10,267 acres in the Indio Hills/Joshua Tree National Park Biological Corridor to maintain Habitat connectivity and ecosystem function between the Thousand Palms Conservation Area and the Joshua Tree National Park Conservation Area for Covered Species. The corridor shall be wide enough to minimize edge effects.
4. Conserve at least 5,457 acres of Other Conserved Habitat for Le Conte's thrasher. Conserve Le Conte's thrasher nesting sites as described in Section 4.4 avoidance, minimization, and mitigation measures.
5. Maintain the ability of wildlife to cross Dillon Road by providing undercrossings to maintain ecosystem function for Covered Species, if this road is widened.

Indio Hills Palms Conservation Area Conservation Objectives.

1. In total, 2,290 acres of the Indio Hills Palms Conservation Area shall be conserved. (This may be less than the sum of acres indicated in the following objectives because there can be overlap among areas covered by the objectives. For example, Core Habitat for two or more species may overlap, or Core Habitat and an Essential Ecological Process area may overlap. The individual acreage figures will be used in compliance monitoring.)
2. Conserve at least 2,290 acres of Core Habitat for Mecca aster, allowing evolutionary processes and natural population fluctuations to occur. Minimize fragmentation, human-caused disturbance, and edge effects to Core Habitat by conserving contiguous Habitat patches and effective linkages between patches of Core Habitat.
3. Conserve at least 7 acres of Other Conserved Habitat for Le Conte's thrasher. Conserve Le Conte's thrasher nesting sites as described in Section 4.4 avoidance, minimization, and mitigation measures.
4. Conserve at least 33 acres of desert dry wash woodland natural community, which provides Habitat for riparian birds and other Covered Species.
5. Conserve at least 1 acre of the mesquite hummocks natural community, which provides Habitat for riparian birds and other Covered Species.
6. Conserve at least 42 acres of desert fan palm oasis woodland natural community, which provides Habitat for southern yellow bat.

<u>East Indio Hills Conservation Area Conservation Objectives</u>.

1. In total, 2,790 acres of the East Indio Hills Conservation Area shall be conserved. (This may be less than the sum of acres indicated in the following objectives because there can be overlap among areas covered by the objectives. For example, Core Habitat for two or more species may overlap, or Core Habitat and an Essential Ecological Process area may overlap. The individual acreage figures will be used in compliance monitoring.)

2. Conserve Habitat, as set forth below, for Mecca aster, flat-tailed horned lizard, Coachella Valley round-tailed ground squirrel, and Palm Springs pocket mouse, allowing evolutionary processes and natural population fluctuations to occur. Minimize fragmentation, human-caused disturbance, and edge effects by conserving contiguous Habitat patches and effective Linkages.

    a. Conserve at least 1,045 acres of Other Conserved Habitat for the Mecca aster in the Riverside County portion of the area.

    b. Conserve at least 415 acres of Other Conserved Habitat for the flat-tailed horned lizard in the Riverside County portion of the area, at least 5 acres in the City of Coachella portion, and at least 100 acres in the City of Indio portion. Conservation of species Habitat in the City of Indio is subject to the conditions in measure 1 of the Required Measures for the Conservation Area section below.

    c. Conserve at least 1,253 acres of Other Conserved Habitat for Le Conte's thrasher in the Riverside County portion of the area, at least 56 acres in the City of Coachella portion, and at least 105 acres in the City of Indio portion. Conserve Le Conte's thrasher nesting sites in the area as described in Section 4.4 for avoidance, minimization, and mitigation measures. Conservation of species Habitat in the City of Indio is subject to the conditions in measure 1 of the Required Measures for the Conservation Area section below.

    d. Conserve at least 896 acres of Other Conserved Habitat for the Coachella Valley round-tailed ground squirrel in the Riverside County portion of the area, at least 5 acres in the City of Coachella portion, and at least 103 acres in the City of Indio portion. Conservation of species Habitat in the City of Indio is subject to the conditions in measure 1 of the Required Measures for the Conservation Area section below.

    e. Conserve at least 944 acres of Other Conserved Habitat for the Palm Springs pocket mouse in the Riverside County portion of the area, at least 7 acres in the City of Coachella portion, and at least 103 acres in the City of Indio portion. Conservation of species Habitat in the City of Indio is subject to the conditions in measure 1 of the Required Measures for the Conservation Area section below.

3. Conserve at least 4 acres of active desert dunes in the Riverside County portion; at least 295 acres of stabilized and partially stabilized desert sand fields in the Riverside County portion of the area; at least 100 acres of stabilized shielded desert sand fields in the City of Indio portion of the area and at least 256 acres in the Riverside County portion; at least 2 acres of mesquite hummocks in the City of Indio portion of the area and at least 39 acres in the Riverside County portion; and at least 7 acres of desert saltbush scrub in the Riverside County portion of the area to conserve these natural communities. Conservation of natural communities in the City of Indio is subject to the conditions in measure 1 of the Required Measures for the Conservation Area section below.
4. Consistent with the research program described in Section 8.4.1.2, restore 80 acres of mesquite hummocks if 80% of the mesquite hummocks natural community in the south half of Section 17, T5S, R8E, is not conserved under the Plan. If the 80% is conserved, the Conservation Objective shall be to restore 40 acres of mesquite hummocks.

Joshua Tree National Park Conservation Area Conservation Objectives.

1. In total, 35,600 acres of the Joshua Tree National Park Conservation Area shall be conserved. (This may be less than the sum of acres indicated in the following objectives because there can be overlap among areas covered by the objectives. For example, Core Habitat for two or more species may overlap, or Core Habitat and an Essential Ecological Process area may overlap. The individual acreage figures will be used in compliance monitoring.)
2. Conserve Core Habitat for desert tortoise, potential Habitat for gray vireo, and ecological processes for the Joshua Tree National Park Conservation Area (as set forth below), allowing evolutionary processes and natural population fluctuations to occur. Minimize fragmentation, human-caused disturbance, and edge effects to Core Habitat by conserving contiguous Habitat patches and effective Linkages between patches of Core Habitat.
    a. Conserve at least 15,367 acres of Core Habitat for desert tortoise. Protect individual tortoises within the area when allowed Development does occur.
    b. Conserve at least 1,208 acres of Other Conserved Habitat for the gray vireo.
    c. Conserve at least 222 acres of Other Conserved Habitat for Le Conte's thrasher. Conserve Le Conte's thrasher nesting sites as described in Section 4.4 avoidance, minimization, and mitigation measures.
    d. Maintain the current capacity for fluvial sand transport in the washes emanating from the Little San Bernardino Mountains that provide sand for the Thousand Palms Conservation Area.
3. Conserve at least 7,195 acres of the Mojave mixed woody scrub and at least 1,208 acres of the Mojavean pinyon and juniper woodland natural communities
4. Conserve at least 119 acres of the desert dry wash woodland natural community, which provides Habitat for riparian birds and other Covered Species.

Desert Tortoise and Linkage Conservation Area Conservation Objectives.

1. In total, 46,350 acres of the Desert Tortoise Linkage Conservation Area shall be conserved. (This may be less than the sum of acres indicated in the following objectives because there can be overlap among areas covered by the objectives. For example, Core Habitat for two or more species may overlap, or Core Habitat and an Essential Ecological Process area may overlap. The individual acreage figures will be used in compliance monitoring.)

2. Conserve Core Habitat as set forth below for desert tortoise, allowing evolutionary processes and natural population fluctuations to occur. Minimize fragmentation, human-caused disturbance, and edge effects to Core Habitat by conserving contiguous Habitat and effective Linkages between patches of Core Habitat. In addition, conserve Habitat for the Mecca aster and Orocopia sage, for which this area provides Core Habitat in conjunction with that in the Mecca Hills/Orocopia Mountains Conservation Area.

    a. Conserve at least 44,977 acres of Core Habitat for the desert tortoise in the Riverside County portion of the area, and at least 270 acres in the City of Coachella portion. Protect individual tortoises within the area when allowed Development does occur. Priority will be given to conserving Core Habitat in the Desert Wildlife Management Area for desert tortoise delineated in the NECO Plan.

    b. Conserve at least 1,855 acres of Core Habitat for the Mecca aster in the Riverside County portion of the Conservation Area.

    c. Conserve at least 398 acres of Core Habitat for the Orocopia sage in the Riverside County portion of the Conservation Area.

3. Conserve at least 25,319 acres of Other Conserved Habitat for Le Conte's thrasher in the Riverside County portion of the area, and at least 270 acres in the City of Coachella portion. Conserve Le Conte's thrasher nesting sites as described in Section 4.4 avoidance, minimization, and mitigation measures.

4. Conserve at least 6,771 acres of the desert dry wash woodland natural community in the Riverside County portion of the area, and at least 109 acres in the City of Coachella portion. Maintain the current capacity for flows in the washes that maintain desert dry wash woodland. This natural community provides Habitat for riparian birds and other Covered Species.

5. Conserve at least 14,143 acres, such that the functionality of each individual Biological Corridor listed below is not compromised, to maintain Linkages between the Joshua Tree National Park Conservation Area and the Mecca Hills/Orocopia Mountains Conservation Area and Biological Corridors under I-10 for desert tortoise, and to maintain ecosystem function for Covered Species.

    a. Conserve Corridor 1, centered on Thermal Canyon.

    b. Conserve Corridor 2 centered on the E. Cactus City Wash and Hazy Gulch culverts.

    c. Conserve Corridor 3 centered on the Happy Gulch culvert.

    d. Conserve Corridor 4 centered on the Desperation Arroyo culvert.

e. Conserve Corridor 5 centered on the Desperation Arroyo, West Buried Mountain Wash, Buried Mountain Wash, Resurrection Wash, West Saddle Gulch, Saddle Gulch, West Cotton Gulch, Cotton Gulch, East Cotton Gulch, and Paul Gulch culverts.

Aside from the freeway bridges and culverts and any Existing Use areas, which are unavoidably narrow segments, the Biological Corridors shall expand to one mile wide to minimize edge effects.

6. Maintain the bridges on I-10 and the culverts under I-10 associated with the aforementioned corridors so as not to affect the existing hydrological regime and Biological Corridors.

Mecca Hills/Orocopia Mountains Conservation Area Conservation Objectives.

1. In total, 23,670 acres of the Mecca Hills/Orocopia Mountains Conservation Area shall be conserved. (This may be less than the sum of acres indicated in the following objectives because there can be overlap among areas covered by the objectives. For example, Core Habitat for two or more species may overlap, or Core Habitat and an Essential Ecological Process area may overlap. The individual acreage figures will be used in compliance monitoring.)

2. Conserve Core Habitat for Mecca aster, Orocopia sage, and desert tortoise (as set forth below), allowing evolutionary processes and natural population fluctuations to occur. Minimize fragmentation, human-caused disturbance, and edge effects to Core Habitat by conserving contiguous Habitat patches and effective Linkages between patches of Core Habitat.

   a. Conserve at least 4,181 acres of Core Habitat for the Mecca aster.

   b. Conserve at least 16,227 acres of Core Habitat for the Orocopia sage.

   c. Conserve at least 23,617 acres of Core Habitat for the desert tortoise. Protect individual tortoises within the area when allowed Development does occur.

3. Conserve at least 5,866 acres of Other Conserved Habitat for Le Conte's thrasher. Conserve Le Conte's thrasher nesting sites as described in Section 4.4 avoidance, minimization, and mitigation measures.

4. Conserve at least 2,861 acres of the desert dry wash woodland natural community, which provides Habitat for the riparian birds and other Covered Species.

<u>Dos Palmas Conservation Area</u> <u>Conservation Objectives</u>.

1. In total, 12,870 acres of the Dos Palmas Conservation Area shall be conserved. (This may be less than the sum of acres indicated in the following objectives because there can be overlap among areas covered by the objectives. For example, Core Habitat for two or more species may overlap, or Core Habitat and an Essential Ecological Process area may overlap. The individual acreage figures will be used in compliance monitoring.)
2. Conserve Core Habitat for crissal thrasher; and Habitat for the California black rail and Yuma clapper rail as set forth below, allowing evolutionary processes and natural population fluctuations to occur. Minimize fragmentation, human-caused disturbance, and edge effects to Core Habitat by conserving contiguous Habitat patches and effective Linkages between patches of Core Habitat.
   a. Conserve at least 343 acres of Core Habitat for the crissal thrasher.
   b. Conserve at least 334 acres of Other Conserved Habitat for the California black rail.
   c. Conserve at least 374 acres of Other Conserved Habitat for the Yuma clapper rail.
   d. Conserve at least 6,689 acres of Other Conserved Habitat for Le Conte's thrasher. Conserve Le Conte's thrasher nesting sites as described in Section 4.4 avoidance, minimization, and mitigation measures.
4. Conserve at least 3,631 acres of Other Conserved Habitat for the flat-tailed horned lizard.
5. Conserve all known locations for the desert pupfish. Conserve newly found locations of this species in the area.
6. Maintain the refugium populations of the desert pupfish in accordance with the Desert Pupfish Recovery Plan.
7. Conserve at least 23 acres of the mesquite hummocks, at least 205 acres of the cismontane alkali marsh, at least 746 acres of the desert dry wash woodland, at least 134 acres of the arrowweed scrub, and at least 320 acres of the mesquite bosque natural communities, which provide Habitat for the riparian birds and other Covered Species. Where disturbance is authorized for cismontane alkali marsh and arrowweed scrub, ensure no net loss.
8. Conserve at least 50 acres of the desert fan palm oasis woodland for the conservation of the southern yellow bat.
9. Conserve at least 4,381 acres of the desert sink scrub natural community.
10. Remove tamarisk to improve Habitat values.

Coachella Valley Stormwater Channel and Delta Conservation Area Conservation Objectives.

1. In total, 3,870 acres of the Coachella Valley Stormwater Channel and Delta Conservation Area shall be conserved. (This may be less than the sum of acres indicated in the following objectives because there can be overlap among areas covered by the objectives. For example, Core Habitat for two or more species may overlap, or Core Habitat and an Essential Ecological Process area may overlap. The individual acreage figures will be used in compliance monitoring.)
2. Conserve at least 781 acres of Core Habitat for crissal thrasher, allowing evolutionary processes and natural population fluctuations to occur. Minimize fragmentation, human-caused disturbance, and edge effects to Core Habitat by conserving contiguous Habitat patches and effective Linkages between patches of Core Habitat.
3. Conserve at least 706 acres of Other Conserved Habitat for Le Conte's thrasher.
4. Establish 66 acres of permanent Habitat for California black rail and Yuma clapper rail in this area to replace the Habitat that is periodically altered by flood control and drain maintenance activities.
5. Establish permanent riparian Habitat including at least 44 acres of Sonoran cotton-wood-willow riparian forest in this area to replace the Habitat that is periodically altered by flood control maintenance activities.
6. Restore and enhance wetlands Habitat as Feasible.
7. Conserve occupied burrowing owl burrows as described in Section 4.4 burrowing owl avoidance, minimization, and mitigation measures.
8. Establish 25 acres of permanent replacement Habitat for pupfish and maintain a desert pupfish population in the agricultural drains.
9. Conserve at least 67 acres of mesquite hummocks, at least 713 acres of the desert saltbush scrub, at least 1,026 acres of desert sink scrub, and at least 51 acres of coastal and valley freshwater marsh natural communities, which provide Habitat for riparian birds and other Covered Species. For the remaining acreage of the coastal and valley freshwater marsh natural community where disturbance is authorized by the Plan, ensure no net loss.
10. Remove tamarisk to improve Habitat values.

Santa Rosa and San Jacinto Mountains Conservation Area Conservation Objectives.

1. In total, 55,890 acres of Santa Rosa and San Jacinto Mountains Conservation Area shall be conserved. (This may be less than the sum of acres indicated in the following objectives because there can be overlap among areas covered by the objectives. For example, Core Habitat for two or more species may overlap, or Core Habitat and an Essential Ecological Process area may overlap. The individual acreage figures will be used in compliance monitoring.)
2. As of June 2003, conserve at least 19,205 acres of Essential Habitat for Peninsular bighorn sheep in the Riverside County portion of the Conservation Area, at least 97 acres in the City of Cathedral City portion, at least 1,158 acres in the City of Indian Wells portion, at least 2,545 acres in the City of La Quinta portion, at least 130 acres in the City of Palm Desert portion, at least 7,211 acres in the City of Palm Springs portion, and at least 450 acres in the City of Rancho Mirage portion. Ensure that any Development allowed does not fragment Core Habitat, and that edge effects from such Development are minimized.
3. As of June 2003, conserve at least 7,930 acres of known and potential gray vireo Habitat in the unincorporated portion of the Conservation Area, and at least 3,883 acres in the City of Palm Springs portion. Minimize fragmentation, human-caused disturbance, and edge effects to Core Habitat by conserving contiguous Habitat patches and effective Linkages between them.
4. As of June 2003, conserve at least 5,508 acres of Other Conserved Habitat for Le Conte's thrasher in the unincorporated portion of this Conservation Area, at least 11 acres in the City of Cathedral City portion, at least 206 acres in the City of Indian Wells portion, at least 387 acres in the City of La Quinta portion, at least 33 acres in the City of Palm Desert portion, at least 560 acres in the City of Palm Springs portion, and at least 17 acres in the City of Rancho Mirage portion.
5. As of June 2003, conserve at least 23,856 acres of Other Conserved Habitat for desert tortoise in the unincorporated portion of this Conservation Area, at least 95 acres in the City of Cathedral City portion, at least 999 acres in the City of Indian Wells portion, at least 1,409 acres in the City of La Quinta portion, at least 436 acres in the City of Palm Desert portion, at least 8,856 acres in the City of Palm Springs portion, and at least 1,326 acres in the City of Rancho Mirage portion.
6. Conserve occupied burrowing owl burrows as described in Section 4.4 burrowing owl avoidance, minimization, and mitigation measures.

7. As of June 2003, conserve at least 15 acres of southern arroyo willow riparian forest in the unincorporated portion of the Conservation Area; for the remaining acreage of this natural community where disturbance is authorized by the Plan, ensure no net loss. Conserve at least 117 acres of southern sycamore-alder riparian woodland in the unincorporated portion of the Conservation Area and at least 24 acres of southern sycamore-alder riparian woodland in the City of Palm Springs portion of this Conservation Area; for the remaining acreage of this natural community where disturbance is authorized by the Plan, ensure no net loss. Conserve at least 58 acres of Sonoran cottonwood-willow riparian forest in the City of Palm Springs portion of the Conservation Area; for the remaining acreage of this natural community where disturbance is authorized by the Plan, ensure no net loss. Conserve at least 1,244 acres of the desert dry wash woodland natural community in the unincorporated portion of the Conservation Area, at least 18 acres in the City of Cathedral City portion, at least 66 acres in the City of Indian Wells portion, at least 76 acres in the City of La Quinta portion, at least 29 acres in the City of Palm Desert portion, at least 36 acres in the City of Palm Springs portion, and at least 9 acres in the City of Rancho Mirage portion.
8. As of June 2003, conserve at least 404 acres of the known desert fan palm oasis woodland natural community, which provides Habitat for the southern yellow bat, in the unincorporated portion of the Conservation Area; and at least 76 acres in the City of Palm Springs portion.
9. As of June 2003, conserve at least 2,093 acres of semi-desert chaparral in the unincorporated portion of the Conservation Area and at least 571 acres in the City of Palm Springs portion. Conserve at least 2,274 acres of red shank chaparral in the unincorporated portion of the Conservation Area. Conserve at least 2,899 acres of peninsular juniper woodland and scrub natural community in the unincorporated portion of this Conservation Area and at least 3,177 acres in the City of Palm Springs portion. Attainment of Goal 2 will also achieve this goal.

6.2 Mitigation Matrix for I-10 Interchange and Related Arterial Projects

To mitigate the impacts of the interchange and related arterial projects identified in Section 7.2.1 of the Plan, Caltrans, CVAG, and CVCC will acquire 1,795 acres in Conservation Areas in accordance with the mitigation matrix shown in Table A6-1.

Table A6-1: Mitigation Matrix for Interchange and Associated Arterials Projects

CDFG and USFWS agree that mitigation land may be purchased for I-10 interchange projects and associated arterials in the CV MSHCP proposed Conservation Areas as indicated in the matrix below. All parties recognize that the location of a parcel need not be reviewed and approved by CDFG or USFWS if the parcel is located in any of the Conservation Areas indicated in the matrix for the given interchange and associated arterial project. All parties recognize, however, that parcels must conform to CDFG and USFWS standards regarding clear title and land condition, e.g., parcels with liens or hazardous materials on site would not be acceptable to CDFG and USFWS.

	Conservation Area Where Mitigation May be Accomplished									
Interchange Project	Snow Creek/ Windy Point[1]	Highway 111/I10	Upper Mission Creek[2]	Mission Creek/ Morongo Wash	Whitewater Floodplain	Willow Hole	Edom Hill	Thousand Palms[1]	Indio Hills/Joshua Tree National Park Linkage[1]	East Indio Hills[1]
Indian Ave.	X	X	X	X	X	X				
Palm/Gene Autry			X	X	X	X			X	
Date Palm					X	X	X	X	X	
Ramon/Bob Hope						X	X	X	X	X
Jefferson								X	X	X

[1] Non mountainous portions only.
[2] Non mountainous portion of the Conservation Area east of Highway 62 only.

7.0 Take Authorization for Covered Activities and Term of Permit

7.1 Information on IID's Overhead Power Line "N50" Circuit Relocation in the Thousand Palms Conservation Area

N50 CIRCUIT RELOCATION

Scope of Work

Scope: Re-routing of distribution line along Thousand Palms Canyon Rd. (approx. 2 mi.) Job above described to be done on the N-50 circuit out of Sky Valley Sub.

Removal of approx. 2 mi of existing distribution line.

Location: Along Thousand Palms Canyon Rd and between Ave 28 and Ave 24.

Justification: This project was brought to IID's attention by the Bureau of Land Management (BLM) to relocate a portion of the existing N-50 circuit. This circuit is in conflict with Palm Oasis within Thousand Palms conservation area. Relocation of existing facilities will preserve existing habitat and will create easy access for IID's maintenance and operation personnel

1. Installation of new pole line

Description of Work	Equipment to be used
A. Delivering material to job site. - Approx. 28 wood poles with a length of 40' each.	Low bed truck w/crane.
B. Framing poles - Pre-assembling of wood pole structures, installing crossarms, braces, pin & dead end insulators. Quantity: approx. 28 poles	Line truck, foreman's truck

C. Excavation for pole installation - Trenching approx. 18" to 24" wide x 6' deep Quantity: approx. 28 units	Backhoe, line truck w/auger
D. Installing down guys - Installing steel screw anchors (10" x 5' in ground) - Installing steel galvanized wire to support poles at pole line dead ends and deflections. Quantity: approx. 4 units	Backhoe, line truck w/auger
E. Stringing conductor - Installing 4-3/0 AAC conductors on top of crossarms, attach them to insulators. Length: approx. 2 mi Quantity: approx 28 poles	Line truck, boom truck

2. Removal of existing pole line section in conflict

Description of Work	**Equipment to be used**
A. Removing conductor - De-energize conductors at both ends - Remove conductors from insulators - Pull & roll up existing conductor. Quantity: approx. 2 mi	Line truck, boom truck, Foreman's truck
B. Removing down guys - Remove steel screw anchors and galvanized wire Quantity: approx. 4 units	Line truck
C. Removal of existing equipment attached to poles Quantity: 3 units	Line truck, boom truck
D. Wood poles removal - Digging around wood poles - Pulling wood poles out Quantity: approx. 32 poles	Line truck, backhoe
E. De-assembling of wood pole structures - Remove crossarms, braces, insulators etc.	Line truck
F. Loading of all equipment and material removed	Low bed truck w/crane

8.0 MSHCP Reserve System Management & Monitoring Program

8.1 Background Information on Development of Niche Models

This process involves developing GIS-based models of habitat associations of the target species (see papers in Scott et al. 2002 for numerous examples). The variables available are those generated directly or calculated from existing area-wide GIS layers. This limitation is imposed by the desire to use these models to predict the likelihood of a species' occurrence (i.e., estimate "habitat quality") for any point within the Plan area. This can only be done for points for which there are values for all variables in any particular model and these variables need to be available as GIS-layers. For a variety of reasons, this is not likely to be a serious limitation. Most significantly, it means that the models will be based more on landscape-level rather than species-level (local-level) attributes.

The dependent variable for most of these models will be a GIS-layer that contains the geographical coordinate location of each observation of the target species (or species group). These points will come from museum specimen collection records, historical observations, personal observations from reliable sources, and surveys performed during the baseline phase or surveys by others. A layer of points at which the target was surveyed for, but at which it was not observed will also be developed. Because of detectability issues noted above, these "negatives" are considered less informative than "positives;" nevertheless, they can be used in certain types of modeling.

Potential independent ("predictor") variables for this habitat modeling are still being determined. It is likely that many will take the form of "percent of area within X meters of the point that consists of vegetation type Y." These sorts of variables are generated by placing a buffer of X-m radius around a point and recording the proportion of area within the resulting circle that consists of each vegetation type, including type Y. Others may summarize the structural configuration of vegetation types within the buffered area (e.g., number of different types, interspersion of different types, amount of edge or ecotone between different types). Yet others may take the form of "distance from the point to the nearest attribute Z," where Z might be a road, an urban boundary, a particular vegetation type, or any other GIS attribute that might be important.

Interpretation of high-resolution satellite images will likely yield attributes that may be important indicators of environmental quality for numerous species. In addition to trying to use "positive" variables (i.e., variables most likely to promote the presence of a species at a point), the models will attempt to use "negative" variables as well, especially those that are related to previously identified potential threats to the target species or vegetation type. Insofar as possible, models will use variables that quantify or capture variation associated with attributes that are potentially under management control.

During the next several years several modeling techniques will be applied and tested. Other potential modeling techniques will be used as they become available or appear suitable such that the following list is not comprehensive. Insofar as possible, we want to use variables that quantify or capture variation associated with attributes that are potentially under management control.

The modeling approaches initially identified for evaluation include:

1. *Mahalanobis* D^2 – we construct a multivariate vector of means (and their associated variances) for all of the variables in use for a target species based on their values over all points at which the species was observed. We can generate for every point in the study area its observed value for each of the variables, then calculate the "distance" between a point and the mean vector based on the variable-by-variable difference between them. The smaller the difference the smaller the distance, and the more the habitat at a point resembles the habitat at points where the species was seen. These distances can be rescaled such that they follow a Chi-squared distribution, and the values converted to a "probability of similarity" ranging from near zero to near one. A new GIS-layer can be generated showing the P-value for the entire study area. Examples include Clark et al. 1993 and Knick and Dyer 1997.

2. *Pearson's Planes* – While conceptually appealing and relatively easy to implement, under certain conditions D^2 fails to predict species' occurrences accurately, especially in a landscape that may be undergoing change (including change undertaken as part of desirable management activities; Knick and Rotenberry 1998). The Pearson's Planes technique is a method for partitioning D^2, with resulting partitioned distances being rankable from most to least relevant to a species' distribution (Rotenberry et al. 2002). The technique is based on a conceptual model of the ecological niche, one that assumes that an occupied point represents at least some minimally suitable configuration of habitat. As with D^2, every point on a map can be scored for its value on each plane, with smaller values (closer distances) associated with greater likelihood of a species' presence. Pearson's Planes will always be equal or superior to an unpartitioned D^2 in predicting distributions. A drawback is that interpretation of the planes in the context of the original measured variables is currently problematic; however, on the positive side the technique appears to be robust to the inclusion of irrelevant variables.

3. *Genetic Algorithm for Rule-set Prediction* – As does Pearson's Planes, GARP modeling

places primacy on point occurrence data, and is based on a concept of the ecological niche (Peterson et al. 2002). GARP tries, interactively, to find non-random correlations between the presence and absence of the species and the values of the environmental parameters, using several types of rules. Each rule type implements a different method for building species prediction models. Currently there are four types of rules implemented: atomic (simple presence/absence), logistic regression, bioclimatic envelope, and negated bioclimatic envelope rules (Stockwell and Peters 1999).

For a smaller set of points we will also have known "negatives," points that were surveyed but at which the target species was not observed. There are two forms of regression-type modeling that can be used for these data; each yields a regression equation that one may use to predict the value of a dependent variable for an observation (e.g., point on the map) based on the observation's scores on the original variables and a set of generated coefficients.

1. *Discriminant Function Analysis* – DFA is a linear technique similar to the familiar multiple regression, only the dependent variable is a class variable that takes on the values of "present" or "absent." The DF is a composite variable constructed so that the two classes are maximally separated along it. Each point has a score on the DF that is a linear combination of its values of the original variables, and one may also calculate the score of any other point (i.e., the rest of the map) for which one has measurements for the original variables. Using the DF scores and Bayes' Theorem one can estimate the probability that any point belongs to one class or the other. These classification probabilities can be plotted on a map of the project area.

2. *Multiple Logistic Regression* – Logistic regression is also similar to ordinary (linear) multiple regression, only the dependent variable is a class variable (usually given the values 0 or 1 denoting absence and presence of the target species), and a logistic (logit-transformed variables) rather than a linear model is fit. Output is the probability of class membership for any particular combination of original variables, which can be plotted on a map of the project area.

3. *Classification and Regression Tree* – CART analysis repeatedly partitions a dataset into homogeneous subsets (Breiman et al. 1984). In this case, subsets are points where the species was detected vs. where it was not. At each partition a value of one of the independent variables is found such that the variance between subsets is maximized and the variance within subsets is minimized. Under some, but not all circumstances CART can outperform logistic regression, discriminant function, and Mahalanobis D^2 in predicting species distributions (Dettmers et al. 2002).

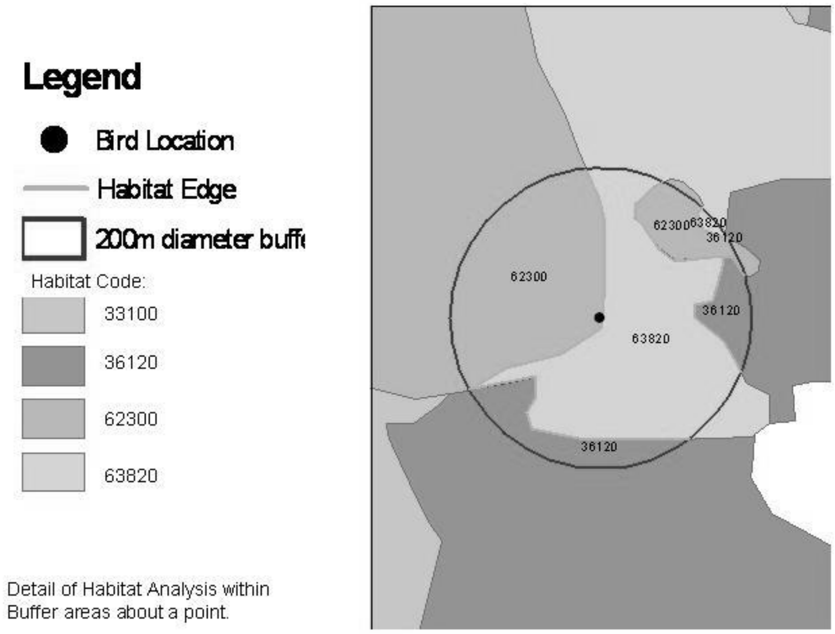
From Example Habitat Model: Riparian bird Species

Number of Sampling Points: This issue will be addressed initially using preliminary analysis of 2002 and 2003 survey data. At least for riparian birds there will be an upper limit to the number of points that can be sampled due to the limited amount of riparian vegetation type throughout the study region. For all species there will be a relatively small number of points associated with pre-existing observations (e.g., museum records). Some non regression-type modeling techniques, such as D^2, Pearson's planes, and GARP, appear to function fairly well even with relatively small numbers of observations, although this is true only so long as there is still a reasonable observations-to-variables ratio (Rotenberry et al. 2002, Peterson et al. 2002).

Distribution of Sampling Points: As noted above, an issue to be resolved is the distribution of sampling points. Randomly distributing points throughout the project area is not likely to be effective; with respect to riparian birds the sampling has been confined to riparian vegetation types. Within riparian corridors, however, the location of points was basically random with respect to locations of birds. Actual locations of points were constrained to a degree by local configuration of vegetation; some areas were not accessible simply because the understory was impenetrable. Such problems are likely to arise as well when sampling points need to be sited in newly targeted but previously unvisited areas. Truly random location of points will undoubtedly result in some placed in difficult-to-access areas, with the tradeoff that fewer points can be sampled for a given level of effort (time + number of observers).

GIS Analysis. A sample GIS analysis for creating a predictive species occurrence map is given below. Using ArcGIS software, a 200 m diameter circular buffer was drawn around each riparian bird observation location collected by UCR biologists during spring/summer 2002 (Figure 9.5). Within each buffered area, vegetation variables were summarized, and included: total area of each vegetation type (indicated by the different colored polygons in Figure 9.5), the total length of edge of each vegetation type (indicated by orange line segments in Figure 9.5), and the total number of vegetation types.

Figure A8-1: Detail of Habitat Analysis with Buffer Areas around a Point



Once these vegetation variables were calculated for the bird location points, they were calculated for a grid of points within Conservation Areas across the entire Plan area.

Figure A8-2a: Sample of Grid Points across the Plan Area

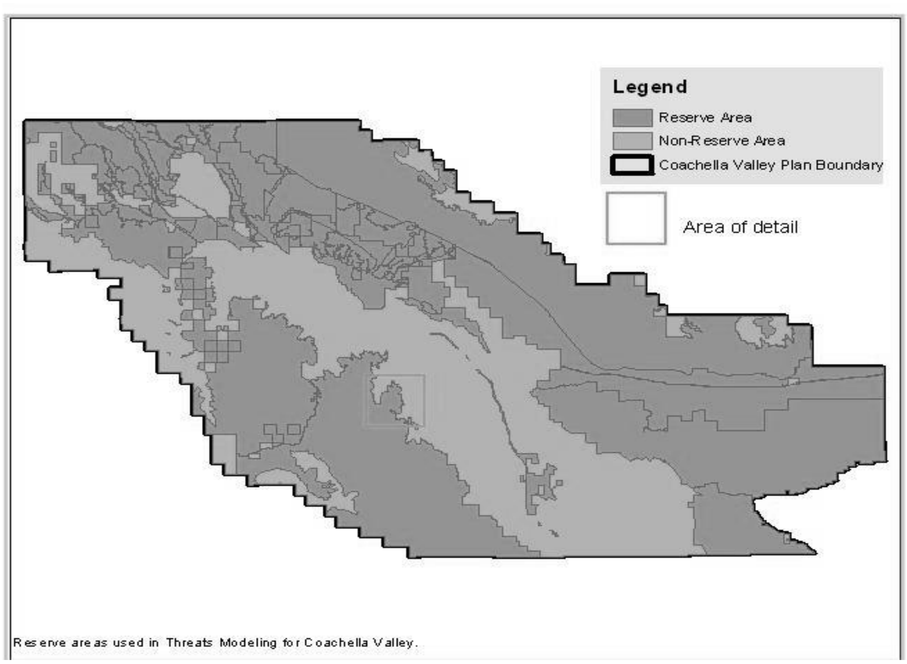
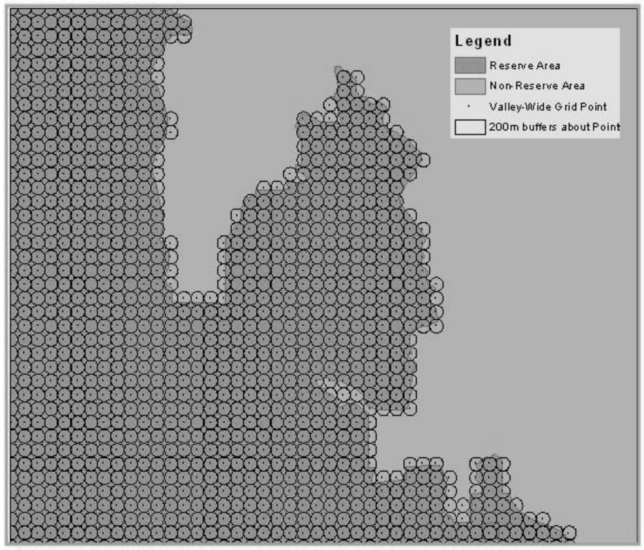


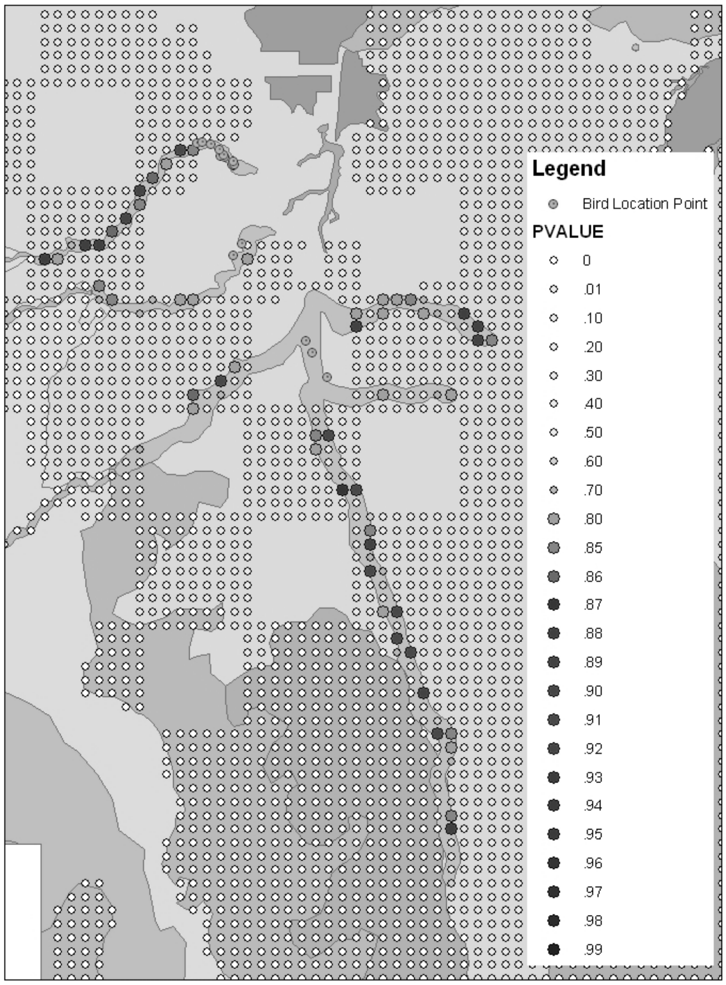
Figure A8-2b: Smaller Area of Detail with Grid of Points for Modeling



Area of Detail: Valley-Wide grid of points and buffer areas for Threats Modeling.

Once the vegetation variables were generated for the bird location points, and the valley-wide points, a statistical comparison was made to identify valley-wide points that showed similarity to bird location points. Those valley-wide points with the greater similarity to bird location points had higher p-values, and are indicated by the orange and pink dots in Figure A8-3.

Figure A8-3: Predictive Occurrence Map for Riparian Bird Species, Coachella Valley, Based on Vegetation GIS Layers and Bird Location Points Collected by UCR Bird Surveys



Predictive Occurence Map (in part) for Riparian Bird Species, Coachella Valley, based on vegetation GIS information and UCR bird surveys.

8.2 Various Approaches to Sampling

8.2.1 Community Classification Index

A subset of points identified in the predictive modeling of species distributions, and additional sites determined to be key contributing ecosystems to Coachella Valley Biodiversity will be visited and sampled to create an index to classify plant and animal communities. Our objectives are to obtain quantitative characterizations of communities that will be sensitive to detection of both natural dynamic and anthropogenic changes in community structure in time and space. Since species endangerment is most often a direct result of degraded community integrity, monitoring the health of communities must be one of our priorities. Populations of priority species are ideally monitored within the context of their relevant species assemblages so that real threats can be differentiated from natural processes, and so threats can be identified and managed before priority species are negatively affected.

1. *Plant Community Classification*: This will be a quantitative augmentation of the vegetation mapping data with an additional element of assessing levels of invasion by exotic species. Re-sampling and gathering more data on the same sites used in the vegetation mapping effort will enable greater accuracy in determining how communities change over time, and will establish confidence intervals for the vegetation mapping data.

2. *Invertebrate Community Classification*: In terrestrial sites, we anticipate that the primary focus will be Hymenoptera. This is because they play crucial roles in the food webs of the vertebrates in the plan, and some constitute a critical threat to many of the species in the plan. We are developing a rapid baited sampling of the dominant species of terrestrial ants and a longer-term pitfall sampling of terrestrial invertebrates, mainly ants and spiders. Other sampling strategies are being explored as needed. The main focus is on ants because they require little training or expertise for identification and are key species for community diversity. Healthy, diverse ant communities are resistant to invasion by the exotic ants (fire ants, argentine ants) identified as serious threats to priority species and community integrity.

3. *Vertebrate Community Classification*: Different assessment groupings (birds, amphibians, reptiles, large mammals, small mammals) have been identified and protocols are being developed for each. The desert pupfish and the desert bighorn sheep are being managed by CDFG independently of our effort.

4. *Remote Monitoring*: We are working through three projects funded by other entities to develop technologies for monitoring bird vocalizations. These systems will be deployed

simultaneously with the organism assessments to determine if these approaches are appropriate and can be utilized in future analyses.

Initially, we envision two teams of two people conducting simultaneous Assessments of Vegetation, Vertebrate, and Invertebrate Communities. Each team will sample two sites per morning for one hour per site. After each morning Rapid Assessment period, teams will create and maintain sampling arrays that require longer term investments (i.e. pitfall arrays, microphones, automated cameras) and monitor spatial and temporal variation at a subset of sites to be determined (mainly highly seasonal ecosystems where precise timing of sampling will be critical). Climatic factors and seasonal probability of detection of priority species will determine where and when teams will be assigned to sample sites. Field sampling protocols will be simple and well defined to minimize variation in data quality between personnel.

8.2.2 Conceptual Framework for Sampling by Species

The second approach for determining sampling locations will be based on habitat modeling. The original plan was based on habitat modeling based on visual differentiation of several characteristics such as sand types, vegetation, and other features. We will expand on this initial effort. We propose to link surveys designed to monitor the distribution and/or abundance of target species with our efforts to model habitat associations for those same species. On the one hand, monitoring data provide observations that can be incorporated into habitat association models; on the other hand, habitat association models can be used to indicate areas where monitoring activities should be located, due to the actual or expected presence of the target species (the latter of which can serve as tests of the models), or in anticipation of expected changes in habitat quality due to management or other activities. As noted above, there are different "types of rarity" associated with the species to be covered under the HCP, and the techniques discussed here pertain primarily to those that, at least in principle, could be distributed over a relatively large spatial extent (whether in a variety of different habitat types, or in only one habitat type, but one that is broadly distributed). In essence, we describe a *regional* (as opposed to local) monitoring/modeling effort (see, for example, Larsen et al. 2001, Yoccoz et al. 2001, Busch and Trexler 2003). For species that occur at only a few well-defined points, regional surveys as we describe them are not effective; instead, such taxa are better monitored by more focused surveys.

REGIONAL MONITORING SURVEYS. We assume that regional monitoring surveys for any target taxon or taxon group will consist of a network of "points" scattered throughout the plan area. An issue to be resolved is the distribution of these points, whether random throughout the entire area, random stratified by habitat/vegetation type, or placed according to the expectation of a taxon's presence at a point. We further assume that the precise methodology for assessing the presence of a target species (or species group) at a sampling point will be specific for that species. Such techniques are generally well-known to ornithologists, herpetologists, mammalogists, botanists, etc., and will be provided by them. Thus, "points" may consist of auditory/visual counts, small grids of traps, short transects, etc., and may differ in size. For longer transects we assume that the precise location of each detection of a target species will be recorded; these become "points" themselves.

We expect that for most points we will have a datum that indicates whether a target species was detected at that point during a specific sampling effort. (For habitat modeling we will also have an additional set of points at which the target species was observed independently from any formal surveys – see below). This implies that most points will be relatively small, that most of our data will be presence/absence, and that we are primarily concerned with a target's distributional extent rather than absolute abundance in any spatially-restricted area (although in practice the two are usually highly correlated over large spatial scales). For a variety of well-documented reasons, the number seen at points in a survey area invariably underestimates the number of individuals actually present; thus, it is necessary to also estimate "detectability," the probability that the target species will be observed at a point if it is, in fact, present. Because not all individuals are detected in any sample,

$C = Np$

where C = number counted, N = number actually present (our primary variable of interest), and p = probability of detection.

Obviously, $N = C / p$, which is why we are interested in estimating p.

Several statistical techniques have been developed to enable estimation of detectability under a variety of sampling schemes, which we illustrate using our on-going monitoring of sensitive riparian bird species.

Example - Riparian Bird Species

The basic sampling unit is a "point count," where an observer stands immobile at a particular spot and for a fixed period of time (15 min) records all target species seen and/or heard. Because several of these species are relatively inconspicuous and hence may have low probability of detection even when present, our counts at riparian points will focus only on the target species, generally ignoring other species (which represent a distraction to observers) that may also be present. The target species are Least Bell's Vireo, Southwestern Willow Flycatcher, Yellow Warbler, Yellow-breasted Chat, and Summer Tanager. We will also track Brown-headed Cowbirds, as they are considered a potential threat to several of the target species due to brood parasitism.
Avian point count data are recorded in such a way as to allow us to estimate a species' presence, detectability, and distribution using four different techniques.

1. *Distance-based method* – requires that we partition sightings of a target species during a count period among distance-from-the-point classes. In our case we use 0-25 m, 25-50 m, and > 50 m. Distance-based methods have a long history of use in estimating species abundances and densities, especially when coupled with line-transect sampling (e.g., Burnham et al. 1980). In current terminology, our points are considered to be transects of zero length, but the analytical technique remains the same (Rosenstock et al. 2002). (For other taxa, non zero-length transects may be more appropriate; they can easily be integrated into this analytical framework).

2. *Temporal-based removal method* – requires that we partition sightings of a target species during a count period among time intervals. We divide the 15-minute count period into four intervals, recording whether species are detected in the first (0-3:00), second (3:00-5:00) third (5:00-10:00), or fourth (10:00-15:00) interval. Removal models assume that once an individual is detected, it may no longer be counted at a subsequent time during the survey; thus, as individuals are detected, fewer are available to be detected in subsequent time intervals. This decline in numbers detected though time can be used to estimate the initial number of individuals present. Farnsworth et al. (2002) provide guidelines for using Program SURVIV (White 1983) to estimate detection probabilities.

3. *Double- or multiple-counting method* – requires multiple counts at points, usually using different observers. After making certain assumptions, observations made on multiple visits can be analyzed using mark-recapture techniques (e.g., Program MARK; White and Burnham 1999; MacKenzie et al. in press) or logistic regression (Manly et al. 1996). An appeal of this method is that the analytical techniques permit the use of covariates as well.

4. *Dual-frame sampling* – requires that we sample from a "list frame" (points at which the target species has been observed in the past) and an "area frame" (points at which the target species might occur) (Haines and Pollock 1998). If the target species is observed at an area frame point during a general sampling period, that point is moved to the list frame for the next sampling period; if the target is not observed at a list frame point, that point is moved to the area frame. This sampling technique dove-tails with our habitat modeling effort, as we will use the habitat model developed for a target species to develop the area frame.

It is not clear at this time which of these approaches will be most suitable for achieving our specific monitoring objectives. It is certainly possible that our explorations of these techniques will suggest that different ones may be more appropriate for different taxa. One major concern will be sufficiency of observations; some of the target taxa may be so uncommon as to generate an insufficient number of detections to apply some of these techniques successfully. Our best guess at the moment is that some combination of multiple-counting (e.g., MacKenzie et al. in press) and dual frame sampling (Haines and Pollock 1998) will best meet our needs.

HABITAT MODELING. We are developing GIS-based models of habitat associations of the target species (see papers in Scott et al. 2002 for numerous examples). This means that the variables we can use are those (and only those) that can be generated directly or calculated from existing area-wide GIS layers. This limitation is imposed by the fact that we wish to predict the likelihood of a species' occurrence (i.e., estimate "habitat quality") for any point within the study or plan area; we can only do so for points for which we have values for all variables in any particular model, and the only area-wide variables currently available are those in the GIS-layers. For a variety of reasons, we do not think this is likely to be a serious limitation. Most significantly, it means that our models will be based more on landscape-level rather than local-level attributes.

The dependent variable for most of our models will be a GIS-layer that contains the geographical coordinate location of each observation of the target species (or species group). These points will come from museum specimen collection records, historical observations, personal observations from reliable sources, and surveys performed by us and others. Secondarily, we will also develop a layer of points at which we know the target was surveyed for, but at which it was not observed. Because of detectability issues noted above, we consider these "negatives" less informative than "positives;" nevertheless, they can be used in certain types of modeling.

We are still developing candidate independent ("predictor") variables for our modeling. We imagine that many will take the form of "percent of area within X meters of the point that consists of vegetation type Y." These sorts of variables are generated by placing a buffer of X-m radius around a point and recording the proportion of area within the resulting circle that consists of each vegetation type, including type Y. Others may summarize the structural configuration of vegetation types within the buffered area (e.g., number of different types, interspersion of different types, amount of edge or ecotone between different types). Yet others may take the form of "distance from the point to the nearest attribute Z," where Z might be a road, an urban boundary, a particular vegetation type, or any other GIS attribute we guess might be important. Finally, we expect that interpretation of high-resolution satellite images will yield a wealth of yet-to-be-determined attributes that may be important indicators of environmental quality for numerous species. In addition to trying to use "positive" variables (i.e., variables we think likely promote the presence of a species at a point), we also wish to use "negative" ones, especially those that are related to previously identified potential threats to the target species or vegetation type.

INITIAL TEST CASE - RIPARIAN BIRD SPECIES IN COACHELLA VALLEY. Because no single target riparian bird species is likely to be very abundant or occur at many different points, and because most are broadly overlapping in general, if not specific, habitat affinities (mainly confined to riparian vegetation types, which occur in mostly discrete patches that are distinctly different from the surrounding matrix of desert vegetation), we will initially lump them together for habitat modeling purposes. In a trial run using data from the Coachella Valley, the model located potential sites that have not been surveyed but likely contain the birds of interest. These will be further explored this next growing season. All organisms will be surveyed using this approach.

One additional point that was generated was the sensitivity to the vegetation mapping. If this mapping is not accurate, the model suffers. For this reason, we stress the need for accurate, high-resolution vegetation maps. The CCB is participating in collaboration with CDFG and CNPS to develop such maps, and to increase the data associated with the maps to increase resolution (see habitat monitoring discussion).

1. *Number of Sampling Points*: This issue is yet to be addressed, but should become somewhat clearer once we undertake preliminary analyses of our riparian data. Unfortunately, at least for riparian birds there will be an upper limit to the number of points we can sample due to the limited amount of riparian vegetation type throughout the study region. For all species there will be a relatively small number of points associated with pre-existing observations (e.g., museum records). Some non regression-type modeling techniques, such as D^2, Pearson's planes, and GARP, appear to function fairly well even with relatively small numbers of observations, although this is true only so long as there is still a reasonable observations-to-variables ratio (Rotenberry et al. 2002, Peterson et al. 2002).

2. Distribution of Sampling Points: As noted above, an issue to be resolved is the distribution of sampling points. We do not think that randomly distributing them throughout the project area is effective; indeed, we have already acknowledged this with respect to riparian birds simply by the fact that we have confined our sampling to riparian vegetation types. Within riparian corridors, however, our location of points was basically random with respect to locations of birds. Actual locations of points were constrained to a degree by local configuration of vegetation; some areas were not accessible to us simply because the understory was impenetrable. Such problems are likely to arise as well when sampling points need to be sited in newly targeted but previously unvisited areas. Truly random location of points will undoubtedly result in some placed in difficult-to-access areas, with the tradeoff that fewer points can be sampled for a given level of effort (time + number of observers).

8.2.3 Conceptual Framework for Habitat Monitoring

VEGETATION ANALYSIS—BEYOND THE MAP. California wildlands are being subject to increasing exotic invasive plant invasion and experiencing fire, an ecological perturbation virtually unknown in the recent past. Coastal sage scrub (CSS) has experienced massive vegetation change to exotic annual grassland over the past 40 years, especially near urban areas where deposition is highest. Deserts have only recently been subject to such perturbation. Because of indirect effects on the environment (CO_2, precipitation, NO_x deposition), suburban humans can leave a footprint hundreds of km. Therefore, the conservation reserves will continue to be impacted by the changing environments. A critical biomass of 0.5 to 1T/ha dry biomass, stimulated by N deposition and produced during wet years, triggered fires and may initiate large-scale vegetation conversion (Fenn et al. 2003). These thresholds are characterized by rapid upward increase in % exotic species that is promoted by increased fire frequency. Our goals are to explore the relationships between areas occupied by exotic grasses and historical fire sites.

Standard techniques employing double sampling for percent cover and biomass of herbs, line transects for shrubs can be used (Mueller-Dombois & Ellenberg 1974) to assess vegetation change, particularly when coupled with vegetation mapping activities. Power analyses are used to determine adequate sample size. Richness can be measured by using a releve approach to detect infrequent species. Regression analysis, principle components analysis, and canonical correspondence analysis will be used to analyze vegetation data. Biomass of herbaceous vegetation will also be sampled to detect yearly variation and fuel load that might promote fire.

ANALYSIS. During the 2003 growing season, we will develop individual locations in collaboration with the resource agencies and incorporate a range of techniques at varying resolution going down to individual line transects. These analyses will allow us to determine areas where threshold values in exotic grass invasions threaten the sustainability of the particular reserve.

METHODS FOR REMOTE SENSING. Ultimately, there will be a need for assessing habitat conditions over larger areas than can be surveyed with regularity. A remote sensing approach is needed. Initially, leaf area index (LAI) can be assessed using 30-m resolution multispectral Thematic Mapper (TM) data. To assess small features crucial to particular species, greater detail can be gained using 4-m resolution multispectral images from the Ikonos satellite. The TM satellite data can be coupled to a bi-directional reflectance distribution function (BRDF) model by Nikolov (1999). This model has been successfully applied to AVHRR data to derive seasonal LAI over the western USA at 1-km resolution and may provide additional means of distinguishing native vegetation from exotic grasses in the remotely sensed images.

Satellite imagery data is improving in resolution and quality rapidly. Current methods include the new IKONOS imagery which can generate a pixel sizes down to $4m^2$, with features (such as shrubs) being identifiable at a 1m resolution. Specific features, such as sand dune edges, can be resolved at sample intervals limited only by the numbers of images acquired.

By linking satellite imagery and field sampling data, a scaling analysis can be used to integrate the habitat structure into a single framework for scaling-up/down. Such matrices can be mathematically linked to stability measures to detect ecological phase transitions or thresholds and relaxation time (Li, 2002).

SYNCHRONIZATION AND VARIATION OF POPULATIONS AND COMMUNITIES. Variation through both time and space is the dominant feature of the biota in Riverside County. Variation in space is addressed through metapopulation modeling and sampling of habitat types. However, variation through time is just as crucial. Although temperature is relatively predictable, precipitation can vary by almost an order of magnitude. This variation exists in the desert and includes the El Nino-Southern Oscillation (ENSO) phenomena and is also subject to the Pacific Decadal Oscillation (PDO). ENSO events have been occurring with a 3-5 year periodicity whereas the PDO occurs in decadal time scales. Although these appear to be independent, if both ENSO and PDO -negative or both positive anomalies occur simultaneously, they may feed back into each other. Double positives include the strong and wet El Ninos of the 1990s, and double negatives include the severe droughts of the 1950s 1890s, and 1680s (the year of the Pueblo Revolts in New Mexico). Projections are that we are entering a period of negative PDO when drought may begin to predominate.

Alternatively, some climatologists have modeled global change phenomena particularly focusing on the warming effect of elevated CO_2. Their projections use a warming ocean model similar to the El Nino phenomena and project increasing precipitation, particularly during the summer, for southern California (e.g., Bachelet et al. 2001).

In either case, populations of both plants and animals are synchronized with these large-scale climate drivers (e.g., Post and Forchhammer 2002). Plant responses are both direct and indirect. Direct, in that many of the sensitive species are water-limited annuals requiring average or above average precipitation to set seed. However, with high precipitation, exotic annual grasses also are highly productive, often out-competing native species (Eliason and Allen 1997) and providing fuel for fires in lowland areas (Fenn et al. 2003). Drought has some advantages in that grass competition can be curtailed, but seed production and annual plant germination can also be reduced. Animal populations are also tightly coupled with food resources.

Clearly, surveys cannot be undertaken on an arbitrary 5, 7, 8 or 10-year periodicity if trends are to be determined. Understanding the relationships between climate and biota, and between sensitive plants, exotic invaders, and animals of concern is going to be crucial for developing accurate monitoring protocols. Our goals are to begin working on relationships between climactic variables, NDVI, and metapopulation dynamics to generate an appropriate sampling periodicity.

8.3 Background on Monitoring: Aeolian Sand Community

Rainfall appears related to fringe-toed lizard reproductive patterns as well (Barrows and Fisher, in prep., Muth and Fisher, in prep., Figure 4). Even though fringe-toed lizard numbers have at times over the past 15 years dropped to nearly non-detectable levels (Figure 4), those declines have been associated with droughts; their numbers have always rebounded during average to above average rainfall years. Sounding alarms and calls for management actions during those drought-related natural declines would have been misguided and a waste of limited human resources. These weather data need to be related to habitat and species level monitoring data that are collected. Only through a thorough understanding of regional weather conditions and patterns, can large spatial scale conclusions be drawn regarding the relative importance of either anthropogenic or natural causes of changes in abundance of target species.

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Figure A8-4: Annual Fluctuation of Fringe-Toed Lizards at the Thousand Palms Preserve

Areal Extent of Habitat

In addition to using weather data to distinguish between human and natural caused changes, monitoring of the areal extent of the habitat is required. This monitoring becomes exceedingly important to 1) determine and quantify the ebb and flow of the extent of this dynamic sand dune habitat and the effects on target species, 2) assess future changes in landscape connectivity, and 3) evaluate the effects of changing proximity to human activities. Digital satellite imagery (Ikonos with four meter resolution, false-color infrared, Space Imaging Corporation, Boulder, CO) is now available and can be used to assess these changes (See example in Figure 5). These images are extremely useful in distinguishing and quantifying different levels of stabilization within the dune and hummock habitat matrix. The digital images are analyzed using ARCVIEW© 3.2 Geographic Information System (GIS, ESRI, Redlands, CA) with the Image Analysis extension. Using satellite imagery of the Coachella Valley Preserve area, the program was tasked to divide the habitat into 10 categories based on reflectance values. Four of the created categories dealt specifically with aeolian habitat (Figure 5) and appeared to make separations consistent with both particle size and compaction (Barrows, pers. obs.); the other six were upland habitats or areas of dense vegetation. Both of these variables have bearing on the relative abundances of the dune-associated species. Additionally, by having the GIS program "choose" the categories, the choices are without observer biases and are more likely to be repeatable and comparable to future images.

Due to the dynamics of this habitat, new digital images should be acquired and analyzed every two years. In this way, change analyses can be performed, directly indicating the extent of habitat gains and losses through time. Of highest priority is the quantity and distribution of the active aeolian habitat, a type clearly and accurately discerned by this kind of analysis. When active aeolian habitat is in decline, the images can be used to help develop hypothesis for that decline, and to evaluate the success of remedial management action that may be taken.

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Glossary

areas of high biological diversity—Although the term conservation site is often used to describe areas chosen through the process of reserve design and site identification, in actuality these are areas of biodiversity significance and different from sites as defined in site conservation planning. Although the planning effort may delineate rough or preliminary site boundaries or use other systematic units such as watersheds or hexagons as site selection units, the boundaries and the target occurrences contained within these areas are first approximations that will be dealt with in more specificity and accuracy in the site conservation planning process.

association—The finest level of biological community organization in the US National Vegetation Classification, defined as a plant community with a definite floristic composition, uniform habitat conditions, and uniform physiognomy. This is the system used in the California Native Plant Society's *Manual of California Vegetation* (Sawyer and Keeler-Wolf 1995). With the exception of a few associations that are restricted to specific and unusual environmental conditions, associations generally repeat across the landscape. They also occur at variable spatial scales depending on the steepness of environmental gradients and the patterns of distribution.

biological diversity—The variety of living organisms considered at all levels of organization including the genetic, species, and higher taxonomic levels. Biological diversity also includes the variety of habitats, ecosystems, and natural processes occurring therein.

biodiversity hot spot—Typically, a geographic location under a high degree of threat and characterized by unusually high species richness and large numbers of endemic species.

bioreserve—A landscape, large in size with naturally functioning ecological processes and containing outstanding examples of ecosystems (ecological systems), communities, and species which are endangered or inadequately protected.

coarse filter-fine filter approach—A working hypothesis that assumes that conservation of multiple, viable examples of all coarse-filter targets (communities and ecological systems) will also conserve the majority of species (fine-filter targets). The term coarse filter refers to targets at the community or system level of biological organization whereas coarse-scale refers to spatial scale of, for example, terrestrial targets that roughly cover 20,000–1,000,000 acres.

coarse-scale approach—Ecological systems or matrix communities are spatially large terrestrial targets referred to as coarse-scale. The coarse-scale approach is the first step in the portfolio assembly process where all coarse-scale targets are represented or "captured" in the ecoregion (including those that are feasibly restorable).

community—Natural or plant communities (also called terrestrial communities) are community types of definite floristic composition, uniform habitat conditions, and uniform physiognomy. Natural communities are defined by the finest level of classification, the "plant association" level of the National Vegetation Classification. Like ecological systems, terrestrial communities are characterized by both a biotic and abiotic component. Even though they are classified based upon dominant vegetation, we use them as inclusive conservation units that include all component species (plant and animal) and the ecological processes that support them.

connectivity—Conservation sites or reserves have permeable boundaries and thus are subject to inflows and outflows from the surrounding landscapes. Connectivity in the selection and design of nature reserves relates to the ability of species to move across the landscape to meet basic habitat requirements. Natural connecting features within the ecoregion may include river channels, riparian corridors, ridgelines, or migratory pathways.

conservation focus—Those targets that are being protected and the scale at which they are protected (e.g. local scale species and small patch communities; intermediate scale species and large patch communities; coarse scale species and matrix communities; and regional scale species).

conservation goal—In ecoregional planning, the number and spatial distribution of on-the-ground occurrences of targeted species, communities, and ecological systems that are needed to adequately conserve the target in an ecoregion.

conservation site—A site which maintains targets and their supporting ecological processes within their natural ranges of variability. A functional conservation site will conserve a small number of ecological systems, communities, or species at one or two scales below regional and targets tend to be relatively few, often sharing similar ecological processes.

conservation status—Usually refers to the category assigned to a conservation target such as threatened, endangered, imperiled, vulnerable, and so on.

conservation target (see target)

conservation value—A criterion in the site selection process that is based upon the number, diversity (scale, aquatic/terrestrial), and health of conservation targets.

Core Habitat—As defined by the SAC, Core Habitat for a given species is a habitat patch or aggregation of habitat patches that 1) is of sufficient size to support a viable population of that species; 2) is not fragmented by roads or unsuitable habitat; 3) has intact ecological processes; and 4) has effective corridors and connections to other habitats, where applicable, to allow gene flow among populations and to promote movement of large predators.

corridor—A route that allows movement of individuals or taxa from one region or place to another. In ecoregional planning, it is important to establish corridors among sites for conservation targets that require such areas for dispersal and movement. Focal species may help in designing corridors and linkages.

data dictionary - A data dictionary is a list that maintains, for each coverage, the names of the attributes and a description of the attribute values (including a description of each code, if necessary). Having a data dictionary for your database is invaluable as a reference during the project as well as for transferring information to others.

data layer (see GIS coverage)

decline/declining - For conservation targets, the historical or recent decline through all or part of its range. Declining species exhibit significant, long-term declines in habitat/and or numbers, are subject to a high degree of threat, or may have unique habitat or behavioral requirements that expose them to great risk.

Disjunct - Disjunct species have populations that are geographically isolated from other populations.

distribution pattern—The overall pattern of occurrence for a particular conservation target. In conservation projects, often referred to as the relative proportion of the target's natural range occurring within a given area (i.e. endemic, widespread, limited, disjunct, peripheral).

ecological communities (see community)

ecological drainage units (EDU)—Aggregates of watersheds that share ecological and biological characteristics. Ecological drainage units contain sets of aquatic systems with similar patterns of hydrologic regime, gradient, drainage density, & species distribution. Used to spatially stratify ecoregions according to environmental variables that determine regional patterns of aquatic biodiversity and ecological system characteristics.

ecological integrity—The probability of an ecological community or ecological system to persist at a given site is partially a function of its integrity. The ecological integrity or viability of a community is governed primarily by three factors: demography of component species populations; internal processes and structures among these components; and intactness of landscape-level processes which sustain the community or system.

ecological system (see terrestrial ecological systems or aquatic ecological system).

ecoregion—A relatively large area of land and water that contains geographically distinct assemblages of natural communities. These communities (1) share a large majority of their species, dynamics, and environmental conditions, and (2) function together effectively as a conservation unit at global and continental scales." Ecoregions were defined by Robert Bailey as major ecosystems resulting from large-scale predictable patterns of solar radiation and moisture, which in turn affect the kinds of local ecosystems and animals and plant found within.

edge effect—The influence of a habitat edge on interior conditions of a habitat or on species that use interior habitat. Greater amounts of edge habitat can often lead to deleterious effects on "interior" target species.

efficiency—A principle in which occurrences of coarse-scale ecological systems that contain multiple targets at other scales are given priority. This is accomplished through identification of functional sites and landscapes. In more academic literature, efficiency refers to conserving the greatest amount of biological diversity in the least amount of land area.

element—A term originating from the methodology of the Natural Heritage Network that refers to species, communities, and other entities (e.g., migratory bird stopovers) of biodiversity that serve as both conservation targets and as units for organizing and tracking information.

element occurrence (EO)—A term originating from the methodology of the Natural Heritage Network, including the California Natural Diversity Data Base, that refers to a unit of land or water on which a population of a species or example of an ecological community occurs. For communities, these EOs represent a defined area that contains a characteristic species composition and structure. In this Plan, element occurrences are referred to as known locations.

endangered species—A species that is federally listed or proposed for listing as Endangered by the U.S. Fish and Wildlife Service under the Endangered Species Act.

endemic—Species that are restricted to an ecoregion (or a small geographic area within an ecoregion), depend entirely on a single area for survival, and therefore, are often more vulnerable.

essential conservation area - Conservation areas that are required for the long-term viability of one or more target species or natural communities. Includes corridors for natural processes as part of essential area. Because a given conservation area was deemed essential does not mean that it, by itself, is sufficient to provide viability for a species.

feasibility—A principle used in this conservation planning process to include Core Habitat, ecosystem process, or linkage areas in the reserve design if they are suitable and contribute to conservation plan goals. Factors contributing to feasibility may include management considerations, the probability of success, and implementation strategies.

fine filter—To ensure that the coarse-fine filter strategy adequately captures all viable, native species and ecological communities, conservation planning also targets species that cannot be reliably conserved through the coarse-filter approach and may require individual attention through the fine filter approach. Wide-ranging, very rare, extremely localized, narrowly endemic, or keystone species are all likely to need fine-filter strategies.

Flagship species—Charismatic species, used to draw attention to an issue or to build support for reserve selection.

focal species—Focal species have spatial, compositional and functional requirements that may encompass those of other species in the region and may help address the functionality of ecological systems. Focal species may not always be captured in the portfolio through the coarse filter. This planning effort used The Nature Conservancy's approach, which defines wide-ranging and keystone as examples of focal species.

fragmentation—Process by which habitats are increasingly subdivided into smaller units, resulting in their increased insularity as well as losses of total habitat area. Fragmentation may be caused by humans (such as development of a road) or by natural processes (such as a tornado).

functionality—A principle to ensure all sites in a conservation area are functional or feasibly restorable to a functional condition. Functional sites maintain the size, condition, and landscape context within the natural range of variability of the respective conservation targets.

GAP (National Gap Analysis Program)—Gap analysis is a scientific method for identifying the degree to which native animal species and natural communities are represented in our present-day mix of conservation lands. Those species and communities not adequately represented in the existing network of conservation lands constitute conservation "gaps." The purpose of the Gap Analysis Program (GAP) is to provide broad geographic information on the status of ordinary species (those not threatened with extinction or naturally rare) and their habitats in order to provide land managers, planners, scientists, and policy makers with the information they need to make better-informed decisions.

georeference—Georeferencing establishes the relationship between objects on a planar map and known real-world coordinates, such as section corners.

GIS (Geographic Information System) - An organized system of computer hardware, software, and geographic data designed to efficiently capture, store, update, manipulate, analyze, and display all forms of spatial (geographically referenced) information.

GIS coverage—1. A digital version of a map forming the basic unit of vector data storage in ARC/INFO. A coverage stores map features as primary features (such as arcs, nodes, polygons, and label points) and secondary features (such as tics, map extent, links, and annotation). Associated feature attribute tables describe and store attributes of the map features. 2. a set of thematically associated data considered as a unit. A coverage usually represents a single theme, or layer, such as soils, streams, or roads.

habitat—The place or type of site where species and species assemblages are typically found and/or successfully reproducing. In addition, marine communities and systems are referred to as habitats. They are named according to the features that provide the underlying structural basis for the community.

habitat enhancement -- any manipulation of habitat that improves its value and ability to meet specified requirements of one or more Covered Species, including actions to reverse the effects of previous disturbance, control exotic species, and retain natural diversity.

indicator species—A species used as a gauge for the condition of a particular habitat, community, or ecosystem. A characteristic or surrogate species for a community or ecosystem.

indigenous—A species that is naturally occurring in a given area and elsewhere.

irreplaceable—The single most outstanding example of a target species, community, or system, or a population that is critical to a species remaining extant and not going extinct.

keystone species—A species whose impacts on its community or ecosystem are large; much larger than would be expected from its abundance. (e.g. beaver or prairie dogs)

landscape—A heterogeneous land area composed of a cluster of interacting ecosystems that are repeated in similar form throughout.

landscape level or landscape scale—Landscape level actions (conservation planning, monitoring) focus on geographically large areas with functional ecosystem processes and coarse-scale conservation targets

large patch—Communities that form large areas of interrupted cover. Individual occurrences of this community patch type typically range in size from 50 to 2,000 hectares. Large patch communities are associated with environmental conditions that are more specific than those of matrix communities, and that are less common or less extensive in the landscape. Like matrix communities, large-patch communities are also influenced by large-scale processes, but these tend to be modified by specific site features that influence the community.

linear communities—Communities that occur as linear strips are often, but not always, ecotonal between terrestrial and aquatic systems. Examples include coastal beach strands, bedrock lakeshores, and narrow riparian communities. Similar to small patch communities, linear communities occur in very specific ecological settings, and the aggregate of all linear communities covers, or historically covered, only a small percentage of the natural vegetation of an ecoregion. They also tend to support a specific and restricted set of associated flora and fauna. Linear communities differ from small patch communities in that both local-scale processes and large-scale processes strongly influence community structure and function.

linkage – A planned connection between habitat "islands" to provide protected movement opportunities and increased range for various species, thereby helping to maintain healthy populations and genetic diversity. *See corridors*

map units - The coordinate units in which a geographic data set (e.g., a coverage) is stored in ARC/INFO or ARCView. Map units can be inches, centimeters, feet, meters, or decimal degrees.

mapping precision - the accuracy with which a location of an observation or occurrence of a species or natural community has been mapped, dependent upon the original source of information.

matrix-forming or matrix communities—Communities that form extensive and contiguous cover may be categorized as matrix (or matrix-forming) community types. Matrix communities occur on the most extensive landforms and typically have wide ecological tolerances. They may be characterized by a complex mosaic of successional stages resulting from characteristic disturbance processes (e.g. New England northern hardwood-conifer forests). Individual occurrences of the matrix type typically range in size from 2,000 to 500,000 hectares. In a typical ecoregion, the aggregate of all matrix communities covers, or historically covered, as much as 75-80% of the natural vegetation of the ecoregion. Matrix community types are often influenced by large-scale processes (e.g. climate patterns, fire) and are important habitat for wide-ranging or large area-dependent fauna, such as large herbivores or birds.

maximum extent practicable—The biological standards as proposed by the SAC focus on maximizing conservation by incorporating natural features, artificial buffers (e.g. roads) and other features to the greatest extent possible.

metadata—Metadata documents the content, source, reliability, and other characteristics of data. Metadata are particularly important in the iterative conservation planning process because this documentation will expedite the review of existing tabular and geospatial data sets when a conservation plan is revisited and will minimize the likelihood of “lost” data.

metapopulation—A network of semi-isolated populations with some level of regular or intermittent migration and gene flow among them, in which individual populations may go extinct but can then be recolonized from other source populations (this is referred to as rescue effect).

minimum mapping unit—The minimum sizes or dimensions for features to be mapped as lines or areas for a given map scale. For example, long narrow features such as streams and rivers will be represented as lines if their width is less than 0.10 inch. If a polygon is smaller than .125 inch on aside, it will be represented as a point.

minimum dynamic area—The area needed to insure survival or re-colonization of a site following disturbance that removes most or all individuals. This is determined by the ability of some number of individuals or patches to survive and the size and severity of stochastic events.

mosaic—An interconnected patchwork of distinct vegetation types.

native—Those species and communities that were not introduced accidentally or purposefully by people but that are found naturally in an area. Native communities are those characterized by native species and maintained by natural processes. Native includes both endemic and indigenous species.

natural community — The array of native plants and animals, many of which are interdependent, in a given ecosystem. Often named for the principal type of vegetation in the community, for example, “desert dry wash woodland” and “active sand dunes.” This assemblage of plants and animals interacts with one another, the abiotic environment around them, and is subject to primarily natural disturbance regimes. Those assemblages that are repeated across a landscape in an observable pattern constitute a natural community type.

network of conservation sites—A reserve system connecting multiple nodes and corridors into a landscape that allows material and energy to flow among the various components.

nonhabitat matrix — A natural habitat that is unsuitable for the survival of the target species, usually adjacent to, interconnected with, or surrounding suitable habitat.

occurrence—Spatially referenced examples of species, communities, or ecological systems. May be equivalent to CNDDB Element Occurrences, or may be more loosely defined locations delineated through 1) the definition and mapping of other spatial data, or 2) the identification of areas by experts.

partnership—Collaborative relationship with a diverse array of public and private organizations, agencies, and individuals.

patch community—Communities nested within matrix communities and maintained primarily by specific environmental features rather than disturbance processes.

photo interpretation —A systematic examination of aerial photos, and frequently, other supporting materials such as maps and reports of field observations. Based on this study, an interpretation is made as to the physical nature of objects and phenomena appearing in the photographs. Interpretations may take place at a number of levels of complexity, from the simple recognition of objects on the earth's surface to the derivation of detailed information regarding the complex interactions among earth surface and subsurface features.

population viability analysis (PVA)—A collection of quantitative tools and methods for predicting the likely future status (e.g., likelihood of extinction or persistence) of a population or collection of populations of conservation concern. A PVA estimates the likelihood of population viability over a determinate time period, based on life history variables.

rangewide—Referring to the entire distribution of a species, community, or ecological system.

rapid ecological assessment (REA)—Technique for using remote sensing information combined with on-the-ground selected biological surveys to relatively quickly assess the presence and quality of conservation targets, especially at the community and ecosystem level.

representation—A principle of reserve selection and design referring to the capture of the full spectrum of biological and environmental variation within a network of reserves or conservation sites, including all genotypes, species, communities, ecosystems, habitats, and landscapes.

representativeness—Captures multiple examples of all conservation targets across the diversity of environmental gradients appropriate to the conservation Plan Area (e.g., temperature/moisture gradient, or some other physical gradient).

resolution—Resolution is the accuracy at which a given map scale can depict the location and shape of map features. For example, at a map scale of 1:63,360 (1 inch = 1 mile), features smaller than .10-mile long or wide only measure .10-inch wide or long on the map. The larger the map scale, the higher the possible resolution. As map scale decreases, resolution diminishes and feature boundaries must be smoothed, simplified, or not shown at all. For example, small areas may have to be represented as points.

satellite imagery—An image, which is a graphic representation or description of an object, that is typically produced by an optical or electronic device. Other common examples include scanned data and photographs. An image is stored as a raster data set of binary or integer values that represent the intensity of reflected light, heat, or another range of values on the electromagnetic spectrum. Remotely sensed images (such as satellite imagery) are digital representations of the Earth. Landsat and SPOT are two types of satellite imagery used in this Plan.

section—Areas of similar physiography within an ecoregional province; a hierarchical level with the U.S. Forest Service ECOMAP framework for mapping and classifying ecosystems at multiple geographic scales.

site (or conservation site)—Areas that are defined by the presence of conservation targets, are the focus of conservation action, and are the locus for measuring conservation success. Conservation planning identifies and selects conservation targets and locates occurrences of these targets. Based on geographic proximity, these target occurrences are grouped together into sites.

SITES—Software consisting of computerized algorithms designed specifically for The Nature Conservancy users in ecoregional planning to aid in selecting conservation sites.

small patch—Communities that form small, discrete areas of vegetation cover. Individual occurrences of this community type typically range in size from 1 to 50 hectares. Small patch communities occur in very specific ecological settings, such as on specialized landform types or in unusual microhabitats. The specialized conditions of small patch communities, however, are often dependent on the maintenance of ecological processes in the surrounding matrix and large patch communities. In many ecoregions, small patch communities contain a disproportionately large percentage of the total flora, and also support a specific and restricted set of associated fauna (e.g. invertebrates or herptofauna) dependent on specialized conditions.

source (of stress)—An extraneous factor, either human (i.e. activities, policies, land uses) or biological (e.g. non-native species), that infringes upon a conservation target in a way that results in stress.

spatial pattern—Within an ecoregion, natural terrestrial communities may be categorized into four functional groups on the basis of their current or historical patterns of occurrence, as correlated with the distribution and extent of landscape features and ecological processes. These groups are identified as matrix communities, large-patch communities, small-patch communities, and linear communities.

stakeholder—In a particular project or area, someone who: 1) would benefit if TNC achieved its project goals, 2) would be hurt, or believe they could be hurt by TNC's goals, 3) could shape public opinion about TNC's project even if it might not directly affect them, and 4) has the authority to make decisions affecting TNC's goals.

stratification—A hierarchical division of an ecoregion into nested, progressively smaller geographic units. Spatial stratification is used to represent each conservation target across its range of variation (in internal composition and landscape setting) within the ecoregion, to ensure long-term viability of the type by buffering against degradation in one portion of its range, and to allow for possible geographic variation.

stress—Something that impairs or degrades the size, condition, or landscape context of a conservation target, resulting in reduced viability.

sufficient conservation area—A conservation area that includes enough habitat to contain a viable population size of one or more target species. The inclusion of one or more additional conservation areas may be sufficient, but not essential, to the protection of a species.

target—Also called conservation target. An element of biodiversity selected as a focus for conservation planning or action. The three principle types of targets in this habitat conservation planning program are species, ecological communities, and ecological systems.

terrestrial ecological community—Plant community types of definite floristic composition, uniform habitat conditions, and uniform physiognomy. Terrestrial ecological communities are defined by the finest level of classification, the "plant association" level of the National Vegetation Classification.

terrestrial ecological systems—Dynamic spatial assemblages of ecological communities that 1) occur together on the landscape; 2) are tied together by similar ecological processes (e.g., fire, hydrology), underlying environmental features (e.g., soils, geology), or environmental gradients (e.g., elevation, hydrologically-related zones); and 3) form a robust, cohesive, and distinguishable unit on the ground. Ecological systems are characterized by both biotic and abiotic (environmental) components and can be terrestrial, aquatic, marine, or a combination of these.

threat—The combined concept of ecological stresses to a target and the sources of that stress to the target.

threatened species—Species federally listed or proposed for listing as Threatened by the U.S. Fish and Wildlife Service under the Endangered Species Act.

umbrella species—Typically wide-ranging species that require large blocks of relatively natural or unaltered habitat to maintain viable populations. Protection of the habitats of these species may protect the habitat and populations of many other more restricted or less wide ranging species.

urgency—A qualitative measure referring to the immediacy of severe threats—taking into account how severe the threat is and how likely it is to destroy or seriously degrade the targets.

viable/viability—The ability of a species to persist for many generations or an ecological community or system to persist over some time period. An assessment of viability will often focus on the minimum area and number of occurrences necessary for persistence. However, conservation goals should not be restricted to the minimum but rather should extend to the size, distribution, and number of occurrences necessary for a community to support its full complement of native species.

viable population—A population is considered viable if it contains an estimated 5,000 to 10,000 individuals for vertebrates, 10,000 to 20,000 individuals for invertebrates. These numbers imply a population of sufficient size to persist through fluctuations caused by environmental variation and to have a realistic potential for genetic interactions.

vulnerable—Vulnerable species are usually abundant, may or may not be declining, but some aspect of their life history makes them especially vulnerable (e.g., migratory concentration or rare/endemic habitat). For example, sandhill cranes are a vulnerable species because a large percentage of the entire population aggregates during migration along a portion of the Platte River in Nebraska.

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