Title
Core 2 Refinement Workshop Report

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CORE 2 REFINEMENT WORKSHOP REPORT

Prepared by the

Center for Conservation Biology
University of California, Riverside

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Regional Conservation Authority

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Center for Conservation Biology

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Executive Summary

The County of Riverside and the City of Murrieta requested that the Regional Conservation Authority (RCA) consider a Criteria Refinement for Core 2 in Western Riverside County's Multiple Species Habitat Conservation Plan (WRC MSHCP). The purpose of this action is to determine if Core 2 can be sustained as a reserve and if WRC MSHCP funds could be more efficiently used in other core areas. The RCA requested a review of the biological research from the Center for Conservation Biology (CCB) that could be brought into their decision-making process. The CCB convened a distinguished group of scientists to review the implications of a Core 2 Criteria Refinement to biological resources. The group evaluated three general topics at a two-day workshop in order to provide this assessment.

Core 2 has been disturbed, particularly around the edges, since its designation as part of the WRC MSHCP in 2004. But, the central watersheds within Core 2 still support relatively undisturbed coastal sage scrub. Other core areas to the northwest and southeast, while unique and valuable, have different ecological features than Core 2. Therefore, it was unanimously agreed by the Core 2 Workshop participants that certain portions of Core 2 have elements not found elsewhere in the WRC MSHCP. Of particular value are the large patches of undisturbed coastal sage scrub, chaparral, and riparian habitats in the center of Core 2 and the undisturbed as well as disturbed but potentially restorable lands providing connectivity between Core 2 and other core areas to the east and west. This assessment was based upon several factors. These include:

- Core 2 contains locations important in the distribution and population structure of the Quino checkerspot butterfly,
- Core 2 may provide linkage between eastern and western populations of California Gnatcatchers,
- There appears to be a lower potential for type conversion of coastal sage scrub to non-native grassland within the central portion of Core 2,
- Core 2 provides a crucial linkage within the WRC MSHCP network.

There are datasets that are needed to make conclusive assessments that are beyond the time and resource scope of this evaluation. Additional ecological studies of the species involved as well as population and community responses in a networking context, would be very helpful in predicting exactly what portions of Core 2, and linkage elements connecting Core 2 to the surrounding cores, are needed to finalize the reserve structure.

Introduction

The Western Riverside County Multiple Species Habitat Conservation Plan (WRC MSHCP, hereafter "the Plan") is a multi-jurisdictional plan that was adopted to conserve 146 sensitive plant and animal species and their natural habitats in the 1.26 million acre plan area (County of Riverside 2003). Covered Species are the 118 sensitive species considered to be adequately protected over the long term through implementation of the Plan. The remaining 28 species will be considered protected after certain specific conservation measures are undertaken. The Plan is to conserve over 500,000 acres, of which 347,000 are currently under Public/Quasi-Public ownership and the remaining 153,000 acres are to be purchased or otherwise conserved.

The Plan was developed through a consensus of biologists, stakeholders, state and federal agencies, and local governments. It is based on a system of 20 core areas, 10 noncontiguous Habitat Blocks, and 28 Linkages, all but one of which are considered constrained (Figure 1). According to the WRC MSHCP (County of Riverside 2003, p. 3-24), a Core Area is defined as "a block of habitat of appropriate size, configuration, and vegetation characteristics to generally support the life history requirements of one or more Covered Species." A Noncontiguous Habitat Block is a "block of habitat not connected to other habitat blocks". A Linkage is defined as a "connection between Core Areas with adequate size, configuration and vegetation characteristics to generally provide for "Live-In" Habitat and/or provide for genetic flow for identified Planning Species". In contrast, a Constrained

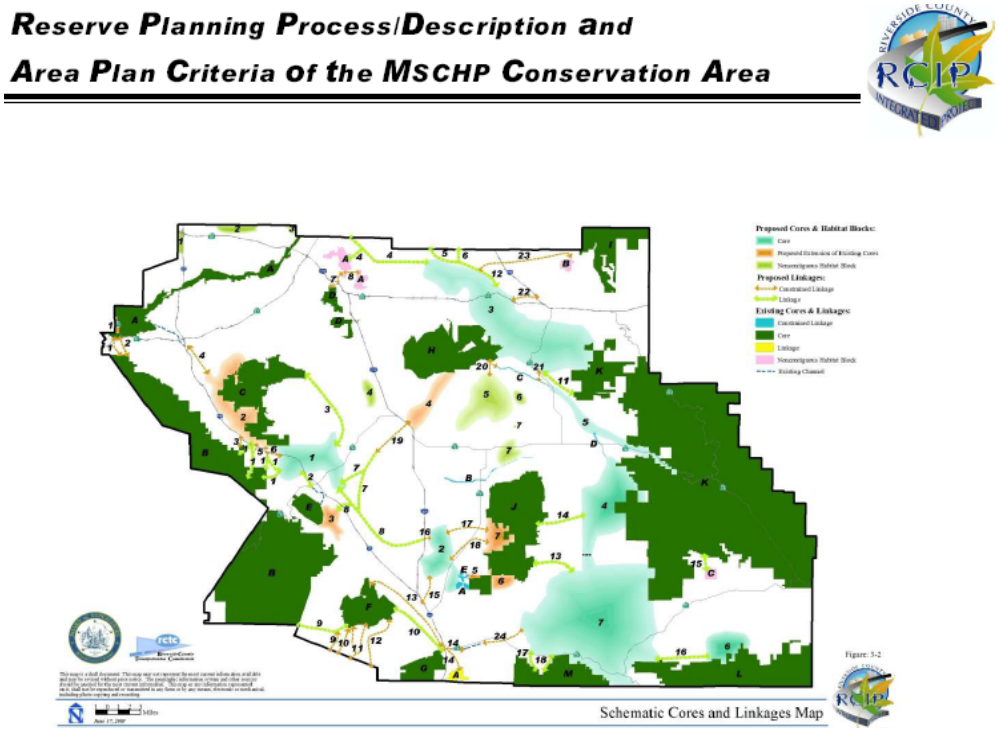

Figure 1. Core and Linkage Areas for the WRC MSHCP Conservation Area (County of Riverside 2003).

Linkage is a "constricted connection expected to provide for movement of identified Planning Species between Core Areas, but where options for assembly of the connection are limited due to existing patterns of use."

The following criteria were evaluated in developing the Plan:

- The distribution of remaining wildlands and existing reserves in western Riverside County in 2001.
- A classification system that divided the wildlands of western Riverside County into four categories: (a) proposed Core Areas and Habitat Blocks, (b) proposed Linkages, (c) existing Core and Linkage areas, and (d) lands where development could occur with the least damage to covered species.
- Management requirements for the persistence of species covered under the plan, including the federally-endangered Quino checkerspot butterfly (*Euphydrydas editha quino*) and federally-threatened California Gnatcatcher (*Polioptila californica*).

The proposed Reserve is composed of a Criteria Area from which the 153,000 acres of land to be conserved will be selected and purchased (County of Riverside 2003). While the exact configuration of parcels to be purchased for conservation is not designated in the WRC MSHCP, a percentage of lands falling within Criteria Areas are required to assemble the Reserve. Lands outside the Criteria Areas are free to be developed. An important component of the Plan is that local jurisdictions are given more oversight and control of the development approval process and the ability to issue permits resulting in "take" of endangered or threatened species. The intention of the Plan is to adequately conserve sensitive species and habitats while facilitating economic growth and development.

Issues and Request

The County of Riverside and the City of Murrieta requested that the Regional Conservation Authority (RCA) consider a Criteria Refinement for Core 2 to determine if Core 2 can be sustained as a reserve and if MSHCP funds could be more efficiently used in other core areas. Core 2 and the surrounding region has been one of the fastest growing suburban areas within the WRC MSHCP since the late 1990's. Land values have appreciated in Core 2, such that the cost of habitat (land) acquisition is much higher than in most other core areas. Prompted by these issues, some stakeholders suggested that the biological resources in Core 2 could be found in other, more manageable, areas at a far lower cost. The RCA was asked to undertake a "criteria refinement" to review the status of Core 2 and the land acquisitions required to complete the Reserve. The criteria refinement process allows for changes to the Plan as long as there is no net reduction in Criteria Area, the replacement lands proposed with the refinement must be biologically equivalent or superior, must clearly benefit Covered Species and be consistent with conservation goals, and be consistent with the reserve assembly accounting process (County of Riverside 2003; Regional Conservation Authority 2006). As part of the process, a biological equivalency analysis is undertaken to evaluate the impacts of refinements to Core 2 on Covered Species.

The RCA requested that the Center for Conservation Biology (CCB) at the University of California Riverside review the biological issues that could be considered in the decision-making process. The CCB convened a group of highly qualified scientists to review

how a Core 2 refinement might affect biological resources. The group evaluated three general topics at a two-day workshop in order to provide an assessment of the biological implications of a Core 2 refinement. These are the questions that framed the discussion:

1. Are the biological resources for which Core 2 was designated for protection found in other areas of the WRC MSHCP and are these areas equivalent in biological value? More specifically:
   a) Is Core 2 an irreplaceable element of the WRC MSHCP or can the Plan's objectives be met in other areas of the MSHCP without inclusion of Core 2?
   b) What information is available to make these comparisons and what information may be lacking?
   c) Does Core 2 provide important source habitat for the Quino Checkerspot Butterfly (QCB) and California Gnatcatcher that can't be obtained elsewhere within the WRC MSHCP?

2. Does Core 2 still provide the resources originally identified in the plan? More specifically:
   a) Does Core 2 retain adequate structural integrity and connectivity to allow it to serve as a sustainable reserve, or has the landscape changed to the point where Core 2 can no longer serve as a reserve core unit?
   b) Are there any new data, models or trend analyses that could clarify the sustainability of this unit?
   c) Is Core 2 critical to the long-term sustainability of the Quino checkerspot butterfly within the WRC MSHCP in light of potentially complex metapopulation dynamics?
   d) Does Core 2 provide habitat for the California Gnatcatcher that is unique within the WRC MSHCP?

3. What information is necessary to integrate assessments of irreplaceability (question #1) and long-term sustainability (question #2)? More specifically:
   a) Are there existing models or case histories where irreplaceability and sustainability have been balanced in a similar planning exercise?
   b) Are there updated scientific assessments of environmental change that would cause a re-evaluation of the biological value of Core 2?

These questions served as the framework for the CCB Workshop evaluation of biological resources in Core 2.

Background

Core 2 Description

The Plan includes the Core 2 area in the foothills between Murrieta and the Perris Plain. The WRC MSHCP (County of Riverside 2003, p. 3-62) describes Core 2 as:

> *Proposed Core 2*
>
> *Proposed Core 2 (Antelope Valley) is located approximately in the southwest region of the Plan Area. This Core Area consists largely of private lands but also contains small pieces of Public/Quasi-Public Lands. Connections from the Core are made through Proposed Constrained Linkages 15 (Lower Warm Springs Creek), 16, 17 (Paloma Valley), and 18. The Core is constrained in all directions by existing agricultural uses and urban Development. Though the Core has one of the highest P/A ratios of all MSHCP proposed or existing Cores, it is highly connected to other MSHCP conserved lands and is located only 1.1 miles from the nearest connected Core, Existing Core J (Lake Skinner/Diamond Valley Lake). This Core provides important Habitat for the Quino checkerspot, which has key populations in this area. This butterfly is restricted by the distribution and availability of its host plants, which in many areas have been replaced by non-native exotic weed species and habitat type conversion. Because of the large number of Covered Activities planned in this area and the constrained condition of the Core, management of edge conditions will be necessary in this area to maintain high quality habitat for the Quino checkerspot and other species using this Core.*

Planning Species

Planning Species are defined as "subsets of Covered Species that are identified to provide guidance for Reserve Assembly in Cores and Linkages and/or Area Plans" (County of Riverside 2003). Of the 146 sensitive species in the WRC MSHCP, there are 26 species that are considered Core 2 Planning Species (Table 1). Conservation of natural habitats and linkages in Core 2 was considered important for meeting WRC MSHCP's conservation goals for these species. Core 2 was identified in the Core 2 Criteria Refinement Work plan (Regional Conservation Authority 2006) as especially important for the QCB and California Gnatcatcher. These species will be addressed first, followed by the remaining Planning Species.

In addition to the Core 2 Planning Species identified in the Plan, two additional WRC MSHCP Covered Species may be relevant to a discussion of Core 2. Stephen's kangaroo rat (*Dipodomys stephensi*) and Engelmann oak (*Quercus engelmannii*) have been recorded in Core 2. The kangaroo rat is federally-endangered and the Engelmann oak population in Core 2 provides a potential connection between populations in the Santa Ana Mountains (e.g., Santa Rosa Plateau) and eastern populations in areas such as the Diamond Valley Core Reserve.

Geographic Structure of Core 2

Prior to the completion of the WRC MSHCP in 2004, Core 2 was becoming increasingly constrained by residential development along its margins. The Plan states that "the core is constrained in all directions by existing agricultural uses and urban development" (County of Riverside 2003, p. 3-62). As of 2005, there were 2,013 acres of

Table 1. WRC MSHCP Planning Species in Core 2.

Taxonomic Group	Common Name	Scientific Name
Plants	California Orcutt grass	*Orcuttia californica*
	Coulter's goldfields	*Lasthenia glabrata coulteri*
	Davidson's saltscale	*Atriplex sernana davidsonii*
	Little mousetail	*Myosurus minimus*
	Long-spined spineflower	*Chorizanthe polygonoides longispina*
	Munz's onion	*Allium munzii*
	Palmer's grapplinghook	*Harpagonella palmeri*
	Parish's brittlescale	*Atriplex parishii*
	Round-leaved filaree	*Erodium macrophyllum*
	San Diego ambrosia	*Ambrosia pumila*
	Smooth tarplant	*Centromadia pungens laevis*
	Spreading Navarretia	*Navarretia fossalis*
	Thread-leaved brodiaea	*Brodiaea filifolia*
	Wright's trichocoronis	*Trichocoronis wrightii*
Invertebrates	Quino checkerspot	*Euphydryas editha quino*
Reptiles	Western pond turtle	*Clemmys marmorata pallida*
Birds	Bell's Sage Sparrow	*Amphispiza belli belli*
	California Horned Lark	*Eremophila alpestris actia*
	California Gnatcatcher	*Polioptila californica*
	Ferruginous Hawk	*Buteo regalis*
	Grasshopper Sparrow	*Ammodramus savannarum*
	Swainson's Hawk	*Buteo swainsoni*
	Southern California Rufous-crowned Sparrow	*Aimophila ruficeps canescens*
Mammals	Bobcat	*Lynx rufus*
	Los Angeles pocket mouse	*Perognathus longimembris brevinasus*

residential and commercial development located within Core 2. Approximately 22% (468 acres) of this development occurred between 1994 and 2002 and 15% (310 acres) after 2002 (Figure 2). This trend of rapid development of natural lands does not appear to be slowing down as evidenced by the Core 2 Workshop field visit on June 19, 2006 that found a substantial amount of new development since late 2005, particularly at the northwestern and eastern edges of Core 2. Of the 8,807 acres of Criteria Area originally present in Core 2, 2,382 acres (27%) are used for agriculture and 4,413 acres (50%) remain in a natural state.

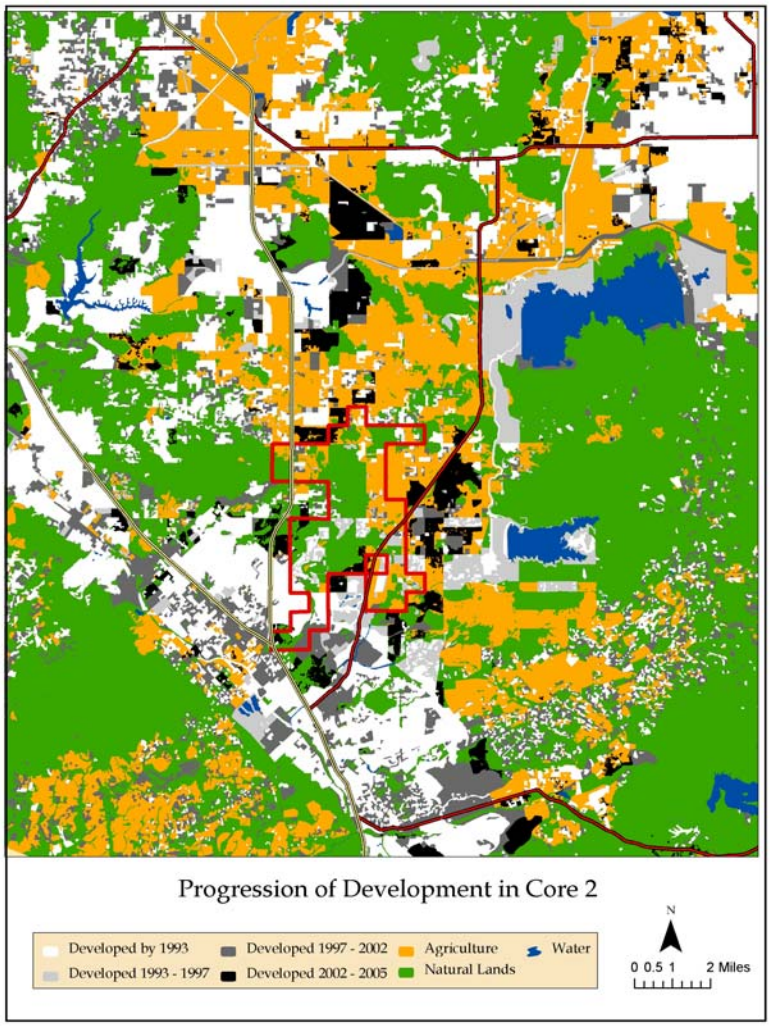

Figure 2. Progression of development in Core 2 from 1994 to 2005 (CCB unpublished).

Reserve Network Structure

Part of the rationale for the organization and structure of the WRC MSHCP is that the core areas, individually, are not large enough to protect all of the species of concern in the area (Chen et al. 2006). Instead, a core/linkage structure might create a single, networked reserve providing for populations that can sustain genetic diversity and, in the case of species that exhibit metapopulation dynamics, provide a means whereby local extinction can be equaled by colonization. The structure of the Criteria Areas, at least in theory, provides a relatively high degree of connectedness across the plan.

Core 2 is a potential critical link in this network approach because of its central location between core areas in the western and eastern portions of the Plan. Core 2 links existing Core J (Lake Skinner/Diamond Valley Lake) and other core areas to the east with Core Areas 1 and E to the west. While there are constraints in the linkages between Core 2 and the other core areas, these are shorter and contain more natural vegetation than for the

other constrained linkages (e.g., 7/19 and 14/ 24; see Figure 1) connecting western and eastern core areas.

Recent Scientific Data and Models Relevant to the Evaluation Process

New Vegetation Maps

The WRC MSHCP, adopted in 2004, was developed with a 1994 vegetation map supplemented by a 1997 development and land use layer. In November 2005, the California Department of Fish and Game (CDFG) released a new vegetation map for western Riverside County. This vegetation map was based on aerial photos taken in spring 2002. CCB staff used satellite imagery analysis and field visits to check the classification scheme and to update the map for development that had occurred between 2002 and November 2005. A visual comparison of the 1994 vegetation map with the CCB's modified CDFG 2005 vegetation map shows differences in vegetation classification (Figure 3). In particular, there are differences in the classification of coastal sage scrub and chaparral habitats within Core 2. A preliminary analysis of vegetation sampling points surveyed by CDFG and by the CCB for various projects shows that the 2005 map more accurately classifies vegetation than does the 1994 map (Figures 3 and 4, CCB Unpub. Data). In the 1994 map, much of Core 2 was described as chaparral. In contrast, in the recent 2005 vegetation map, a higher fraction of Core 2 that remains as natural vegetation is identified as coastal sage scrub, with patches of chaparral and riparian woodland.

Within Core 2 Criteria Cells, 50 percent of the land is developed for housing or agriculture (Table 2). Coastal sage scrub is the most abundant vegetation type followed by non-native grassland and chaparral. Warm Springs Creek runs through Core 2 and supports riparian and oak woodland habitats.

Of particular concern to this analysis is the classification of the vegetation present in Core 2, and the vegetation types further to the east in Cores 4 and 7. These areas have been suggested as areas to focus acquisition if undeveloped lands were lost in Core 2 as part of the refinement process. At issue is the protection of coastal sage scrub, one of the most vulnerable vegetation types harboring a number of species of concern. Specifically, in the

Table 2. Vegetation types in WRC MSHCP's Core 2 (from CCB-CDFG 2005 map)

Vegetation Type	Acreage	Percent
Agriculture	2,382	27.0
Developed	2,013	22.9
Coastal Sage Scrub	1,744	19.8
Chaparral	1,144	13.0
Non-Native Grassland	1,231	13.9
Oak Woodland	69	0.8
Riparian	219	2.5
Open Water	6	0.1
Total	**8,808**	**100.0**

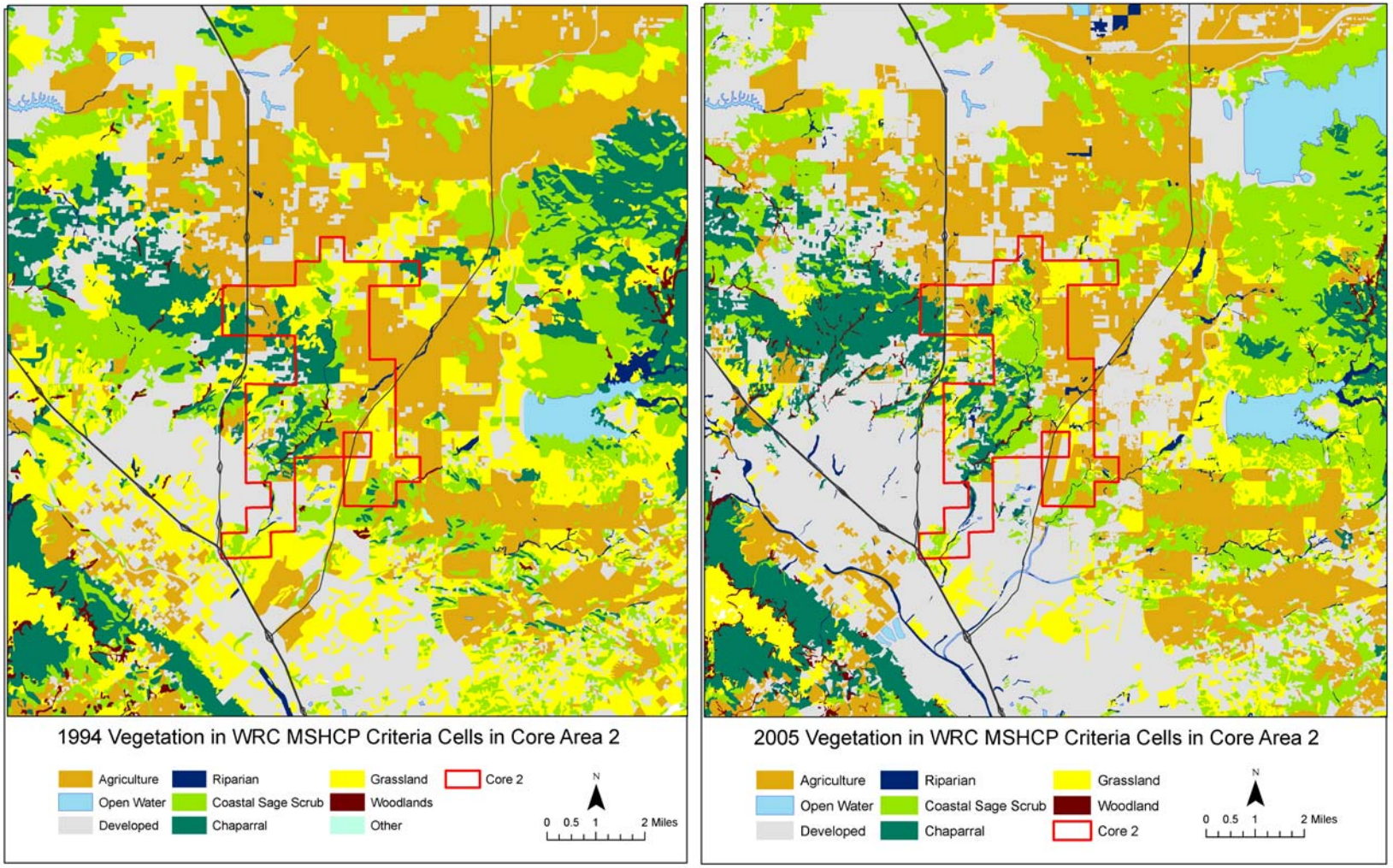

Figure 3. Differences between the 1994 vegetation map and the CCB updated CDFG 2005 vegetation map for Core 2.

1994 map, on which planning was based, a large amount of the vegetation in Core 7 is classified as coastal sage scrub (Figure 4). In the CCB revised 2005 CDFG vegetation map, portions of that coastal sage scrub have been reclassified as chaparral and other desert shrublands, distinct vegetation types hosting different species. Inland coastal sage scrub in Cores 4 and 7 support different plant and animal species compared with more westerly distributed coastal sage scrub within Core 2.

Niche Modeling

Scientists at the CCB recently refined a modeling approach, called a "niche model", for predicting suitable habitat for species of concern (Rotenberry et al. 2002, 2006). In brief, niche models are based on modeling techniques that use presence-only location data for each species to calibrate the models. The models are constructed with environmental variables calculated from Geographic Information Systems (GIS) layers. Environmental variables included in each species model are hypothesized to be important in determining the species distribution and can include climatic, topographic, vegetation, land use, soils, and hydrology variables. For each niche model, a Habitat Similarity Index (HSI) value is calculated for every point in a map grid of ~75,000 points overlaid on the WRC MSHCP study area. The HSI represents the similarity in environmental characteristics of any point in the map grid to the multivariate mean for locations where the species is known to occur. HSI values range from 0 to 1.0 with a 0 indicating that the location is very dissimilar to occupied habitat (unsuitable), whereas a 1.0 indicates that the point is most similar (suitable) to the multivariate mean for occupied habitat.

New Species Location Data

Since 2003 CCB staff has collected species location data to augment the initial database compiled by Dr. Scott at the University of California, Riverside for developing the WRC MSHCP. These data were obtained from museums and herbaria, government databases, environmental documents, local experts, the WRC MSHCP monitoring program, and from field surveys conducted by CCB personnel. These species location records are used to develop niche models identifying suitable habitat for species of conservation concern, as well as for more commonly occurring species. Currently the CCB has constructed niche models for 26 WRC MSHCP Covered Species including plant, invertebrate, reptile, bird, and mammal species. From 2002 to 2006, the CCB conducted field surveys and collected independent datasets to evaluate the performance of these models.

Species of Concern in Core 2

Quino Checkerspot Butterfly

Portions of Core 2 may be of particular importance in the conservation of the federally-endangered QCB. It is the northwest most location with consistent, recent detections of populations in the current known range of this subspecies. Data from the recovery plan contain spotty recent records in the Elsinore, Lake Matthews, Harford Springs, and Canyon Lake area, and many of these sites have been subsequently developed. There is no evidence that a viable population currently exists northwest of Core 2 (U.S. Fish and Wildlife Service 2003). QCB were regularly observed in Core 2 between 1998 and 2005, the last year for which survey data are available. The WRC MSHCP includes within the Criteria Area most of the extant, known populations within the Plan area.

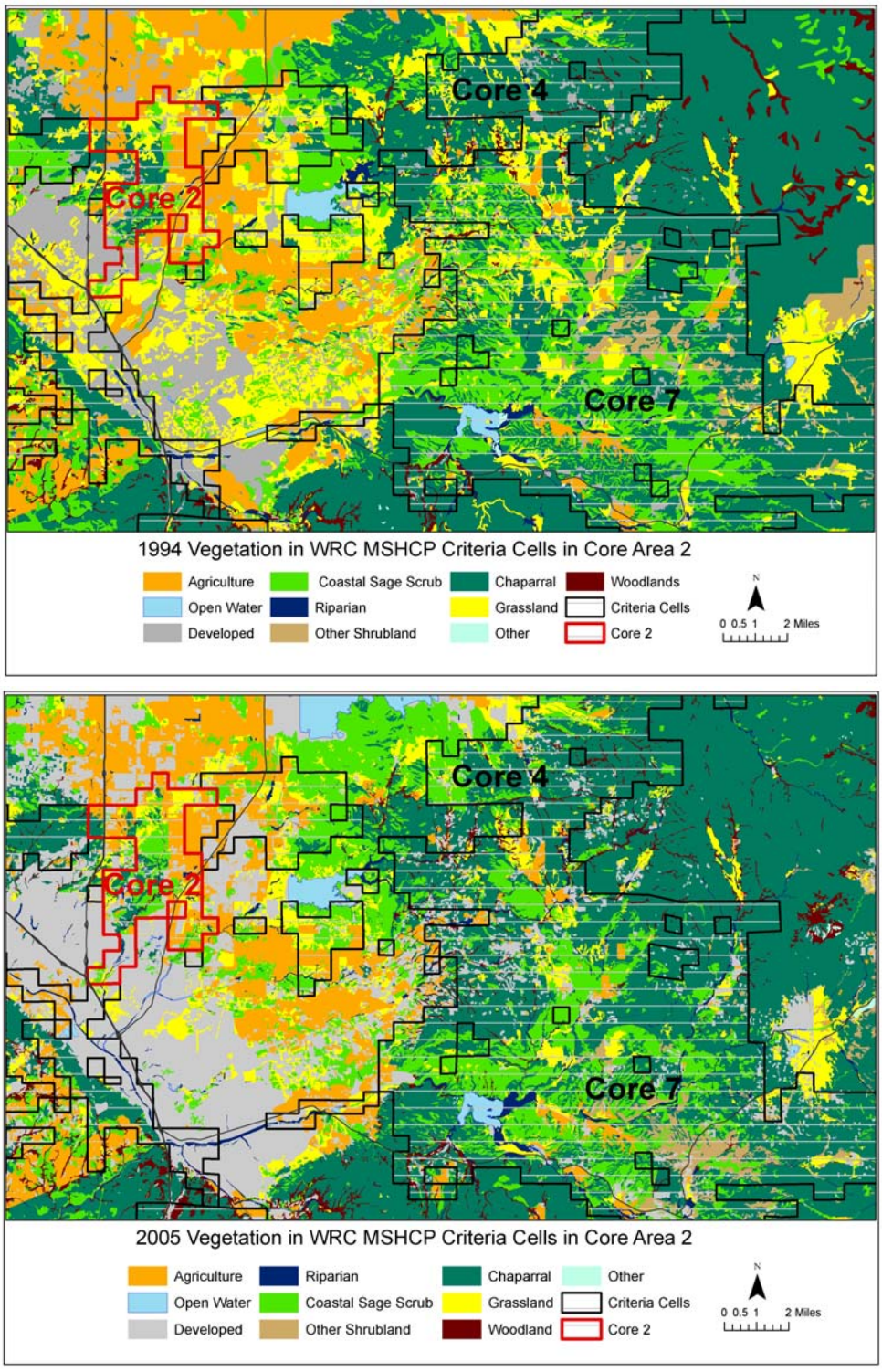

Figure 4. Differences in vegetation between the 1994 vegetation map and the CCB updated CDFG 2005 vegetation map for Core areas 2, 4 and 7.

The most important habitat requirements for QCB are the presence of sufficient populations of *Plantago erecta*, the primary larval host plant, other native annual flowering plants that provide food for pre-diapause larvae (e.g., *Castilleja exserta*), and nectar for flying adults (such as *Lomatium* spp., *Muilla* spp., *Amsinckia* spp., *Lasthenia* spp., U.S. Fish and Wildlife Service 2003). QCB occur in open coastal sage scrub and chaparral habitats with varying topography, including relatively flat lands for larval development and ridgelines with varied slope aspects for adult basking. *Plantago erecta* is found in small isolated patches in open shrublands where invasive annual grasses are sparse (Osborne and Redak 2000). The large-scale invasion of coastal sage scrub habitats by non-native annual grasses in the WRC MSHCP is reducing the distribution of *Plantago erecta* populations, thus limiting habitat available to QCB (Osborne and Redak 2000; U.S. Fish and Wildlife Service 2003). Restoration experiments with *Plantago erecta* demonstrate that competition from exotic grasses is probably the major factor limiting patch size and distribution of this key plant (Marushia and Allen 2005). The restoration treatments, aimed at increasing the abundance of *Plantago erecta*, include grass-specific herbicide, solarization to kill weed seed, and mowing. Although done at a small scale (≤1 acre), the study suggests restoration can be done economically on ≤ acre-sized patches. Restoration would be effective in areas where patches have been disturbed within a matrix of natural vegetation, or in designated corridors. The Core 2 area is especially suitable for restoration because it has somewhat higher precipitation (T. Scott Unpub. Data) than other areas of Riversidean coastal sage scrub, making it easier to establish native vegetation. In addition, Core 2 has relatively low levels of nitrogen deposition (see below), so exotic grasses will be easier to control.

CCB developed a niche model for QCB. In this model, Core 2 is at the northern and western edge of large patches of potentially suitable habitat overlapping with USFWS points showing recent populations, extending to the eastern and southeastern portions of the study area (Figure 5). Internal model validation indicates that the model performs moderately well at predicting known QCB occurrences (median HSI of the validation dataset = 0.7).

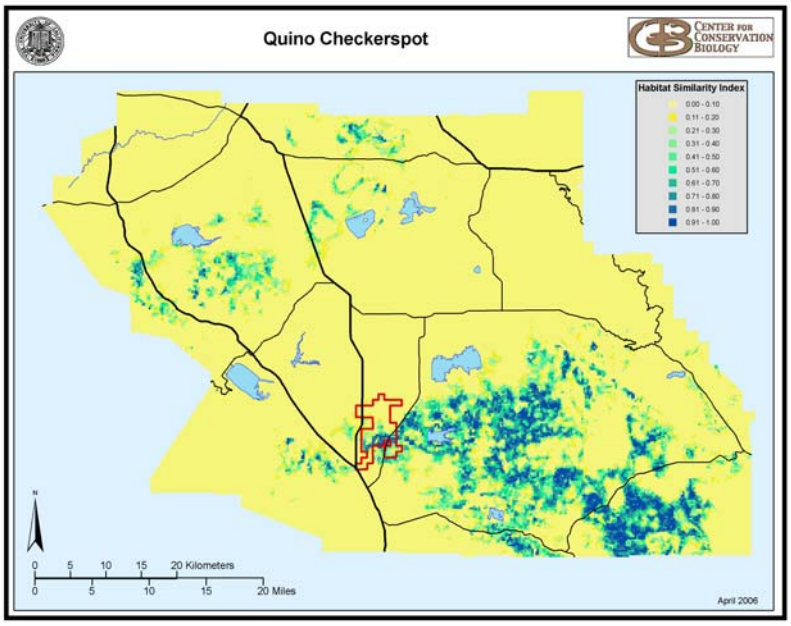

Figure 5. CCB niche model for the Quino checkerspot butterfly showing potential habitat.

California Gnatcatcher

California Gnatcatchers are commonly distributed throughout coastal sage scrub habitats in the valleys and lower foothills of the western half of the WRC MSHCP (Atwood and Bontrager 2001; County of Riverside 2003). Gnatcatchers occur in coastal sage habitats in the Core 2 region. Core 2 is located between large gnatcatcher populations in Sedco Hills (Linkage 8) to the west and the Shipley Skinner Multiple Species Reserve to the east (Core J). In contrast to the northwest and south-central portions of the MSHCP, there are relatively few gnatcatcher records from the eastern foothills despite substantial survey efforts in these areas. Only a few gnatcatchers have been recently reported from the Badlands (Core 3) and Cactus Valley (Core 4) areas. Repeated surveys in the Wilson Valley area (Core 7) have documented both California Gnatcatchers and Black-tailed Gnatcatchers *(Polioptila melanura)* in this transition zone between coastal sage scrub habitats and more arid desert scrub and sagebrush habitats to the east (CCB Unpub. Data); this represents one of the very few areas in southern California where the two species co-occur. In general, California Gnatcatchers are much more sparsely and unevenly distributed in the eastern foothills compared with more westerly locations.

CCB developed a niche model describing suitable habitat for California Gnatcatchers (Rotenberry et al. 2006). During 2005 and 2006 the CCB conducted surveys to collect data to test the model. A preliminary validation shows a very high median HSI of 0.93 for known occupied points indicating the model performs well in describing suitable habitat. The niche model (Figure 6) identifies coastal sage scrub in the western and central portions of the WRC MSHCP, including Core 2, as most suitable for California Gnatcatchers; coastal sage scrub habitats further east (especially Core 7, east of Vail Lake and Core 4) are less suitable.

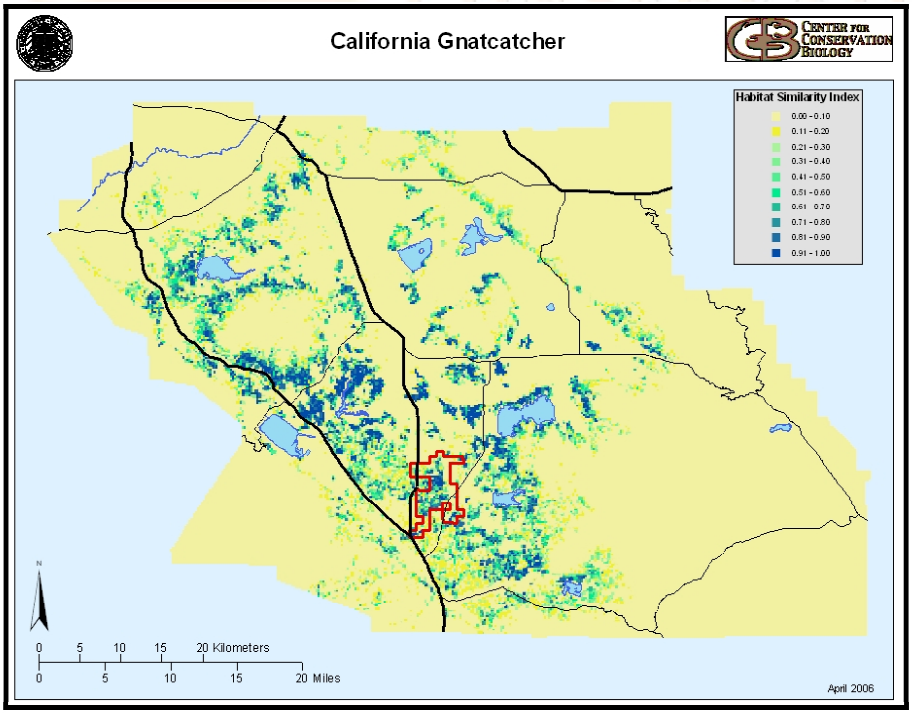

Figure 6. Niche model for the California Gnatcatcher showing potential habitat (reprinted with permission from Rotenberry et al. 2006).

The Core 2 area represents the primary linkage, albeit highly constrained and disrupted by recent development activity, between eastern and western gnatcatcher populations in the Plan area.

Rare Plants

The CCB has compiled a database of rare plant records obtained from museums, herbaria, and environmental reports. This historic database has been augmented by rare plant surveys that CCB conducted on public lands from 2002-2006. There is limited information available for rare plants in Core 2. Five WRC MSHCP plant species considered Core 2 Planning Species have been recorded within Core 2. They are California orcutt grass, long-spined spineflower, Palmer's grapplinghook, Parish's brittlescale, and smooth tarplant. Other Planning Species known from the surrounding area include Coulter's goldfields, little mousetail, Munz's onion, round-leaved filaree, spreading Navarettia, and thread-leaved brodiaea. Niche models for Coulter's goldfields and smooth tarplant are shown in Figure 7. The models show potentially suitable habitat for smooth tarplant but not Coulter's goldfields, in Core 2.

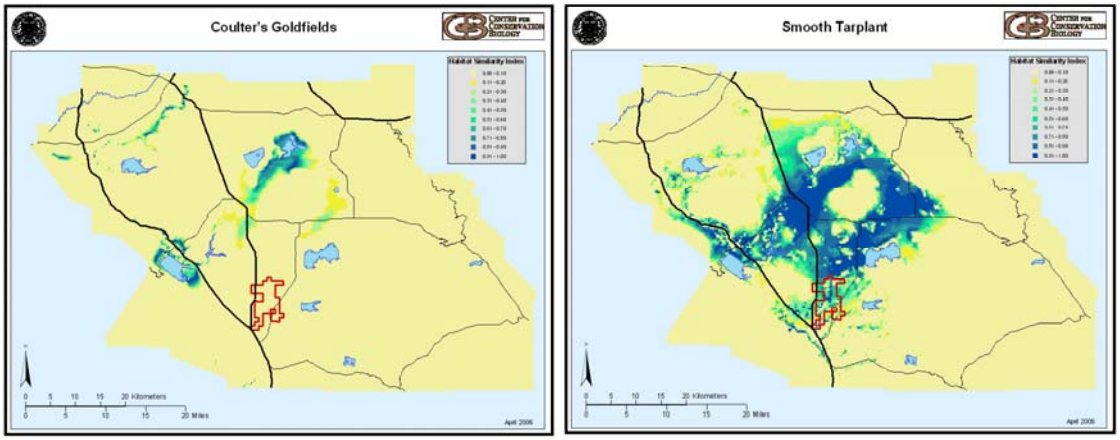

Figure 7. CCB niche models for Coulter's goldfields and smooth tarplant showing potential habitat.

Reptiles

Western pond turtle is the only reptile species considered a Core 2 Planning Species. There is no information available as to whether this species occurs in Core 2. However, it has been recorded nearby to the southeast. There are insufficient data for niche modeling.

Birds

Ferruginous Hawk is the only avian Core 2 Planning Species that has not been recorded in Core 2. Bell's Sage Sparrow, California Horned Lark, Grasshopper Sparrow, Swainson's Hawk, Southern California Rufous-crowned Sparrow, and Western Burrowing Owl have all been recorded in Core 2. CCB has developed niche models for Bell's Sage Sparrow, Southern California Rufous-crowned Sparrow, and Western Burrowing Owl. For all three species, the niche models identify suitable habitat within Core 2 (Figure 8).

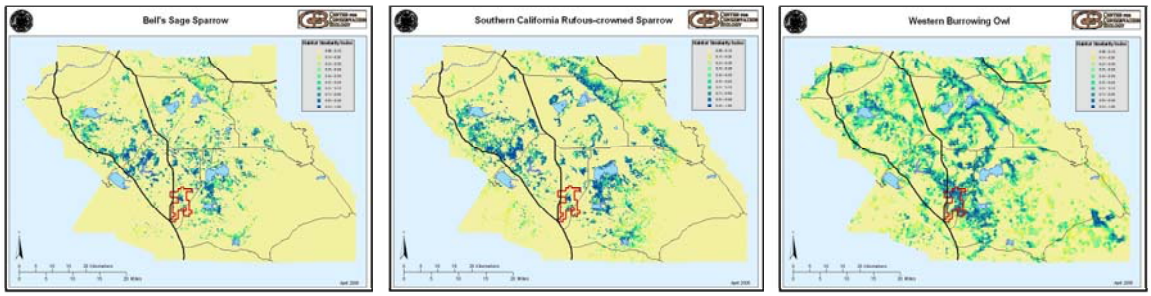

Figure 8. CCB niche models for avian planning species showing potential habitat.

Mammals

There are two mammalian WRC MSHCP Covered Species considered as Planning Species for Core 2. Bobcats are widely distributed throughout natural habitats in the region and likely to occur in the area. The Los Angeles pocket mouse has been recorded from the southeastern corner of Core 2 and is also documented from other areas in the vicinity. The federally-endangered Stephen's kangaroo rat (*Dipodomys stephensi*) is not considered a Planning Species for Core 2, but in 1990 was recorded from three locations in Core 2. It has also been detected at many locations in the region surrounding Core 2.

Reserve Sustainability and Core 2

Core 2 is located in the southwestern portion of the WRC MSHCP. Half of the land has been converted to either agriculture (27%) or residential development (23%; Figure 3, Table 2). Undeveloped lands in Core 2 consist of coastal sage scrub, chaparral, non-native grassland, oak woodland, and riparian habitats. Warm Springs Creek runs through the southern half of Core 2. While Core 2 is surrounded by development and agriculture and is becoming increasingly isolated, the central portions of Core 2 appear to be less degraded than many other low-lying regions in the WRC MSHCP.

Type Conversion Issue

In California, nitrogen deposition from air pollution is associated with the conversion of natural habitats to non-native annual grasslands (Weiss 1999, Fenn et al. 2003). Western Riverside County has a high level of nitrogen deposition, particularly in the northern portion of the study area (Fenn et al. 2003 and unpublished). The production and deposition of nitrous oxides from vehicle emissions, agriculture, and suburban lawns provides a fertilization response that enhances growth and competitive capacity of exotic, invasive grasses in the naturally nitrogen-limited coastal sage scrub systems (Allen et al. 1998; Padgett and Allen 1999). Nitrogen deposition coupled with invasion by annual grasses alters fire and hydrologic regimes and mycorrhizal communities further facilitating this conversion (Minnich and Dezzani 1998; Egerton-Warburton and Allen 2000; Fenn et al. 2003; Wood et al. 2006). Cox (2006) analyzed the spatial patterning of exotic grass cover and nitrogen deposition, and reported a highly significant positive relationship (r^2=0.234, $p<0.001$). In the WRC MSHCP, annual grasses have invaded coastal sage scrub, and to a lesser extent chaparral habitats. The highest level of exotic grass cover in shrublands is found in the central and northern portions of the study area with some highly invaded patches in the southeast (Figure 9). Core 2 has a relatively low cover of invasive annual grasses invading

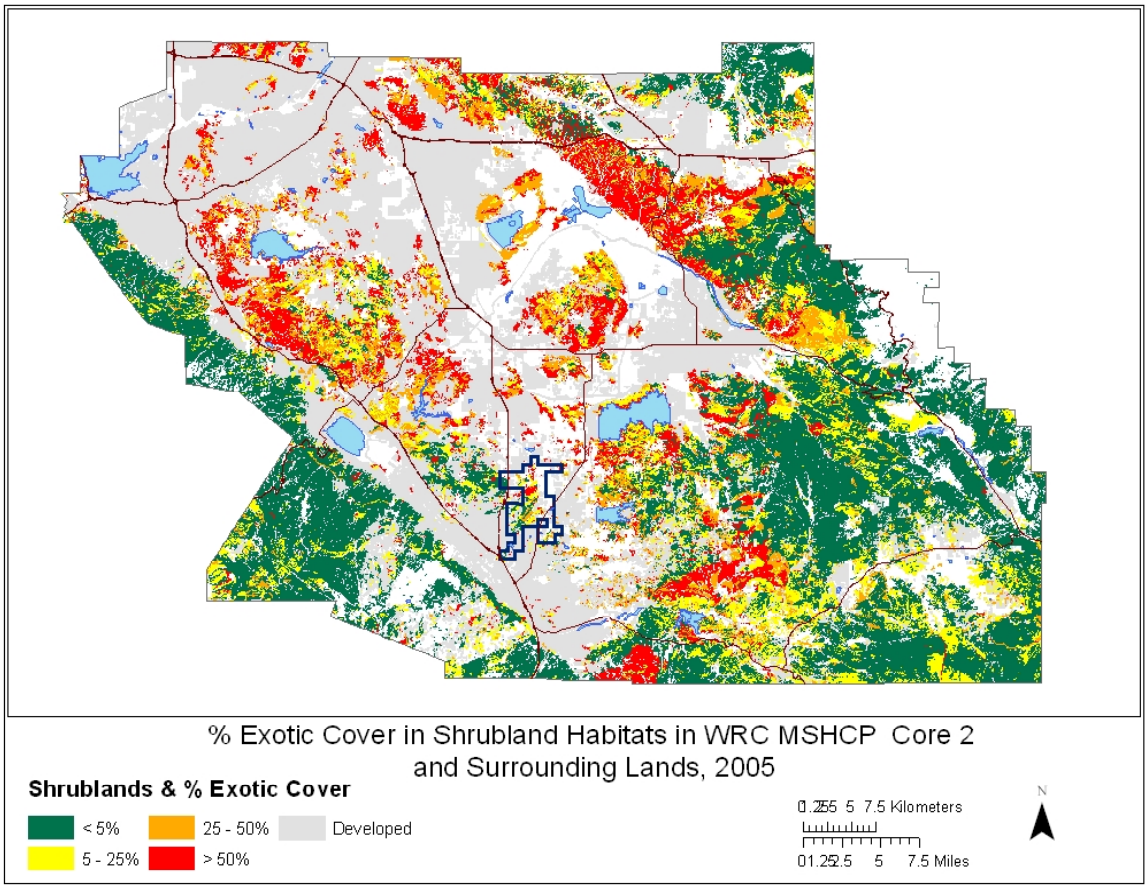

Figure 9. Proportion of exotic plant cover in shrublands across WRC MSHCP planning area.

shrublands. This may be attributable to lower levels of nitrogen deposition and a lack of recent wildfires within Core 2 compared with other areas of the WRC MSHCP.

Isolation and Connectivity

Core 2 provides a potential connection between reserves west of Interstate 215 and reserve lands to the east of Highway 79. There is another east-west Constrained Linkage (7/19) through the center of the WRC MSHCP, which is quite long (>10 miles) and narrow and primarily composed of agricultural lands. In contrast, Core 2 provides an archipelago of natural habitats that is tenuously connected via four constrained linkages to core lands located to the west, east, and southwest. Constrained Linkage 15 is over two miles long and follows the lower portion of Warm Springs Creek between Core 2 and Interstate 15 (Figure 1 and 3). It is a narrow linkage with riparian, coastal sage scrub and non-native grassland habitats. Surrounded by urban development, this linkage has one of the highest perimeter to area ratios of all linkages, indicating the great extent to which it is constricted (County of Riverside 2003). It was identified by the WRC MSHCP as being important for western pond turtle, bobcat and Los Angeles pocket mouse.

Figure 10. Constrained Linkage 16, a meandering riparian strip through agriculture and between suburban tracts. Left is a view from the north (Michael Allen photo, 2006) and right is from the road on the east (Megan Enright photo, 2006).

Constrained Linkage 16 is an unnamed drainage that connects Linkage 8 to the northwest portion of Core 2 at Interstate 215 (Figure 1). Linkage 8 is an approximately seven mile long linkage through the Sedco Hills and Wildomar that proposes to connect Core 2 to Core Areas C (Lake Mathews/Estelle Mountain) and 1 (Alberhills). Constrained Linkage 16 east of Interstate 215, which is surrounded by residential development and agriculture, currently consists of a single narrow strand of riparian trees and herbs meandering across parcels 5366, 5361, and 5256 (Figure 10). Natural habitats remaining in Constrained Linkage 16 include chaparral, riparian, and coastal sage scrub. This proposed linkage was intended to be wider than the current vegetated drainage, although recent development greatly constricts this linkage near I-215. This linkage was designed for movement of QCB, California Gnatcatcher and bobcat (County of Riverside 2003).

Constrained Linkage 17 is approximately 2.5 miles long. It connects the northeast portion of Core 2 to Core J (Lake Skinner/Diamond Valley Lake -Figure 1). This "stepping-stone" linkage consists of non-native grassland and coastal sage scrub habitats embedded within a matrix of agriculture and residential development. Constrained Linkage 17 today exists as a series of granite outcrop "islands" (Figure 11). The Plan describes this Constrained Linkage as having a relatively low perimeter to area ratio and because of the rural nature of planned land uses it was considered to have potentially lower edge effects compared with other Constrained Linkages (County of Riverside 2003). This linkage was designed for QCB, California Gnatcatcher, and bobcat (County of Riverside 2003).

Constrained Linkage 18 is an unnamed drainage running over three miles through agricultural lands from the eastern edge of Core 2 to Core 7 (Figure 1). Located south of Constrained Linkage 17, this connection is largely developed. Planning Species thought to potentially use this linkage include bobcat and Los Angeles pocket mouse (County of Riverside 2003).

Figure 11. Stepping stone islands comprising Constrained Linkage 17 between Core 2 and Core 7 (Michael Allen photo, 2006).

Core 2 Refinement Workshop:
Evaluating the Biological Implications of Refining Core 2

After reviewing and discussing the available biological data and conducting a field trip to Core 2, workshop participants addressed a number of questions important in informing the Core 2 criteria refinement process.

Responses to Questions

1. ***Are the biological resources for which Core 2 was designated for protection found in other areas of the WRC MSHCP and are these areas equivalent in biological value? This general question was broken into 3 sub-questions:***

    a) ***Is Core 2 an irreplaceable element of the WRC MSHCP or can the Plan's objectives be met in other areas of the MSHCP without inclusion of Core 2?***

It was unanimously agreed by the Core 2 Workshop participants that portions of Core 2 has elements not found elsewhere in the WRC MSHCP. This assessment was based upon several factors.

The most important consideration was the impact that the loss of all Core 2 coastal sage and chaparral habitats could have on QCB. QCB have been detected in Core 2 on a regular basis since the 1990s. The Core 2 QCB population may also serve as a source of potential colonists for other nearby populations. There is a difference in breeding phenology between populations in the western and eastern portions of the WRC MSHCP. Differences in late winter and early spring climatic conditions, particularly temperature, are thought to drive the difference in timing of adult emergence and breeding. There appears to be little temporal overlap in breeding between the earlier emerging western populations and late emerging, more easterly populations. This indicates that portions of Core 2 are a potential source of colonists particularly for Core J (with extension 6, Johnson Ranch and Shipley-Skinner). There may be a lower chance for colonization of QCB from the east (Proposed Core 7, e.g., Wilson Valley). This is because early emerging adults from westerly populations presumably have time to travel east and to potentially breed with individuals as they begin to emerge and fly in the east. In contrast, butterflies from eastern populations that emerge later than western individuals will be less likely to reach the western populations in time to breed.

Portions of Core 2 may also serve as a linkage between sub-populations of California Gnatcatchers. They appear to be abundant and the area could provide an east-west connection between core reserves. Even though linkages included within Core 2 are becoming increasingly constrained, there may still be the potential for connectivity, especially with restoration of natural habitats. The other east-west linkage (7/ 19) is more than 10 miles long, and is almost entirely converted to agriculture. In contrast, Core 2 still provides over 1,700 acres of coastal sage scrub habitat.

While Core 2 is becoming increasingly isolated by previously approved development, it remains unique in western Riverside County. Climatic conditions are relatively mesic in Core 2, leading to substantial differences in vegetation composition compared with areas to the north and southeast. This was particularly evident in comparing Core 2 with Wilson Valley (Core 7), which represents a transition area from coastal sage scrub to desert vegetation communities, and where California and Black-tailed Gnatcatchers both occur

(CCB Unpub. Data). Available location data suggest that California Gnatcatcher populations are relatively dense in the western half of the WRC MSHCP, with populations becoming sparser to the east. This pattern is consistent with distribution patterns observed in other portions of the species' range (Atwood 1993; Preston et al. 1998; Atwood and Bontrager 2001). After reviewing the available information it was agreed that lands east of the Shipley Skinner Multi-Species Reserve (Core J), while valuable, are not biologically equivalent to Core 2 for California Gnatcatchers.

Coastal sage scrub vegetation in the Core 2 area is less invaded by annual grasses than other Core areas (e.g., Core C, proposed Core 1- Lake Mathews/Estelle Mountain, proposed Core 3- the Badlands and Core H- Lake Perris). This is likely a result of more mesic climatic conditions, lower rates of nitrogen deposition and a lack of recent fires in Core 2. Because of these factors, Core 2 may be more resilient to anthropogenic disturbance than other areas to the north that are already highly degraded by invasive grasses, and may respond more successfully to management activities aimed at habitat restoration.

One element that stands out in the WRC MSHCP is the attempt to create a linked network of reserves, not individual, isolated core reserves. The goal is to have a reserve system that can reduce genetic isolation, allow populations of concern to recolonize following the local extinctions that will result from stochastic events (e.g., fire), and migrate in response to directional environmental change (such as extended drought or global environmental change). While connectivity takes time to empirically demonstrate, it has become a testable tenant in conservation biology. The alternative, small isolated reserves, will result in reduced numbers of individuals and increased genetic isolation ("fragment unto death"- Quammen 1996). In fact, MSHCPs, such as the WRC MSHCP represent a crucial test of the linkage concept.

Maintaining a relatively undisturbed central core of Core 2 with linkages across the valley may well be an ultimate test of the linkage hypothesis. Under this hypothesis, connectivity is considered important for conserving biodiversity, enhancing the persistence of sensitive plant and animal populations by allowing for dispersal, and in maintaining ecological functions within a reserve system (Johnson et al. 1992, Pascual-Hortal and Saura 2006). Losing this linkage entirely would effectively sever the western and eastern parts in the central portion of the WRC MSHCP. We recognize that the linkages between proposed Core 1 and Core J are constrained, but the less-disturbed, central portion of Core 2 represents the only potential large stopover between them. Further, it remains large enough to support populations of key organisms, a true live-in corridor element. It appears to contain relatively stable populations of California Gnatcatchers and QCB. Although we do not have population data, it may well host the largest population of California Gnatcatchers per unit area in the central part of the WRC MSHCP. The northern and western-most stable populations of QCB occur in Core 2 suggesting that any migration would need to go through this area to repopulate the areas to the north and west- directions that many species of butterflies are expected to move in response to global change (Parmesan et al. 1999). Core 2 hosts at least five plant species considered Planning Species as well as other WRC MSHCP Covered species including a relatively large population of Engelmann oak. This plant has wind-dispersed pollen probably linking the Santa Ana populations (e.g., Core F-Santa Rosa Plateau) with those in Core J (Lake Skinner/Diamond Valley Lake).

b) What information is available to make these comparisons and what information may be lacking?

These comparisons were made using a species occurrence database with many location records, niche models identifying suitable habitat for seven of the Core 2 Planning Species, an updated vegetation map, maps of exotic annual vegetation cover, nitrogen deposition, and recent fire history. This information was unavailable when the plan was developed and represents an increase in our knowledge and understanding of the biological resources and processes in the WRC MSHCP. Despite all this newly available information, there are still significant knowledge gaps in assessing the impacts of a Core 2 refinement.

There is insufficient knowledge about QCB population dynamics. To effectively manage a species that has a complex life cycle, it is essential to move beyond simple presence/absence characterizations and to understand the ecology of the species. Put simply, key ecological studies by qualified ecologists are essential to generate the information needed to effectively manage this species. To understand the relative importance of the Core 2 QCB population, more information needs to be gathered on the distribution and metapopulation dynamics of this species. ***This requires larval and adult surveys to document reproduction and population levels in different locations and over multiple years with varying environmental conditions***. Surveys need to be expanded into new areas to determine if there are additional, undocumented populations in the WRC MSHCP; this information would improve the quality of QCB niche models. A better understanding of the key host plant, *Plantago erecta* is needed. One of the difficulties in working with QCB is that it represents a metapopulation species dependent upon another metapopulation species, meaning that modeling and managing its persistence and dynamics across a reserve network is doubly complicated. Both species need to be studied, in concert, and individually. As *P. erecta* is not endangered *per se*, it does not receive the same level of study as QCB, however, without understanding *P. erecta* dynamics, QCB cannot be effectively managed. To understand the broader patterns of QCB distribution within the study area, a database should be compiled that documents where and when QCB were surveyed, as well as the results of these survey activities.

To identify the relative importance of Core 2 in comparison to other areas in the reserve system, the distribution, abundance and dynamics of nectar and host plant sources should be assessed across core areas. This will allow a comparison of Core 2 with other areas in terms of potential habitat for QCB colonization and areas undergoing environmental change where such resources may be lost. Dispersal patterns of individual QCB will become increasingly important. Do the "stepping-stone" linkages east of Core 2 really function to sustain a metapopulation species such as the QCB? Understanding the precise behavior of movement in response to the landscape topography and patch structure is crucial to determining if an effective linkage has been created (see for example, Pe'er et al. 2006, Hein et al. 2004). Performance of the niche model will likely be improved by including these variables as well as those describing micro-climatic conditions and the occurrence of the larval host plant, *Plantago erecta*.

Specific information remains lacking on QCB population demography. The species is hypothesized to have a complex metapopulation structure comprised of local populations subject to potential extinction and recolonization events, consistent with dynamics observed in other butterfly species (Mattoni et al. 1997; U.S. Fish and Wildlife Service 2003). The exact nature of the metapopulation structure is unknown. Based upon patchy distributions of the host plant and relatively small numbers of flying adults observed at any one site, it is likely that QCB populations are small and isolated. Different populations of QCB show

variable phenologies. One hypothesis is that these are due to differences in late winter and early spring temperatures in western Riverside County, not to population differentiation. Warmer late winter temperatures in Core 2, Johnson Ranch (Core 6) and the Shipley Skinner Multi-Species Reserve (Core J) facilitate development of larvae so that adults emerge to fly and breed earlier compared with colder locations to the east. The differences in phenology can be considerable, such that there may be an overlap of only one week in adult flight and breeding periods between the western and eastern populations.

The potential differential phenology between western and eastern metapopulations of QCB needs to be carefully described in the context of the population structure. The differences are probably simply a response to the different climate regimes. But, genetic studies of QCB would facilitate an understanding of patterns of gene flow between populations in the WRC MSHCP. Of particular importance is the relationship between Core 2 and nearby populations (e.g., Johnson Ranch, Shipley-Skinner Multi-Species Reserve, Oak Mountain) compared with populations farther east in proposed Core 7.

To better understand the importance of Core 2 for California Gnatcatchers more information is needed on habitat quality and dispersal across the WRC MSHCP. To determine that other areas are biologically equivalent to Core 2 would require research into habitat quality (e.g., fire history, vegetation composition and structure, shrub age structure, etc.) as it relates to annual variation in reproductive success and survivorship under different environmental conditions. To evaluate whether Core 2 provides an east-west connection between gnatcatcher populations would require a study of gnatcatcher dispersal behavior in an urbanizing landscape. As with QCB, we hypothesize that the "stepping-stone" and narrow riparian corridor linkages created in the MSHCP will sustain gene flow between metapopulations, but the data to validate such a hypothesis need to be collected.

There is a lack of information about other plant, bird, and mammal Planning Species in Core 2. There is a need to survey for rare plants considered Core 2 Planning Species, given the occurrence of five of these species within Core 2 and six other species in adjacent lands. Although the Los Angeles pocket mouse has been detected in the southeast corner of Core 2, its distribution within the area is unknown. Stephen's kangaroo rat, a federally-endangered species, has also been documented from three locations in Core 2 and the current status of this species in Core 2 is unknown. Surveys of Core 2 and other potentially equivalent areas would need to be conducted to determine if there was biological equivalence for these species.

c) *Does Core 2 provide important source habitat for the QCB and California Gnatcatcher that can't be obtained elsewhere?*

Core 2 provides habitat that potentially supports the most northwesterly and most consistently observed population of QCB across the range of this subspecies. As discussed above, differences in breeding phenology between western and eastern populations are likely to make the Core 2 population an important source of colonists for nearby populations to the east. If climate change results in a northward expansion of suitable QCB habitat, then the Core 2 population would provide a source of colonists for northward expansion. If there is an increase in temperature or decrease in rainfall in the future, the relatively mesic climatic conditions at Core 2 would buffer potential adverse affects on QCB and California Gnatcatchers relative to harsher climatic conditions to the east.

2. Does Core 2 still provide the resources identified in the plan? Specifically:

a) Does Core 2 retain adequate structural integrity and connectivity to allow it to serve as a sustainable reserve, or has the landscape changed to the point where Core 2 can no longer serve as a reserve core unit?

Core 2 supports the western and northern edge of the population of QCB and hosts a significant population of California Gnatcatchers. Portions of the area have not been altered and appear to have long-term functional value. In fact coastal sage scrub and chaparral in the central parts of Core 2 (parcels 5260, 5367, 5369, 5475, 5569, part of 5671 and 5784, 5786, and parts of 5781, 5878, 5876, 5875, and 5974) appear, from a distance, less degraded than the same habitats present in some of the larger core areas, particularly where exotics have invaded. Connectivity to the east has a stepping-stone structure and remains tenuous but could be improved with habitat restoration. It is unclear whether connectivity is still retained to the west. There is a thin green line bisected by roads (constrained linkage 16), but with the construction of future underpasses (especially for I-215) designed for animal movement, and restoration of patches, such as in parcels 5256, 5361 and 5366, this might provide a functional linkage. Core 2 and constrained linkage 16 currently provides the only potential for east-west connectivity between the Tenaja Corridor near Temecula and the highly constrained, very long linkage 19/7.

The central portion of Core 2 provides an important patch of habitat for California Gnatcatchers that is relatively intact. Without Core 2 potential connectivity between coastal sage habitats may be eliminated resulting in two reserves with gnatcatchers on either side of the valley. Connectivity in this species can exist along habitat archipelagos and is potentially still retained in the central part of Core 2. This broader connectivity issue is not driven solely by the QCB and California Gnatcatcher, but also includes the other Core 2 Planning Species. In the time since the plan was prepared and signed, there has been substantial development affecting connectivity in Core 2. Habitat restoration and construction of underpasses could improve future connectivity between eastern and western portions of the WRC MSHCP conservation areas.

b) Are there any new data, models or trend analysis that could clarify the sustainability of this unit?

The nitrogen deposition map, fire history map, and exotic annual cover maps all help with evaluating the sustainability of Core 2 relative to other core areas within the WRC MSHCP. These are new sources of information not available when the Plan was developed and all show that the central portion of Core 2 is relatively less impacted than some of the other larger core areas. (This information is addressed in greater detail above). To evaluate trends in sustainability for QCB and California Gnatcatcher populations, it is necessary to have population and dispersal data identified above (Question 1b).

c) Is Core Area 2 critical to the long-term sustainability of the QCB within the WRC MSHCP in light of potentially complex metapopulation dynamics?

The available evidence suggests that it is likely to be an important population by anchoring the northwestern population edge and providing a metapopulation capable of colonizing locally-extirpated patches in Core J.

d) Does Core Area 2 provide habitat for the California Gnatcatcher that is unique within the WRC MSHCP?

No, although it does provide California Gnatcatcher habitat and potential connectivity. Notably, with respect to California Gnatcatchers, habitat in Core 2 is superior to that found further east.

3. What information is necessary to integrate assessments of irreplaceability (Question 1) and long-term sustainability (Question 2)? More specifically:

a) Are there existing models or case histories where irreplaceability and sustainability have been balanced in a similar planning exercise?

Since 2000, there have been over 400 papers published in the primary literature on the selection of nature reserves, but none have addressed the selection decisions that need to be made when irreplaceable biological resources occur in areas where reserves may not succeed because of human influences. There is long term recognition that species persistence is an important criterion in preserve selection (Lockwood et al 1997), but this recognition has not lead to merger of the preserve selection literature with the equally large body of literature on preserve management in human-dominated landscapes.

Most of the preserve design models have been created to select the best preserve system among a series of options (Margules and Pressey 2000), often detached from the subsequent management costs of the selected preserves. Models are designed to create optimal networks of preserves, by ranking the importance of all possible preserves. These optimal models are not designed to define the intrinsic value of a single reserve, and the overall ranking system may not be able to judge the relative value of one reserve against another.

Although there is wide recognition that species and habitat persistence is a critical component of preserve design, very few studies have included this concept in preserve selection models. Lockwood et al. (1997) used the predicted survival of species within individual preserves to choose the best of equally ranked preserves, based on a simple ranking system. McCarthy et al. (2006) created a similar model of persistence of species within preserves, and made this estimate of persistence an integral part of the preserve selection model. Unfortunately, they based their estimates of species persistence on preserve size, which is criteria used in all preserve selection models and makes their results similar to traditional models. Neither Lockwood et al. (1997) nor McMarthy et al. (2006) merged their models with the concept of irreplaceability, so their work cannot be used to judge the significance of critically important preserve that becomes unsustainable.

The preserve management literature offers a diffuse and often idiosyncratic analysis of preserve persistence in human dominated landscapes (see Breuste 2004, Williams et al.

2005). Operational models, such as the Property Analysis Record (PAR; CNLM 2004), provide estimates of management costs but are untested, have no way to estimate error, and have no estimate of efficiency across a range of situations. They can be used to indirectly calculate preserve persistence, because a preserve could be considered unviable when its management costs exceeded available funds. To date no one has attempted to merge these techniques with preserve selection models.

b) Are there updated scientific assessments of environmental change that would cause a re-evaluation of the biological value of Core 2?

Yes, but they actually show areas within Core 2 potentially more valuable than initially projected (see background section). The area comprising Core 2 consists of lands important for conservation of Quino checkerspot and California Gnatcatcher, although not all lands within Core 2 are essential, particularly some of the disturbed and agricultural lands. Our review of the most recent available information shows that the central watershed and associated uplands (coastal sage scrub and chaparral) that provide habitat for the QCB and California Gnatcatcher and that provide connectivity through Core 2 are critical for conservation. Acquisition and restoration of lands that enhance the central core or improve connectivity in the Constrained Linkages is also important. Additional ecological studies of the species involved (see response to question 1b) would be very helpful in predicting the specific portions of Core 2 and the linkage elements connecting Core 2 to the surrounding cores that are needed to finalize the reserve structure. The build-out scenario and climate change predictions ***also*** need to be evaluated to see how this might impact Core 2 relative to the other core areas. Without Core 2, populations to the southeast will have to make a larger jump to move to the northwest. If the region becomes drier in the future, Core 2 could stay mesic longer than areas to the east.

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