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COLLEGE OF NATURAL AND AGRICULTURAL SCIENCES
CITRUS RESEARCH CENTER AND AGRICULTURAL EXPERIMENT STATION

CALIFORNIA STATE DEPARTMENT OF TRANSPORTATION AND CENTER FOR CONSERVATION BIOLOGY: WRC MSCHP NICHE MODEL TASK ORDER

Final Report

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CHAPTER 1

INTRODUCTION

Western Riverside County Multiple Species Habitat Conservation Plan

Southern California is considered a biodiversity hotspot of conservation concern (Myers et al. 2000), with many plant and animal species listed as rare, threatened, endangered or sensitive by both the state and federal governments. Over the past two decades there has been a paradigm shift in how sensitive species are conserved in the region. Conservation efforts have switched from the traditional model of preserving a single species to a more holistic approach of conserving groups of sensitive species within the natural communities in which they occur. Several multiple species habitat conservation plans have been adopted or are at various stages of development in southern California (http://www.dfg.ca.gov/nccp/). Compared with single species conservation, multi-species conservation requires a different approach to designing reserve systems and to monitoring and managing conserved plant and animal populations. The intent is to conserve plant and animal populations using a habitat based approach and to proactively conserve species before they are listed as threatened or endangered. In southern California, the design and implementation of conservation plans is complicated by limited availability of resources for identifying and acquiring lands most important for conservation or for monitoring and managing large numbers of species subjected to a host of anthropogenic stressors in an increasingly fragmented and urbanized landscape (Kelly and Rotenberry 1993, Barrows et al. 2005).

Adopted in 2004, the Western Riverside County Multiple Species Habitat Conservation Plan (WRC MSHCP) has the goal of conserving 146 sensitive plant and animal species and their habitats over 1.26 million acres (Figure 1; County of Riverside 2003; http://www.rcip.org/conservation.htm) so as to maintain biological and ecological diversity within a region facing rapid urbanization, to provide jurisdictions with local control of land use decisions, and to accommodate economic and infrastructure development. The proposed MSHCP Conservation Area will conserve approximately 500,000 acres of land. At the time of the WRC MSHCP's adoption, approximately 347,000 acres of land were already in Public/Quasi-Public ownership. An additional 153,000 acres of land in private ownership needs to be acquired to complete the reserve system. Criteria Areas were delineated encompassing approximately 300,000 acres of land from which privately-owned lands could be acquired to complete the proposed Conservation Area (County of Riverside 2003).

Caltrans and WRC MSHCP Implementing Agreement Commitments

Along with many other local, state and federal agencies and jurisdictions, the state of California Department of Transportation (Caltrans) is a party to the WRC MSHCP. In exchange for permits to develop future transportation projects in the Plan Area, Caltrans entered into an implementing agreement with a number of requirements including:

> "….Contribute to the assembly of the Additional Reserve Lands through acquisition of two conservation land areas pursuant to Section 8.4.4 of the MSHCP, one of approximately 2,000 acres in the eastern portion of the Criteria Area and one of approximately 1,000 acres in the western portion of the Criteria Area, within the first eight (8) years of the permits. These areas shall, if at all feasible, be acquired in close proximity to new highway projects, improvement projects for existing highways, or wildlife movement corridors. The precise locations of the conservation lands shall be determined in consultation with the Wildlife Agencies. The funds utilized by Caltrans for the acquisition of the conservation land will be funded from the State Transportation Improvement Program funds" (County of Riverside 2003: 47).

Identifying Lands for Conservation in the WRC MSHCP
A large dataset of over 8,700 covered species locations was used in designing the WRC MSHCP (County of Riverside 2003). Despite this large number of records, there was a lack of specific information for many species regarding the distribution of suitable habitat in the Plan Area. This can be attributed to several different factors, the chief of which is the infeasibility of surveying the entire 1.26 million acre plan area for 146 different plant and animal species. Many of the Covered Species are rare, occurring in low densities and absent from large areas of the Plan. Some species, such as small mammals, are difficult to detect without intensive trapping studies. Lack of access to privately-owned land also limits the ability to assess the distribution of species and conservation value of all lands across the study area.

The WRC MSHCP was developed using a traditional model of delineating the reserve system based upon available species location data and the distribution of vegetation types across the landscape (County of Riverside 2003). Vegetation type is often used as a surrogate for suitable habitat for a species, particularly in areas where there is little information on a species occurrence. One problem with this approach is that species' habitat relationships are complex, incorporating in addition to vegetation characteristics other features of the environment such as climate, topography, soils, and land use. Species are often not distributed evenly across a vegetation type and may use multiple vegetation types. Ideally, when designing a conservation plan the distribution of species would be well documented across the entire study area so that there is confidence that important populations have been conserved. However, this is seldom the case, particularly for rare species distributed patchily over large regions and across privately-owned lands (Rahn et al. 2006). A further difficulty in delineating conservation areas is identifying those lands that have the highest potential to support multiple species of conservation interest and highest levels of biodiversity.

To address these problems there has been a surge in the development of Geographic Information Systems (GIS) based spatially-explicit habitat models that identify lands important for the conservation of sensitive species. New modeling techniques incorporate improved GIS software and digital environmental layers to create multivariate species' niche models encompassing large geographic areas. These regional niche models incorporate hypotheses about a species occurrence relative to various environmental variables that are available as GIS spatial layers. Digital environmental layers such as elevation, slope aspect, precipitation, temperature, soil type, land use, and vegetation type may be incorporated into regional niche models.

Caltrans-CCB Research Project

The goal of this research contract was to provide Caltrans with niche models for the assessment of the conservation potential of lands within the delineated Criteria Areas. Caltrans could then use these results to prioritize lands for further evaluation and potential acquisition in order to meet their Implementing Agreement commitments under the WRC MSHCP. To accomplish this goal, the CCB completed the tasks described below. However, it is important to note that the CCB constructed preliminary niche models using the partitioned Mahalanobis D^2 niche models (Rotenberry et al. 2002, 2006) for 16 Covered Species as part of developing a monitoring framework for the WRC MSHCP (Allen et al. 2005). These models were constructed using a 1994 vegetation map for western Riverside County; they may be viewed on-line at the University of California's eRepository (http://repositories.cdlib.org/ccb). Because this 1994 map was rapidly becoming obsolete due to the pace of landscape change throughout the region (primarily due to increasing suburbanization), the California Department of Fish and Game (CDFG) created a new vegetation map for western Riverside County based upon 2002 aerial photographs. This map was made available to the CCB in late October 2005 to construct new niche models for WRC MSHCP Covered Species.

Task 1. Construct Niche Models for Covered Species Using 2005 Vegetation Map

The CCB evaluated the accuracy of the October 2005 CDFG vegetation map and updated it for additional urban development occurring between 2002 and 2005 (Chapter 3), and we classified development polygons using satellite imagery, followed by field checks to verify accuracy of the classification. The CCB constructed niche models for 54 WRC MSHCP Covered Species using the updated vegetation map and other environmental variables describing climate, topography, soils, and land use (Chapters 4, 6-10). Multiple models were developed for each species to provide a range of models for evaluation.

Task 2. Collect Independent Datasets to Validate Niche Models

The purpose of model validation was two-fold: to determine the models' accuracy at identifying suitable habitats in unsurveyed areas, and to confirm on-the-ground habitat suitability, which could assist Caltrans in its selection of conservation lands within the WRC MSHCP area. To evaluate how well the preliminary niche models predicted habitat suitability for WRC MSHCP Covered Species, CCB staff conducted field surveys to compile an independent dataset of species occurrences (Chapter 5). Surveys were conducted on public lands for coastal sage scrub/chaparral birds, reptiles, and rare plants during spring and summer 2006. Surveys were carried out at points encompassing a range of predicted habitat suitability values for each species and where data on the occurrence of these species was lacking.

Task 3. Evaluation and Refinement of Niche Models

Using species location datasets gathered in spring 2006 along with datasets acquired from other available sources, we evaluated niche models to determine which of the candidate models best predicted the occurrence of a species (Chapters 6-10). The validation datasets included presence-absence data for some species and sets of randomly withheld points for a larger subset of species. There were insufficient location records to create validation datasets for a third group of species for which models had been developed. In these cases, niche maps were visually assessed based upon a current understanding of these species' distributions. The performance of models with independent presence-absence datasets was assessed using logistic regression techniques (Hosmer and Lemeshow 1989). For each species we selected the "best" model and identified and assessed the environmental variables important in defining suitable habitat. For selected groups of species we combined individual species models to create community maps predicting the potential for multiple species to co-occur.

Task 4. Identifying and Prioritizing Lands for Conservation

Using the "best" niche maps for each Covered Species, we assessed the conservation potential of lands across the WRC MSHCP (Chapters 12-14). These analyses focused on Criteria Areas identified by the WRC MSHCP as important for conservation and from which the MSHCP Conservation Area is to be assembled. Caltrans also provided the approximate location of parcels of particular interest that had been recently purchased for inclusion in the reserve system. The CCB created equivalently-sized polygons centered upon these parcels and encompassing surrounding land and evaluated these polygons for biological importance and conservation value.

CHAPTER 2

METHODS FOR CONSTRUCTING AND EVALUATING NICHE MODELS

Modeling Species' Habitats
Ecological niche modeling uses species occurrence data and GIS environmental variables to construct models that identify and map suitable habitat for species over large spatial areas (Guisan and Zimmerman 2000, Hirzel et al. 2002, Rotenberry et al. 2002, 2006). These models can lead to a greater understanding of habitat relationships and are useful in conservation planning and in designing species monitoring and management plans (Barrows et al. 2005). Some modeling techniques identify environmental variables that are important in influencing the distribution of a species. This information can be used to develop working hypotheses that guide further, perhaps more experimental, investigation and can assist in making adaptive management decisions. The models provide a spatially explicit assessment of habitat suitability; identifying where the appropriate combination of suitable environmental conditions occurs. Predictions about habitat suitability can be extended into areas where there is currently no information about the occurrence of a particular species. These spatially-explicit predictions not only facilitate conservation planning and assessments of the conservation potential of lands at a large scale, they can also be used at a finer scale to focus survey efforts in conducting on-the-ground parcel evaluations or in monitoring already conserved lands.

There are different techniques for identifying suitable habitat for a species; including models that use abundance, density, or presence-absence data collected during surveys for the species or taxonomic group of interest (Guisan and Zimmerman 2000, Brotons et al. 2004). However, development of models encompassing large geographic areas generally requires multiple sources of data, often collected with different survey methodologies. Most large databases for sensitive plant and animal species (e.g., CDFG California Natural Diversity Database and museum collections) provide information on the presence of a species, but rarely report its absence from a surveyed area. Even in directed surveys obtaining "true absence" data can be difficult, especially for species that are rare or difficult to detect (Knick and Rotenberry 1998, Dunn and Duncan 2000, Hirzel et al. 2002, Rotenberry et al. 2002). Moreover, predicting a species' occurrence in a novel study area or in an area where the environment is undergoing change can be problematic; in these cases, particular combinations of habitat characteristics present where the original data were collected may not exist (Knick and Rotenberry 1998, Rotenberry et al. 2002). New niche modeling techniques have been developed to respond to these problems. These techniques predict habitat suitability based on presence-only species location data and some are designed to accommodate non-relevant environmental variation (Clark et al. 1993, Knick and Rotenberry

1998, Dettmers and Bart 1999, Dunn and Duncan 2000, Hirzel et al. 2002, Rotenberry et al. 2002, 2006).

Mahalanobis D^2 Niche Modeling

Mahalanobis D^2 is a niche modeling technique that calculates the standardized difference between the multivariate mean for environmental variables at locations where a species is detected relative to the values for these same environmental variables at any point in the region being modeled (Clark et al. 1993, Dunn and Duncan 2000, Rotenberry et al. 2002, 2006). The more similar in environmental conditions a point is to the species' mean, the smaller the D^2 and the more "suitable" the habitat at that point. Habitat Similarity Index (HSI) values are derived from D^2 values; because these values follow a Chi-squared distribution they can be rescaled to range from 0 to 1 (Clark et al. 1993). An HSI of 1 represents environmental conditions identical to the species' mean whereas 0 represents conditions most dissimilar. Although D^2 often performs well in identifying suitable habitat (e.g., Knick and Dyer 1997), it may perform poorly when applied to areas not included in the original sample or if applied to dynamic landscapes, such as those that are disturbance prone or undergoing restoration or succession (Knick and Rotenberry 1998). It also assumes that only environmental variables influencing a species' distribution have been included in the model.

The performance of D^2 can be improved by "partitioning" it into separate components representing independent relationships between a species' distribution and environmental variables (Dunn and Duncan 2000, Rotenberry et al. 2002, 2006). These distance partitions are additive and the number of partitions for each model equals the number of variables included in that model. Each partition is associated with an eigenvalue and eigenvector arising from a principal components analysis (PCA) of the dataset containing the values of the environmental variables at points where the species occurs. However, unlike a regular PCA, biological significance is attached to those components with the smallest, rather than the largest, eigenvalues (which in PCA are measures of variance). Based upon the concept of a species' niche (Hutchinson 1957, Pulliam 2000) the aim is to identify the constant relationships in a species' distribution. These are the variables that maintain a consistent value where the species occurs and which are those most likely to be associated with limiting factors. Environmental variables taking on a wide range of values where a species occurs (and which are associated with components with larger eigenvalues) are less likely to be informative since they are not restrictive of a species' distribution over the range of variation sampled. Partitioned D^2's can be considered sequentially, beginning with the partition associated with the single smallest eigenvalue, then the two smallest, the three smallest, and so forth. Adding all partitions together yields the original D^2 model.

Assessing which environmental variables are associated with the likelihood of occurrence of a species is based upon examining the PCA's eigenvector values associated with each component (i.e., each partition of D^2). Variables with larger absolute eigenvector values are considered more “important.” A major advantage of partitioning is that variables that are less important in determining a species distribution are shifted to components with larger eigenvalues, and thus may not contribute to the final, reduced-rank model (Rotenberry et al. 2002, 2006). Increasing the number of retained partitions increases the precision of the model, but reduces its generality. Once a satisfactory model is obtained for a species, it may be used to calculate a HSI value for every point in the landscape that is being modeled.

As an example of the difference between partitions, we show two preliminary partitioned Mahalanobis D^2 niche models for the California Gnatcatcher (Figs. 2 and 3, from Rotenberry et al. 2006). These models were constructed using the outdated 1994 vegetation map for western Riverside County and do not reflect current environmental conditions. Both are based on an analysis of 21 environmental variables primarily characterizing climate, topography, and the proportion of different vegetation types within a 250-m radius. These variables are assessed for a calibration dataset of 566 spatially distinct California Gnatcatcher location records. One is a full-rank model based on the total D^2 (Fig. 2); the other is a reduced-rank model using the smallest partitioned D^2’s (Fig. 3). Note that the increased precision (reduced generality) of the full-rank model is represented by the identification of less area as potentially “suitable.”

Constructing WRC MSHCP Niche Models

Compiling Species Location Records and Selecting Variables for Models

The CCB has compiled approximately 56,000 species location records for common and Covered Species in western Riverside County. We obtained these records from many sources, including online databases, government databases, museum records, published and unpublished accounts, environmental impact reports, and field notes of local naturalists. The largest sources of records are surveys conducted by CCB and UCR biologists over the last decade. Calibration datasets consisted of the location records used to construct models and validation datasets were those used to evaluate models. Records vary in spatial precision; only those with high spatial precision were used to construct and validate models. Only records with spatial precision of < 125 m were used for models developed at the 250 m x 250 m scale, and only those with spatial precision of < 250m for use at the 500 m x 500 m modeling scale. We modeled species at the 250 m x 250 m scale unless there were too few records for compiling calibration and validation datasets, in which case we modeled at 500 m x 500 m scale for which there were usually more location records. Many of our records for a particular species are recorded from the same or nearby location because of observations of multiple individuals or repeated observations over time. Any spatially redundant records for a species (locations within 250 m of each other) were deleted from the model calibration and validation datasets.

Typically, when constructing our models we attempted to keep a ratio of 10 location records:1 environmental variable. However, given that location data were limited for some species, we reduced that requirement to a ratio of 7:1 in some instances. We recommend modeling species with at least 40 or more records (Rotenberry et al. 2006), although we constructed models for several species with as few as 20-30 spatially distinct locations. This was done most often with plant species which tended to have fewer location records and which often have relatively strong and distinct abiotic habitat relationships that can accommodate smaller modeling datasets (see Chapter 7).

For each species we ran a series of models with different suites of related variables. For animal species we ran several types of models. “Combined” models included landscape and local-scale vegetation variables as well as abiotic variables (see below for definition of scales and lists of variables). “Local” models consisted of local-scale vegetation plus abiotic variables whereas “Landscape” models incorporated landscape-scale vegetation and abiotic variables. “Abiotic” models included only topographic and climate variables. For plants we constructed alternative models with different sets of abiotic variables (climate, topography and soils) and seldom included vegetation variables in these models.

Calculating Environmental Variables

The WRCMSHCP regional map was divided into 74,832 “map points” in a grid with points spaced 240 m apart. Thus, each “point” is actually a 240 m x 240 m “cell” for which we summarize each of the various environmental attributes described below. We calculated all environmental variables at every map point across the landscape as described in Allen et al. (2005). For each species we extracted the environmental variables for each map point at which the species was detected and these values became the habitat data in the calibration and validation datasets. Environmental variables were derived from the CDFG 2005 digital vegetation map for vegetation types (updated for development by the CCB) and from GIS-based climatic, topographic, soil, and land use layers (Appendix Table 1).

Vegetation variables consisted of the amount of each vegetation type within a square centered on each map point. Squares captured vegetation composition at three spatial scales: two local scales that included the amount of each vegetation type within a 240 m x 240 m or 500 m x 500 m grid around a point, and a landscape scale that consisted of the proportion of each vegetation type within a 2,250 m x 2,250 m grid around the point. We also calculated the distance in meters from each point to the closest polygon of every vegetation type. Similar variables were calculated for land use types. We estimated the amount of urban edge by quantifying the length (in meters) of development adjacent to natural habitat within a 2,250 m x 2,250 m grid around the point. Climatic variables included minimum and maximum average temperatures (°F or °C) for different periods of the year, annual and seasonal precipitation (mm), and measures of seasonal radiation (watts/m^2). Topographic variables included median elevation and three slope values (eastness, northness and percent) within a 240 m x 240 m grid centered on the point.

Field Surveys to Collect an Independent Dataset for Niche Model Evaluation

Models are abstractions and even quantitative models based on theoretically sound manipulations (e.g., Rotenberry et al. 2002, 2006) may achieve the apparent precision they do at the sacrifice of realism and generality (Guisan and Zimmerman 2000). Accuracy assessment remains one of the most neglected aspects of predicting species' occurrences (Boone and Krohn 2002). The "gold standard" for evaluating habitat models is to use a validation dataset generated independently from the observations (calibration dataset) used to construct the model in the first place (Guisan and Zimmermann 2000).

One objective of this study was to collect an independent dataset of species location records for different taxa from across the WRC MSHCP area to evaluate the performance of sets of candidate models predicting species' occurrence. We focused on coastal sage scrub and chaparral habitats and conducted point count surveys for birds, area and time constrained searches for reptiles, and area constrained wandering transects for rare plants (Appendix Tables 2-8). We were able to conduct two bird surveys at most sampling points as we were able to begin surveys in late February and extend our survey period into mid-May. In contrast, the survey period for rare plants and reptiles was shorter and only single surveys could be conducted at each point. The survey period was shorter for reptiles as they are ectothermic and rely on relatively warm temperatures to emerge and become active so they can be detected. This meant that the favorable survey period for reptiles was relatively short, beginning in late spring and continuing into early summer, which permitted only a single survey at each point. Plant surveys also began late in spring and into early summer permitting only single visits to survey points. Survey protocols and datasheets are presented in Appendix Tables 2-8 and Appendix Figure 1.

In addition to the CCB's 2006 surveys, we had several other independent datasets to evaluate models that were collected by CCB and UCR biologists over the last decade. We had a second independent presence-absence dataset for shrubland birds collected by UCR Department of Biology researchers in WRC MSHCP from 1995-1997. This dataset included 80 points where avian point counts were conducted using similar methodology as described in Appendix Table 2. Points were visited from one to five times over three spring and two fall survey periods. All species observed were recorded. For riparian birds we had an independent presence-absence data collected by CCB biologists conducting avian point count surveys during spring 2004. This dataset consists of 281 riparian survey points, most of which were surveyed 2-3 times and in a similar manner to the coastal sage scrub point count surveys. This dataset was used to evaluate models for riparian bird species with sufficient location data to develop niche models independent of the observations in this validation dataset. A third presence-absence dataset was used to evaluate models for those rare plant species with enough location records besides those used to construct models. CCB biologists conducted rare plant surveys in western Riverside County from 2003 through 2006. Many points were surveyed more than once and exhaustive areal searches as well as releve vegetation sampling were conducted at surveys points. We were able to use the 2005 survey dataset as presence-absence points to evaluate models for several rare plants. For one species, there was sufficient data available to model independent of the CCB surveys so that the 2003-2005 surveys were used as the presence-absence dataset (see Chapter 6 for more details).

Identifying Survey Areas and Survey Methods

Using the CCB species location database we identified public lands within the WRCMSHCP study area where there was no information on the occurrence of the target species. We evaluated candidate niche model maps identifying suitable habitat for each species within these accessible public lands to select survey locations that reflected a range of HSI values. We surveyed public lands belonging to the Bureau of Land Management, County of Riverside Regional Park and Open Space District, Western Riverside County Regional Conservation Authority, Shipley-Skinner Multi-Species Reserve, and San Diego State University (see Chapter 5).

Because wildfires in the region are frequent and large, our previous experience suggested we evaluate whether a fire had burned recently before visiting a site to conduct surveys. Recently burned areas do not provide an accurate assessment of habitat suitability for species that depend on shrubland vegetation and we eliminated these points from consideration. To screen for recent burns, we used a fire history layer developed by the CCB to help direct our survey efforts in 2006. However, some fires were so recent they were not yet entered into our database and we inadvertently visited a few sites that burned in the last few years. Thus, any points with mapped fires within five years of the survey date were deleted from analyses.

Evaluating Niche Models

To evaluate the niche models we constructed for each species, we first had to identify candidate models and their associated partitions (model-partitions) with the greatest potential to accurately delineate suitable habitat for a particular species. Each model consists of a suite of environmental variables and different partitions (equal to the number of variables in the model) and these model-partitions vary in how restrictively they map suitable habitat (see above). Thus, it is important to identify not only the model with best combination of environmental variables, but it is also crucial to identify the partition for each model that best delineates suitable habitat. We evaluated models and their associated partitions in the following ways.

Evaluating Candidate Niche Models with Independent Presence-Absence Datasets

For coastal sage scrub and grassland passerine birds our validation dataset consisted of the presence or absence of each species at each point from the 1995-1997 and 2006 surveys described above. For these relatively highly detectable species we were confident the species was absent from a point if it was not detected over repeated surveys (2-5 visits). We followed the same guidelines for riparian birds and included in our presence-absence dataset only those points that were surveyed at least two times during the CCB's 2004 riparian surveys. In evaluating plant models we used the CCB's 2005 or 2003-2005 survey results to determine presence and absence points for species with sufficient data for modeling independent of these data.

We evaluated each species model by running the presence-absence validation dataset through the calibration model derived from the calibration dataset, and calculating Habitat Similarity Index (HSI) values for each validation point for all partitions of D^2 in that model. We constructed logistic regression models predicting the probability of a species' presence at each point in the presence-absence validation dataset, using as our predictor variable the HSI values for each model partition. We selected as our candidate models those that had the highest median validation HSI values, and in which the significant logistic regression models included HSI values from at least one of the partitions as a significant variable predicting species occurrence. We used Akaike's Information Criteria (AIC; Burnham and Anderson 2002) to compare the different regression models to select the models and partition(s) best predicting species occurrence. For each species, we selected the model partition with the lowest AIC value and subtracted that from the AIC values for the other partitions in the model to determine the difference in AIC value (Δ_i). This value was used to compare and rank model partitions. Model partitions with a Δ_i value of 2 or less were considered equivalent candidate models predicting habitat suitability for that species (Burnham and Anderson 2002). The "best" model for a species was generally the model and partition with the lowest AIC value.

In reporting the logistic regression evaluation results for plants and birds in Chapters 6 and 9, we present median HSI values for the presence points and for the absence points. We use the median as it is less sensitive to outliers than the mean and allows us to assess the central tendency of HSI values for validation datasets. The greater the difference between the medians for the presence and absence points, the better the model does at distinguishing habitat that is likely to be occupied from unsuitable habitat. It is important to note that the logistic regression analysis evaluates mean values and in some cases the best model may have a lower median HSI value than other candidate models. This is not a true discrepancy, rather a difference in the statistical parameters; the logistic regression analyses focus on means whereas we report medians. For each logistic regression analysis we present the candidate models selected for $\Delta_i < 2.00$, the model-partition AIC values, the Δ_i, and the AIC value for the intercept (i.e., no variables fitted). Models are only considered as candidates if the logistic regression model significantly predicted the occurrence of that species.

<u>Evaluating Candidate Niche Models with Presence-Only Datasets</u>
For species without a presence-absence dataset we used the data we independently collected in 2006 to evaluate models. Some species were not surveyed for in 2006 but had sufficient location data so that we were able to randomly withhold 20-30% of the points to use as validation points. For all these species we used a presence-only validation procedure to evaluate candidate models and partitions. We ran the presence-only validation points through the calibration models and calculated median HSI values for each model and all

partitions within each model (Rotenberry et al. 2006). We selected as candidate model-partitions those with high median validation HSI values.

Evaluating Candidate Niche Models with Calibration Datasets and Visual Assessment
For species with insufficient records to create validation datasets, we reviewed the median calibration HSI values for each model-partition; choosing candidates that performed relatively well at classifying suitable habitat for the calibration points used to construct models. While calibration and validation values are not always positively correlated, the calibration data does provide information on how well the model identifies suitable habitat for the calibration points. A high median HSI indicates that environmental characteristics do not vary substantially at calibration locations.

Once candidate model-partitions were selected using presence-absence, presence-only, or calibration evaluation techniques, we visually assessed each candidate model-partition to determine how well it captured the described and documented distribution of the species. We also evaluated whether the models may have been too liberal in delineating suitable habitat. We used our calibration and validation location datasets to determine how well niche models identified suitable habitat at documented species locations. To assess described distributions, we used WRC MSHCP Species Accounts (County of Riverside 2003). These species accounts are based upon extensive literature searches regarding the historic and current distribution of each species and provide information on each species habitat requirements.

Final selection of the "best" model-partition was based primarily upon the presence-absence logistic regression or the presence-only validation results and confirmed with visual assessments of the candidate model-partition niche maps. For species without validation datasets, the emphasis in model selection was on the visual assessment of niche maps. The "best" model was the one that identified suitable habitat in areas of known populations but did not appear too liberal in over-predicting suitable habitat in areas with low potential for the species to occur.

Issues in Model Assessment
In evaluating models it is important to keep in mind that the models calculate how similar each point in the landscape is to the multivariate mean environmental variable values for the species calibration dataset (Rotenberry et al. 2002, 2006). As a result, some areas that provide suitable habitat for a species may be designated as low suitability since they differ substantially from the typical habitat characteristics. This may be particularly true of regions at the margins of the study area where environmental conditions differ substantially from other areas. Thus, if the distribution of calibration locations is biased toward particular regions of the study area this can affect how well the model captured suitable habitat in other regions.

A second issue in model evaluation is that some model partitions have high median HSI values because most of the map area is classified as very similar to the species multivariate mean. This tends to be the case for the lower-ranked model partitions (e.g., Figure 3) in which the relationships between only a few variables are emphasized and do not vary greatly across the study area. In comparison, the most restrictive maps tend to be representative of higher ranking or full models (e.g., Figure 2) that include relationships of all environmental variables and can be analogous to over-fitting of models (Rotenberry et al. 2002, 2006).

A third concern is that while an area of habitat may be identified as suitable for a species, it does not mean that the species will occur in that area. Actual species distributions may be more restrictive than the availability of suitable habitat. This can be a result of many factors, including the inability of individuals to disperse to unoccupied areas of suitable habitat, interactions with other species (e.g., competition, predation) that preclude establishment or continued persistence in an area, cycles of local population extinction and colonization within a larger metapopulation leading to complex patterns of occurrence in any one area, and to a lack of some limiting resources that are not captured by the GIS-based environmental variables in the model (e.g., specific food resources, mates, breeding site requirements, etc.).

Thus, there can be trade-offs in selecting models, between those that are too restrictive and those that are too liberal in designating suitable habitat. If there appeared to be no models that performed well at predicting suitable habitat based upon the presence-absence, presence-only, or visual evaluation methods, then no model was selected for that species. Evaluations using presence-absence data provide the strongest assessment method by examining not only how well the models predict presence but also how well they capture the absence of a species. This helps to eliminate candidate models that over-predict suitable habitat. The presence-only validation is the next "best" evaluation technique as it provides a measure of how well the model predicts species occurrence. However, this method gives no information on how the model performs in predicting absence of a species or in over-predicting suitable habitat. Visual evaluation was important in final assessment of all models. However, model evaluation only by visual assessment is the least reliable evaluation method. For species without validation data, independent datasets need be acquired to permit more in-depth evaluation of the models.

<u>Assessing Important Environmental Variables</u>

Once our best model was selected, eigenvector values associated with that partition of D^2 were assessed to identify important environmental variables. For each included component any environmental variable with an eigenvector value of $\geq |0.400|$ was considered an important variable associated with a species occurrence (Rotenberry et al. 2006).

CHAPTER 3

UPDATING AND EVALUATING THE CDFG 2005 VEGETATION MAP

A vegetation map created in 1994 was used to develop the WRC MSHCP (County of Riverside 2003). A new vegetation map based upon 2002 aerial photography was created by the California Department of Fish and Game and released to the CCB in late October 2005. Since the western Riverside County region continued to rapidly develop, the CCB used satellite imagery to identify areas of new development that occurred between 2002 and 2005, and thus were not depicted on the CDFG map (see below). There are substantial differences in the delineation and configuration of natural vegetation types, agricultural lands, and developed areas between the 1994 vegetation map and the CDFG 2005 vegetation map updated for development by the CCB (Figures 2 and 3). This led to large differences between niche models constructed with the 1994 vegetation map (Allen et al. 2005) and models based upon the CDFG 2005 vegetation map that are presented in this report. The CDFG and CNPS with assistance from the CCB conducted 1203 rapid assessment point (RAP) surveys in 2002 and 2003 throughout western Riverside County. The purpose of these surveys was to provide a means of assessing the accuracy of the CDFG 2005 vegetation map (see below). These sampling points can also be used to assess the accuracy of the 1994 vegetation map.

Updating Development in the CDFG 2005 Vegetation Map
Our update to the CDFG vegetation map included identification of areas of new urban development, which was accomplished by supervised classification of Landsat imagery collected in April 2005. The task was to be able to differentiate between new urban development and some types of agriculture, which have similar spectral reflectances. Initially, the areas of potential new development we identified were overlain on a GIS layer of major roads and previously known areas of development and agriculture. Maps were produced from this information, taken to the field, and checked for accuracy. This ground truth information provided a sample of known agriculture and new development areas. Landsat spectral data were extracted from the sample areas and subsequently processed via discriminant analysis to develop a function to differentiate between newly developed areas and agricultural fields. This function classification had a correct classification rate of 80%. Once the classification function was obtained for the sampled areas, it was applied to the entire western Riverside project area. Those areas identified as new urban development were used to replace the previous land classification and update the map. The accuracy of the map was further improved by field checks to sites accessible from public roads to verify the classification of large polygons of newly designated development. This revised map was used to calculate vegetation variables for niche modeling.

Figure 4 shows the progression of development from 1994 to 2002 and from 2002 to 2005 in the WRC MSHCP. The Plan Area is over 1,256,000 acres in size and approximately 26% of the land was converted to residential, commercial, and industrial development by 2005 (Figure 5). Natural lands comprise 62% of the area and agriculture 10%, with reservoirs and lakes equaling close to 2%. Between 1994 and 2005, 115,052 acres of land were developed for homes, businesses, industry, and reservoirs. Over 66% of this land was converted from natural habitats while the remaining 34% was developed from agriculture. Prior to 1994 there were 218,044 acres of developed land.

Evaluating the 1994 and CDFG 2005 Vegetation Maps

Classification of the 1994 and the CDFG 2005 Vegetation Maps

The CDFG 2005 vegetation map delineates 183 plant alliances compared to the 1994 vegetation map which categorized vegetation into 50 types. The California Native Plant Society (CNPS) worked with CDFG to develop a classification scheme to assign plant alliances identified in the 2005 vegetation map to a vegetation category consistent with the 1994 vegetation map. The CCB also aggregated the detailed CDFG classification from several hundred categories, re-classifying it into ten major classes of vegetation (Appendix Table 1). An additional 31 subclasses were identified for specific plant associations.

We evaluated the classification scheme developed by the CDFG and CNPS and identified several differences between the 1994 vegetation map, the CDFG 2005 vegetation map, and the CCB re-classification of the CDFG 2005 vegetation map. These categories principally involve the designation of coastal sage scrub vegetation in the CDFG 2005 vegetation map and account for over 50,600 acres. There are two major issues: distinguishing between coastal sage scrub and chaparral communities when the plant alliance contains species from both types; and the classification of shrublands that are transitional to desert scrub.

Over 48,000 acres of shrubland in the CDFG 2005 vegetation map are classified as coastal sage scrub but could be considered chaparral depending on how the "Chamise (*Adenostoma fasciculatum*) – Coastal Sage Scrub Disturbance Mapping Unit" alliance is categorized. Although dominated by Chamise and resulting from disturbance to the original chaparral vegetation type, this alliance is classified as coastal sage scrub in the CDFG 2005 vegetation map. In contrast, chaparral is the designated vegetation type for other Chamise-dominated alliances. Part of the problem is there is a mosaic of coastal sage scrub and chaparral plant species in much of western Riverside County making it difficult to place a patch of vegetation into one type or the other. The 1994 vegetation map appears to designate this vegetation as chaparral as does the CCB reclassification of the CDFG 2005 vegetation map.

A second issue is classifying shrublands transitional from coastal sage scrub to desert shrublands. There are five different plant alliances that fit into this category; not true desert scrub, yet not true coastal sage scrub. These plant alliances comprise over 2100 acres and have been classified as coastal sage scrub in the CDFG 2005 vegetation map. It is not clear how the 1994 vegetation map handles these categories. The CCB reclassified the CDFG 2005 vegetation map to categorize these polygons as "other" shrublands.

Differences in Vegetation Types between the 1994 and 2005 Vegetation Maps
Figure 6 shows the CCB reclassification of the 2005 CDFG vegetation map that has been updated for development through 2005. Chaparral is the predominant natural vegetation type (Table 2), followed by coastal sage scrub. There are large differences between the 1994 and CDFG 2005 vegetation maps (Table 2). These represent changes resulting from development of natural and agricultural habitats, the conversion of natural lands to agriculture, and from differences between the two maps in classifying and mapping vegetation types. Table 2 shows the amount of each vegetation type, as identified by the 1994 vegetation map. The two maps differ substantially in the amount and configuration of chaparral and coastal sage scrub in the Plan Area. This can be attributed to differences in classification of vegetation type, with the CDFG 2005 map identifying more lands as coastal sage scrub (see above), to differences in identification and delineation of vegetation types (see below), and to development occurring between 1994 and 2002.

Evaluation of the 1994 and CDFG 2005 Vegetation Maps with Independent Survey Data
The CCB evaluated the 1994 and CDFG 2005 vegetation maps for accuracy of vegetation classification using the CDFG 2005 Rapid Assessment Point survey data. The 1994 vegetation map classified 502 of the 1,194 points (42.0%) differently than the CDFG/CNPS classification scheme determined from the plant alliances measured at the survey point. In contrast, the CDFG 2005 vegetation map had greater success in categorizing vegetation with only 241 points (20.2%) classified differently from the RAP surveys. The two maps, 1994 versus the CDFG 2005 vegetation map, differed in MSHCP classification at 514 (43.0%) of the 1,194 RAP samples. Chaparral was the vegetation type sampled most often during the rapid assessment surveys (Table 3). The 1994 vegetation map classified a greater percentage of points as chaparral than the RAP points would indicate based upon the CDFG/CNPS classification. Coastal sage scrub was the second most frequently sampled vegetation type with the 1994 vegetation map under-classifying this vegetation type.

A more thorough evaluation of the differences in classification indicates that a major source of differences in classification is due to the scale of mapping and the mosaic nature of many vegetation types; in this region, small or linear patches of different habitat types produce a spatially heterogeneous landscape. In many cases, points that were classified differently in the vegetation maps were in close proximity to the habitat type detected in the surveys. This indicates that there were difficulties in delineating small and linear polygon boundaries from aerial photographs. Plant alliances identified at the RAP may not fully describe the complexity of species composition at that point and this may be further simplified when applying the CNPS/CDFG classification scheme to plant alliances. There were also errors in identifying vegetation types that appear similar from aerial photos (e.g., mistaking one shrubland type for another or one woodland type for another).

CHAPTER 4

OVERVIEW OF NICHE MODELS DEVELOPED BY THE CCB

During this project, the CCB collected thousands of new species location records from the 2006 surveys. Additional records were acquired from the California Department of Fish and Game WRC MSHCP monitoring program, from the California Natural Diversity Database, and from searches of on-line databases. Originally, 16 plant and animal species were modeled using the 1994 vegetation map (Allen et al. 2005). However, enough additional records were collected early in the project period enabling us to model 28 WRC MSHCP Covered Species by 30 April, 2006 (CCB 2006). Data acquisition, including surveys (see below), continued eventually allowing the CCB to model 54 Covered Species by the end of the project period (Table 1). This included constructing models for 18 rare plant species, one invertebrate species, one amphibian species, six reptile species, 22 bird species, and six mammal species. The CCB acquired validation datasets (presence-only or presence-absence) for 30 (56%) of these species while the remaining 24 species had their models visually assessed. Alternative models for five species were considered to be of poor quality after evaluation and a "best" model was not chosen for these species. Chapters 6-10 present the results of model construction and evaluation for each WRC MSHCP Covered Species modeled by the CCB.

CHAPTER 5

FIELD SURVEYS TO COLLECT INDEPENDENT SPECIES LOCATION DATASETS

CCB biologists surveyed public lands at 27 different sites managed by the Bureau of Land Management, Riverside County Regional Park and Open Space District, Western Riverside County Regional Conservation Authority, San Diego State University, and the Southwestern Riverside County Multi-Species Reserve (Figure 7). Appendix Figures 2-15 show survey sites and sampling points at each site. We conducted point 513 count surveys for birds at 319 survey points between 22 February and 15 May, 2006. The majority of points were surveyed twice. Some points were only surveyed one time due to difficulties accessing the site or because the site had recently burned or was highly degraded because of invasion by non-native grasses making it unlikely for shrubland birds to occur at the site. CCB biologists carried out 219 reptile surveys between 17 April and 5 July, 2006, and 198 rare plant surveys from 25 May to 29 June, 2006. For these surveys each point was surveyed one time. Appendix Tables 9-13 list the plant and animal species detected at sites managed by the various land managers. A total of 27 WRC MSHCP Covered Species were detected during the 2006 surveys. Over 8,300 individual birds were detected representing 94 bird species, 18 of which were Covered Species. The CCB detected more than 470 lizards and snakes representing nine different species, five of which were Covered Species. Five species of rare plants categorized as WRC MSHCP Covered Species were discovered totaling 59 different occurrences. Figure 8 depicts the distribution of WRC MSHCP Covered Species detected during the 2006 surveys.

Surveys were all conducted within recommended survey periods and weather conditions. Specific information regarding survey conditions, survey dates and times, personnel, and location coordinates as well as records for each individual observation have been entered in the databases provided to Caltrans with this final report.

CHAPTER 6

RARE PLANT NICHE MODELING RESULTS

The CCB developed and evaluated niche models for a total of 18 WRC MSHCP Covered plant species (Table 1). For each species we constructed from three to eleven models with different suites of environmental variables (Appendix Table 14). Using the partitioned Mahalanobis D^2 modeling technique (Chapter 2), each model had multiple partitions and each of these model-partitions had to be assessed. Plant models were constructed at the 500 m x 500 m scale and typically included climatic and topographic variables such as average minimum January temperature, average maximum July temperature, average annual precipitation, elevation, percentage slope, and aspect (eastness and northness). For many plant models, we also included soil variables such as % clay, % silt, and pH. Our digital soil layers were missing information for some regions of the Plan Area and these regions were excluded from models that included soil variables. For a few plant species, local scale vegetation variables were included in one or more models. Those environmental variables identified as important for the selected "best" model-partition (e.g., eigenvector values $>|0.40|$ in the best model-partition) are identified in Appendix Table 14.
All plant niche maps were overlaid with polygons representing development (e.g., residential, commercial, and industrial land uses) in western Riverside County through 2005. Developed areas were delineated because the plant models include primarily abiotic variables, which unlike vegetation type and land use variables, are not indirectly or directly affected by or associated with development and so do not identify developed areas as unsuitable. Table 4 presents the candidate models selected for each plant species based upon evaluation of validation datasets (presence-absence or presence-only) and inspection of calibration HSI values for species lacking validation datasets. Descriptions of the species models and niche maps are presented in the following sections.

Evaluating Plant Niche Models with Presence-Absence Datasets and Logistic Regression
Presence-absence points were available for Coulter's goldfields, San Jacinto Valley crownscale, and smooth tarplant. For these species we were able to use logistic regression to select the niche model best predicting each species' occurrence (see Chapter 2). For each species, the model-partition with the lowest AIC value is listed in Table 4 along with any other candidate model-partitions with $\Delta_i < 2.00$. Logistic regression analyses for all candidate plant models were statistically significant.

<u>Coulter's Goldfields</u>
The calibration data for Coulter's goldfields (*Lasthenia glabrata*) included locations obtained from historic records and CCB surveys conducted during 2003, 2004, and 2006. An independent presence-absence dataset was collected during CCB's 2005 surveys. The "best" model for Coulter's goldfields is LASGLA R7B, PV1, a full-rank model (e.g., with all

partitions included) constructed with topographic, climatic and soils variables (Table 4 and Appendix Table 14). There is a large difference of 0.746 in median HSI values at locations where the species is present versus where it is absent. This indicates the model performs well at identifying suitable habitat without over-predicting. A second candidate model with a lower rank (PV3) performs similarly.
Coulter's goldfields are found in alkali habitats, such as floodplains and vernal pools, and the niche map for the selected model (Figure 9) identifies suitable habitat at most populations described in the WRC MSHCP species account (County of Riverside 2003). The model also predicts most calibration and validation locations as moderately to highly suitable. All environmental variables in the model have eigenvector values >| 0.400 |; including average minimum January and average maximum July temperatures, average annual precipitation, elevation, and soil pH (Appendix Table 14). Coulter's goldfields occur in alkaline soils at lower elevations with substantially warmer temperatures and lower annual rainfall compared with the overall Plan Area.

San Jacinto Valley Crownscale

The calibration dataset for San Jacinto Valley crownscale (*Atriplex coronat***a** var *notatior*) consists of historic locations and CCB 2003 and 2004 survey data. The independent presence-absence dataset is composed of 2005 CCB survey data. Five candidate model-partitions representing three models with different combinations of abiotic variables were identified with logistic regression (Table 4). All but one candidate model-partition included soils along with topographic and climatic variables (Appendix Table 14). The best model, with the lowest AIC value, was ATRCOR R7B, PV1 (Table 1). The difference in HSI value between presence and absence points was 0.689, showing that the model easily distinguished between occupied and unoccupied habitat. The niche map (Figure 10) identifies suitable habitat at documented population locations described in the WRC MSHCP species account (County of Riverside 2003) and at most calibration/validation points. Important environmental variables are average minimum January and maximum July temperatures, average annual precipitation, elevation, % silt and % clay. San Jacinto Valley crownscale is found at low elevation sites with warmer temperatures, lower rainfall totals, and soils with higher clay content compared with averages for the Plan Area.

Smooth Tarplant

The smooth tarplant (*Centromadia pungens laevis*) calibration dataset included historical locations whereas CCB 2003-2005 surveys comprised the presence-absence dataset. Only one candidate model, CENPEN R6B, PV2, was identified with logistic regression (Table 4). All other models and partitions had Δ_i > 2.0. This model includes climatic, topographic, and soil variables (Appendix Table 14) and has a 0.620 difference in median HSI values for presence and absence points (Table 4). The smooth tarplant niche map (Figure 11) is more restrictive compared to the species account in the WRC MSHCP (County of Riverside 2003). The map identifies larger concentrations of areas as suitable for this species, but classifies outlying points as unsuitable. This indicates that there is some variability in the environmental conditions under which smooth tarplant occurs, particularly in areas along the margins of its distribution. However, the bulk of records are classified as highly suitable. All environmental variables in the model are considered important; including average minimum and maximum temperatures, elevation, precipitation, and % silt. Smooth tarplant is found at lower elevations with warmer temperatures, lower annual rainfall, and lower percent silt in the soils compared with the mean values for the entire Plan Area.

Evaluating Plant Niche Models with Presence-Only Datasets

Parry's Spineflower

There were insufficient Parry's spineflower (*Chorizanthe parryi* var *parryi*) location records to permit using the CCB 2005 survey data as an independent presence-absence dataset. However, there were enough points to allow for random withholding of 38% of the points in a presence-only dataset. There were two partitions of the same model with relatively high median validation HSI values (Table 4). The selected model includes climatic, topographic, and soil variables (Appendix Table 14). Visual inspection of the maps showed that CHOPAR R5, PV5 (the lowest-ranked or last partition) also did the best job of identifying suitable habitat (Figure 12) for documented locations described in the WRC MSHCP (County of Riverside 2003). Parry's spineflower is widely, but patchily distributed across the Plan Area in alluvial flood plains and alluvial shrublands. The niche map shows many suitable areas across the WRC MSHCP and may over-predict suitable habitat in some locations. An independent presence-absence dataset would be required to assess if this is the case. The most important environmental variables with eigenvector values >| 0.400 | are % clay and % silt. In the Plan Area, Parry's spineflower occurs in areas where soils have lower clay and silt content.

Evaluating Plant Niche Models with Calibration Datasets and Visual Inspection

Of the 18 Covered plant species that CCB modeled, 14 (78%) had insufficient location records to permit creation of validation datasets for evaluating the candidate model-partitions. Only two of these species have 40 or more spatially precise locations, and seven have less than 30 data points. Despite the low number of observations, we were still able to develop models that appeared to predict suitable habitat fairly well in locations where the species is known to occur or to have occurred in the past. For these remaining plant species, we need additional data to create validation datasets with which to evaluate model performance, particularly whether or not the models are overly liberal in predicting suitable habitat. *These preliminary, untested models should be used with caution.* These models can be used to suggest potentially suitable habitat that is similar in characteristics to locations where the species is known to occur. However, these models will need further evaluation with presence-absence datasets before they can be considered to reliably delineate suitable habitat for areas with no records of that species.

Beautiful Hulsea

Two candidate models for beautiful hulsea (*Hulsea vestita callicarpha*) were identified based upon median calibration HSI values, although these values were not very high (Table 4). Visual inspection of the niche maps for both candidates indicated one model-partition performed better at identifying suitable habitat. HULVES R1, PV1 is rather restrictive in delineating suitable habitat (Figure 13), although it categorizes habitat as suitable at locations of known populations, with the exception of the Agua Tibia region (County of Riverside 2003). Suitable habitat for this species is found in the San Jacinto foothills and mountains. The best model-partition includes climatic and topographic variables, all of which were identified as important, including minimum and maximum temperatures, annual precipitation, and elevation (Appendix Table 14). Beautiful hulsea is found at higher elevations with colder temperatures, and higher annual precipitation.

Coulter's Matilija Poppy

Three candidate model-partitions with relatively high calibration median HSI values were distinguished for Coulter's matilija poppy (*Romneya coulteri*; Table 4). The models include various combinations of topographic, climatic, soils, and vegetation variables (Appendix Table 14). Visual inspection of niche maps identifies ROMCOU R9, PV2 (Figure 14) as the model best identifying suitable habitat for known populations. The niche map identifies large areas of suitable habitat and may over-predict, particularly to the east. This species is described as widely but patchily distributed in canyons, particularly in the northwestern portion of the Plan Area in the Chino Hills, Gavilan Hills, and Santa Ana Mountains (County of Riverside 2003). Environmental variables identified as important in the best model are average minimum January temperature, average precipitation, elevation, % silt and the amount of chaparral habitat at the local scale. Coulter's matilija poppy is located at lower elevations in the Plan Area with lower annual rainfall, warmer minimum temperatures, less silt content in the soils, and greater amounts of chaparral vegetation.

Engelmann Oak

We selected two candidate model-partitions for Engelmann oak (*Quercus engelmannii*) based upon moderate median calibration HSI values (Table 4). Both candidates include only climatic and topographic variables (Appendix Table 14). The best selected model, QUEENG R1, PV2 distinguishes habitat as highly suitable in the Santa Rosa Plateau, which supports the largest population of this species in western Riverside County (Figure 15). The model may be liberal in predicting suitable habitat east of Temecula and Vail Lake and in the northwestern portion of the Plan Area. Nevertheless, these areas have abiotic conditions similar to occupied habitat. There are scattered calibration points in the eastern portion of the county indicating that while the species is not abundant it can occur there. Variables identified as important include average minimum January and maximum July temperatures, annual precipitation and elevation (Appendix Table 14). Engelmann oaks are found in low to mid-elevation foothills and valleys with relatively low rainfall totals, warmer minimum temperatures in January and cooler temperatures in July.

Graceful Tarplant

We selected two candidate models for graceful tarplant (*Holocarpha virgata elongata*) based upon moderately high median calibration HSI values from a small dataset of only 23 location records (Table 4). Both models include climatic and topographic variables (Appendix Table 14). Visual assessment of the two candidate model-partitions indicate that HOLVIR R1, PV1 is more restrictive (Figure 16), and most representative of the described distribution (County of Riverside 2003). Most records for this species are from the Santa Rosa Plateau. All environmental variables in the model have values >| 0.400 |, including average annual precipitation, elevation and percent slope (Appendix Table 14). In the Plan Area, Graceful tarplant occurs at foothill elevations in areas with low percent slope and moderate levels of annual precipitation.

Little Mousetail

We identified three candidate models for little mousetail (*Myosurus minimus*) based upon relatively high median calibration HSI values and a small calibration dataset of 25 observations (Table 4). These models include climatic and topographic variables (Appendix Table 14). The model with the highest calibration HSI; MYOMIN R5, PV2, produces a niche map (Figure 17) that fits the described distribution (County of Riverside 2003). Little mousetail is restricted to alkali floodplains and vernal pools with populations documented in Salt Creek, Santa Rosa Plateau and Harford Springs, which are predicted as suitable by the niche map. Other historic locations such as Menifee and Wildomar are also identified as suitable in the model. The model may be too liberal; identifying new areas of suitable habitat with no location records near the San Jacinto Wildlife Area, along the San Jacinto River, and east of Canyon Lake. Important environmental variables are average minimum January temperature, average annual precipitation, and percent slope (Appendix Table 14). Little mousetail occurs in areas of the Plan with low annual precipitation, little or no slope, and warm minimum temperatures in January.

Long-spined Spineflower

There are two models, each with two partitions, identified as candidates for long-spined spineflower (*Chorizanthe polygonoides* var *longispina*; Table 4). Both models include climatic and topographic variables, with one model also incorporating soil variables (Appendix Table 14). Figure 18 shows the distribution of suitable habitat based upon the model, CHOPOL R3, PV1, that best captures the documented distribution (County of Riverside 2003). Long-spined spineflower has a fairly wide distribution and specific association with clay or rocky soils. The selected model may be fairly unrestrictive as it is not constrained by soil types. However, the model with soil variables was too restrictive and did not capture as many known locations for long-spined spineflower. Important variables with eigenvector values >| 0.400 | include elevation, average annual precipitation, percent slope, and northness (Appendix Table 14). Long-spined spineflower occur at foothill elevations in the Plan Area with relatively low levels of precipitation and steeper slopes.

Mojave Tarplant
Three candidate model-partitions were identified for Mojave tarplant (*Deinandra mohavensis*) based upon moderate median calibration HSI values for a small calibration dataset of 20 occurrences (Table 4). The candidate models included climatic and topographic variables (Appendix Table 14). The niche map for the best model, DEIMOH R3, PV1 (Figure 19) captures known locations for Mojave tarplant (County of Riverside 2003). This species is restricted to the San Jacinto Mountains. Important environmental variables in this model are average minimum January temperature, average annual precipitation, and elevation (Appendix Table 14). In the Plan Area, Mohave tarplant is found in the mountains at higher elevations, with lower minimum January temperatures and higher annual rainfall.

Munz's Onion
Three candidate model-partitions were identified for Munz's onion (*Allium munzii*) based upon a small calibration dataset of 24 location records (Appendix Table 14). The selected model, ALLMEN R2, PV3, included climatic and topographic variables and had a high median calibration HSI (Table 4). This model-partition predicts large areas of suitable habitat in the Plan Area (Figure 20) and predicted suitable habitat at known locations better than other candidate models, capturing Gavilan Plateau/Estelle Mountain, Alberhill, Lake Skinner, Scott Road, Sycamore Creek, and other regions (County of Riverside 2003). Important environmental variables are elevation and average annual precipitation (Appendix Table 14). Compared with the general Plan Area, Munz's onion occurs at lower elevations with low rainfall.

Nevin's Barberry
We selected two candidate model-partitions for Nevin's barberry (*Berberis nevinii*) based upon high median calibration HSI values (Table 4). The best model, R1, PV2, contains climatic, topographic, and local-scale vegetation variables (Appendix Table 14). This model predicted suitable habitat near Vail Lake, in San Timoteo Canyon/badlands, and Agua Tibia mountains (Figure 21) where the species is found in chaparral and alluvial scrub (County of Riverside 2003). However, this model may be too liberal in delineating suitable habitat. Important environmental variables include average annual precipitation, elevation, and the amount of rock outcrops and chaparral vegetation at the local scale (Appendix Table 14). Nevin's barberry occurs in chaparral habitats in lower elevation foothills and valleys with low rainfall.

Palmer's Grappling Hook
Two different partitions of the same model were selected as candidates for Palmer's grappling hook (*Harpagonella palmeri*) and contained climatic, topographic, and soil variables (Table 4, Appendix Table 14). Median calibration HSI values were moderate and the best model was selected as HARPAL R1, PV3. The niche map (Figure 22) identifies suitable habitat for most documented locations in the Riverside lowlands, San Jacinto foothills, and Santa Ana Mountains, including Temescal Wash, Alberhill, Lake Elsinore, Harford Springs, French Valley, Skinner Lake, and Murrieta Hot Springs (County of Riverside 2003). Some

locations where this species has been recorded, such as Lake Hemet and Vail Lake, were not identified as suitable by the model. Elevation and average annual precipitation are important variables in this model (Appendix Table 14), with Palmer's grappling hook occurring at intermediate elevations with low rainfall.

Plummer's Mariposa Lily

Four different models were run for Plummer's mariposa lily (*Calochortus plummerae*), with all four substantially over-predicting suitable habitat to include areas outside of the described range of this species in the San Jacinto Mountains (County of Riverside 2003). Although the median calibration HSI values were relatively high for one model, this was because most of the Plan Area was identified as suitable. An explanation is that the 26 calibration points used to construct the model ranged widely through the foothills and into the northern portions of the study area, even west of the described range. It is possible that there are errors in location among the points in the calibration dataset. Because these models produced results so different from the documented range, they were considered to be poor models. It is likely a better model could be developed for this species if additional records were obtained for calibration and validation datasets.

Rainbow Manzanita

Three candidate model-partitions were selected for rainbow manzanita (*Arctostaphylos rainbowensis*) based upon rather low median calibration HSI values (Table 4). The models included only climatic and topographic variables. The best niche map was produced by ARCRAI R5, PV4 (Figure 23), which was rather restrictive and representative of the known distribution of rainbow manzanita (County of Riverside 2003). This species is found in chaparral on iron rich soils in the Santa Ana Mountains, particularly on the Santa Rosa Plateau and Santa Margarita Ecological Reserve, and in the Temecula/Pehcanga areas, and Agua Tibia wilderness. The selected model identifies these areas as suitable habitat, although not all calibration points are well predicted. The important environmental variables in this model are average maximum July temperature and elevation (Appendix Table 14). Rainbow manzanita occurs at lower elevations with cooler summer temperatures.

Small-flowered Microseris

This species was modeled using only 20 calibration points and three candidate model-partitions were identified for small-flowered microseris (*Microseris douglasii* var *platycarpha*) based upon moderate median calibration HSI values (Table 4). The two different models included climatic and topographic variables with and without soil variables (Appendix Table 14). The best model was MICDOU R3, PV3 (Figure 24), which captured most locations where the species is known to occur, although the map may be liberal in delineating suitable habitat. Small-flowered microseris is restricted to clay soils and vernal pools and is often associated with native grasslands (County of Riverside 2003). The niche map identifies suitable habitat for known populations in the Santa Ana Mountains, Lake Mathews, Temescal Canyon, Alberhill, French Valley, Lake Skinner, and Vail Lake. The environmental variables identified as important in this model are average annual precipitation and elevation (Appendix Table 14). Small-flowered microseris is found at intermediate elevations with low annual rainfall.

Thread-leaved Brodiaea

Four models were constructed for thread-leaved brodiaea (*Brodiaea filifolia*) and all substantially over-predicted suitable habitat for this species in the Plan Area. This plant has a scattered distribution in alkali floodplains, vernal pools, grasslands and alluvial fan sage scrub along the San Jacinto River, in the San Jacinto Wildlife Area, along Salt Creek, and on the Santa Rosa Plateau (County of Riverside 2003). The candidate niche model-partitions did not distinguish these areas from most other areas of the Riverside lowlands. We did not select a best model for this species as none of the models we ran performed well in distinguishing suitable habitat. If additional records were obtained for calibration and validation datasets, it is likely that a better performing model could be developed for this species.

Summary of Plant Niche Model Results

Sixteen of eighteen WRC MSHCP Covered plant species had models that performed relatively well in predicting suitable habitat. Median validation HSI values ranged from 0.620 to 0.759 for the four plant species with validation datasets. Three of these species had presence-absence datasets allowing the best model to be selected using logistic regression techniques. Twelve plant species had insufficient data with which to validate models and the best models were selected based upon an evaluation of their niche maps. These models should be used with caution. Of the best selected models, nine included climatic and topographic variables and six others also included soil variables. One model was constructed with climatic, topographic and vegetation variables.

CHAPTER 7

QUINO CHECKERSPOT NICHE MODELING RESULTS

The Quino checkerspot butterfly (*Euphydryas editha quino*) is a federally-endangered species that was historically an abundant and widespread species in southern California. Much of the butterfly's former range has been developed or converted to agriculture, and remaining natural areas supporting Quino checkerspot are in degraded condition (U.S. Fish and Wildlife Service 2003). Habitat degradation is attributed to habitat fragmentation, invasion by annual grasses, altered wildfire regimes, and other anthropogenic disturbances. The butterfly is now confined to San Diego and Riverside counties and a few locations in Baja California, Mexico. Quino checkerspot butterflies occur in open shrublands (coastal sage scrub, chaparral, and desert transition) with sparse non-native vegetation. The presence of primary plant populations (*Plantago erecta* and to a lesser extent *Antirrhinum coulterianum*) are essential for larval feeding and adult reproduction.

After deleting spatially redundant locations, the CCB species occurrence database for western Riverside County contained 161 Quino checkerspot records with high spatial precision (<125 m) provided by the US Fish and Wildlife Service. Approximately 75% of these records were used as calibration points to construct models and 25% were randomly selected to create a presence-only validation dataset. We obtained an independent presence-only validation dataset of 30 high spatial precision records from CDFG surveys conducted in 2005. A third validation dataset was created with 65 less spatially precise records (< 250 m and > 125 m) that were obtained from the WRC MSHCP database. All records in the calibration and various validation datasets were relatively recent (1997 or later) reflecting the current population distribution but not the historic range of this species. As a result, our models largely reflect current environmental conditions where the species is still extant.

Evaluating candidate model-partitions was complicated by having three different validation datasets with different spatial distribution characteristics. The randomly selected 75% calibration and 25% validation datasets encompasses a wider range of locations across the Plan Area, including several locations from recently extirpated populations in the western portion of this species' recent range (Lake Mathews, Gavilan Plateau, Harford Springs, and near Canyon Lake). The CDFG 2005 survey dataset is confined entirely to the southeast corner of the Plan Area (~9 miles east of Aguanga and north to Bautista Canyon). The less spatially precise data are largely constrained to the southern half of the study area. As a result, we evaluated both the randomly selected 25% dataset that best represents the entire study area and the complete validation dataset composed of all observations. We combined an assessment of median validation values with a visual inspection of the niche maps in order to choose the model best representing the current and recent distributions of Quino checkerspot.

We ran 20 different partitioned Mahalanobis D^2 models for Quino checkerspot. These included abiotic, local, landscape, and combined local/landscape scale models with different combinations of climatic, topographic, and vegetation variables (Appendix Table 15). In some models we used climatic variables characterizing environmental conditions during the larval development period whereas in other models we incorporated the same climatic variables we used to model other taxa. We selected EUPEDI 4B, PV12 as the "best" model-partition from five candidates (Table 5, Figure 25). It is composed of abiotic and landscape scale vegetation variables (Appendix Table 15). This model performed the best of all model-partitions in predicting the random 25% validation dataset that encompasses the largest spatial extent of the study area. Considering the entire validation dataset, this model-partition had slightly lower median HSI values than other model-partitions and this is attributed to the biased distribution of model validation points to the south and southeast areas of the Plan (see below). Based upon visual inspection of the niche maps, R4B, PV12 best captures the current species distribution along with documented portions of recently occupied habitat in the Gavilan Hills, around Lake Mathews and in Harford Springs. Most other model-partition niche maps did not identify these areas as suitable. For this model-partition we identified important environmental variables with eigenvector values of $>|0.400|$; including elevation, average minimum January temperature, and percent chaparral and coastal sage scrub at a landscape scale. Quino checkerspot occur at higher elevations with greater proportions of coastal sage scrub and chaparral compared to the overall Plan Area.

An inspection of the dispersion of calibration and validation locations and a comparison of environmental characteristics across the Plan Area explains why the model-partition with the niche map that best captures recently occupied habitat in the western portion of the Quino's range results in somewhat lower validation HSI values for the entire validation dataset. This is because of a greater distribution of observations in the south and extreme southeast portions of the study area. Thirty of the 120 (25%) calibration locations are from the southeast corner of the Plan Area (~9 miles east of Aguanga and north to Bautista Canyon). In contrast, the western region (recently occupied habitat south of Lake Mathews to Sedco Hills and bounded by I-15 and I-215 to the west and east) is represented by only two (2%) calibration points. There are 44 (32%) of 136 total validation points from the southeastern region and only 10 (7%) are from the western area. The margins of the Plan Area, in particular this southeast corner differs in environmental characteristics from more central regions. In particular, recently occupied habitat in the western portion of this species range differs substantially in environmental characteristics at occupied points east of Aguanga (Table 6). This southeast region forms a transition from low-lying shrublands in the western portion of Riverside County to higher elevations in the San Jacinto Mountains to the east. Elevation is an important variable in the selected model-partition and mean elevation for occupied points in the southeast portion of the study area is 2.5 times greater than mean elevation for map points encompassing recently occupied habitat in the west. Precipitation is also an important variable in the selected Quino checkerspot model with calibration points in the southeast region receiving 50% more annual rainfall on average than map points in the western area. Quino locations east of Aguanga also support lower levels of coastal sage scrub and higher levels of chaparral compared with the overall calibration dataset and recently occupied habitat to the west. There are also many differences in other environmental attributes that are considered less important in defining Quino checkerspot habitat. Thus, the greater distribution of modeling points in southeastern portions of the Plan influences the ability of the niche models to identify historically suitable habitat in the western portion of this species distribution.

CHAPTER 8

AMPHIBIAN AND REPTILE SPECIES NICHE MODELING RESULTS

We constructed and evaluated partitioned Mahalanobis D^2 niche models for one amphibian and six reptile species (Table 1). For each species we ran from five to ten models, including abiotic, local, landscape, and combined local/landscape scale models (Appendix Tables 16 and 17). The amphibian model was constructed at the 250 m x 250 m scale and the reptile models at the 500 m x 500 m scale.

Amphibian Models

Arroyo Toad

We had a total of 62 high spatial precision records for modeling the federally-endangered arroyo toad (*Bufo californicus*). We randomly withheld 27% of the observations for a presence-only validation dataset. Three candidate models were selected with high median validation HSI values (Table 7). Based upon the validation values and niche maps produced by the model-partitions, BUFCAL R3, PV3 was selected as the model best identifying suitable habitat (Figure 26). This model is based upon a combination of climatic, topographic, and local and landscape-scale vegetation variables (Appendix Table 16). Environmental variables for this model-partition with eigenvector values > | 0.400 | include elevation, average minimum January temperature, precipitation and the percent of development at the landscape scale. Arroyo toads occur in areas with substantially lower levels of development compared to the mean for the overall Plan Area.

Arroyo toads are limited in distribution in the Plan Area (County of Riverside 2003) and the model reflects this. It identifies suitable, occupied habitat at Arroyo Seco Creek near Vail Lake, at Wilson Valley Creek, in Bautista Canyon, along parts of the San Jacinto River east of Hemet and at a location on the Santa Rosa Plateau (Figure 26). However, it does not identify documented locations in Temecula Creek as suitable. This may be because this area has rapidly developed and the model indicates that arroyo toads are found in areas with low levels of development at the landscape scale. The model may over-predict as suitable some locations south of Lake Skinner and west of Bautista Canyon. Additional calibration and validation data could improve this model and resolve whether it is too liberal in areas where the species has not been documented.

Reptile Niche Models

Coast Horned Lizard

The CCB has 174 spatially distinct and relatively high precision location records for the coast horned lizard (*Phrynosoma coronatum blainvillei*). We randomly selected 34% of these records to use as a presence-only validation dataset. We ran seven different models with different combinations of abiotic and local/landscape scale vegetation variables (Appendix Table 17).

Based upon an evaluation of the median validation HSI values we identified two candidate model-partitions, the best of which we determined to be PHRCOR R7, PV1 (Table 7). This model-partition had a relatively high validation value and the niche map did a good job characterizing habitat at known locations and across the described distribution (Figure 27). Coast horned lizards are found in coastal sage scrub and chaparral habitats in many areas of the WRC MSHCP (County of Riverside 2003). All environmental variables in the model were identified as important with eigenvector values of > | 0.400| on at least one of the principal components included in the full model (Appendix Table 17). The results show that compared with the overall Plan Area, coast horned lizards occur at lower elevations with reduced exotic plant cover, higher amounts of shrubland vegetation at local and landscape scales, and reduced agriculture and development at the landscape scale.

Coastal Western Whiptail

There were 274 spatially non-redundant observations of coastal western whiptail (*Cnemidophorus tigris multiscutatus*), of which 35% were randomly withheld for a presence-only validation dataset. Eight models were developed including different abiotic, local, landscape, and combined local/landscape scale models (Appendix Table 17). Two partitions of the same model composed of climatic, topographic, and local/landscape scale vegetation variables were identified as best predicting suitable habitat based upon the validation points (Table 7). CNETIG R1, PV3 was selected as the best model as it had the highest validation values and a niche map (Figure 28) that fit the described range of coastal western whiptail in the Plan Area (County of Riverside 2003). This species is widespread in shrubland habitats throughout western Riverside County. The niche model identifies large blocks of habitat as suitable in the Plan Area but excludes lands that are developed or converted to agriculture or at higher elevations. The only environmental variable not identified as important in this model-partition was the amount of oak woodland at a local scale (Appendix Table 17). Compared to mean environmental characteristics for the entire study area, coastal western whiptails occur at lower elevations supporting higher amounts of coastal sage scrub and grassland vegetation at the local scale, and reduced levels of agriculture and development at the landscape scale.

Granite Spiny Lizard

The CCB has 404 distinct spatial locations for granite spiny lizard (*Sceloporus orcutti*) within the Plan Area. Approximately 45% of these observations were included in a presence-only calibration dataset to evaluate the ten different models run for this species (Appendix Table 17). A total of four model-partitions were selected as candidates for further evaluation; each of these included climatic, topographic and local scale vegetation variables (Table 7). Median validation values were moderate and niche maps from the different model-partitions were very similar and rather restrictive in capturing the documented locations and described range of this species. Granite spiny lizards are widespread within the Plan Area but constrained to boulder fields and rock outcrops (County of Riverside 2003). The selected model SCEORC R8, PV2 shows concentrations of suitable habitat in the Box Springs, Sycamore Canyon, Reche Canyon, Alberhills, Steele Peak, Harford Springs, Gavilan Hills, Lake Perris, Sedco Hills, Warm Springs Creek, Shipley Skinner Multi-Species Reserve and lands to the east, and the hills west of Lake Elsinore (Figure 29). The niche model failed to predict suitable habitat for known granite spiny lizard locations at the Santa Rosa Plateau, Wilson Valley, Agua Tibia, Potrero Canyon and near Canyon Lake. Given the extensive dataset it is unlikely that additional data will improve this model. Instead the problem may be that the environmental variables used to construct this model do not capture some important aspects of granite spiny lizard habitat. Since this species primarily occurs on large rocks, it is likely that improving the resolution of our rock outcrop digital layers would improve the performance of our model. All variables used to construct this model had high eigenvector values on one or more of the selected model partitions. Compared to the overall Plan Area, granite spiny lizards occur at lower elevations with less rainfall, steeper slopes, substantial rock outcrops, reduced development and greater grassland and shrubland cover at the local scale.

<u>Northern Red Diamond Rattlesnake</u>
The CCB database contains 84 records for northern red diamond snake (*Crotalus ruber ruber*), of which 29% were randomly withheld for presence-only validation. We constructed six models for the rattlesnake that incorporated various combinations of climatic, topographic, and local/landscape scale vegetation variables. We selected CRORUB R1, PV3 from two candidates based upon the median validation HSI values (Table 7). This model captures the documented distribution fairly well (Figure 30 and County of Riverside 2003), except for a few outlying areas such as Banning and the northern portion of the City of Riverside. All the environmental variables included in this model are considered important as assessed by their eigenvector values in modeled components (Appendix Table 17). Northern red diamond rattlesnakes inhabit areas with slightly higher minimum and maximum temperatures, relatively low rainfall, and substantially higher levels of coastal sage scrub cover compared to chaparral at the local scale.

<u>Orange-throated Whiptail</u>
The CCB had 194 spatially distinct records for orange-throated whiptail (*Cnemidophorus hyperythrus beldingi*); retaining 35% in a randomly selected validation dataset and including the remaining 65% in a calibration dataset with which nine models were constructed (Appendix Table 17). The two candidate model-partitions included a combination of climatic, topographic, and local and landscape scale vegetation variables. Validation values were relatively high for both candidates, with the highest validation values predicted by CNEHYP R3, PV9 (Table 7). This selected model-partition performed well in identifying suitable habitat for orange-throated whiptail (Figure 31), which is found in scattered locations in open coastal sage scrub and chaparral habitats throughout the Plan Area (County of Riverside 2003). The model did not identify suitable habitat for records in the southwest portion of the Plan Area. All environmental variables in this model were identified as important (Appendix Table 17). Orange-throated whiptails are found at low elevations in the Plan Area with relatively high minimum and maximum temperatures and high levels of

coastal sage scrub cover. This species tended to avoid areas with high levels of local scale agriculture and landscape level development.

Southern Sagebrush Lizard

There were only 37 records that could be used for modeling for the southern sagebrush lizard (*Sceloporus graciosus vandenburgianus*), and all of these records were used to construct the model. Five models were constructed including abiotic, local, landscape, and combined local/landscape scale (Appendix Table 17). Three model-partitions were selected as candidates based upon relatively high calibration values (Table 7). Upon visual inspection, SCEGRA R2, PV2 was selected as best capturing location records for this species (Figure 32). This species is described from the San Jacinto and Santa Rosa Mountains, occurring in montane areas with scattered bushes (County of Riverside 2003). Our calibration data included some observations in the San Jacinto foothills, although most were clustered at higher elevations at the eastern edge of the study area. The niche map probably over-predicts suitable habitat at lower elevations in the western half of the Plan Area. It is likely that models for this species could be improved with additional location records for calibration and validation datasets. The important environmental variables identified in this model include elevation, average annual precipitation, and local scale chaparral and other shrubland habitats (Appendix Table 17). Our model confirms that southern sagebrush lizards occur at high elevations with elevated annual rainfall.

Summary of Amphibian and Reptile Niche Models

The CCB constructed niche models for one amphibian and five reptile species. These models had high median validation HSI values varying from 0.699 to 0.872, depending on the species. The best models for three species included climatic, topographic, and local-scale vegetation variables whereas the other four species' models also included landscape level vegetation variables.

CHAPTER 9

BIRD NICHE MODELING RESULTS

We constructed and evaluated partitioned Mahalanobis D^2 niche models for 22 bird species (Tables 1 and 8). For each species we ran from 4 to 11 models, including abiotic, local, landscape, and combined local/landscape scale variables (Appendix Table 18). We constructed bird models at 250 m x 250 m scale and 500 m x 500 m scales, depending on the spatial resolution of each species location data. We evaluated models for sixteen of these species with independently collected presence-absence datasets or with randomly withheld location data (Table 8). We assessed models for seven species using presence-absence data and logistic regression analyses and we evaluated models for nine species by comparing median HSI values for random validation data points. All candidate models were visually assessed relative to the documented distribution for each species. Models including abiotic, local and landscape variables were selected as best predicting suitable habitat for seven species. Models with only abiotic variables were selected for five species, local-scale and abiotic variables for four species, and landscape-scale and abiotic variables for three species. There were no model-partitions selected for three species as all models were determined to perform poorly at predicting suitable habitat. Details of the selected models are presented below for each species.

<u>Bell's Sage Sparrow</u>
We constructed partitioned Mahalanobis D^2 niche models for Bell's Sage Sparrow *(Amphispiza belli belli)* with 144 calibration location points (Appendix Table 18). We used a presence-absence dataset with 493 points surveyed two or more times in western Riverside County from 1995-1997 or in 2006. Bell's Sage Sparrows were observed at 146 of these sampling points. Only one model-partition was selected as a candidate model best predicting suitable habitat (Table 8). The selected model-partition, SAGS R3 PV8, is relatively unrestrictive including abiotic and landscape-scale variables. The difference between presence and absence median HSI values is relatively small (0.365) although the model significantly predicts presence and absence of Bell's Sage Sparrows at the sampling points. A visual inspection of the niche map (Figure 33) indicates that it fits well with the WRC MSHCP species account except for Wilson Valley and Aguanga (County of Riverside 2003). According to the niche map, highly suitable habitat is relatively fragmented but widely distributed through much of the Plan Area. Despite being a lower-ranked model-partition, the niche map is fairly restrictive as it does not predict suitable habitat for calibration and validation points in the northwest, southwest, and southeast margins of the Plan Area. Environmental variables associated with the occurrence of Bell's Sage Sparrow include average minimum January and maximum July temperatures, elevation, percent of land at the landscape scale comprised of urban development, coastal sage scrub and chaparral habitats, and the amount of natural versus developed edge. In the Plan Area, sage sparrows are found

at relatively low elevations with warm temperatures, low levels of development and urban edge, and high amounts of coastal sage scrub and little chaparral.

Cactus Wren

There were only 50 spatially distinct location records with high enough spatial precision to use in developing niche models for the Cactus Wren *(Campylorhynchus brunniecapillus)* with insufficient records for a validation dataset (Appendix Table 18). Based upon an analysis of median calibration HSI values and visual assessments of niche maps, CACW R3, PV3 was selected as the model-partition that fit the documented distribution of the species (Table 8). This model is based upon only abiotic (climatic and topographic) environmental variables. The Cactus Wren niche map (Figure 34) does not predict suitable habitat for documented locations in Chino Hills or Aguanga (County of Riverside 2003) or calibration points in Lake Skinner, west of Vail Lake and in the Sun City area. All variables included in the selected model-partition are considered relatively important based upon inspection of the eigenvector values. Cactus Wren occur in valleys and lower foothills of the Plan Area with relatively low levels of precipitation, warmer average minimum January temperatures but lower than average maximum July temperatures.

California Gnatcatcher

A large database was available to construct and evaluate California Gnatcatcher *(Polioptila californica)* niche models. There were sufficient data to randomly withhold 164 (30%) of the presence-only records for validation with the remaining 384 records used to construct the models. Repeated point count surveys conducted at 493 locations in 1995-1997 and in 2006 resulted in an independently collected presence-absence dataset to evaluate model-partitions using logistic regression techniques. Gnatcatchers were detected at 81 of these latter points. Four alternative niche models were constructed including abiotic only and abiotic plus local or landscape or combined local-landscape variables (Appendix Table 18). Based upon logistic regression analyses we selected the abiotic and local-scale model CAGN R2 PV1 as the best model (Table 8). This model provided exceptionally high differentiation between points where a species was present (median HSI of 0.915) versus where it was absent (median HSI of 0.098). The randomly withheld validation HSI was slightly lower with a median HSI of 0.704.

The selected model-partition performs well in predicting suitable habitat for all identified California Gnatcatcher core population areas in the Plan Area (Figure 35) with the exception of Wilson Valley (County of Riverside 2003). The Wilson Valley/Aguanga area in the southeastern portion of the gnatcatcher's distribution is predicted as low habitat suitability. To evaluate this discrepancy, we calculated means and standard deviations for environmental variables in the California Gnatcatcher calibration dataset. We compared these means characterizing the range of occupied habitat in western Riverside County with means for environmental variables at map points encompassing gnatcatcher locations in the southeastern portion of the distribution. We evaluated the magnitude of difference between the two sets of means and considered a large difference to be equal to or greater than one standard deviation unit for the calibration dataset (Table 9). Wilson Valley and the surrounding southeastern area is cooler, wetter, and higher in elevation with higher amounts of chaparral compared with typical occupied gnatcatcher habitat. There is also less coastal sage scrub in the southeastern area, although this difference is slightly less than one standard deviation unit in magnitude. Because the southeastern area is substantially different from occupied habitat, it is not surprising that it is identified as low suitability. Mahalanobis D^2 compares the degree of similarity of environmental characteristics at each point in the study area with the multivariate mean for environmental characteristics at locations where the species occurs. Since most observations in the calibration dataset occur in areas with similar environmental characteristics, it is not surprising that marginal areas differing in environmental characteristics have relatively low HSI values. The model is also rather conservative in predicting suitable habitat for scattered gnatcatcher locations at other areas at the margin of the species' range in the Plan Area. The gnatcatcher map classifies as low suitability several gnatcatcher locations in the southwest corner of the Plan Area near I-15 and on the Santa Rosa Plateau, and in the northwest portion of the Plan near Corona, north of the Santa Ana River, and just east of the Box Spring mountains.

All environmental variables included in the selected model-partition are associated with the occurrence of gnatcatchers based upon eigenvector values. California Gnatcatchers are found at low elevations with warmer January temperatures, lower annual rainfall, and substantially more coastal sage scrub (Table 9). They are also associated with warmer maximum July temperatures and less agriculture, development and chaparral at the local scale, although these differences compared to the overall Plan Area are less than one standard deviation unit in magnitude.

<u>California Horned Lark</u>

Five alternative California Horned Lark *(Eremophila alpestris actia)* models were run and evaluated with 24 (29%) randomly withheld presence-only records (Appendix Table 18). The selected model-partition, HOLA R2B, PV1 included abiotic and local-scale vegetation variables and has a median validation HSI value of 0.648. It predicts most of the known horned lark distribution (Figure 36) although it is somewhat restrictive for described locations in Prado Basin, Banning and Beaumont (County of Riverside 2003).

All environmental variables included in the model are assessed as important based upon eigenvector values (Appendix Table 18). In the Plan Area California Horned Larks occur in areas with lower elevations and annual rainfall, greater amounts of agriculture and grassland, and lower levels of development.

<u>Cooper's Hawk</u>

We constructed six alternative niche models for Cooper's Hawk *(Accipiter cooperii)* using a calibration dataset of 110 records and evaluated models with a randomly selected validation dataset of 50 (31%) presence-only records (Appendix Table 18). The selected model – partition, COHA R4B, PV7, includes abiotic and local-scale vegetation variables and has a median validation HSI value of 0.839 (Table 8). According to the WRC MSHCP Species Account, Cooper's Hawks are widely distributed throughout western Riverside County occurring in a variety of habitat types (County of Riverside 2003). The selected niche map reflects this widespread distribution (Figure 37) and performs well in predicting suitable habitat for occupied locations in the CCB database.

Important environmental variables identified for the selected model-partition include elevation, precipitation, and local scale amounts of coastal sage scrub, chaparral, and oak woodland (Appendix Table 18). Cooper's Hawks are found at relatively low elevations with slightly lower average rainfall and higher amounts of coastal sage scrub and oak woodland, and slightly lower amounts of chaparral.

<u>Downy Woodpecker</u>
Spatially-independent and precise location records for Downy Woodpecker *(Picoides pubescens)* are limited in the CCB database. We constructed seven alternative niche models with 36 points with high spatial precision and evaluated models by assessing median calibration HSI values and visually inspecting niche maps (Appendix Table 18). The chosen model-partition, DOWO R3, PV1, contains abiotic variables with a median calibration HSI value of 0.642 (Table 8). The niche map predicts suitable habitat in WRC MSHCP identified core areas such as the Prado Basin/Santa Ana River, Temescal Canyon, and the Temecula Creek/Vail Lake areas (Figure 38). The map is restrictive to the east in Potrero Canyon and Wilson Valley, failing to predict suitable habitat for some documented locations, although it does captures other known locations such as San Timoteo Canyon, Sycamore Canyon, and Lake Skinner. Since the map is based only upon abiotic variables and does not account for vegetation or development, it is liberal in identifying some areas away from riparian habitat as suitable. This identifies potential areas for riparian restoration that could eventually support Downy Woodpecker after establishment of mature trees with cavities for nesting.

Environmental variables identified as important in association with Downy Woodpecker occurrence include precipitation, average minimum January and maximum July temperatures, elevation, and percent slope (Appendix Table 18). Downy Woodpeckers occur in areas within the Plan that are relatively flat and low elevation with warmer temperatures and average rainfall amounts.

<u>Ferruginous Hawk</u>
We had a small calibration dataset of 29 observations to construct four models for Ferruginous Hawk.*(Buteo regalis)*. We evaluated models by assessing median calibration HSI values and niche maps (Appendix Table 18). The model chosen, FEHA R3, PV1, included only abiotic climatic and topographic variables, with a median calibration HSI of 0.622 (Table 8). The niche map (Figure 39) predicts habitat for migratory and winter resident

Ferruginous Hawks in documented use areas in Prado Basin, Santa Ana River, and Mystic Lake-San Jacinto Wildlife Refuge (County of Riverside 2003). Calibration locations along the I-215 corridor, near Hemet, Diamond Valley Lake, and Lake Skinner are also identified as suitable. All environmental variables included in the model were evaluated as important based upon eigenvector values. Ferruginous Hawks occur at lower elevations with little slope, slightly warmer average minimum January temperatures, and lower levels of precipitation.

<u>Golden Eagle</u>
We developed four Golden Eagle *(Aquila chrysaetos)* niche models with 43 calibration points and evaluated them with 15 records (Appendix Table 18). The chosen model, GOEA R4, PV1, had a median validation HSI of 0.839 (Table 8). This model included abiotic, local, and landscape-scale environmental variables, and the map showed suitable habitat throughout most of the Plan Area (Figure 40). This fits the widespread distribution of points in our database that are found scattered throughout the Plan Area. The WRC MSHCP Species Account for Golden Eagle describes it as widespread except at higher elevations (County of Riverside 2003). This model captures foraging habitat for this species, which can have large home ranges, but does not identify suitable nesting sites which are much more restricted in distribution. All variables in this full model were assessed as important (Appendix Table 18). Golden Eagles are found at low to moderate elevations in association with areas with relatively high amounts of grassland and low amounts of development at the landscape scale.

<u>Grasshopper Sparrow</u>
We used 81 presence-only records to construct Grasshopper Sparrow *(Ammodramus savannarum)* models (Appendix Table 18). Spatially-precise calibration data used in modeling were compiled from 2004-2006 CCB bird surveys and from focused grassland bird surveys conducted by the CDFG Monitoring Program in 2005. We also had an independent dataset of 80 repeated point count surveys conducted during 1995-1997. These presence-absence data were used to evaluate model-partitions with logistic regression techniques. There were six candidate models based upon an assessment of AIC values (Table 8). The model-partition that best distinguished suitable habitat for Grasshopper Sparrows was GRSP R1, PV3 and included abiotic, local, and landscape-scale variables. This model distinguished between points where sparrows were detected (median HSI = 0.644) and where they were absent (median HSI = 0.002). Some of the other model-partitions had higher median validation HSI values, but this apparent anomaly is because logistic regression is based upon analysis of mean, not median, values. Visual inspection of niche maps indicates a high degree of similarity between the different candidate model-partitions. The maps identify suitable habitat at locations where Grasshopper Sparrows are most numerous, such as the Santa Rosa Plateau, Shipley-Skinner Multi-Species Reserve, and patches of habitat east of I-15 between Lake Mathews and Highway 74 (Figure 41). However, the map is conservative and predicts low suitability habitat at locations with one or two reported observations such as Sycamore Canyon, the Santa Ana River, Potrero Canyon, Canyon Lake, and near Vail Lake.

There is a lack of specific information on Grasshopper Sparrow distributions in the WRC MSHCP Species Account (County of Riverside 2003). All environmental variables in the model have relatively high eigenvector values on one or more partitions. Relative to the entire Plan Area, Grasshopper Sparrows occur at low elevations with warmer average minimum January temperatures, and higher amounts of local and landscape-scale grassland and coastal sage scrub cover. They are also found in areas with limited development.

<u>Least Bell's Vireo</u>
The CCB used 117 spatially-distinct, high precision records to create Least Bell's Vireo *(Vireo bellii pusillus)* models and used a presence-absence dataset collected by the CCB during 2004 to evaluate models. This latter dataset had 281 sampling points with Least Bell's Vireos detected at 70 of the points. Nine different models were compared and the selected model-partition, LBVI R5, PV1, is comprised of abiotic and local-scale environmental variables (Appendix Table 18, Table 8). This model partition best distinguishes between occupied points (median HSI = 0.705) and unoccupied points (median HSI = 0.082). The niche map predicts suitable habitat for major concentrations of Least Bell's Vireo along the Santa Ana River, in Prado Basin, Temescal Wash, Mockinbird Canyon, Sycamore Canyon, and San Timoteo Canyon (Figure 42). It also identifies habitat at documented locations near Lake Skinner, the San Jacinto River, and Bautista Canyon. The map predicts low habitat suitability for single observations to the west and north of Canyon Lake, near Wilson Valley, and in Potrero Canyon. The niche model liberally identifies potentially suitable habitat outside of occupied riparian areas for a large portion of the northwestern Plan Area and to the south in the vicinity of the merge of Interstates 15 and 215. The amount of local-scale riparian vegetation was an important factor in determining vireo occurrence with 20 times more at occupied locations than in the map area as a whole. Nevertheless, riparian vegetation was not the only defining feature identifying suitable habitat for vireos. This pattern is attributed to the preponderance of climatic and topographic variables that are associated with vireo occurrence and to the confluence of appropriate abiotic conditions at locations lacking riparian habitat. Interestingly, this combination of abiotic variables and local scale riparian and shrubland vegetation describes vireo occurrence better than models that emphasized different combinations of specific riparian associations (e.g., willow riparian and mulefat elderberry scrub) or models emphasizing vegetation types at local and landscape scales. As a result, this niche map could be helpful in identifying and prioritizing areas for riparian restoration with the greatest potential for vireo occupancy based upon current habitat relationships in western Riverside County. Environmental variables most consistently associated with vireo occurrence were average minimum January temperature, average maximum July temperature, elevation, slope, and the amount of shrubland and riparian vegetation at the local scale. Within the Plan Area, Least Bell's Vireos occur at predominantly low elevation sites with little slope, high amounts of riparian vegetation and low amounts of shrubland, warm average minimum January temperatures, and low annual rainfall.

Loggerhead Shrike

We constructed five different models for Loggerhead Shrike *(Lanius ludovicianus)* with 136 calibration locations (Appendix Table 18). We evaluated models using logistic regression analyses and a presence-absence dataset composed of 80 points sampled two or more times from 1995-1997. Shrikes were detected at only 11 of these points. Although we had several significant logistic regression models the median validation HSI values were very low and the ability of the model-partitions to distinguish between points where shrikes were present from points where they were absent was poor. Model AIC values were close to the values that would be obtained with the Y-Intercept and no variables included in the model. Niche maps were similar for the various models and were biased in showing suitable habitat as only occurring in the central portion of the County, whereas the calibration and validation datasets indicated a wider distribution. The maps delineating suitable habitat were very restrictive compared with the WRC MSHCP Species Account, failing to predict suitable habitat at described locations at the Prado Basin, Santa Ana River, Lake Mathews-Estelle Mountain, Wasson Canyon, Wildomar, Temecula Creek, and Wilson Valley (County of Riverside 2003). After evaluating these results, we rejected the current models as inadequate in predicting shrike occurrence. We suspect that a biased distribution of calibration points used to create the model (from oversampling in the San Jacinto-Lake Perris areas) may explain the poor performance of these models. Additional location data from other regions of the Plan Area will be necessary to develop models that better predict Loggerhead Shrike occurrence.

Mountain Quail

Thirty-three observations with high enough spatial precision were available to construct Mountain Quail *(Oreortyx pictus)* niche models (Appendix Table 18). We evaluated the models using median calibration HSI values and visually assessing niche maps. There were three candidate model-partitions with high median HSI calibration values; the one that appeared to perform best at predicting suitable habitat was MOQU R4, PV1 (Table 8). This model-partition includes abiotic and landscape-scale variables and the median calibration HSI was highest at 0.712. The selected niche map (and the other candidate maps) is relatively liberal; identifying suitable habitat at lower elevations than expected (Figure 43). However, there are several low elevation observations (e.g., four records west of Canyon Lake and east of I-15 and a record just west of Lake Elsinore) indicating this species has the potential to occur at lower elevations in some regions of the Plan. The model does a good job of predicting occupied points in the San Jacinto Mountains and foothills. There is no specific location information in the WRC MSHCP Species Account and the distribution is identified as occurring in the San Bernadino, San Jacinto, and Santa Ana Mountains (County of Riverside 2003). All variables in the model (Appendix Table 18) have high eigenvector values on one or more partitions. Compared with the overall Plan Area, suitable habitat for Mountain Quail includes foothills and mountains with greater levels of annual precipitation and lower average minimum January temperatures. They also occur in areas with high percentage of chaparral and low percentage of development at the landscape scale.

Northern Harrier

We developed seven niche models for Northern Harrier *(Circus cyaneus)* with a calibration dataset of 68 records and a randomly withheld presence-only validation set of 29 (30%) observations (Appendix Table 18). The chosen model-partition is NOHA R5, PV1 based upon a high median validation HSI value of 0.828. This model depicts much of the Plan Area as highly suitable (Figure 44). While this model predicts suitable habitat for the majority of calibration and validation locations spread throughout western Riverside County, it is conservative in predicting suitable habitat in particular areas. This is particularly the case for predicted low habitat suitability areas in the center of the study area, from Moreno Valley south to Temecula, which encompasses several documented records. The model also does not predict suitable habitat at scattered locations in Banning, along the Santa Ana River, and southwest of Lake Hemet. All variables in the model are consistently associated with this species occurrence (Appendix Table 18). Within western Riverside County, Northern Harriers are found at relatively low elevations with higher than average amounts of local-scale grassland and near average levels of development, grassland, agriculture and shrublands at the landscape scale.

Sharp-shinned Hawk

The Sharp-shinned Hawk *(Accipiter striatus)* is a winter resident in western Riverside County with a calibration dataset of only 30 records (Appendix Table 18). We assessed median calibration HSI values and visually inspected niche maps to select a model-partition. Based upon an evaluation of four alternative models, we selected SSHA R3, PV1 as the model-partition best representing suitable habitat for Sharp-shinned Hawks (Table 8). The median calibration HSI value is 0.725 and the niche map predicts suitable habitat throughout much of the study area (Figure 45) accounting for all but a few of the broadly dispersed calibration points. The chosen model-partition generally matches the WRC MSHCP Species Account, which predicts widespread distribution throughout the Plan Area (County of Riverside 2003). This model is based only upon abiotic variables and disturbances of natural lands due to development and agriculture are not accounted for, althought this species commonly occurs, and even nests, within urban and suburban areas. This makes it difficult to determine whether the model over-predicts the availability of suitable habitat. A few outlying calibration points are predicted as low suitability including two locations in the San Jacinto Mountains and two along the Santa Ana River. As is typically expected with full model-partitions, all environmental variables in the model are ranked as important (Appendix Table 18). Sharp-shinned Hawks tend to winter in western Riverside County at relatively low elevations with slightly higher than average January minimum temperatures, reduced precipitation and moderate slopes.

Southern California Rufous-crowned Sparrow

The CCB database has many location records for the Southern California Rufous-crowned Sparrow *(Aimophila ruficeps canescens)*. A calibration dataset of 233 spatially-distinct and precise points were used to construct five alternative models (Appendix Table 18) and a presence-absence dataset in conjunction with logistic regression analysis was employed to select candidate models. The independent presence-absence dataset was compiled from 1995-1997 and 2006 coastal sage scrub bird point count surveys. There were 493 points sampled two or more times with rufous-crowned sparrows detected at 293 points. Four model-partitions were selected based upon AIC values with final selection confirmed by a visual inspection of the niche map. All partitions were from the same model that included abiotic, local and landscape-scale variables. The selected model-partition RCSP R1, PV9 was the least restrictive of the partitions with a moderate differentiation between presence (median validation HSI = 0.536) and absence (median validation HSI = 0.056) points (Table 8). As with other species, for those partitions with larger differences between median presence and absence values, this can be explained by the fact that the analysis assesses mean and not median values.

The selected niche map for Southern California Rufous-crowned Sparrow is fairly restrictive with highly fragmented and patchy distribution of suitable habitat (Figure 46). This map captures the general distribution of the calibration and validation points but performs less well at predicting individual locations within the general distribution, accounting for the relatively low validation values. The map generally meets the WRC MSHCP description of the species distribution, predicting suitable habitat in areas such as Lake Mathews/Estelle Mountain, Gavilan Plateau, Box Springs Mountains, the Badlands, Lake Perris, Lake Elsinore, Wasson Canyon, Santa Rosa Plateau, Lake Skinner, and the Hogbacks (County of Riverside 2003). Important environmental variables in the selected model-partition include average minimum January and maximum July temperatures, annual precipitation, elevation, local-scale amounts of coastal sage scrub and grassland, landscape-scale percentage development, coastal sage scrub, and chaparral, and the amount of developed edge adjacent to natural lands (Appendix Table 18). Southern California Rufous-crowned Sparrows are found at lower elevations with warmer January and July temperatures and below-average precipitation. Compared to the overall Plan Area these sparrows occur where there is substantially greater local and landscape-scale coastal sage scrub cover, reduced landscape-scale development and chaparral, and less natural land with developed edges.

Turkey Vulture

Turkey Vultures *(Cathartes aura)* are widely distributed in the Plan Area, although breeding sites are rare and not well documented (County of Riverside 2003). We used 160 location records to construct six models and 86 (35%) randomly selected points to assess model performance (Appendix Table 18). The model-partition with the highest median validation value (0.682) was TUVU R4, PV1 (Table 8). This model was constructed with abiotic, local, and landscape-scale variables. The model predicts suitable habitat throughout the Plan Area with the exception of the San Jacinto Mountains and the southeastern portion of the study area (Figure 47). The niche map does a good job predicting the distribution of the calibration and validation location records. Several records at the margin of the species distribution in western Riverside County are not well predicted, such as north of the Santa Ana River, along Highway 91 in Corona, Banning, and the San Jacinto Mountains. Another area identified as low suitability but with observations is northwest and south of Mystic Lake and on March Air Reserve Base. According to the WRC MSHCP Species Account, Turkey Vultures area widely distributed with concentrations in the southwestern portion of the Plan including the Santa Rosa Plateau, Lake Elsinore, and east to Wilson Valley and Lake Skinner (County of Riverside 2003). Our database and niche model indicate a broader representation of vultures to the north. All environmental variables in the full model have relatively high eigenvector values on one or more partitions and are considered important in association with Turkey Vulture occurrences (Appendix Table 18). Turkey Vultures are found in areas with warmer average minimum January temperature, greater amounts of local-scale grassland, higher percentage of landscape-scale agriculture and more urban-natural edge.

<u>Western Burrowing Owl</u>
We had 198 calibration points for constructing Western Burrowing Owl *(Athene cunicularia hypugea)* niche models and independently collected presence-absence data to evaluate models with logistic regression. This dataset had 86 sampling points with the owl occurring at 42 of these points. Eleven niche models were constructed with various combinations of abiotic, local and landscape scale variables (Appendix Table 18). There were two candidate models identified using logistic regression (Table 8). The selected model-partition, BUOW R4, PV1, had a slightly lower AIC value but performed best in predicting occupied points, whereas the model with the lowest AIC (BUOW R3, PVQ) performed best at predicting unoccupied points. We decided to go with the less conservative model since it performed better in identifying suitable habitat. Niche maps for both model-partitions showed similar configurations of suitable habitat, although the selected model was less restrictive (Figure 48). This map shows suitable habitat for Western Burrowing Owl distributed throughout the Perris Plain and lower valleys of the Plan Area. The niche map captures many of the larger blocks of occupied habitat described in the WRC MSHCP species account, although it does predict the Santa Ana River area or more isolated occurrences at Vail Lake, Wilson Valley (County of Riverside 2003). All environmental variables in the model are considered important in characterizing burrowing owl habitat (Appendix Table 18). Within the Plan Area, Western Burrowing Owls are found at lower elevations with warmer minimum January and maximum July temperatures, lower annual rainfall, and little slope. The owls tend to occur in rural residential areas with greater than average amounts of agriculture and non-native grassland and reduced rock outcrop cover at the local-scale.

<u>White-tailed Kite</u>
The CCB used 83 calibration records to create six different niche models for White-tailed Kite *(Elanus leucurus)* and evaluated these with 35 (30%) randomly selected validation points (Appendix Table 18). There were two candidate models with the selected model-partition, WTKI R3, PV3, having the greatest median validation HSI value (0.720; Table 8). This model, based only upon abiotic climatic and topographic variables, delineated potential

habitat for kites throughout most of the low-lying valleys and foothills in the Plan Area (Figure 49) and encompassed most calibration and validation locations. Only a few documented locations along the margins of the distribution were classified as low suitability. This niche map also compared well to the described distribution in the WRC MSHCP Species Account (County of Riverside 2003), with the exception of core areas in the Prado Basin, Santa Ana River, and Wilson Valley, which were primarily identified by the model as low suitability. Evaluation of eigenvector values for each variable reveals that they are all important in association with the occurrence of White-tailed Kites (Appendix Table 18). Kites inhabit lower elevations with warmer average minimum January temperatures, reduced annual rainfall, and gentler slopes.

<u>Willow Flycatcher</u>
There are two subspecies of Willow Flycatcher, the endangered Southwestern Willow Flycatcher *(Empidonax traillii extimus)* and *E.t. brewsteri*, that migrate through the Plan Area. The endangered subspecies also occurs as a rare breeding resident. The two subspecies are difficult to distinguish from one another in the field, which is why the CCB database can not definitively assign subspecific status to some observations. Further confounding the difficulty of modeling summer breeding residents is distinguishing between migrant and resident individuals of the endangered subspecies. There are likely to be different habitat relationships depending on the subspecies as well as between migrating and breeding individuals of the same subspecies. Combined with the low number of observations (36) available to construct niche models this made it difficult to obtain a model-partition that reliably depicts suitable habitat. We developed four different Willow Flycatcher models (Appendix Table 18) that resulted in relatively low median calibration HSI values. The niche maps did not appear to perform well in delineating potential habitat. As a result, we decided to discard the models (Table 8). If more spatially distinct and high precision records can be obtained for the flycatcher in western Riverside County, then it is likely a better model can be constructed. Obtaining additional location data for Southwestern Willow Flycatcher will not be an easy task given the difficulty in differentiating between subspecies and the limited distribution of the endangered subspecies within the Plan Area.

<u>Wilson's Warbler</u>
The Wilson's Warbler *(Wilsonia pusilla)* is a migrant through the Plan Area and uses many different habitat types while traveling. We had sufficient data to construct five niche models with 48 presence-only observations (Appendix Table 18). To evaluate models we had an independent dataset of 28 observations collected during 2004 CCB riparian bird surveys. Median validation HSI values were very low (<0.500) and the maps from the selected candidate models were very different in the configuration and amount of suitable habitat. Based upon these results, we decided that these models did not reliably predict this species' occurrence. Difficulties in modeling Wilson's Warbler are likely due to the fact the species is migrating through the study area through many different habitat types and is more plastic in habitat associations compared with on the breeding or winter grounds.

Yellow-breasted Chat

We used 45 spatially-precise calibration points to construct 8 niche models for the Yellow-breasted Chat *(Icteria virens)*. We had 11 location records with a relatively low spatial precision (≤250 m) to use to evaluate the models. Two partitions from the same model had relatively high median validation HSIs given the low precision and small number of validation points (Table 8). A visual inspection of the candidate maps indicated the YBCH R7, PV2 better described the documented distribution of this species in western Riverside County (Figure 50). The model is fairly restrictive and does not predict suitable habitat in areas with documented locations such as Prado Basin, Temecula Creek, Vail Lake, San Timoteo Canyon, Canyon Lake, Potrero Creek, San Jacinto River, and the Motte-Rimrock Reserve (County of Riverside 2003). This may be partially explained by the limited number of calibration records and the fact that most observations were from the Santa Ana River area. However, the distribution of this species appears to be changing in some areas of western Riverside County with a potential disappearance of chats from areas in which they historically occurred. For example, in 2004 the CCB conducted repeated bird surveys at San Timoteo Canyon, the Motte Reserve, and Potrero Creek and found no Yellow-breasted Chats where they had previously been documented. UCR biologists also conducted repeated bird surveys along the San Jacinto River in 2002 and found only one Yellow-breasted Chat. The CCB database has current records for chats at the Santa Ana River, Mockingbird Canyon, Sycamore Canyon, Lake Skinner, Temesal Wash, and the Santa Margarita River downstream of Temecula Creek. The CCB has no records from Prado Basin although a large population is known to occur there. Interestingly, this area was not identified as suitable, indicating that the chat model is very restrictive and could be improved with additional location data. All environmental variables in this model are important in the chat's distribution (Appendix Table 18). In western Riverside County, Yellow-breasted Chats in our calibration dataset are typically found at flat, or slightly sloping, low elevation sites with extensive local riparian vegetation cover, and warm average minimum January temperatures.

Yellow Warbler

We used 72 records to construct six Yellow Warbler *(Dendroica petechia brewsteri)* partitioned Mahalanobis D^2 models and 31 (30%) points to evaluate the models (Appendix Table 18). There were three candidate model-partitions with relatively high median validation HSI values (Table 8). The selected model-partition, YWAR R1, PV7, had slightly lower validation HSI values but a niche map that appeared to better capture the documented distribution of this species (Figure 51). Core areas for Yellow Warbler include Prado Basin, Santa Ana River, Temescal Canyon, Wasson Canyon, Temecula Creek, Murrieta Creek, Vail Lake, Wilson Creek, San Timoteo Creek, and Santa Rosa Plateau (County of Riverside 2003). All of these areas are identified as suitable by the chosen model, plus other documented locations such as Potrero Creek, Lake Skinner, and Bautista Creek. The model also captures the wide distribution of points for Yellow Warbler in the CCB database. The model may be somewhat liberal in predicting suitable habitat away from riparian vegetation. This can be partially explained by the use of other habitats by migrating Yellow Warblers. There were insufficient location data to model only breeding residents.

We assessed eigenvector values of the environmental variables and determined that those most consistently associated with Yellow Warbler occurrence are elevation, and the percentage of development, riparian vegetation, and shrublands at the landscape-scale (Appendix Table 18). This species occurs at relatively low elevations with high percentage of riparian vegetation and low percentage of shrublands. Development levels at the landscape scale are near average compared to the overall Plan Area.

CHAPTER 10

MAMMAL NICHE MODELING RESULTS

We modeled six WRC MSHCP Covered mammal species (Tables 1 and 9). For each species we constructed from 4 to 7 models with different combinations of abiotic, local, and landscape-scale variables (Appendix Table 19). All models were developed at the 500 m x 500 m scale. For four of the species we had sufficient data to randomly select records to create presence-only validation datasets. We also visually evaluated model-partitions to identify those that best fit each species' documented distribution. Models containing abiotic and local-scale vegetation variables were selected as best describing suitable habitat for four of the species (Table 10). Models including abiotic and landscape-scale variables were selected for one species and abiotic plus combined local and landscape scale variables for the sixth species. Model results for each species are described below.

Brush Rabbit

We created six models for brush rabbit *(Sylvilagus bachmani)* using 45 location records; there were insufficient records to create a validation dataset (Appendix Table 19). We used median calibration HSI values and assessments of the niche maps to select two candidate models for the rabbit (Table 10). SYLBAC R6B, PV2, an abiotic and combined local-landscape scale model, had the highest median validation value (0.633). The niche map (Figure 52) fit very well the described distribution of the brush rabbit in western Riverside County (County of Riverside 2003). This model-partition also captured all calibration points except for a couple in the Menifee area and just west of Interstate 15 in Temecula. We reviewed eigenvector values for each variable in the model and determined all were important (Appendix Table 19). Compared to the overall Plan Area, brush rabbits are found where there is extensive local chaparral cover, slightly steeper slopes, and low percentage of landscape-scale development and high percentage of shrublands.

Coyote

Seven niche models were developed for the coyote *(Canis latrans)* using 67 calibration points and 29 (23%) for randomly selected validation datasets (Appendix Table 19). Two candidate models were chosen with high median validation values (Table 10). The selected model-partition, CANLAT R6B, PV2, identifies suitable habitat throughout much of western Riverside County (Figure 53). This model which includes abiotic and local-scale variables performed well in predicting locations in the CCB database and fit well with the WRC MSHCP species account (County of Riverside 2003). The only area where the model tended to be somewhat restrictive was in the southwestern portion of the Plan Area around the Santa Rosa Plateau where there were a number of coyote observations falling into low to moderate habitat suitability values. All environmental variables included in the chosen model-partition were considered important (Appendix Table 19). Coyotes tended to occur where there was greater than average amounts of agriculture, riparian, and grassland, and lower amounts of development at the local scale.

Northwestern San Diego Pocket Mouse

There were only 44 records available to model Northwestern San Diego Pocket Mouse *(Chaetodipus fallax falla*x). We evaluated four models with the median calibration HSI and visual inspection of the niche maps (Appendix Table 19). The selected model-partition, CHAFAL R4, PV1, included abiotic and landscape-scale variables (Table 10). It performed moderately well in identifying suitable habitat for documented range in western Riverside County (County of Riverside 2003). This species is considered to be relatively widespread in the Plan Area which is consistent with the niche map (Figure 54). The model captured most of the locations in the CCB database, although it was a little restrictive along the margins of the documented distribution. It failed to predict suitable habitat at documented locations in the southwest corner of the Plan Area, near Banning, and in Aguanga and Anza Valley. Average minimum January temperature and elevation, and percent development, grassland, and shrubland at the landscape scale were associated with the occurrence of the northwestern San Diego pocket mouse. Compared with the overall Plan Area this species tended to occur at intermediate elevations with slightly warmer minimum January temperatures. It was found where there are slightly lower levels of development and near 50% shrublands and relatively high percent of grassland.

San Diego Black-tailed Jackrabbit

The CCB has a fairly large number of records for San Diego black-tailed jackrabbit *(Lepus californicus bennettii)* allowing models to be constructed with 87 location records and evaluated with 30 (26%) presence-only points (Appendix Table 19). Of the four models developed for the jackrabbit, three were selected as candidates best describing this species distribution. The best model, LEPCAL R2B, PV4, included abiotic and local-scale variables and had a high median validation HSI value of 0.838 (Table 10). The niche map showed suitable habitat widespread throughout the Plan Area, particularly in the valleys and lower foothills (Figure 55). This model-partition did a fairly good job of predicting suitable habitat at known locations for this species (County of Riverside 2003), although is was a little conservative in identifying suitable habitat at the margins of the distribution in western Riverside County. All environmental variables we used had relatively large eigenvector values on one or more partitions and were considered important in this model (Appendix Table 19). Jackrabbits were found at slightly lower than average elevations with somewhat warmer January temperatures, shallower slopes, and lower annual rainfall compared with means for the overall study area. They occurred in areas with substantially lower levels of local-scale development and higher amounts of shrubland and grassland.

San Diego Desert Woodrat

We constructed five models for the San Diego desert woodrat *(Neotoma lepida)* with 45 calibration points and evaluated models with 17 (27%) randomly withheld points (Appendix

Table 19). Six candidate model-partitions were picked as candidates based upon high median validation HSI values (Table 10). The best model-partition, NEOLEP R5, PV3 had a median validation HSI value of 0.896 and included abiotic and local-scale variables. Not only did this model do a good job of predicting species locations in the CCB database, it also fit well with the WRC MSHCP description of core populations (County of Riverside 2003). The niche map showed suitable habitat at Lake Mathews-Estelle Mountain, Kabian Park, the Badlands, Lake Perris, Shipley-Skinner Multi-Species Reserve, Vail Lake, the Santa Ana Mountains and in the southeast corner of the Plan Area (Figure 56). Average minimum January temperature, elevation, and local scale development and shrubland were all associated with the occurrence of desert woodrats (Appendix Table 19). San Diego desert woodrats typically occur in the foothills at intermediate elevations with minimum temperatures similar to the average for the entire Plan Area. They were found in areas that have locally substantially lower levels of development and higher amounts of shrubland.

<u>Stephens' Kangaroo Rat</u>
We developed seven partitioned Mahalanobis D^2 niche models for the federally-endangered Stephens' kangaroo rat *(Dipodomys stephensi)* (Appendix Table 19). We used a calibration dataset of 125 observations to build the models and evaluated them with a randomly selected validation dataset of 54 (30%) records. Three models were selected based upon median validation HSI values, with the selected model, DIPSTE R6, PV3 having a validation of 0.732 (Table 10). This model included abiotic and local-scale environmental variables and the niche map (Figure 57) did a good job of capturing the described distribution in the WRC MSHCP species account (County of Riverside 2003). All variables in the selected model-partition had relatively high eigenvector values indicating their importance in association with occupied habitat (Appendix Table 19). Within the Plan Area, Stephens' kangaroo rats were found at low elevations with warmer January temperatures and very high amounts of grassland at the local scale. They were also associated with relatively low amounts of development and high amounts of agriculture and coastal sage scrub.

CHAPTER 11

COMMUNITY NICHE MODELS

We created community maps examining the potential for occurrence of multiple WRC MSHCP Covered Species across the Plan Area. We overlaid individual species niche maps from within the same taxonomic group and with similar habitat affinities (e.g., alkali plants or coastal sage scrub birds) or life history requirements (e.g., passerines or raptors). A cumulative HSI value, consisting of the summation of individual species HSI values, was calculated for each point in the map grid. The greater the HSI value, the greater the likelihood of appropriate habitat for multiple species at that location. Alternatively, to the extent that particular species were deemed more "valuable" different weights could be applied to their HSI values before summation, yielding a cumulative HSI based towards those favored species. Lacking such information, however, we proceeded with unweighted sums. We constructed three community maps for plants, one for reptiles, four for birds, and one for mammals.

Plant Community Maps
Community maps were developed for three different plant communities; low-elevation plant species associated with alkali soils, low to intermediate elevation plant species typically found in shrublands, and high elevation plant species occurring in the mountains.

<u>Alkali Plant Community</u>
Alkali plants in the WRC MSHCP are associated with low-elevation floodplains consisting of Willows, Domino, and Traver soil series (County of Riverside 2003). These plants are associated with alkali grasslands, playas, and vernal pools, primarily in the vicinity of the San Jacinto River, Mystic Lake, and Salt Creek. We included the following four species in this community map: Coulter's goldfields, little mousetail, San Jacinto Valley crownscale, and smooth tarplant. Historically, alkali floodplains have been extensively used for agriculture, such as dry-land farming (County of Riverside 2003, CCB unpublished data). The current status of alkali plant populations is unclear as the CDFG 2005 vegetation map and CCB surveys suggest most alkali playas are currently in agricultural production (dry farming, turf, and crop production). There is evidence of some native plant species persisting at the margins of agricultural fields along public roads and ditches (CCB Database). The status of WRC MSHCP Covered alkali plant species within the interior of agricultural fields is undetermined. There is little potential for rare plants to occur in or be restored to lands that have been developed for residential, commercial, or industrial uses. Thus, we have overlaid developed (urban) lands upon the alkali plant community map to distinguish and delete areas with no habitat value. However, the community map does not delineate areas currently in agricultural production since isolated plant populations may still persist within these areas or

could be restored. As a result, the alkali plant community map suggests the potential of lands for restoration as well as for current occupancy.

As expected, the alkali plant community map shows the highest potential for multiple species occurrence in the San Jacinto River and Salt Creek floodplains (Figure 58). Other potential areas include south of Highway 74 and along floodplains north of Lake Elsinore. Habitat suitability for these species is based upon the presence of suitable soils and appropriate topographic and climatic conditions and does not reflect current land use. As a result, it is expected that the actual distribution of alkali plant species within areas designated as suitable will be restricted by current land uses, particularly agriculture. However, lands identified as highly suitable manifest the greatest potential for restoration of plant populations since these areas are most similar in environmental conditions to occupied habitat for these species.

<u>Low to Intermediate Elevation Shrubland Plant Community</u>
A number of WRC MSHCP Covered plant species occur at low to intermediate elevations, often in association with shrublands. Some of these species have more specialized habitat requirements such as specific soil associations or are only found in certain regions of the Plan area. We developed a community map for five of these species: Engelmann oak, long-spined spineflower, Munz's onion, Rainbow manzanita, and Nevin's barberry. We did not include Coulter's matilija poppy, Palmer's grappling hook or Parry's spineflower, which also occur in shrublands because selected models for these species include soil variables so as a result of missing soil information their niche maps do not encompass the entire Plan Area. We identify lands that have been developed or converted to agriculture as these land uses are not compatible with the occurrence of these species. The southwestern portion of the Plan Area shows the greatest potential for supporting multiple Covered shrubland plant species (Figure 59). This includes the Santa Rosa Plateau, eastern edge of Temecula, Agua Tibia Wilderness, Oak Mountain, and vicinity of Vail Lake. Lands with moderate potential to support several species are concentrated between the I-15 and I-215 corridors, east of I-215 to the Shipley Skinner Multi-Species Reserve, and in the Badlands.

<u>High Elevation Plant Community</u>
We developed niche models for two Covered plant species occurring at high elevations and with sufficient location data for modeling. We depict developed lands and lands devoted to agriculture to identify areas where there is not likely to be habitat for these two species. The highest potential for the occurrence of both beautiful hulsea and Mojave tarplant is predicted to be in the San Jacinto and Santa Rosa mountains and foothills (Figure 60).

Reptile Community Maps
<u>Coastal Sage Scrub and Chaparral Reptile Community</u>
We constructed a community model for five WRC MSHCP Covered reptile species found in coastal sage scrub and chaparral habitats. The community model was created with individual

models for coast horned lizard, coastal western whiptail, granite spiny lizard, northern red diamond rattlesnake, and orange-throated whiptail. The distribution of potential habitat for several reptile species is widespread throughout lands at low to intermediate elevation that are not developed or converted to agriculture (Figure 61). In particular, large blocks of highly suitable habitat are predicted for the Badlands, for hills between Lake Mathews and Highway 74, and for natural lands from the Shipley-Skinner Multi-Species Reserve east into the San Jacinto foothills and southeast to Sage and Wilson Valley areas. The Sedco hills and natural lands in the vicinity of Murrieta Hot Springs provide a fragmented linkage of suitable habitat for multiple reptile species between the large northwest and eastern blocks of highly suitable habitat.

Bird Communities

Coastal Sage Scrub Bird Community

Three WRC MSHCP Covered Bird Species were included in the coastal sage scrub bird community model: Bell's Sage Sparrow, California Gnatcatcher, and Southern California Rufous-crowned Sparrow (Figure 62). Cactus Wren was not included in the model as this species' distribution is largely driven by the distribution of cactus, not coastal sage scrub. To focus on areas with the potential to support multiple species, we deleted developed and agricultural land uses, which provide no habitat for coastal sage scrub birds. Natural lands with the greatest potential to support all three bird species are located between I-15 and I-215, between I-215 and Highway 79, and at the Shipley-Skinner Multi-Species Reserve. There are smaller patches of high potential habitat northwest of Cactus Valley Road, near Lake Perris, in the Badlands, between Vail Lake and Los Altos Road to the northeast, and west of I-15 between Corona and Alberhill.

Riparian Bird Community

Four riparian bird species; Downy Woodpecker, Least Bell's Vireo, Yellow-breasted Chat, and Yellow Warbler were included in the riparian bird community model. We focused on natural lands with potential to support riparian birds and deleted agriculture and development as potential habitat (Figure 63). The areas identified as most suitable for all three species include the Santa Ana River, Mockingbird Canyon, Sycamore Canyon, Temescal Wash, and Warm Springs Creek. The Prado Basin, which is known to support these riparian bird species, is not identified as suitable. This is most likely due to the absence of riparian bird data from this area which is a large, wide riparian forest differing substantially in characteristics from locations of birds in the calibration dataset which are found in narrow, riparian corridors. The riparian bird models would be improved with inclusion of data for Prado Basin.

Songbird Community

Songbirds are in the order Passeriformes and tend to be relatively small birds inhabiting smaller territories or home ranges in comparison with large birds such as raptors. Natural lands in western Riverside County form a mosaic of grassland, shrubland, and woodland vegetation types that often support different bird communities. As a result, sensitive bird species inhabiting one community type are often found in close proximity to sensitive species occurring in other community types and may make use of these other vegetation communities as well. To identify which lands have the potential to support a mixture of sensitive species from different habitat types, we developed a general model for songbirds. There are nine bird species in this model, including Bell's Sage Sparrow, Cactus Wren, California Gnatcatcher, California Horned Lark, Grasshopper Sparrow, Least Bell's Vireo, Southern California Rufous-crowned Sparrow, Yellow-breasted Chat, and Yellow Warbler. Areas with the potential to support the greatest number of sensitive songbird species are located in the western half of the Plan Area (Figure 64). These lands include Alessandro Highlands, Sycamore Canyon, Lake Mathews and vicinity, southwest of I-15 near Glen Eden Road, Steele Peak and surrounding area north of Highway 74, Warm Springs Creek and the Hogbacks, and the Shipley-Skinner Multi-Species Reserve.

Raptor Community
Raptors as a group include hawks, falcons, and owls and are typically large birds with extensive area requirements for foraging and nesting. We developed a raptor community model that included eight Covered Species: Cooper's Hawk, Ferruginous Hawk, Golden Eagle, Northern Harrier, Turkey Vulture, Sharp-shinned Hawk, Western Burrowing Owl, and White-Tailed Kite. These species use grasslands, shrublands, and woodland habitats for foraging and some are year round residents whereas other species only winter in the Plan Area. Raptors use agricultural lands for foraging so we did not differentiate agricultural areas from natural lands in identifying suitable habitat. Some raptor species such as Cooper's Hawk, may also inhabit urban areas. However, most raptor species are relatively intolerant of development and require large areas of natural and agricultural land. So we overlaid urban development on the community map to indicate areas which are unlikely to provide much suitable habitat for the raptor community. Many areas of western Riverside County have the potential to support multiple raptor species (Figure 65). Concentrations of large blocks of land suitable for multiple raptor species occur between the I-15 and I-215, around Warm Springs Creek and the Hogbacks, the Shipley-Skinner Multi-Species Reserve and south to Vail Lake and east to Sage and Cactus Valley Roads. Other areas of high potential are west and east of Hemet, the Badlands, San Timoteo Canyon, west of I-15 between Corona and Alberhill, and the Santa Rosa Plateau.

The higher slopes of the San Jacinto Mountains and Santa Ana Mountains and the southeast corner of the Plan Area were identified as having a low potential to support multiple raptor species. This can be partially explained by the fact that several raptor species are absent or only sparsely distributed in the mountains or the desert transition zone in the southeast (e.g., Ferruginous Hawk, Northern Harrier, Western Burrowing Owl, and White-tailed Kite). As a result, these areas would be expected to have a lower potential to support multiple raptor species. However, several species are known to occur at higher elevations and/or in the desert transition zone (e.g., Cooper's Hawk, Golden Eagle, Sharp-shinned Hawk, and

Turkey Vulture). Thus, it would be expected that some portions of these regions would have a moderate potential to support multiple raptor species. The lack of moderate suitability habitat can be explained by the fact that high elevations and desert transition areas differ substantially in environmental characteristics from other regions of the Plan Area where the bulk of species observation data have been collected. This results in relatively low HSI's for individual species models in these areas with a cumulative low potential to support multiple raptor species. Some portions of these higher elevation and desert transition regions (e.g., Garner Valley) may support three or four of Covered raptor species, which is not reflected in the raptor community model.

Sensitive Bird Community

To predict where the potential for the greatest number of Covered bird species is highest, we overlaid all individual bird models to create a bird community model. Nineteen bird species (Table 1) were included in this model. Figure 66 delineates developed and agricultural land uses and cumulative HSI values for natural lands. Consistent with the other bird community models, the highest potential for multiple species occurrence is in the western two-thirds of the Plan Area. The largest hot spots of potential species-rich lands stretch from just west of I-15 and east to I-215 starting at Lake Mathews and extending south to where the interstates merge. Within this corridor, there are many small patches of potentially high species richness. This swath of high suitability habitat continues southeast through the Hogbacks to Highway 79. There is potentially species rich habitat further east at the Shipley-Skinner Multi-Species Reserve. Beyond the reserve, small scattered patches of high suitability land in the Badlands and near Lake Perris.

Shrubland Mammal Community

We created a community model for five Covered mammal species inhabiting shrubland habitats, primarily coastal sage scrub and chaparral. The species included in this community model are brush rabbit, coyote, desert woodrat, northwestern San Diego pocket mouse, and San Diego black-tailed jackrabbit. Lands with the potential to support multiple sensitive mammal species are widely distributed throughout the Plan Area (Figure 67). The biggest area of species-rich mammal habitat is predicted to extend from the east side of Temecula north through the Shipley-Skinner Multi-Species Reserve to the north side of Diamond Valley Lake and east past Aguanga and Bautista Canyon. The Santa Rosa Plateau, the Hogbacks, and lands from west of the Santa Ana foothills east to I-215, the Box Springs Mountains, the Badlands, San Timoteo Canyon, and Lake Perris are also highly suitable for multiple species occurrence.

CHAPTER 12

EVALUATING WRC MSHCP CRITERIA AREAS FOR CONSERVATION POTENTIAL

The planned WRC MSHCP reserve system is composed of existing conservation lands in Public/Quasi-Public ownership and Criteria Areas, which include privately-owned lands, approximately 50% of which are targeted for eventual acquisition and conservation (County of Riverside 2003). As part of the WRC MSHCP Implementing Agreement, Caltrans will purchase 2,000 acres of land in the eastern portion of the Criteria Areas and 1,000 acres in Criteria Areas west of I-15 (WRC MSHCP 2003). Figure 67 shows the WRC MSHCP reserve system and labels Core Areas, Habitat Blocks, and Linkages that are identified for potential conservation. The Criteria Areas comprise approximately 300,000 acres of privately-owned land for which there is a lack of information on the distribution of Covered Species. To prioritize those lands that are most important for inclusion in the reserve system, it is necessary to identify which areas support Covered Species and biologically diverse communities, or that provide crucial connectivity between conserved populations. Our niche models can be used to guide initial assessment of lands for their conservation potential. These models provide spatially-explicit predictions of potentially suitable habitat for each species and for communities of species that can be used to identify lands for further evaluation and potential conservation.

Niche Models as Hypotheses of Species' Habitat Relationships
It is important to point out that each niche model represents a *hypothesis* about a species' relationship to the environment. As with any modeling technique, the performance of a niche model is dependent upon the nature and quality of the calibration data available to construct it. Often, models that best predict suitable habitat are those with a calibration dataset representing the full range of environmental conditions where the species occurs and in which environmental conditions characterized in the calibration dataset are also present in the modeled landscape. It should also be emphasized that HSI values do not represent habitat quality; this is an attribute that should be measured using fitness parameters describing reproduction and survival of parents and their offspring. Indeed, some locations that deviate from the species' mean may be of higher quality than locations that are most similar.

Not all Occupied Habitat is Identified as Suitable; Not All Suitable Habitat May be Occupied
The calibration dataset is used to calculate a multivariate mean for environmental variables describing habitat characteristics associated with a species' occurrence, against which each point in the landscape is compared. Since a model measures how similar each point is to the species' multivariate mean, it is expected that some locations where a species occurs will differ sufficiently from the species' mean to have relatively low HSI values. This can often occur at the margin of a species distribution or in heterogeneous and changing

environmental conditions. Thus, even though a species may be known to occur at a particular point, if that point lies relatively further from the habitat mean than most other points it may have a low HIS.

Even if a model accurately predicts that a patch of habitat is suitable for a species, individuals of that species may not be present. The species may have been extirpated from the patch and is unable to re-colonize due to recent loss of connectivity and subsequent isolation. Alternatively, the species may never have occurred at the patch as it may have been historically inaccessible. The patch may be located far from extant populations or there may be barriers to dispersal that restrict the ability of individuals to reach it. Rare species may also have population levels below the carrying capacity of the environment such that there are not enough individuals available to occupy all suitable habitat patches. Some species have complex metapopulation dynamics characterized by local population extinctions and recolonizations that can lead to an inconsistent pattern of occupancy at any one site. As a result, the patch may be temporarily unoccupied. Furthermore, the landscape may be changing and the patch may be newly suitable and not yet discovered and occupied by the species of interest. Thus, when using these models to assess conservation potential, it is important to realize the models are measuring how similar each point in the landscape is to occupied habitat and characterizing the potential of the point to support a particular species. To determine the presence of a species at a site where there are no records of occurrence requires that sufficient levels of appropriate species-specific field surveys be conducted.

Methods for Evaluating Conservation Potential: A Hypothetical Example with Quino Checkerspot
The WRC MSHCP Covered Species niche maps consist of 78,542 points spaced 250 m apart throughout the Plan Area. For each of these map points, an HSI value has been calculated measuring how similar that point is to the multivariate mean for locations where the target species occurs. This value ranges from 0 (most dissimilar) to 1.0 (most similar). There are different scales of assessment. Over large geographic regions, visual inspection of niche maps can provide a qualitative comparison of the distribution and amount of high, moderate, and low potential habitat. At a more detailed, parcel-specific level, a quantitative comparison can be made identifying and ranking parcels as to their conservation importance for particular species or for communities of species. This can include calculating and comparing the mean or median HSI values for individual map points contained within each parcel. This level of evaluation for Caltrans specified parcel areas is presented in Chapter 14.

We use the Quino checkerspot to illustrate how niche models can be used to evaluate the conservation potential of lands. Figure 68 shows the distribution and configuration of suitable habitat for the Quino checkerspot butterfly within the WRC MSHCP reserve system. Depicted are HSI values for land within Criteria Areas, 50% of which will be acquired for conservation, and within already conserved Public/Quasi-Public lands. Lands outside of the potential reserve system are excluded from our evaluation. A visual assessment of the niche map shows that lands with highest similarity to currently occupied

Quino checkerspot habitat are found primarily in the south-central and south-eastern portions of the Plan Area. Focusing in on the Shipley-Skinner Multi-Species Reserve (in green) and surrounding lands, it is evident that there are many locations within Criteria Areas in this region that have a high potential to support Quino checkerspot (Figure 69). Concentrating on lands in the vicinity of Lake Skinner, we randomly selected three parcels for which we wish to assess specific conservation potentials (Figure 70). Calculating mean HSI values for each parcel, we see that Parcel B with the greatest number of dark brown cells (HSI values > 0.67) has the highest mean HSI value. Parcel A is ranked second and Parcel C has the lowest mean HSI of the three parcels. Based simply upon mean HSI values, Parcel B may be considered of highest conservation potential for Quino checkerspot. However, upon further evaluation of landscape context, it is evident that Parcel C with a mixture of low, moderate, and high potential habitat improves connectivity and reduces edge effects for existing conserved lands. Based upon these initial evaluations, a recommendation could be made to conduct field surveys in Parcels B and C to evaluate connectivity, the presence of Quino checkerspots, and the general condition of habitats within each parcel. Based upon this follow-up assessment, the parcels could be prioritized in terms of importance for conservation of this species.

Depending on identified needs, the above-described process could be carried out for each modeled species or for a few selected species of greatest conservation interest. This type of analysis can also be used to assess where multiple species are most likely to co-occur as represented by the community models. Confidence in model performance is greatest for those species with presence-absence datasets allowing model comparison with logistic regression techniques. Confidence is lowest for those species with insufficient location data for validation datasets, and where models were assessed by median calibration HSI values and visual inspection of the niche maps. Nevertheless, these models may serve as guidelines to direct on-the-ground surveys for the presence of a target species.

Evaluation of the Conservation Potential of Criteria Areas in the WRC MSHCP

We visually evaluated niche maps (Figures 68, 71-118) for seven core areas within WRC MSHCP Criteria Areas (Figure 67), to assess relative conservation potential for each species and for suites of species (Table 11). We also assess whether our niche models identify cores as suitable habitat for the identified Planning Species for each core area. Planning Species are "subsets of species identified to provide guidance for Reserve Assembly in Cores and Linkages and/or Area Plans" (County of Riverside, 2003; Vol. 1 Def/Acr-xi). Following is our brief assessment of the overall conservation potential for modeled WRC MSHCP Covered Species in the seven core areas and their associated linkages.

<u>Core 1 and Associated Linkages</u>

Core 1 is composed primarily of private lands in the Alberhill area, north of Lake Elsinore (Figure 67) and includes lands on the west and east sides of I-15 (County of Riverside 2003). Core 1 and associated linkages comprise the only Criteria Areas west of Interstate 215. Core 1 connects via western and eastern linkages to existing core areas at Lake Mathews/Estelle

Mountain in the northwestern portion of the Plan Area. There are also linkages to existing core areas in the Santa Ana Mountains to the west and linkages to the south that ultimately connect with Core 2.

Based upon our niche modeling, Core 1 has the potential to support many WRC MSHCP Covered Species (Figures 68, 72-118). We ranked Core 1 as providing potentially high conservation value to 25 species, moderate potential for 12 species, and relatively low potential for 11 species (Table 11). The CCB database contains high precision species location records for 31 of the 48 modeled WRC MSHCP Covered Species in Core 1. Linkages from Core 1 to the north, west, and south are critical for maintaining connectivity within the WRC MSHCP and contain potentially high suitability habitat for many species. Of the species that the CCB modeled, the WRC MSHCP identifies Cactus Wren, California Gnatcatcher, and Munz's onion as Planning Species for Core 1. Our models concur with this assessment. Core 1 is predicted to support species-rich coastal sage scrub bird (Figure 62), songbird (Figure 63), overall bird (Figure 65), and shrubland mammal (Figure 66) communities east of Interstate 15. Diverse reptile (Figure 61) and raptor (Figure 64) communities are also identified throughout Core 1 on both sides of Interstate15.

Linkage 1 (Santa Ana Mountain foothills) and Constrained Linkages 3 (Indian Truck Trail area), 5 (Temescal Wash at Horse Thief Canyon Road), and 6 (Temescal Wash area) connect Core 1 and Lake Mathews/Estelle Mountain with the Santa Ana Mountains (Figure 67, County of Riverside 2003). As such, these linkages are critical to maintaining connectivity between the Santa Ana Mountains and Shipley-Skinner Multi-Specie Reserve, Core 7, and the San Jacinto Mountains. These high priority linkages provide suitable habitat for a number of upland and riparian species (Figures 68, 72-118). The Constrained Linkages across Interstate 5 and it will be important in any future road-widening to retain these connections. Given the rapid urbanization of this area over the last couple of years, these linkages are becoming constrained by development and are priorities for conservation to ensure connectivity is not lost between the Santa Ana Mountains and other regions in the reserve system.

Linkage 2 (Figure 67) is the Collier Marsh area north of Lake Elsinore and provides important habitat for riparian and wetland species (County of Riverside 2003). Our niche maps identify this area as important for several modeled species (Figures 68, 72-118).

Linkage 3 (Figure 67) is composed of private lands in Criteria Areas and conserved Public/Quasi-Public lands in the vicinity of Gavilan Hills, Harford Springs, and the North Peak Conservation Bank (County of Riverside, 2003). This linkage is still relatively unconstrained by development and edge effects and provides high suitability habitat for many of the modeled species (Figures 68, 72-118).

Linkages 7 and 8 provide large blocks of live-in riparian and upland habitat for species between Core 1 and Core 2, encompassing conserved lands in the Kabian Park and Canyon Lake areas, the Sedco Hills, and Wildomar areas. Conserving large blocks of natural lands in these two linkages is critical to maintaining connectivity between the western and eastern core areas in the reserve system. There is also high habitat suitability for many species within these linkages (Figures 68, 72-118) making them important conservation areas beyond their linkage functions.

<u>Core 2 and Associated Linkages</u>
Core 2 is a highly fragmented and relatively small area between Interstate 215 and Highway 79 (Figure 67). It is crucial for maintaining connectivity between eastern and western portions of the WRC MSHCP reserve system, especially for the California Gnatcatcher (County of Riverside 2003, Allen and Preston 2006). There is rapid development in this core that is constraining connectivity, reducing the amount of high quality habitat, and increasing edge effects and management issues for conserved lands (Allen and Preston 2006). This area is of especially high importance to Quino checkerspot. It currently represents the most northwesterly extant population after recent extinctions of populations at Lake Mathews, Gavilan Plateau, Harford Springs, and surrounding areas to the northwest (U.S. Fish and Wildlife Service 2003). According to our niche maps (Figures 68, 71-118), Core 2 is of potentially high importance for 22 species, moderate importance for 15 species, and of lower importance for 11 species (Table 11). Despite the relatively small area of natural land remaining in this core, there are occurrence records for 26 of the 48 modeled species.

There has been extensive development in Core 2 (Figure 4), particularly since 2005 (CCB Unpublished Data). Maintaining connectivity between Core 2 and conserved and Criteria Area lands to the northwest and east is of critical importance for a number of species (Allen and Preston 2006). Linkages to Core 2 are becoming increasingly fragmented by development and degraded by human activities. Core 1, conserved lands at Lake Mathews-Estelle Mountain, and the Santa Ana Mountains are linked through Core 2 to conserved lands at the Shipley Skinner Reserve and Criteria Areas in Core 7 (Figure 67). Connectivity west of Interstate 215 is provided by Linkages 7 and 8, which have relatively large patches of natural land with the potential to support a number of Covered Species (Figures 68, 71-118). Constrained Linkage 16 connects Linkage 8 with Core 2 and includes a crossing at Interstate 215. While the western side of the freeway is currently undeveloped, the east side is considerably restricted by recent housing construction. Conservation and restoration of Constrained Linkage 16 is essential for maintaining connectivity between western and eastern portions of the WRC MSHCP reserve system. Core 2 connects to Core 7 via Constrained Linkages 17 and 18; Figure 67). These linkages are becoming increasingly constricted by new residential development; although within these linkages there remains suitable habitat for some species that could be improved for other species with conservation, restorations, and management. These linkages are also critical in maintaining connectivity within the reserve system.

The WRC MSHCP classifies seven of the modeled species as Planning Species, including Munz's onion, Quino checkerspot, Bell's Sage Sparrow, California Gnatcatcher, California Horned Lark, Grasshopper Sparrow, and Southern California Rufous-crowned Sparrow (County of Riverside 2003). Our conservation assessment based upon niche model output predicts moderate to high conservation potential for each of these species. Core 2 is identified by our community models as having high potential to support suites of coastal sage scrub and chaparral reptile species (Figure 61), all the various bird communities (Figures 62, 63, 64, and 65), and the shrubland mammal communities (Figure 66).

<u>Core 3, Non-Contiguous Habitat Block 5, and Linkages</u>
Core 3 includes the Badlands and Potrero Canyon, while Habitat Block 5 consists of the Lakeview Mountains (Figure 67). These areas are adjacent to the San Jacinto Wildlife Area and are considered together in this assessment because of their close proximity and connectivity. This is a large core comprised primarily of natural and agricultural land uses. The Badlands have been affected by increasingly frequent and large wildfires that are changing the composition and structure of the natural communities in this region (CCB Unpublished Data). Our niche models indicate that Core 3 and Non-contiguous Habitat Block 3 have the potential to support many Covered Species (Figures 68, 72-118). We estimate that this large area has high potential for 26 species, moderate potential for 9 species, and lower potential for 13 species (Table 11). Our database contains spatially precise records for 29 of the 48 modeled species in these two areas. The WRC MSHCP identifies these two areas as important for six Planning Species: Nevin's barberry, Bell's Sage Sparrow, Cactus Wren, Southern California Rufous-crowned Sparrow, Western Burrowing Owl, and Stephens' kangaroo rat (County of Riverside 2003). Our conservation assessment identifies suitable habitat for each of these species (Table 11). Based upon the community models, Core 3 and Non-Contiguous Habitat Area 5 have the potential to support diverse communities of alkali plants (Figure 58), reptiles (Figure 61), raptors (Figure 64), and to a lesser extent shrubland mammals (Figure 66). There is moderate potential for multiple WRC MSHCP Covered Species in the coastal sage scrub, passerine, and total bird communities to co-occur in this area (Figures 63, 63, and 65). There are several linkages connecting Core 3 through conserved lands to natural lands in San Bernardino County to the north (Figure 67). These linkages through the Badlands include Reche and San Timoteo Canyons and appear especially important to reptiles, raptors, riparian birds, and shrubland mammals (Figures 72-118).

<u>Core 4 and Linkages</u>
Cactus Valley is included within Core 4, which connects the Shipley-Skinner Multi-Species Reserve on the west with the San Jacinto Mountains to the east (Figure 67). This core area is relatively unconstrained by development and agriculture and is expected to continue to remain rural with fewer edge effects compared with other core areas (County of Riverside 2003). Based upon the niche modeling (Figures 68, 72-118) this core is expected to have

high suitability for 23 species, moderate suitability for 10, and lower suitability for 15 species (Table 11). We have records of occurrence for 22 of the 48 modeled species in Core 4. The WRC MSHCP identifies this area as important for Quino checkerspot and as a core area with large intact open space that is less likely to become degraded by human activities than other core areas (County of Riverside 2003). Planning Species for this core include Quino checkerspot butterfly, arroyo toad, Cactus Wren, Bell's Sage Sparrow, and Stephens' kangaroo rat. Our models also identify this core area as of moderate to high conservation potential for each of these species (Table 11). Our community models show Core 4 to have high potential to support a rich assemblage of coastal sage scrub and chaparral reptiles (Figure 61), raptors (Figure 64), and shrubland mammals (Figure 66). There are relatively small areas with the potential to support multiple coastal sage scrub bird species and a species-rich community of all modeled Covered bird species (Figures 62 and 65). Linkage 14 (Figure 67) joins Core 4 with the Shipley-Skinner Multi-Species Reserve in the Mica Butte area (County of Riverside 2003). This area is important for a number of upland species, including Quino checkerspot (Figures 68, 72-118).

Core 5

Core 5 is a small, linear core area comprising the upper San Jacinto River to just east of Hemet (Figure 67). Compared with some of the other larger, more westerly situated core areas, Core 5 lacks highly suitable habitat for some species. It has high conservation potential for 12 species, moderate potential for 16, and relatively low potential for 12 species (Table 11). This core area is most important for riparian species. In our database, ten of the 48 modeled species have spatially precise location records within Core 5. Four Planning Species for this core area were modeled by the CCB (County of Riverside 2003). Arroyo toad, Cooper's Hawk, Least Bell's Vireo, and Yellow Warbler were all ranked by our modeling as having moderate or high conservation potential in this core area (Table 11). Core 5 is likely to support suites of reptile (Figure 61) and raptor (Figure 64) species, with small patches scattered around with potential for multiple coastal sage scrub bird species (Figure 62), all Covered bird species (Figure 65), and reptiles (Figure 61). Linkage 11 joins Core 5 to Core 3 (Figure 67) in the Soboba/Gilman Springs Area (Figure 67). It is primarily private land and is becoming increasingly constrained by development. Our models show that it is of relatively low suitability for most species (Figures 67, 72-118).

Core 6

Core 6 is comprised of Silverado Ranch in the southeastern corner of the Plan Area (Figure 67). Compared with other core areas, Core 6 has suitable habitat for the smallest number of modeled species (Figures 68, 72-118). Based upon the niche modeling results we hypothesize that Core 6 is of high suitability and conservation value for five species, of moderate importance to six species, and of lower importance to 37 species (Table 11). Our database has occurrence records in Core 6 for only four of the 48 modeled species. This relatively low ranking for most species in Core 6 has several explanations. Most importantly, many species do not occur in the higher elevation, desert transitional chaparral vegetation that characterizes this area. So it is not surprising that this area would be predicted to be of low habitat suitability for many species. However, some species do occur in this region such as Golden Eagle (Figure 101) and Turkey Vulture (Figure 108). The models for these species are rather restrictive for Core 6, particularly for the Turkey Vulture. This is because the calibration locations used to create the models for these two species differ substantially in environmental characteristics from the conditions found in Core 6; causing the area to be ranked as low or moderate similarity. In contrast, several species models identify suitable habitat in Core 6, even with a lack of calibration data from this region. These includes Mojave tarplant (Figure 78), coastal western whiptail (Figure 89), Mountain Quail (Figure 104), brush rabbit (Figure 113), coyote (Figure 114), San Diego black-tailed jackrabbit (Figure 116), and San Diego desert woodrat (Figure 117). The Quino checkerspot model for which there is a good representation of calibration points from this area also performs well in predicting suitable habitat in Core 6 (Figure 68). The WRC MSHCP identifies six Planning Species for Core 6 that were also modeled by the CCB. These include the Quino checkerspot, Bell's Sage Sparrow, Cactus Wren, Golden Eagle, Least Bell's Vireo, and Stephens' kangaroo rat (County of Riverside 2003). CCB models predict suitable habitat for Quino checkerspot and Golden Eagle (Table 11). However, our models predict this area to be of low suitability for the other species.

<u>Core 7 and Associated Linkages</u>
Core 7 consists of a variety of upland habitats and riparian areas (County of Riverside 2003) in the south and southeast portions of the Plan Area (Figure 67). It includes the Vail Lake, Sage, and Wilson Valley areas. It has many large blocks of natural habitat interspersed with rural development. Our models indicate that Core 7 provides suitable habitat for many species (Figures 68, 72-118) and it is ranked with Cores 2 and 3 as having the highest conservation potential for the most species. Core 7 is highly suitable for 30 species, moderately suitable for 8, and of lower suitability for 10 (Table 11). Our database has records for 38 of the 48 modeled species in Core 7. There is substantial variability in vegetation and environmental conditions within Core 7 so that there is a mosaic in habitat suitability for many species. This area is very important for conservation as there are fewer edge effects and the potential to preserve large blocks of natural habitat with high potential to support many WRC MSHCP Covered Species. Core 7 is likely to support species-rich shrubland plant (Figure 59), reptile (Figure 61), raptor (Figure 64), and shrubland mammal (Figure 66) communities. Core 7 is also predicted to have smaller patches of high-species richness for coastal sage scrub bird (Figure 62), passerine (Figure 63), and total bird (Figure 65) communities. Fourteen Planning Species for Core 7 were also modeled by the CCB (County of Riverside 2003). These include Parry's spineflower, Quino checkerspot, arroyo toad, Bell's Sage Sparrow, Cactus Wren, California Gnatcatcher, Cooper's Hawk, Northern Harrier, Southern California Rufous-crowned Sparrow, White-tailed Kite, and Yellow Warbler. The CCB models predict suitable habitat and moderate to high conservation potential for thirteen of these species (Table 11). The only species that our model predicts to be of low conservation potential is the Least Bell's Vireo (Figure 103, Table 11). A few small

patches of moderately suitable habitat are predicted for this species in Core 7, but the highest value habitats are found to the west and northwest of this core area. Linkage 13 along Tucalota Creek connects the Shipley-Skinner Multi-Species Reserve and other conserved lands and core areas to the west with Core 7 and other core areas to the east (Figure 67). This linkage has relatively few edges and current constraints, and is important for retaining connectivity within the reserve system (County of Riverside 2003). It provides suitable habitat for many of the modeled species (Figures 68, 72-118).

Changing Environmental Conditions Affects Conservation Potential of Criteria Areas
There is a final consideration when evaluating lands for conservation potential. Natural lands within the WRC MSHCP are subject to many human-related stressors that can degrade natural habitats. Currently, many coastal sage scrub habitats are being invaded by exotic grasses and converting over time to non-native grassland vegetation (Allen and Preston 2006). This process is facilitated by fertilization of historically nitrogen poor shrubland communities by nitrogen deposited from air pollution, and by altered fire regimes such that wildfires are more frequent, burn hotter, and cover larger areas. Conversion to non-native grassland results in a reduction in habitat suitability for many species, particularly those associated with shrubland habitats. Areas where coastal sage scrub has converted to grassland have much reduced conservation value unless they can be restored. There is great expense and effort in restoring shrublands, so one important consideration in identifying and prioritizing lands for conservation is to avoid where feasible lands that have high levels of invasive species, unless these areas are critical for connectivity and can be restored.

Some regions within the Plan Area have been more affected by these processes and show greater conversion rates to non-native grassland habitats. These areas include Cores 1 and 3, although the effects of these processes can be observed throughout the Plan Area. Our niche models are based on the conditions of shrublands in 2002, the year of the aerial photographs used to create the CDFG 2005 vegetation map. Thus, in evaluating parcels for conservation potential, we reiterate that it is important to conduct site visits to evaluate the actual, current condition of the vegetation onsite and to evaluate whether conversion to non-native grassland is occurring and reducing the conservation value of that particular parcel.

CHAPTER 13

EVALUATING CONSERVATION POTENTIAL OF CALTRANS PARCEL POLYGONS

Caltrans provided 11 parcels located within Criteria Areas in the WRC MSHCP to be assessed for potential conservation value using our niche modeling results. We were given the approximate location of the parcels, although not parcel boundaries. Each parcel has an identification number using the format specified by Western Riverside County's Regional Conservation Authority (Regional Conservation Authority 2004). We created polygons centered upon each parcel and which encompassed the parcel's boundaries (Figure 120). Parcels varied in size from tens of acres to hundreds of acres. We made the parcel polygons equivalent in size (1,262 acres), to allow for direct comparison. There were two small parcels (Area 6 Detail 14 and Area 6 Detail 15) falling within the same polygon that were evaluated together. We clipped out the developed portions of each polygon to exclude these areas from evaluation of conservation value. For every species we calculated median HSI values representing the similarity in environmental conditions of undeveloped and agricultural lands within each polygon to the mean characteristics of occupied habitat for that species. We evaluated the entire polygon and could not distinguish characteristics of Caltrans-specified parcels contained by the polygon. We also visited some of these parcels, which are owned by the Regional Conservation Authority (RCA), during CCB 2006 surveys to collect independent datasets for evaluating niche models (Chapter 5). Following is an assessment of the conservation potential for Caltrans parcel polygons.

<u>Area 2, Detail 8 Polygon</u>

The Area 2, Detail 8 polygon is located in the north-central region of the Plan Area at the western end of the Badlands, just north of Highway 60 and east of Redlands Boulevard (Figure 120). The Caltrans-identified parcel in this polygon was visited by CCB biologists during 2006 to conduct surveys (Chapter 5, Appendix Figure 15). However, a recent fire had burned all vegetation so bird, reptile, and plant surveys were not undertaken. Vegetation within the polygon is primarily chaparral followed by coastal sage scrub (Table 12). Three WRC MSHCP Covered Species were detected in the course of visiting the parcel (Appendix Table 13). In this polygon, the CCB database also contains location records for Bald Eagle, Cooper's Hawk, Loggerhead Shrike, Sharp-shinned Hawk, and northwestern San Diego pocket mouse. This parcel (in an unburned state) is predicted to have moderately-high to high average habitat suitability (HSI $\geq$ 0.600) for four plant, four reptile, ten bird, and five mammal species (Table 13, Figures 69, 72-119).

<u>Area 4, Detail 7 Polygon</u>

Polygon Area 4, Detail 7 is east of Diamond Valley Lake in the Cactus Valley area (Figure 120) and was surveyed by the CCB on a single visit in 2006 (Chapter 5, Appendix Figure 14). Reptile and bird surveys were conducted in the predominantly chaparral vegetation (Table

12). Five WRC MSHCP Covered Species were detected during CCB surveys at the parcel of interest (Appendix Table 13) and there is also a record for Nashville Warbler in this polygon. Moderately-high to highly suitable habitat (average HSI ≥ 0.600) has been identified for two plant, five reptile, six bird, and five mammal species (Table 13, Figures 69, 72-119). The parcel polygon area is identified by the models as having average moderate potential to support Quino checkerspot.

<u>Area 4, Detail 8 Polygon</u>
Polygon 4, Area 8 is located just east of Wilson Valley Road in the southeastern portion of the Plan Area (Figure 120). The dominant habitat at this site is chaparral followed by coastal sage scrub (Table 12). This polygon was surveyed twice for reptiles and birds and once for rare plants by CCB biologists (Chapter 5, Appendix Figure 15). Ten WRC MSHCP Covered Species were detected at the site during the surveys (Appendix Table 13). Other WRC MSHCP Covered Species with records in this polygon include Quino checkerspot, coast horned lizard, northern red diamond rattlesnake, California Gnatcatcher, San Diego desert woodrat, and Stephens' kangaroo rat. This polygon area is predicted to have moderately-high to high habitat suitability (average HSI ≥ 0.600) for four reptile, four bird, and four mammal species (Table 13, Figures 69, 72-119). There is also average moderate potential for Quino checkerspot.

<u>Area 4, Detail 9 Polygon</u>
The Area 4, Detail 9 polygon is located east of Sage Road (Figure 120) and supports mainly chaparral vegetation with some coastal sage scrub (Table 12). The CCB database has records for coastal western whiptail and Golden Eagle in the southwestern corner of this polygon area. Based upon CCB's niche modeling results, this polygon has moderately high to high average habitat suitability (average HSI ≥ 0.600) for two reptile species, three bird, and four mammal species (Table 13, Figures 69, 72-119).

<u>Area 4, Detail 10 Polygon</u>
This parcel polygon, Area 4, Detail 10, is located just northeast of the Area 4, Detail 9 parcel polygon (Figure 120). It is primarily comprised of chaparral (Table 13). There are four WRC MSHCP location records for this polygon in the CCB database: granite spiny lizard, Bell's Sage Sparrow, Southern California Rufous-crowned Sparrow, and brush rabbit. This polygon parcel is predicted to be of moderately-high to high suitability (average HSI ≥ 0.600) for two reptile, three bird, and four mammal species (Table 13, Figures 69, 72-119).

<u>Area 4, Detail 12 Polygon</u>
Area 4, Detail 12 parcel polygon is located just south of Area 4, Detail 8 polygon just south of Wilson Valley Road (Figure 120). This polygon contains mainly chaparral, coastal sage scrub, and other shrubland vegetation types as well as a fair amount of residential development (Table 12). There are moderately precise records in the CCB database for WRC MSHCP Covered Species in this polygon. These include Quino checkerspot, granite spiny

lizard, Bell's Sage Sparrow, Cactus Wren, California Gnatcatcher, Loggerhead Shrike, Northern Harrier, Southern California Rufous-crowned Sparrow**,** northwestern San Diego pocket mouse, San Bernardino kangaroo rat, San Diego black-tailed jackrabbit, San Diego desert woodrat, and Stephens' kangaroo rat. The CCB's niche models identify this polygon as having an moderately-high to high potential on average for one lizard, four bird, and four reptile species (Table 13, Figures 69, 72-119). There is also moderate potential for Quino checkerspot, four reptiles, two birds, and one mammal in this parcel.

Area 4, Detail 14 Polygon

The Area 4, Detail 14 parcel polygon is near Oak Mountain east of de Portola Road in the southern portion of the Plan Area (Figure 120). It is a mixture of chaparral and coastal sage scrub (Table 12). The CCB conducted two rare plant, lizard and bird surveys on Bureau of Land Management lands in this polygon during 2006 (Chapter 5, Appendix Figure 3). There were six WRC MSHCP Covered Species detected by CCB biologists during the surveys (Appendix Table 9) The CCB database has records for additional WRC MSHCP Covered Species including graceful tarplant, Nevin's barberry, Palmer's grappling hook, Payson's jewelflower, round-leaved filaree, small-flowered microseris, small-flowere morning-glory, Quino checkerspot, and Grasshopper Sparrow. This polygon is predicted to have moderately-high to high potential for three reptile, five bird, and four mammal species (Table 13, Figures 72-119). There is average moderate suitability for three plant species, two reptile, four bird, and one mammal species. While much of the polygon is low potential for Quino checkerspot, there are some areas that have very high suitability (Figure 69).

Area 4, Detail 15 Polygon

The polygon for Area 4, Detail 15 is situated on Highway 371 east of polygon Area 4, Detail 12 (Figure 120). This polygon is largely chaparral with some coastal sage scrub and riparian vegetation and residential development (Table 12). The CCB datasbase has one record for WRC MSHCP Covered Species that is of moderate spatial precision. Cooper's Hawk has been recorded in the polygon. The niche models suggest moderately-high to high average habitat suitability for Quino checkerspot, three reptile, two bird, and four mammal species (Table 13, Figures 69, 72-119).

Area 4, Detail 20 Polygon

This polygon, Area 4, Detail 20, is just south of Area 4, Detail 12 and west of Highway 371 in the southeastern portion of the Plan Area (Figure 120). This polygon is primarily desert transition shrubland, chaparral, and coastal sage scrub (Table 12). Records for WRC MSHCP Covered Species in the CCB database include Payson's jewelflower, Quino checkerspot, coast horned lizard, coastal western whiptail, Bell's Sage Sparrow, Cactus Wren, California Gnatcatcher, Least Bell's Vireo, Southern California Rufous-crowned Sparrow, San Diego black-tailed jackrabbit, and San Diego desert woodrat. Our niche models identify moderately-high to high average potential for two bird species and four mammal species (Table 13, Figures 69, 72-119). This area and some of the surrounding polygons are ranked relatively low for several species. This is because of the large difference in environmental conditions in this area at the margins of many species' ranges, compared with the average conditions where these species tend to be concentrated.

Area 6, Details 14 & 15 Polygon

This polygon contains two parcels of interest to Caltrans and is located between Interstate 215 and Highway 79 in the Murrieta Hot Springs area (Figure 120). This polygon supports the most development of any of the parcel polygons (Table 12). It is a mosaic of chaparral and coastal sage scrub with some agriculture. Despite the high level of development in this parcel, there are many WRC MSHCP Covered Species records in the CCB database. This includes locations for Quino checkerspot, granite spiny lizard, orange-throated whiptail, Bell's Sage Sparrow, California Gnatcatcher, Cooper's Hawk, Downy Woodpecker, Least Bell's Vireo, Loggerhead Shrike, Sharp-shinned Hawk, Southern California Rufous-crowned Sparrow, Turkey Vulture, White-tailed Kite, and San Diego black-tailed jackrabbit. Our niche models suggest moderately-high to high suitability habitat for three plant species, Quino checkerspot, one reptile species, six bird species, and two mammal species (Table 13, Figures 69, 72-119). There is moderate potential for three plants, one lizard, four bird, and two mammals. The models predict higher potential for many species in adjacent areas to the northeast where there are larger blocks of habitat and less development.

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Table 1. List of WRC MSHCP Covered Species for which the CCB constructed partitioned Mahalanobis D^2 niche models**.**

Common Name	Scientific Name
Rare Plants	
Beautiful Hulsea	*Hulsea vestita* ssp. *callicarpha*
Coulter's Goldfields	*Lasthenia glabrata* ssp. *coulteri*
Coulter's Matillija Poppy	*Romneya coulteri*
Englemann Oak	*Quercus engelmannii*
Graceful Tarplant	*Holocarpha virgata* ssp. *elongata*
Little Mousetail	*Myosurus minimus*
Long-spined Spineflower	*Chorizanthe polygonoides* var. *longispina*
Mojave Tarplant	*Deinandra mohavensis*
Munz's Onion	*Allium munzii*
Nevin's Barberry	*Berberis nevinii*
Palmer's Grappling Hook	*Harpogonella palmeri*
Parry's Spineflower	*Chorizanthe leptotheca*
Plummer's Mariposa Lily	*Calochortus plummerae*
Rainbow Manzanita	*Arctostaphylos rainbowensis*
San Jacinto Valley Crownscale	*Atriplex coronata* var. *notatior*
Small-flowered Microseris	*Microseris douglassi* var. *plattycarpha*
Smooth Tarplant	*Centromadia pungens* ssp. *laevis*
Thread-leaved Brodiaea	*Brodiaea filifolia*
Invertebrates/insects	
Quino Checkerspot	*Euphydryas editha quino*
Amphibians	
Arroyo Toad	*Bufo californicus*
Reptiles	
Coastal Western Whiptail	*Cnemidophorus tigris multiscutatis*
Coast Horned Lizard	*Phrynosoma coronatum blainvillei*
Granite Spiny Lizard	*Sceloporus orcutti*
Northern Red-diamond Rattlesnake	*Crotalus ruber ruber*
Orange-throated Whiptail	*Cnemidophorus hyperythrus beldingi*
Southern Sagebrush Lizard	*Sceloporus graciosus gracilis*
Birds	
Bell's Sage Sparrow	*Amphispiza belli belli*
Cactus Wren	*Campylorhynchus brunneicapillus*
California Gnatctcher	*Polioptila californica*
California Horned Lark	*Eremophila alpestris actia*
Cooper's Hawk	*Accipiter cooperii*
Downy Woodpecker	*Picoides pubescens*
Ferruginous Hawk	*Buteo regalis*
Golden Eagle	*Aquila chrysaetos*

Common Name	Scientific Name
Grasshopper Sparrow	*Ammodramus savannarum*
Least Bell's Vireo	*Vireo bellii pusillus*
Loggerhead Shrike	*Lanius ludovicianus*
Mountain Quail	*Oreortyx pictus*
Northern Harrier	*Circus cyaneus*
Sharp-shinned Hawk	*Accipiter striatus*
Southern California Rufous-crowned Sparrow	*Aimphila ruficeps canescens*
Turkey Vulture	*Cathartes aura*
White-tailed Kite	*Elanus leucurus*
Western Burrowing Owl	*Athene cunicularia hypugaea*
Willow Flycatcher	*Empidonax traillii*
Wilson's Warbler	*Wilsonia pusilla*
Yellow-breasted Chat	*Icteria virens*
Yellow Warbler	*Dendroica petechia brewsteri*
Mammals	
Brush Rabbit	*Sylvilagus bachmani*
Coyote	*Canis latrans*
Northwestern San Diego Pocket Mouse	*Chaetodipus fallax fallax*
San Diego Black-tailed Jackrabbit	*Lepus californicus bennettii*
San Diego Desert Woodrat	*Neotoma lepida intermedia*
Stephens' Kangaroo Rat	*Dipodomys stephensi*

Table 2. Acreages of vegetation types in the MSHCP 1994 and CDFG 2005 western Riverside County Vegetation Maps.

Vegetation Type	**1994 Vegetation Map (Acres)**	**CDFG 2005 Vegetation Map (Acres)**
Agriculture	169,346.7	152,000.2
Chaparral	465,445.6	368,968.0
Coastal Sage Scrub	159,232.5	222,159.5
Desert Scrub	22,213.4	8,921.5
Developed/Disturbed	218,709.0	296,630.7
Grassland	156,100.3	91,228.0
Meadows and Marshes	2,932.6	2,206.2
Montane Coniferous Forest	44,158.0	31,710.5
Peninsular Juniper Woodland	1,102.5	1,739.6
Playas and Vernal Pools	7,907.2	2,162.1
Riparian Scrub, Woodland, Forest	14,653.6	21,959.5
Riversidean Alluvial Fan Sage Scrub	8,553.5	4,664.9
Water	12,201.1	21,100.2
Woodlands and Forests	37,337.4	31,695.5
Total	**1,319,893.4**	**1,257,146.4**

Table 3. Vegetation classifications for Rapid Assessment Points determined by the plant alliances observed at each point compared with the vegetation classifications at that point for the 1994 and CDFG 2005 vegetation maps.

Vegetation Type	RAP No. of Pts	RAP % of Pts	1994 Map No. of Pts	1994 Map % of Pts	2005 Map No. of Pts	2005 Map % of Pts
Agriculture	0	0.0	2	0.2	5	0.4
Chaparral	513	43.0	587	49.2	498	41.7
Coastal Sage Scrub	308	25.8	212	17.8	297	24.9
Desert Scrub	26	2.2	29	2.4	22	1.8
Developed/Disturbed	0	0.0	9	0.8	10	0.8
Grassland	29	2.4	104	8.7	32	2.7
Meadows and Marshes	10	0.8	3	0.3	8	0.7
Montane Coniferous Forests	78	6.5	60	5.0	76	6.4
Playas and Vernal Pools	5	0.4	12	1.0	14	1.2
Riparian Scrub, Woodland, Forest	115	9.6	64	5.4	99	8.3
Riversidean Alluvial Fan Sage Scrub	14	1.2	14	1.2	15	1.3
Water	0	0.0	6	0.5	10	0.8
Woodlands and Forests	96	8.0	92	7.7	108	9.0
Total	**1194**	**100.0**	**1194**	**100.0**	**1194**	**100.0**

Table 4. Candidate niche models for WRC MSHCP Covered Plant Species and evaluation metrics. The "best" model for each species is in gray.

Common Name	Type of Model	Model	No. of Partition	Selected Partition	Eigen-value	Median Calibration HSI	Presence-Only Median Validation HSI (n)	Logistic Regression				
								Median Presenc HSI (n)	Median Absence HSI (n)	Intercept Only AIC	Regression AIC	Δi
Beautiful Hulsea	Abiotic (no/Soils)	HULVES R1	4	PV1	3.290	0.537 (39)						
Beautiful Hulsea	Abiotic (no/Soils)	HULVES R3	5	PV5	0.121	0.537 (39)						
Coulter's Goldfields	Abiotic (w/Soils)	LASGLA R7B	5	PV1	2.430	0.621 (47)	0.768 (20)	0.746 (19)	0.000 (116)	111.70	87.27	0.00
Coulter's Goldfields	Abiotic (w/Soils)	LASGLA R7B	5	PV3	0.571	0.571 (47)	0.778 (20)	0.775 (19)	0.000 (116)	111.70	87.60	0.33
Coulter's Goldfields	Abiotic (w/Soils)	LASGLA R9B	6	PV1	2.438	0.759 (47)	0.777 (20)	0.771 (19)	0.000 (116)	111.70	89.77	2.17
Coulter's Matilija Poppy	Abiotic (w/Soils)	ROMCOU R9	5	PV2	1.023	0.729 (41)						
Coulter's Matilija Poppy	Abiotic (w/Soils)	ROMCOU R9	5	PV1	3.301	0.712 (41)						
Coulter's Matilija Poppy	Abiotic (no/Soils)	ROMCOU R1	5	PV4	2.782	0.698 (41)						
Coulter's Matilija Poppy	Abiotic & Local Vegetation	ROMCOU R3	4	PV4	0.119	0.673 (41)						
Engelmann Oak	Abiotic (no/Soils)	QUEENG R1	4	PV2	2.561	0.647 (32)						
Engelmann Oak	Abiotic (no/Soils)	QUEENG R3	4	PV2	0.901	0.577 (32)						
Graceful Tarplant	Abiotic (no/Soils)	HOLVIR R2	4	PV1	2.655	0.716 (23)						
Graceful Tarplant	Abiotic (no/Soils)	HOLVIR R1	4	PV1	2.406	0.699 (23)						
Little Mousetail	Abiotic (no/Soils)	MYOMIN R5	3	PV2	1.121	0.806 (25)						
Little Mousetail	Abiotic (no/Soils)	MYOMIN R3	4	PV2	1.211	0.756 (25)						

Common Name	Type of Model	Model	No. of Partition	Selected Partition	Eigen -value	Median Calibration HSI	Presence-Only Median Validation HSI (n)	Logistic Regression					
								Median Presenc HSI (n)	Median Absence HSI (n)	Intercept Only AIC	Regression AIC	Δi
Little Mousetail	Abiotic (no/Soils)	MYOMIN R4	4	PV2	1.237	0.750 (25)						
Long-spined Spineflower	Abiotic (w/Soils)	CHOPOL R4	3	PV3	0.155	0.605 (40)						
Long-spined Spineflower	Abiotic (w/Soils)	CHOPOL R4	3	PV2	1.115	0.600 (40)						
Long-spined Spineflower	Abiotic (no/Soils)	CHOPOL R3	4	PV1	2.395	0.580 (40)						
Long-spined Spineflower	Abiotic (no/Soils)	CHOPOL R3	4	PV2	0.631	0.579 (40)						
Mojave Tarplant	Abiotic (no/Soils)	DEIMOH R3	3	PV1	2.775	0.661 (20)						
Mojave Tarplant	Abiotic (no/Soils)	DEIMOH R3	3	PV2	0.178	0.627 (20)						
Mojave Tarplant	Abiotic (w/Soils)	DEIMOH R1	3	PV1	1.947	0.556 (20)						
Munz's Onion	Abiotic (no/Soils)	ALLMEN R2	3	PV3	0.033	0.742 (24)						
Munz's Onion	Abiotic (no/Soils)	ALLMEN R2	3	PV2	0.093	0.637 (24)						
Munz's Onion	Abiotic (no/Soils)	ALLMEN R4	3	PV2	0.482	0.593 (24)						
Nevin's Barberry	Abiotic & Local Vegetation	BERNEV R1	4	PV2	1.029	0.858 (34)						
Nevin's Barberry	Abiotic (no/Soils)	BERNEV R3	4	PV1	2.191	0.820 (34)						
Palmer's Grappling Hook	Abiotic (w/Soils)	HARPAL R1	3	PV3	0.074	0.617 (27)						
Palmer's Grappling Hook	Abiotic (w/Soils)	HARPAL R1	3	PV2	0.533	0.566 (27)						
Parry's Spineflower	Abiotic (w/Soils)	CHOPAR R5	5	PV5	0.221	0.574 (30)	0.750 (22)					

Common Name	Type of Model	Model	No. of Partition	Selected Partition	Eigen-value	Median Calibration HSI	Presence-Only Median Validation HSI (n)	Logistic Regression				
								Median Presenc HSI (n)	Median Absence HSI (n)	Intercept Only AIC	Regression AIC	Δi
Parry's Spineflower	Abiotic (w/Soils)	CHOPAR R5	5	PV3	0.952	0.651 (30)	0.729 (22)					
Plummer's Mariposa Lily	No Good Model											
Rainbow Manzanita	Abiotic (no/Soils)	ARCRAI R1	4	PV2	1.102	0.575 (31)						
Rainbow Manzanita	Abiotic (no/Soils)	ARCRAI R1	4	PV3	0.920	0.544 (31)						
Rainbow Manzanita	Abiotic (no/Soils)	ARCRAI R5	4	PV4	0.537	0.524 (31)						
San Jacinto Valley Crownscale	Abiotic (w/Soils)	ATRCOR R7B	6	PV1	2.875	0.754 (52)	0.689 (15)	0.689 (13)	0.000 (122)	87.55	76.12	0.00
San Jacinto Valley Crownscale	Abiotic (no/Soils)	ATRCOR R5B	5	PV4	0.116	0.796 (52)	0.748 (15)	0.748 (13)	0.000 (122)	87.55	76.52	0.40
San Jacinto Valley Crownscale	Abiotic (w/Soils)	ATRCOR R7B	6	PV3	0.781	0.787 (52)	0.489 (15)	0.489 (13)	0.000 (122)	87.55	76.70	0.58
San Jacinto Valley Crownscale	Abiotic (w/Soils)	ATRCOR R6B	6	PV5	0.112	0.842 (52)	0.693 (15)	0.693 (13)	0.000 (122)	87.55	77.56	1.44
San Jacinto Valley Crownscale	Abiotic (w/Soils)	ATRCOR R7B	6	PV5	0.258	0.721 (52)	0.501 (15)	0.501 (13)	0.000 (122)	87.55	77.75	1.63
San Jacinto Valley Crownscale	Abiotic (w/Soils)	ATRCOR R6B	6	PV1	2.940	0.900 (52)	0.722 (15)	0.722 (13)	0.000 (122)	87.55	77.92	1.80
Small-flowered Microseris	Abiotic (no/Soils)	MICDOU R3	3	PV3	0.016	0.606 (20)						
Small-flowered Microseris	Abiotic (w/Soils)	MICDOU R2	3	PV2	0.957	0.570 (20)						
Small-flowered Microseris	Abiotic (no/Soils)	MICDOU R3	3	PV1	1.802	0.570 (20)						
Smooth Tarplant	Abiotic (w/Soils)	CENPEN R6B	5	PV2	1.015	0.667 (70)	0.620 (39)	0.620 (39)	0.000 (271)	236.57	143.72	0.00
Thread-leaved Brodiaea	No Good Model											

Table 5. Candidate niche models for Quino checkerspot and evaluation metrics. The "best" model is highlighted in gray.

Type of Model	Model	No. of Partitions	Selected Partition	Eigenvalue	Median Calibration HSI (n = 120)	Randomly Selected 25% Validation Median HSI (n = 41)	All Validation Data Median HSI (n = 136)
Abiotic & Landscape	EUPEDI R4B	13	PV12	0.019	0.688	0.624	0.631
Abiotic & Local	EUPEDI R19B	9	PV2	1.584	0.754	0.610	0.667
Abiotic	EUPEDI R3B	7	PV5	0.542	0.524	0.547	0.733
Abiotic & Combined	EUPEDI R9B	11	PV10	0.046	0.566	0.547	0.673
Abiotic	EUPEDI R14B	11	PV8	0.070	0.701	0.501	0.676

Table 6. Differences in mean (± standard error) values of environmental variables associated with recently occupied habitat compared with current Quino checkerspot calibration and validation locations in different areas of the WRC MSHCP. Environmental variables identified as most important are highlighted in gray.

Environmental Variable	**Quino Checkerspot Calibration Locations (n = 120)**	**Map Points in Recently Occupied Quino Checkerspot Habitat South of Lake Mathews to I-15/I-215 Split (n = 9723)**	**Quino Checkerspot Calibration Points East of Aguanga and North to Bautista Canyon (n = 31)**	**Quino Checkerspot CDFG 2005 Validation Points east of Aguanga and North to Bautista Canyon (n = 30)**
Average Minimum January Temperature	37.46 ± 0.29	38.12 ± 0.01	32.39 ± 0.10	33.59 ± 0.49
Average Maximum July Temperature	90.35 ± 0.18	95.10 ± 0.02	88.44 ± 0.06	89.07 ± 0.20
Precipitation	330.23 ± 5.30	287.13 ± 0.41	419.78 ± 2.38	402.15 ± 8.32
Elevation	758.30 ± 30.13	503.19 ± 1.15	1,277.79 ± 10.11	1,166.51 ± 50.85
Percent Slope	8.01 ± 0.43	6.87 ± 0.07	5.18 ± 0.37	8.30 ± 0.76
Northness	0.06 ± 0.02	0.12 ± 0.00	0.11 ± 0.04	0.08 ± 0.04
Eastness	-0.05 ± 0.02	-0.09 ± 0.00	-0.09 ± 0.04	-0.05 ± 0.03
Percent Agriculture (Landscape Scale)	8.36 ± 1.35	9.46 ± 0.18	0.72 ± 0.42	0.74 ± 0.45
Percent Development (Landscape Scale)	9.27 ± 1.10	34.93 ± 0.26	5.81 ± 0.94	2.90 ± 0.78
Percent Coastal Sage Scrub (Landscape Scale)	28.36 ± 1.76	24.67 ± 0.23	13.39 ± 2.59	31.72 ± 3.26
Percent Chaparral (Landscape Scale)	38.04 ± 2.66	15.16 ± 0.23	65.95 ± 4.33	48.94 ± 3.88
Percent Non-Native Grassland (Landscape Scale)	8.92 ± 0.79	7.53 ± 0.11	6.26 ± 1.87	8.14 ± 1.49
Amount of Natural vs. Developed Edge	82.05 ± 11.50	26.76 ± 10.90	59.53 ± 19.14	26.76 ± 10.90

Table 7. Candidate niche models for WRC MSHCP Covered Amphibian and Reptile Species and evaluation metrics. The "best" model for each species is highlighted in gray. RIPOV = Random/Independent Presence-Only Validation

Common Name	Type of Model	Model	No. of Partitions	Selected Partition	Eigen-value	Calibration HSI	RIPOV HSI (n)
<u>Amphibians</u>							
Arroyo Toad	Abiotic & Combined	BUFCAL R3	5	PV3	0.281	0.742 (45)	0.872 (17)
Arroyo Toad	Abiotic & Combined	BUFCAL R3	5	PV1	3.765	0.706 (45)	0.817 (17)
Arroyo Toad	Abiotic & Landscape	BUFCAL R5	5	PV1	3.730	0.847 (45)	0.892 (17)
<u>Reptiles</u>							
Coast Horned Lizard	Abiotic & Combined	PHRCOR R7	11	PV1	3.772	0.741 (115)	0.710 (59)
Coast Horned Lizard	Abiotic & Combined	PHRCOR R5	10	PV1	3.769	0.751 (115)	0.680 (59)
Coastal Western Whiptail	Abiotic & Combined	CNETIG R1	12	PV3	1.358	0.729 (178)	0.849 (96)
Coastal Western Whiptail	Abiotic & Combined	CNETIG R1	12	PV4	1.067	0.775 (178)	0.817 (96)
Granite Spiny Lizard	Abiotic & Local	SCEORC R8	9	PV2	2.067	0.584 (219)	0.683 (185)
Granite Spiny Lizard	Abiotic & Local	SCEORC R8	9	PV1	3.262	0.653 (219)	0.674 (185)
Granite Spiny Lizard	Abiotic & Local	SCEORC R10	12	PV1	3.496	0.655 (219)	0.658 (185)
Granite Spiny Lizard	Abiotic & Local	SCEORC R10	12	PV2	2.253	0.633 (219)	0.632 (185)
Northern Red Diamond Rattlesnake	Abiotic & Local	CRORUB R1	6	PV3	1.149	0.718 (60)	0.699 (24)
Northern Red Diamond Rattlesnake	Abiotic	CRORUB R3	5	PV4	0.624	0.646 (60)	0.645 (24)
Orange-throated Whiptail	Abiotic & Combined	CNEHYP R3	9	PV1	2.421	0.742 (125)	0.783 (68)
Orange-throated Whiptail	Abiotic & Combined	CNEHYP R8	9	PV1	2.605	0.730 (125)	0.771 (68)
Sagebrush Lizard	Abiotic & Combined	SCEGRA R1	5	PV3	0.925	0.712 (37)	
Sagebrush Lizard	Abiotic & Local	SCEGRA R2	4	PV2	0.981	0.711 (37)	
Sagebrush Lizard	Abiotic & Combined	SCEGRA R4	5	PV1	3.632	0.691 (37)	

Table 8. Candidate niche models for WRC MSHCP Covered Bird Species and evaluation metrics. The "best" model for each species is highlighted in gray. RPOMV = Random Presence-Only Median Validation; ILRPM = Independent Logistic Regression Presence Median; ILRAM = Independent Logistic Regression Absence median.

Common Name	Type of Model	Model	No. of Partition	Selected Partition	Eigen-value	Calibration HSI	RPOMV HSI (n)	ILRPM HSI (n)	ILRAM HSI (n)	Logistic Regression Intercept Only AIC	Logistic Regression Model AIC	Δ_i
Bell's Sage Sparrow	Abiotic & Landscape	R3	11	PV8	0.384	0.601 (144)		0.599 (146)	0.234 (347)	601.06	580.83	0.00
Cactus Wren	Abiotic	R3	5	PV3	0.960	0.696 (50)						
Cactus Wren	Abiotic	R3	5	PV1	2.032	0.680 (50)						
Cactus Wren	Abiotic & Landscape	R6	6	PV3	1.126	0.672 (50)						
Cactus Wren	Abiotic & Local	R2	5	PV5	0.196	0.670 (50)						
Cactus Wren	Abiotic & Local	R5	7	PV6	0.261	0.661 (50)						
California Gnatcatcher	Abiotic & Local	R2	12	PV1	2.829	0.659 (384)	0.704 (164)	0.915 (81)	0.098 (412)	442.48	333.22	0.00
California Gnatcatcher	Abiotic & Local	R2	12	PV2	1.598	0.670 (384)	0.686 (164)	0.917 (81)	0.092 (412)	442.48	334.21	0.99
California Horned Lark	Abiotic & Local	R2B	6	PV1	2.361	0.601 (60)	0.648 (24)					
Cooper's Hawk	Abiotic & Local	R4B	9	PV7	0.644	0.732 (109)	0.839 (50)					
Cooper's Hawk	Abiotic & Local	R4B	9	PV4	1.152	0.693 (109)	0.800 (30)					
Cooper's Hawk	Abioric & Combined	R1B	12	PV6	0.504	0.682 (109)	0.793 (30)					
Downy Woodpecker	Abiotic & Combined	R6	5	PV4	0.404	0.619 (36)						
Downy Woodpecker	Abioric & Landscape	R7	4	PV3	0.269	0.825 (36)						
Downy Woodpecker	Abiotic & Combined	R4	5	PV4	0.233	0.723 (36)						
Downy Woodpecker	Abiotic	R3	5	PV1	2.451	0.642 (36)						
Ferruginous	Abiotic	R3	4	PV1	2.341	0.622 (29)						

Common Name	Type of Model	Model	No. of Partition	Selected Partition	Eigen-value	Calibration HSI	RPOMV HSI (n)	ILRPM HSI (n)	ILRAM HSI (n)	Logistic Regression Intercept Only AIC	Logistic Regression Model AIC	Δ_i
Hawk												
Golden Eagle	Abiotic & Combined	R4	5	PV1	1.853	0.666 (42)	0.839 (15)					
Golden Eagle	Abiotic & Combined	R1	6	PV1	2.088	0.562 (42)	0.817 (15)					
Golden Eagle	Abiotic	R3	5	PV1	3.276	0.661 (42)	0.721 (15)					
Grasshopper Sparrow	Abiotic & Combined	R1	9	PV3	0.933	0.772 (81)		0.644 (10)	0.002 (70)	62.28	47.33	0.00
Grasshopper Sparrow	Abiotic & Combined	R1	9	PV2	2.696	0.782 (81)		0.701 (10)	0.003 (70)	62.28	47.81	0.48
Grasshopper Sparrow	Abiotic & Combined	R1	9	PV1	3.704	0.715 (81)		0.753 (10)	0.002 (70)	62.28	47.85	0.52
Grasshopper Sparrow	Abiotic & Landscape	R3	7	PV1	2.712	0.752 (81)		0.871 (10)	0.003 (70)	62.28	48.00	0.67
Grasshopper Sparrow	Abiotic & Landscape	R3	7	PV3	0.768	0.721 (81)		0.755 (10)	0.003 (70)	62.28	48.67	1.34
Grasshopper Sparrow	Abiotic & Landscape	R3	7	PV2	2.678	0.779 (81)		0.839 (10)	0.005 (70)	62.28	48.76	1.43
Least Bell's Vireo	Abiotic & Local	R5	9	PV1	3.160	0.555 (117)		0.705 (70)	0.082 (211)	317.48	229.29	0.00
Loggerhead Shrike	No Good Model			PV1		0.688					155.68	
Mountain Quail	Abiotic & Landscape	R4	5	PV1	3.215	0.712 (33)						
Mountain Quail	Abiotic & Landscape	R4	5	PV3	0.321	0.681 (33)						
Mountain Quail	Abiotic	R3	5	PV3	0.638	0.645 (33)						
Northern Harrier	Abiotic & Combined	R5	7	PV1	2.749	0.680 (67)	0.828 (29)					
Northern Harrier	Abiotic & Combined	R5	7	PV7	0.082	0.708 (67)	0.683 (29)					
Sharp-shinned	Abiotic	R3	4	PV1	2.857	0.725 (30)						

Common Name	Type of Model	Model	No. of Partition	Selected Partition	Eigen-value	Calibration HSI	RPOMV HSI (n)	ILRPM HSI (n)	ILRAM HSI (n)	Logistic Regression Intercept Only AIC	Logistic Regression Model AIC	Δ_i
Hawk												
Sharp-shinned Hawk	Abiotic & Combined	R1	4	PV1	3.071	0.667 (30)						
Southern California Rufous-crowned Sparrow	Abiotic & Combined	R1	14	PV9	0.274	0.543 (233)		0.536 (293)	0.056 (200)	667.79	574.75	0.00
Southern California Rufous-crowned Sparrow	Abiotic & Combined	R1	14	PV7	0.699	0.571 (233)		0.500 (293)	0.047 (200)	667.79	574.86	0.11
Southern California Rufous-crowned Sparrow	Abiotic & Combined	R1	14	PV1	4.022	0.576 (233)		0.631 (293)	0.051 (200)	667.79	576.12	1.37
Southern California Rufous-crowned Sparrow	Abiotic & Combined	R1	14	PV8	0.572	0.538 (233)		0.595 (293)	0.049 (200)	667.79	576.37	1.62
Turkey Vulture	Abiotic & Combined	R4	11	PV1	3.060	0.682 (160)	0.652 (86)					
Turkey Vulture	Abiotic	R3	7	PV1	2.488	0.599 (160)	0.613 (86)					
Turkey Vulture	Abiotic & Landscape	R6	9	PV7	0.269	0.664 (160)	0.611 (86)					
Western Burrowing Owl	Abiotic	R3	9	PV1				0.592 (41)	0.097 (44)	121.18	106.63	0.00
Western Burrowing	Abiotic & Combined	R4	12	PV1				0.723 (41)	0.191 (44)	121.18	107.65	1.02

Common Name	Type of Model	Model	No. of Partition	Selected Partition	Eigen-value	Calibration HSI	RPOMV HSI (n)	ILRPM HSI (n)	ILRAM HSI (n)	Logistic Regression Intercept Only AIC	Logistic Regression Model AIC	Δ_i
Owl												
White-tailed Kite	Abiotic	R3	7	PV3	1.060	0.691 (83)	0.720 (35)					
White-tailed Kite	Abiotic & Local	R2	8	PV5	0.945	0.609 (83)	0.660 (35)					
Willow Flycatcher	No Good Model											
Wilson's Warbler	No Good Model											
Yellow-breasted Chat	Abiotic & Landscape	R7	6	PV1	2.963	0.667 (45)	0.674 (11)					
Yellow-breasted Chat	Abiotic & Local	R7	6	PV2	1.460	0.601 (45)	0.669 (11)					
Yellow Warbler	Abiotic & Combined	R1	8	PV8	0.072	0.675 (72)	0.714 (31)					
Yellow Warbler	Abiotic & Combined	R1	8	PV7	0.086	0.624 (72)	0.687 (31)					

Table 9. Comparison of mean ± standard deviation values for environmental variables for the California Gnatcatcher calibration dataset used to construct partitioned Mahalanobis D2 niche models compared with map points for the entire study area and for the southeastern portion of the gnatcatcher's distribution in western Riverside County. Map point means highlighted in gray are at least 1 gnatcatcher calibration dataset standard deviation greater or smaller than the mean for the calibration dataset.

Environmental Variable	Calibration Points (n = 384)	Southeast Map Points (n = 1,300)	All Map Points (n = 74,832)
Average Minimum January Temperature (°F)	39.03 ± 1.48	37.33 ± 1.10	37.04 ± 3.45
Average Maximum July Temperature (°F)	94.08 ± 2.64	89.06 ± 0.56	92.70 ± 3.40
Average Annual Precipitation (mm)	278.01 ± 19.34	307.02 ± 34.60	339.86 ± 80.20
Elevation (m)	463.15 ± 76.35	742.70 ± 113.57	679.81 ± 362.66
Slope (%)	10.35 ± 5.66	8.21 ± 4.74	8.66 ± 8.10
East (measure of Eastness)	0.07 ± 0.21	-0.03 ± 0.20	-0.08 ± 0.37
North (measure of Northness)	0.01 ± 0.21	0.03 ± 0.22	0.11 ± 0.32
Agriculture (local)	4.51 ± 12.38	2.03 ± 0.84	7.01 ± 17.41
Development (local)	7.07 ± 12.98	4.41 ± 10.11	17.42 ± 25.00
Coastal Sage Scrub (local)	37.54 ± 21.92	18.51 ± 19.90	9.27 ± 17.75
Chaparral (local)	6.55 ± 14.52	28.25 ± 22.83	19.88 ± 25.80
Grassland	5.07 ± 10.32	7.73 ± 7.29	4.57 ± 12.46

Table 10. Candidate niche models for WRC MSHCP Covered Mammal Species and evaluation metrics. The "best" model for each species is highlighted in gray.

Common Name	Type of Model	Model	No. of Partitions	Selected Partition	Eigen-value	Calibration HSI	Random Presence-Only Median Validation HSI (n)
Brush Rabbit	Abiotic & Combined	R6B	6	PV2	1.385	0.633	
Brush Rabbit	Abiotic & Landscape	R4	5	PV2	1.182	0.587	
Coyote	Abiotic & Local	R6B	6	PV2	1.351	0.619	0.786
Coyote	Abiotic & Local	R7B	6	PV3	1.032	0.522	0.776
Northwestern San Diego Pocket Mouse	Abiotic	R3	5	PV2	1.086	0.627	
Northwestern San Diego Pocket Mouse	Abiotic & Landscape	R4	5	PV1	2.638	0.589	
Northwestern San Diego Pocket Mouse	Abiotic & Local	R2	4	PV4	0.220	0.560	
San Diego Black-tailed Jackrabbit	Abiotic & Local	R2B	8	PV4	0.937	0.593	0.838
San Diego Black-tailed Jackrabbit	Abiotic & Combined	R1B	9	PV2	1.575	0.601	0.799
San Diego Black-tailed Jackrabbit	Abiotic & Landscape	R4	8	PV2	1.322	0.654	0.755
San Diego Desert Woodrat	Abiotic & Local	R5	4	PV3	0.302	0.737	0.896
San Diego Desert Woodrat	Abiotic & Local	R5	4	PV1	2.547	0.780	0.831
San Diego Desert Woodrat	Abiotic & Landscape	R4	5	PV3	0.993	0.619	0.894
San Diego Desert Woodrat	Abiotic & Landscape	R4	5	PV1	2.331	0.629	0.881
San Diego Desert Woodrat	Abiotic & Local	R2	5	PV1	2.685	0.726	0.812
San Diego Desert Woodrat	Abiotic	R3	5	PV1	2.474	0.788	0.809
Stephens' Kangaroo Rat	Abiotic & Local	R6	6	PV3	1.235	0.603	0.732
Stephens' Kangaroo Rat	Abiotic & Combined	R7	9	PV9	0.069	0.539	0.654
Stephens' Kangaroo Rat	Abiotic & Local	R2	9	PV6	0.382	0.618	0.647

Table 11. Evaluation of conservation potential in Core Areas for WRC MSHCP Covered Species based upon niche modeling.

Common Name	Core 1	Core 2	Core 3/Non-contiguous Habitat Block 5	Core 4	Core 5	Core 6	Core 7
Plants							
Beautiful Hulsea	L	L	L	L	L	L	L
Coulter's Goldfields	P, M/H	L	P, H	L	L	L	L
Coulter's Matillija Poppy	P, H	M/H	L	L	L	L	L
Englemann Oak	L	M/H	P, L	L	L	L	P,M/H
Graceful Tarplant	L	L	L/M	L/M	L	L	P, M
Little Mousetail	L	L	H	L	L	L	L
Long-spined Spineflower	H	P, H	H	H	M	L	P, H
Mojave Tarplant	L	L	L	L	L	L/M	L
Munz's Onion	P, H	P, H	L, M	M	L/M	L	M
Nevin's Barberry	L	L	H	L	M/H	L	P, H
Palmer's Grappling Hook	P, H	M	M/H	M/H	L	L	P, H
Parry's Spineflower	L	L/M	H	P,H	L	L	P, H
Rainbow Manzanita	L	L	L	L	L	L	P, M
San Jacinto Valley Crownscale	P, M	L	P, H	L	L	L	L
Small-flowered Microseris	L	L/M	L	M	L	L	P, H
Smooth Tarplant	P, H	P, H	P, H	L	L	L	L
Invertebrates							
Quino Checkerspot	M	P, H	L	P, H	L	P, H	P, H
Amphibians							
Arroyo Toad	L	L	L	M/H	P, H	L	P, H
Reptiles							
Coast Horned Lizard	P, H	P, M	P, H	P, H	P, M	L	P, H
Coastal Western Whiptail	P, H	M	P, H	P, H	P, H	M	P, H
Granite Spiny Lizard	P, M	P, M	L	P, H	L	L	P, M

Common Name	Core 1	Core 2	Core 3/Non-contiguous Habitat Block 5	Core 4	Core 5	Core 6	Core 7
Northern Red-diamond Rattlesnake	P, H	P, M	P, H	P, H	H	L	P, H
Orange-throated Whiptail	P, H	P, M/H	P, H	P, M/H	P, M	L	P, M/H
Southern Sagebrush Lizard	L	L	L	P, M	P, M	L	P, M
Birds							
Bell's Sage Sparrow	P, M	P, M	P, M	P, M/H	M	L	P, H
Cactus Wren	M	M	P, M	P, L/M	M	L	P, H
California Gnatcatcher	P, H	P, H	P, L/M	L	L	L	P, H
California Horned Lark	P, H	P, H	P, H	M	M	L	P, H
Cooper's Hawk	P, H	P, H	P, H	P, H	H	L	P, H
Downy Woodpecker	P, H	P, H	P, M	L	L	L	P, M
Ferruginous Hawk	P, M	P, H	P, H	P, M	M	L	L/M
Golden Eagle	P, H	P, H	P, H	H	P, H	M/H	P, H
Grasshopper Sparrow	P, M	P, M	P, L/M	L	L	L	P, L
Least Bell's Vireo	P, H	M	P, L	L	P, M	L	P, L
Mountain Quail	L/M	L	L	H	P, H	M	P, M/H
Northern Harrier	P, H	P, H	P, H	P, H	M	L	P, H
Sharp-shinned Hawk	P, H	P, H	P, H	P, H	H	L	P, H
Southern California Rufous-crowned Sparrow	P, M	P, M	P, M/H	P, M	P, M	L	P, M
Turkey Vulture	P, H	P, H	P, H	P, H	H	L/M	P, H
White-tailed Kite	P, H	P, H	P, M/H	P, M	M	L	P, M/H
Western Burrowing Owl							
Yellow Warbler	P, H	P, M	P, H	P, H	P, H	L	P, H
Yellow-breasted Chat	M	M	L	L	L	L	L
Mammals							
Brush Rabbit	P, M	H	M	P, H	M	M/H	P, H

Common Name	Core 1	Core 2	Core 3/Non-contiguous Habitat Block 5	Core 4	Core 5	Core 6	Core 7
Coyote	P, H	P, H	P, H	P, H	H	P, H	P, H
Northwestern San Diego Pocket Mouse	H	P, H	P, H	P, H	H	P, L/M	P, H
San Diego Black-tailed Jackrabbit	P, H	P, H	P, H	P, H	M	P, H	P, H
San Diego Desert Woodrat	P, M	M	P, M	H	M	M	P, H
Stephens' Kangaroo Rat	P, H	P, H	P, H	M	L	L	P, H

Table 12. Acreages of different vegetation types in Caltrans parcel polygons of interest.

Vegetation Type	Acreage of Vegetation by Parcel									
	Area 02, Detail 8	**Area 4, Detail 7**	**Area 4, Detail 8**	**Area 4, Detail 9**	**Area 4, Detail 10**	**Area 4, Detail 12**	**Area 4, Detail 14**	**Area 4, Detail 15**	**Area 4, Detail 20**	**Area 6, Details 14 & 15**
Agriculture	40.3	0.0	0.0	5.9	0.2	7.8	13.4	0.0	1.6	89.7
Alkali Floodplain	0.0	0.0	0.0	9.5	10.7	2.1	0.0	0.7	0.0	0.0
Chaparral	722.1	1,037.7	764.9	913.8	1,140.2	553.7	809.6	857.3	378.1	283.1
Coastal Sage Scrub	366.0	83.4	373.5	278.2	30.9	360.6	332.8	190.0	275.5	302.0
Development	27.9	8.7	30.0	44.0	37.5	119.2	41.5	77.5	33.4	478.0
Grassland	65.5	7.7	27.4	5.0	3.4	3.2	33.1	25.3	7.7	43.4
Riparian	5.6	0.0	22.1	0.0	12.4	62.7	0.2	65.0	0.9	21.3
Open Water	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.8	0.0	3.7
Other Shrubland	0.0	0.0	40.5	0.0	0.0	138.5	0.0	41.6	563.9	0.0
Oak Woodland	35.1	124.6	4.0	6.1	27.3	14.7	32.0	4.3	1.4	41.3
Total Acres	**1,262.4**	**1,262.5**	**1,262.4**	**1,262.5**	**1,262.5**	**1,262.5**	**1,262.5**	**1,262.4**	**1,262.4**	**1,262.4**

Table 13. Comparison of Median Habitat Similarity Index (HSI) values for modeled WRC MSHCP Covered Species in Caltrans-specified parcel polygon areas.

	Median HSI per parcel									
Taxa	**Area2, Detail 8 (n=78)**	**Area4, Detail 7 (n=78)**	**Area4, Detail 8 (n=89)**	**Area4, Detail 9 (n=79)**	**Area4, Detail 10 (n=78)**	**Area4, Detail 12 (n=84)**	**Area4, Detail 14 (n=80)**	**Area4, Detail 15 (n=77)**	**Area4, Detail 20 (n=87)**	**Area6, Detail 14,15 (n=62)**
Plant Models with no Soil Variables										
Beautiful Hulsea R1,PV1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Engelmann Oak R1,PV2	0.154	0.023	0.027	0.434	0.027	0.027	0.324	0.003	0.001	0.670
Graceful Tarplant R1,PV1	0.000	0.000	0.001	0.000	0.000	0.001	0.001	0.000	0.000	0.028
Little Mousetail R5,PV2	0.000	0.000	0.002	0.000	0.000	0.268	0.000	0.000	0.008	0.000
Long-spined Spineflower R3,PV1	0.645	0.376	0.113	0.187	0.019	0.345	0.628	0.004	0.025	0.447
Mojave Tarplant R3,PV1	0.014	0.049	0.042	0.100	0.034	0.019	0.001	0.110	0.018	0.000
Munz's Onion R2,PV3	0.651	0.121	0.003	0.147	0.014	0.015	0.312	0.000	0.000	0.801
Nevin's Barberry R1,PV2	0.236	0.000	0.000	0.000	0.000	0.000	0.033	0.000	0.000	0.325
Rainbow Manzanita R5,PV4	0.000	0.000	0.075	0.016	0.001	0.438	0.025	0.130	0.227	0.005
Small-flowered Microseris R3,PV3	0.724	0.171	0.001	0.188	0.004	0.014	0.310	0.000	0.000	0.346
Sample Sizes for Plant Models with Soil Variables:	(n =10)	(n =78)	(n = 89)	(n = 79)	(n = 70)	(n = 84)	(n = 80)	(n = 66)	(n = 75)	(n = 62)
Coulter's Goldfields R7B,PV1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Coulter's Matilija Poppy R9,PV2	0.117	0.182	0.009	0.057	0.013	0.025	0.341	0.000	0.000	0.426
Palmer's Grappling Hook R1,PV3	0.426	0.603	0.008	0.152	0.016	0.000	0.129	0.001	0.000	0.403
Parry's Spineflower R5,PV5	0.661	0.735	0.510	0.520	0.220	0.038	0.564	0.239	0.479	0.166
San Jacinto Valley Crownscale R7B,PV1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.008
Smooth Tarplant R6B,PV2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.840
Invertebrates:										
Quino Checkerspot R4B,PV12	0.236	0.478	0.539	0.015	0.213	0.384	0.215	0.755	0.000	0.750
Amphibians:										
Arroyo Toad R3,PV3	0.004	0.324	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Reptiles:										
Coast Horned Lizard R7,PV1	0.918	0.965	0.886	0.801	0.615	0.574	0.871	0.672	0.185	0.304
Coastal Western Whiptail R1,PV3	0.935	0.888	0.859	0.968	0.985	0.609	0.862	0.769	0.000	0.500

	Median HSI per parcel									
Taxa	**Area2, Detail 8 (n=78)**	**Area4, Detail 7 (n=78)**	**Area4, Detail 8 (n=89)**	**Area4, Detail 9 (n=79)**	**Area4, Detail 10 (n=78)**	**Area4, Detail 12 (n=84)**	**Area4, Detail 14 (n=80)**	**Area4, Detail 15 (n=77)**	**Area4, Detail 20 (n=87)**	**Area6, Detail 14,15 (n=62)**
Granite Spiny Lizard R8,PV2	0.393	0.810	0.141	0.441	0.303	0.021	0.237	0.017	0.001	0.064
Northern Red Diamond Rattlesnake R1,PV3	0.744	0.792	0.375	0.311	0.217	0.407	0.658	0.086	0.135	0.270
Orange-throated Whiptail R3,PV1	0.899	0.398	0.218	0.122	0.014	0.360	0.529	0.041	0.000	0.686
Sagebrush Lizard R2,PV2	0.471	0.633	0.673	0.559	0.578	0.075	0.352	0.709	0.000	0.021
Birds:										
Bell's Sage Sparrow R3,PV8	0.500	0.265	0.356	0.450	0.673	0.086	0.548	0.005	0.003	0.201
Cactus Wren R3,PV3	0.022	0.015	0.387	0.003	0.000	0.785	0.003	0.419	0.230	0.544
California Gnatcatcher R2,PV1	0.065	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.477
California Horned Lark R2B,PV1	0.624	0.220	0.051	0.074	0.002	0.179	0.468	0.001	0.016	0.380
Cooper's Hawk R4B,PV7	0.629	0.586	0.283	0.547	0.600	0.336	0.650	0.197	0.008	0.719
Downy Woodpecker R6,PV4	0.000	0.005	0.007	0.001	0.001	0.000	0.023	0.000	0.000	0.000
Ferruginous Hawk R3,PV1	0.000	0.000	0.105	0.005	0.009	0.214	0.001	0.159	0.002	0.346
Golden Eagle R4,PV1	0.910	0.821	0.738	0.802	0.619	0.719	0.873	0.686	0.786	0.873
Grasshopper Sparrow R1,PV3	0.040	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.000
Least Bell's Vireo R5,PV1	0.004	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.049
Mountain Quail R4,PV1	0.823	0.840	0.697	0.877	0.332	0.482	0.398	0.639	0.084	0.012
Northern Harrier R5,PV1	0.915	0.655	0.611	0.367	0.065	0.763	0.678	0.270	0.546	0.887
Sharp-shinned Hawk R3,PV1	0.823	0.828	0.636	0.727	0.362	0.700	0.722	0.388	0.464	0.798
Southern California Rufous-crowned Sparrow R1, PV9	0.682	0.306	0.065	0.089	0.089	0.011	0.273	0.001	0.000	0.328
Turkey Vulture R4,PV1	0.941	0.889	0.404	0.393	0.292	0.420	0.767	0.184	0.018	0.947
White-tailed Kite R3,PV3	0.724	0.553	0.039	0.024	0.001	0.025	0.354	0.001	0.009	0.833
Yellow-breasted Chat R7,PV2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.142
Yellow Warbler R1,PV7	0.748	0.626	0.097	0.066	0.009	0.192	0.290	0.007	0.036	0.428
Mammals:										
Brush Rabbit R6B, PV2	0.790	0.857	0.573	0.888	0.972	0.446	0.561	0.899	0.632	0.208
Coyote R6B, PV2	0.972	0.944	0.732	0.934	0.897	0.710	0.953	0.660	0.912	0.667
Northwestern San Diego Pocket	0.885	0.665	0.600	0.435	0.071	0.866	0.633	0.330	0.517	0.607

	Median HSI per parcel									
Taxa	**Area2, Detail 8 (n=78)**	**Area4, Detail 7 (n=78)**	**Area4, Detail 8 (n=89)**	**Area4, Detail 9 (n=79)**	**Area4, Detail 10 (n=78)**	**Area4, Detail 12 (n=84)**	**Area4, Detail 14 (n=80)**	**Area4, Detail 15 (n=77)**	**Area4, Detail 20 (n=87)**	**Area6, Detail 14,15 (n=62)**
Mouse R4,PV1										
San Diego Black-tailed Jackrabbit R2B,PV4	0.880	0.900	0.919	0.863	0.878	0.724	0.776	0.747	0.708	0.484
San Diego Desert Woodrat R5,PV3	0.872	0.920	0.865	0.791	0.677	0.874	0.762	0.739	0.776	0.442
Stephen's Kangaroo Rat R6,PV3	0.345	0.021	0.187	0.159	0.025	0.314	0.159	0.100	0.113	0.212

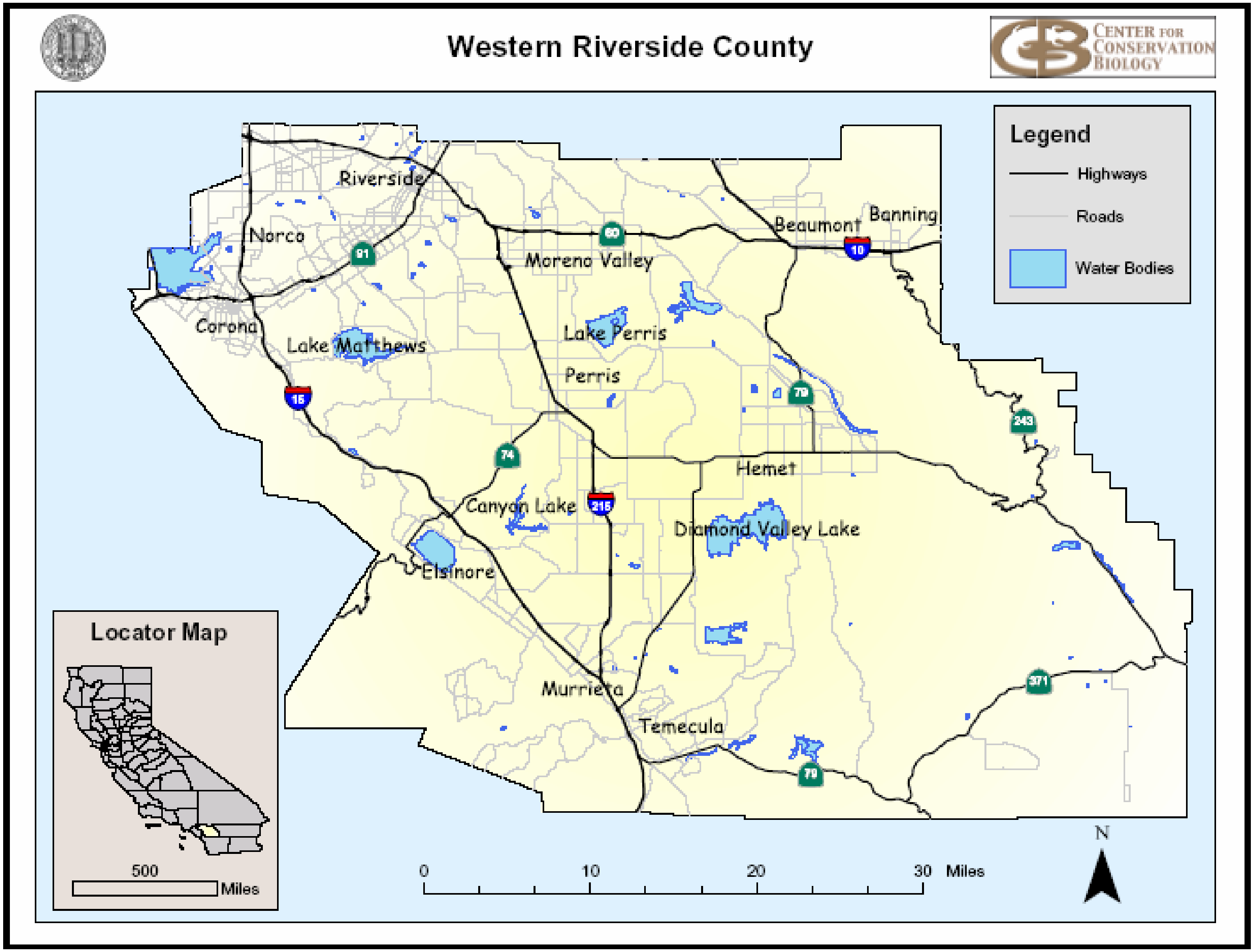


Figure 1. Western Riverside County Multiple Species Habitat Conservation Plan Area.

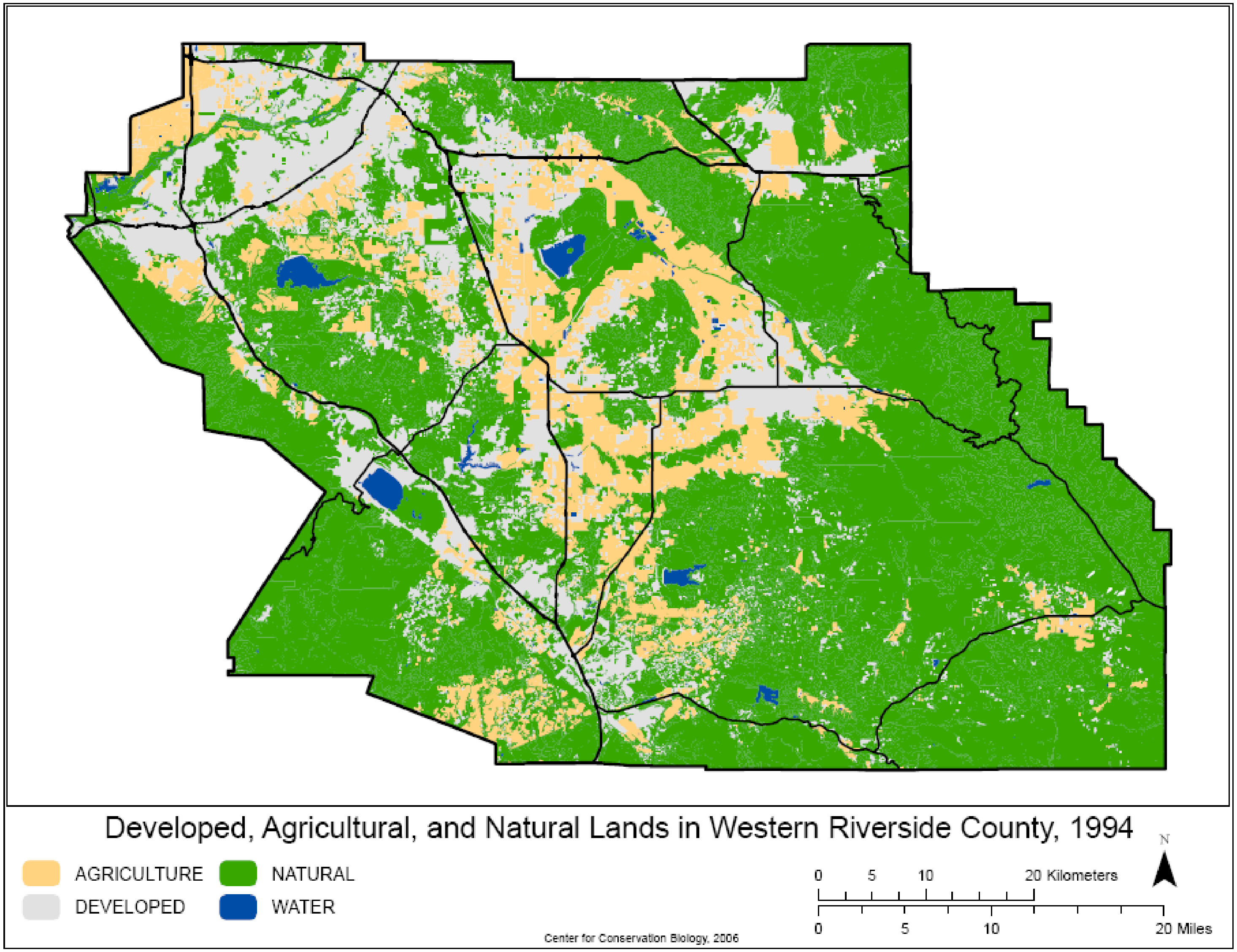


Figure 2. Natural, developed and agricultural lands in WRC MSHCP in 1994.

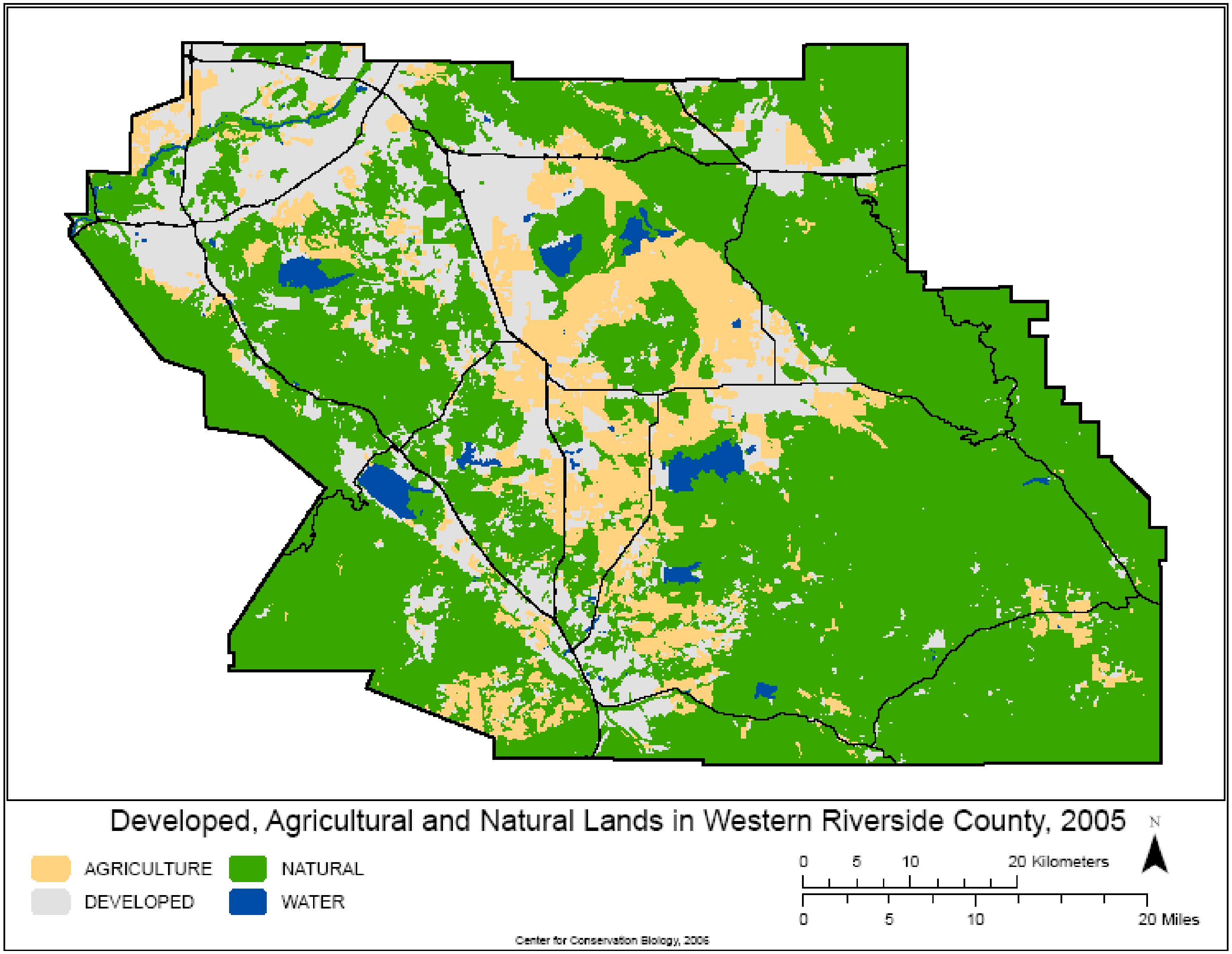


Figure 3. Natural, developed and agricultural lands in WRC MSHCP in 2005 as identified by the CDFG vegetation map updated for recent development.

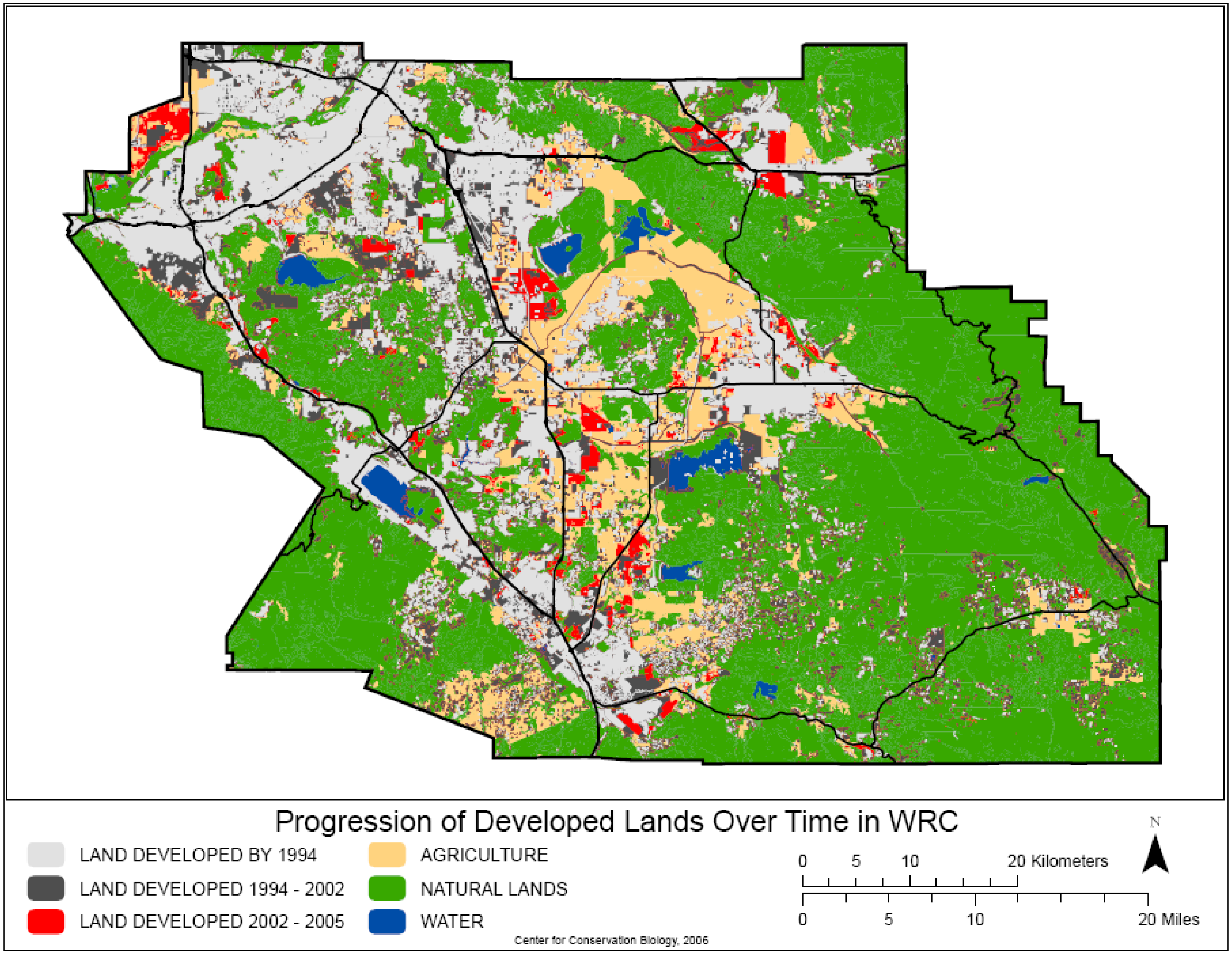


Figure 4. Change in development over time in WRC MSHCP (1994-2005).

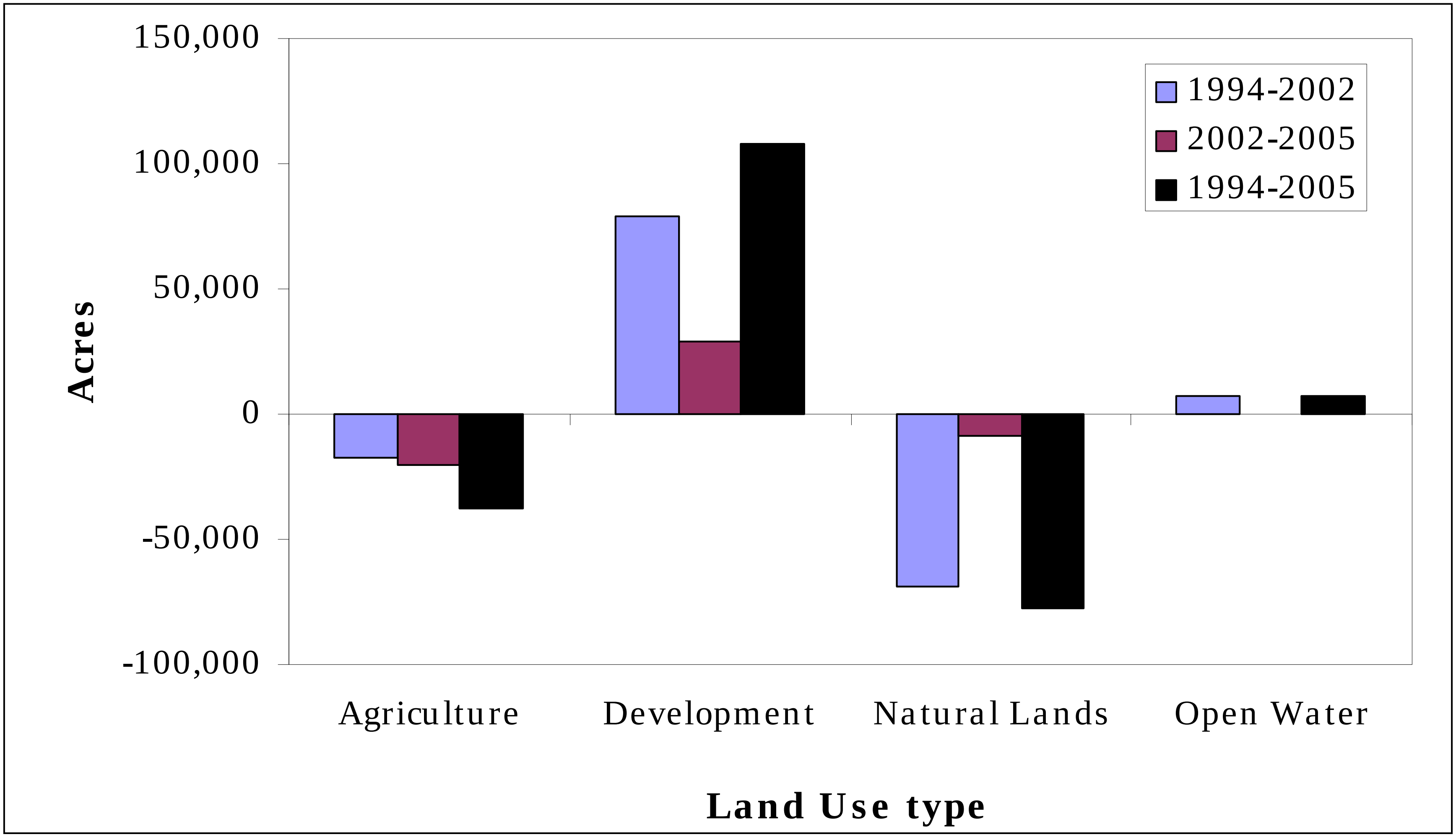


Figure 5. Changes in acreages of natural lands, agriculture, development, and reservoirs in the WRC MSHCP from 1994 to 2005.

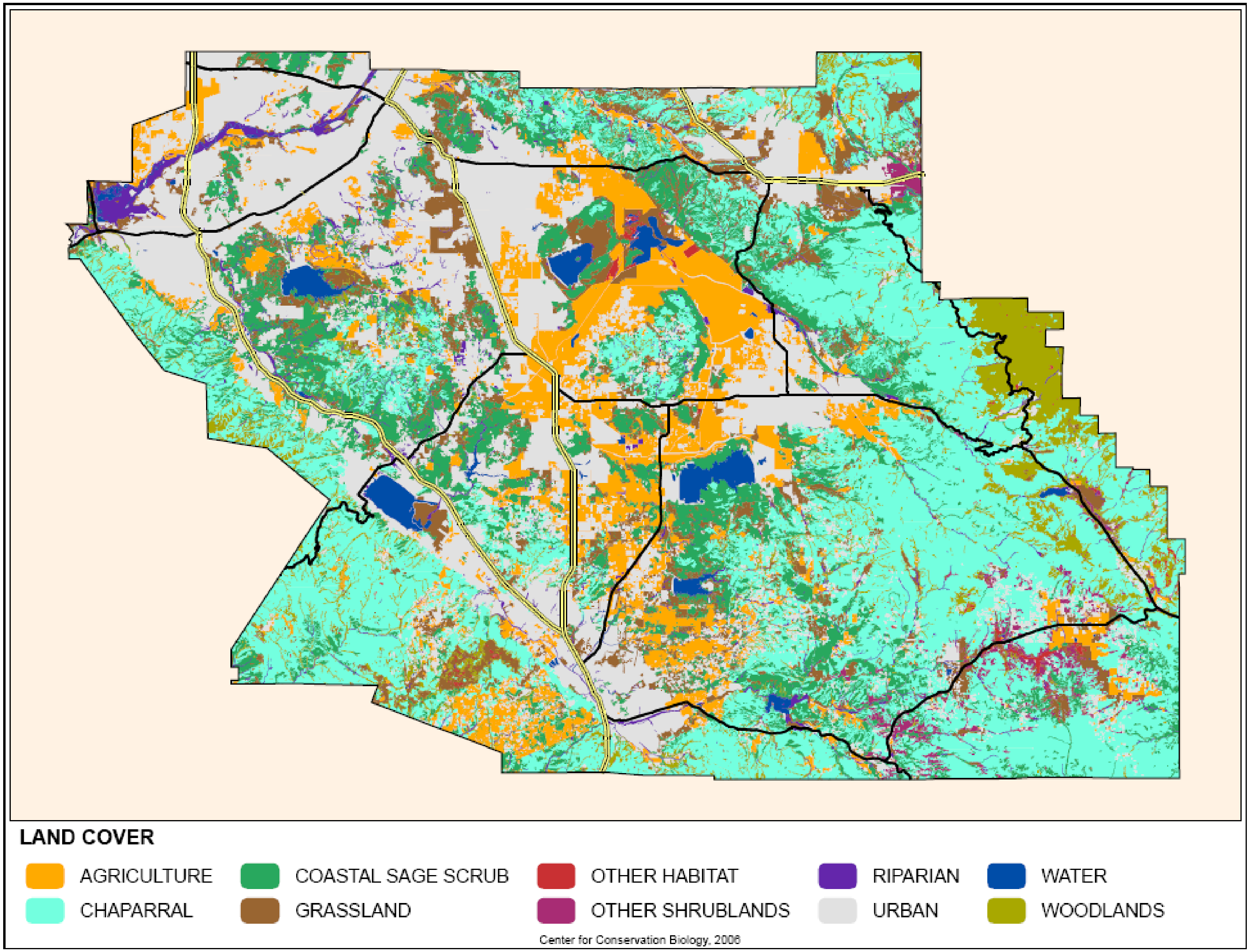


Figure 6. CDFG 2005 vegetation map for WRC MSHCP updated for recent development by CCB.

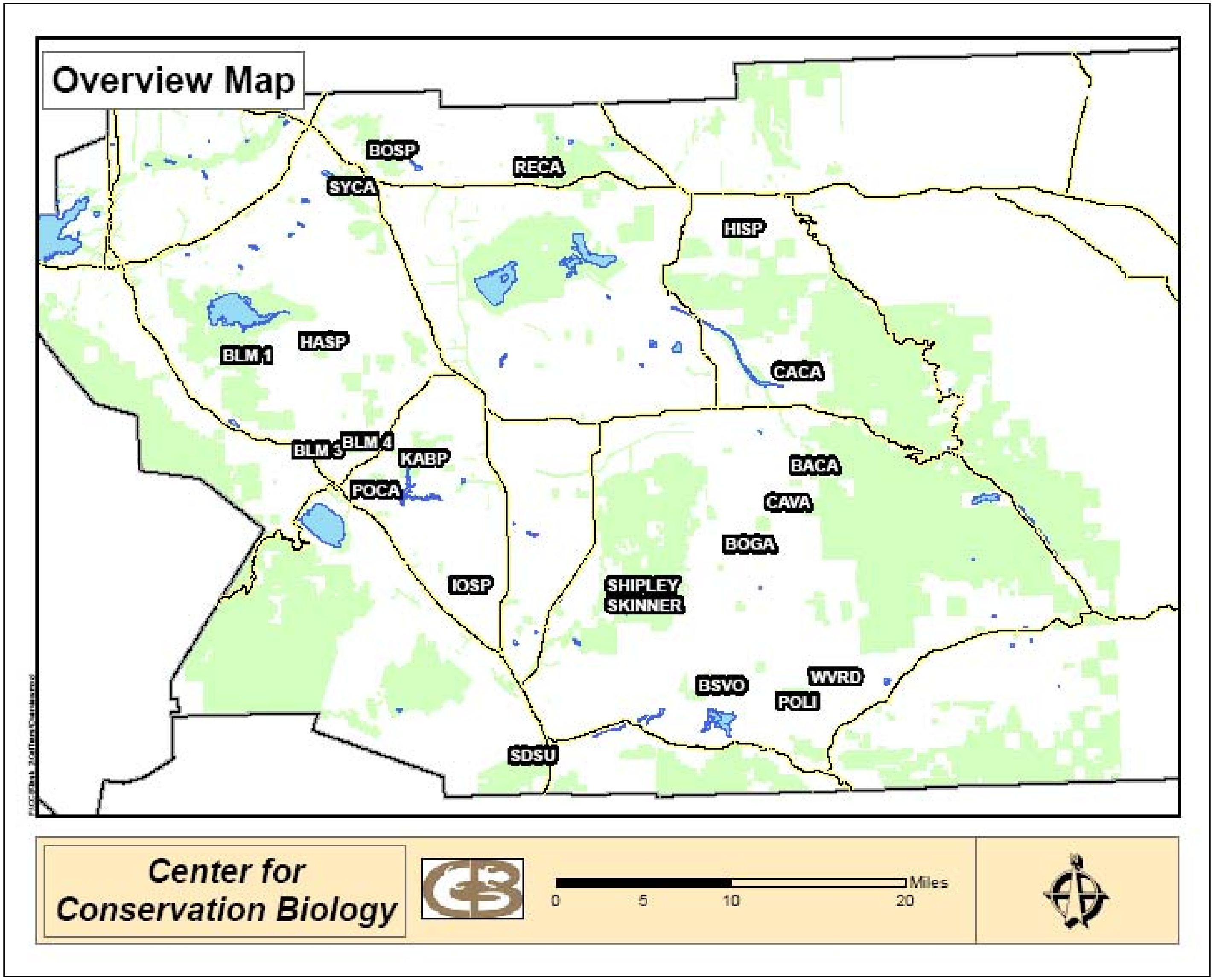


Figure 7. CCB survey locations in western Riverside County during 2006.

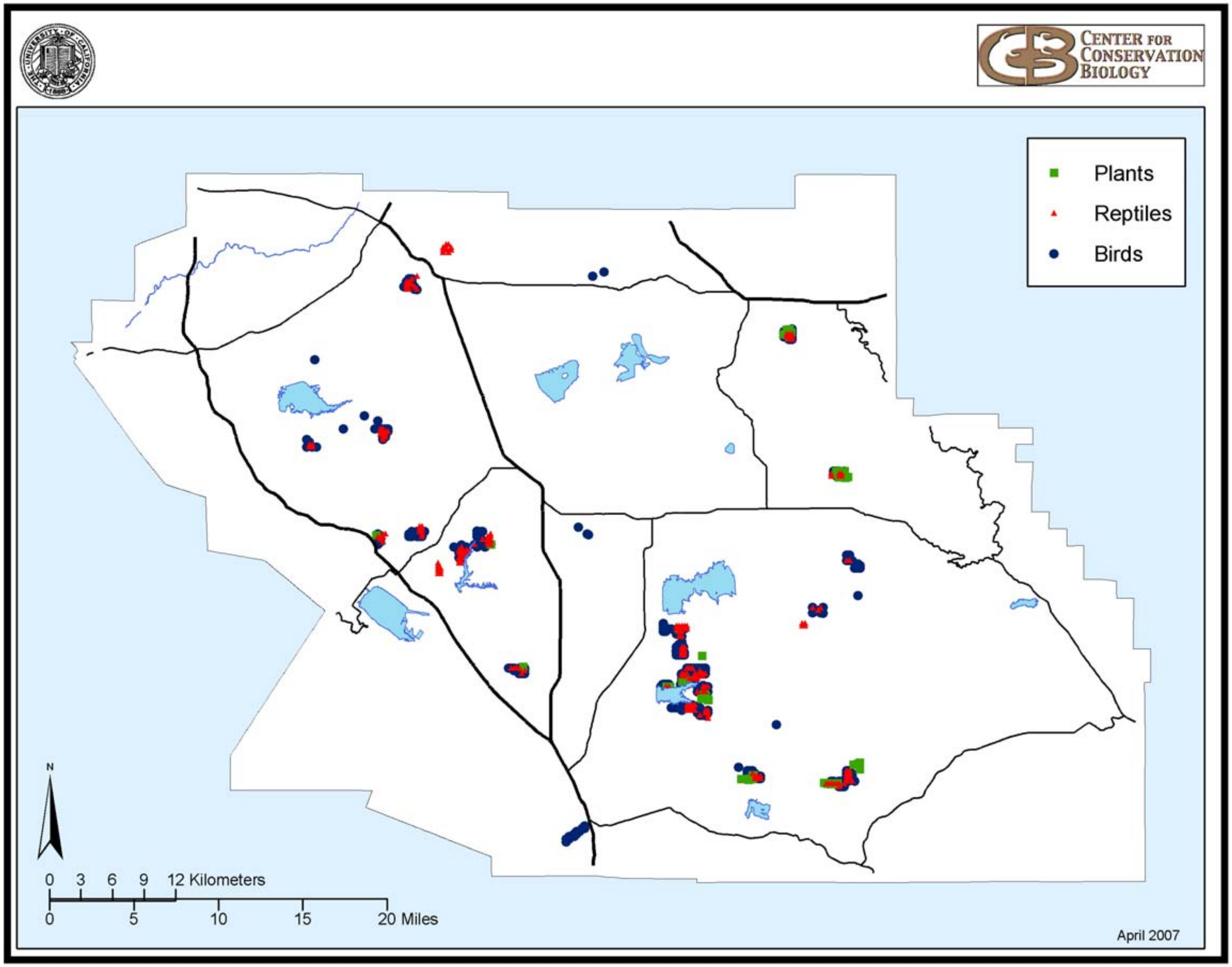


Figure 8. WRC MSHCP Covered plant and animal species detected during CCB surveys of shrubland habitats in 2006.

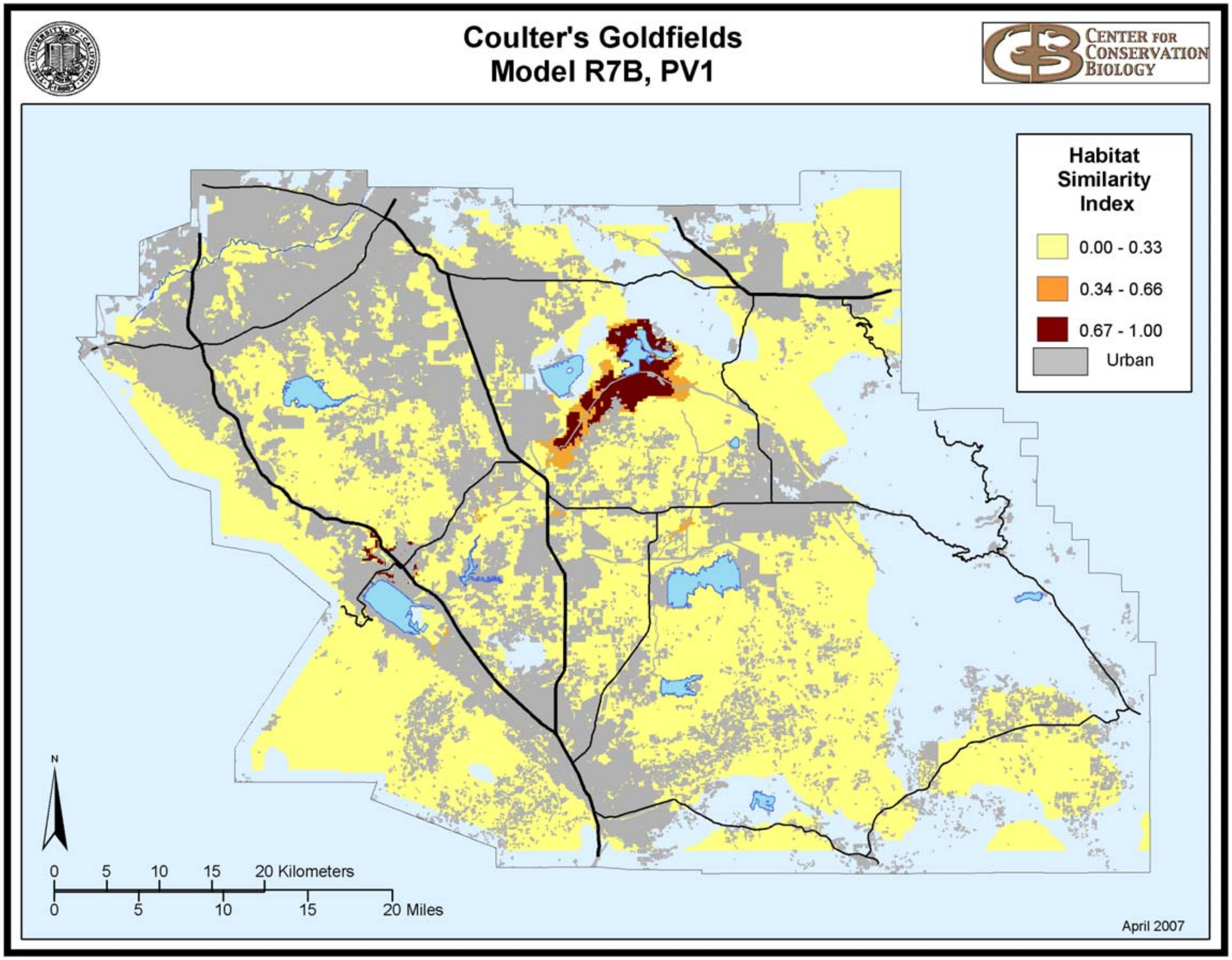


Figure 9. "HSI's" of habitat similarity for Coulter's goldfields across the WRC MSHCP.
The higher the HSI, the greater the similarity to occupied habitat.

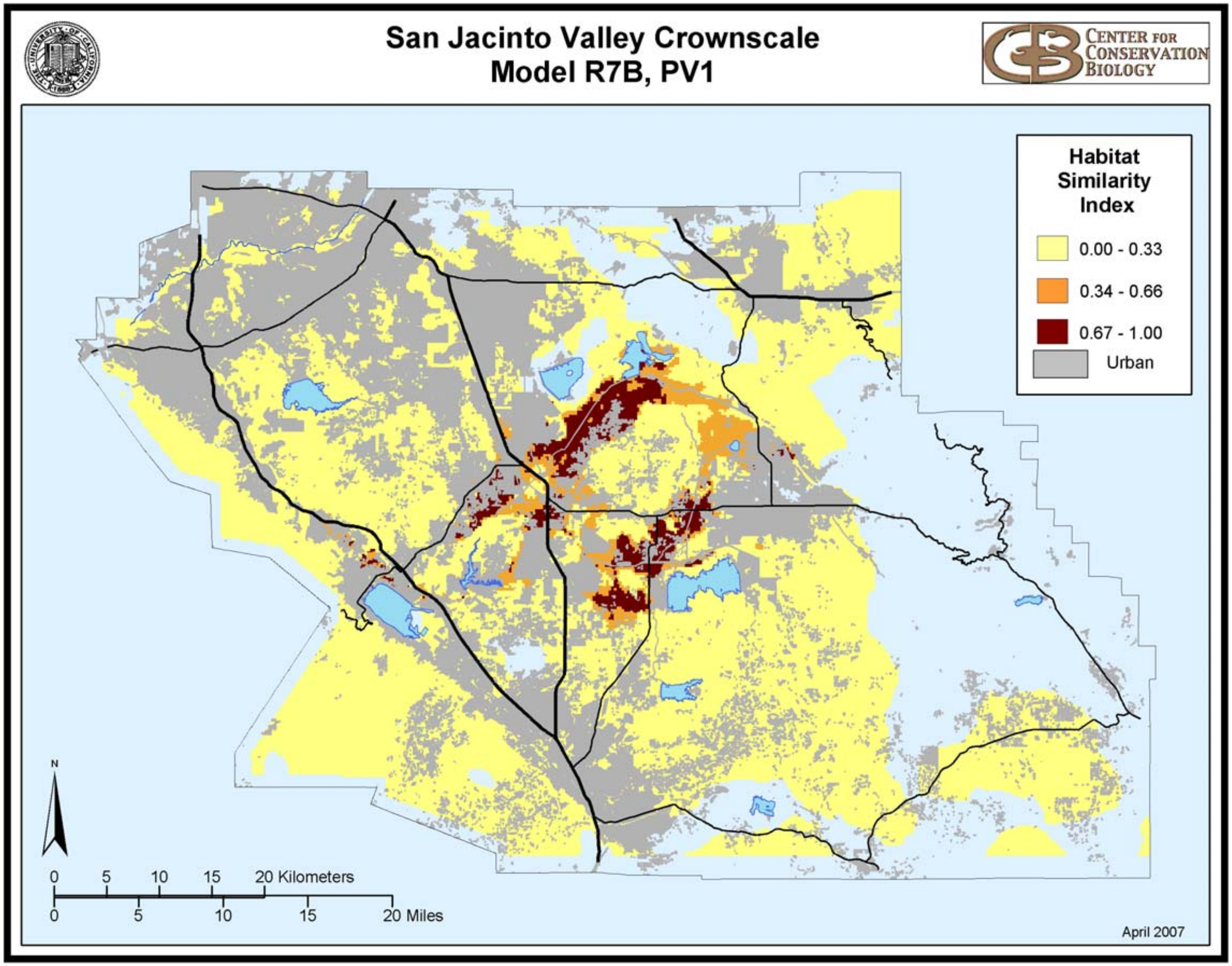


Figure 10. "HSI's" of habitat similarity for San Jacinto Valley crownscale across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

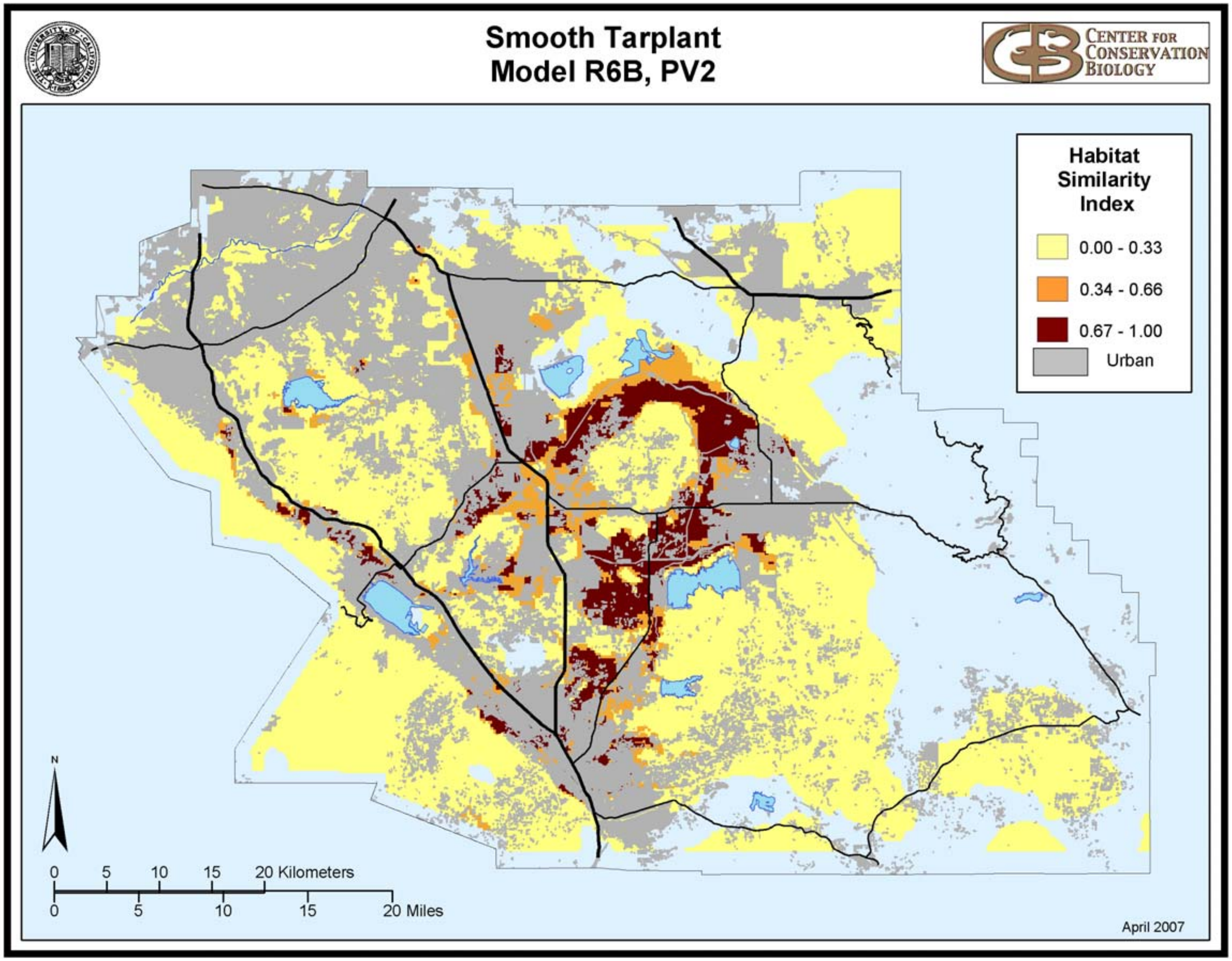


Figure 11. "HSI's" of habitat similarity for smooth tarplant across the WRC MSHCP.
The higher the HSI, the greater the similarity to occupied habitat.

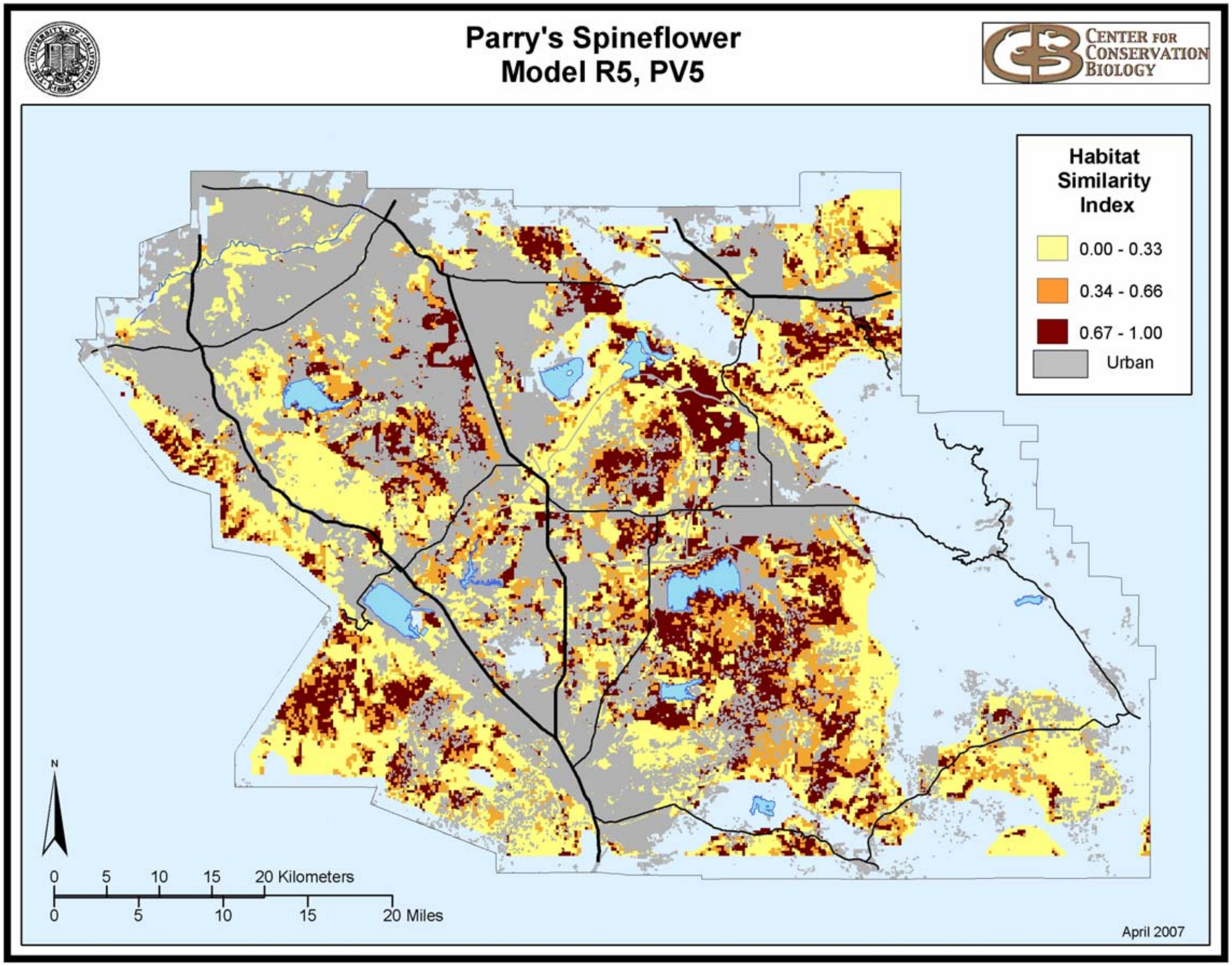


Figure 12. "HSI's" of habitat similarity for Parry's spineflower across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

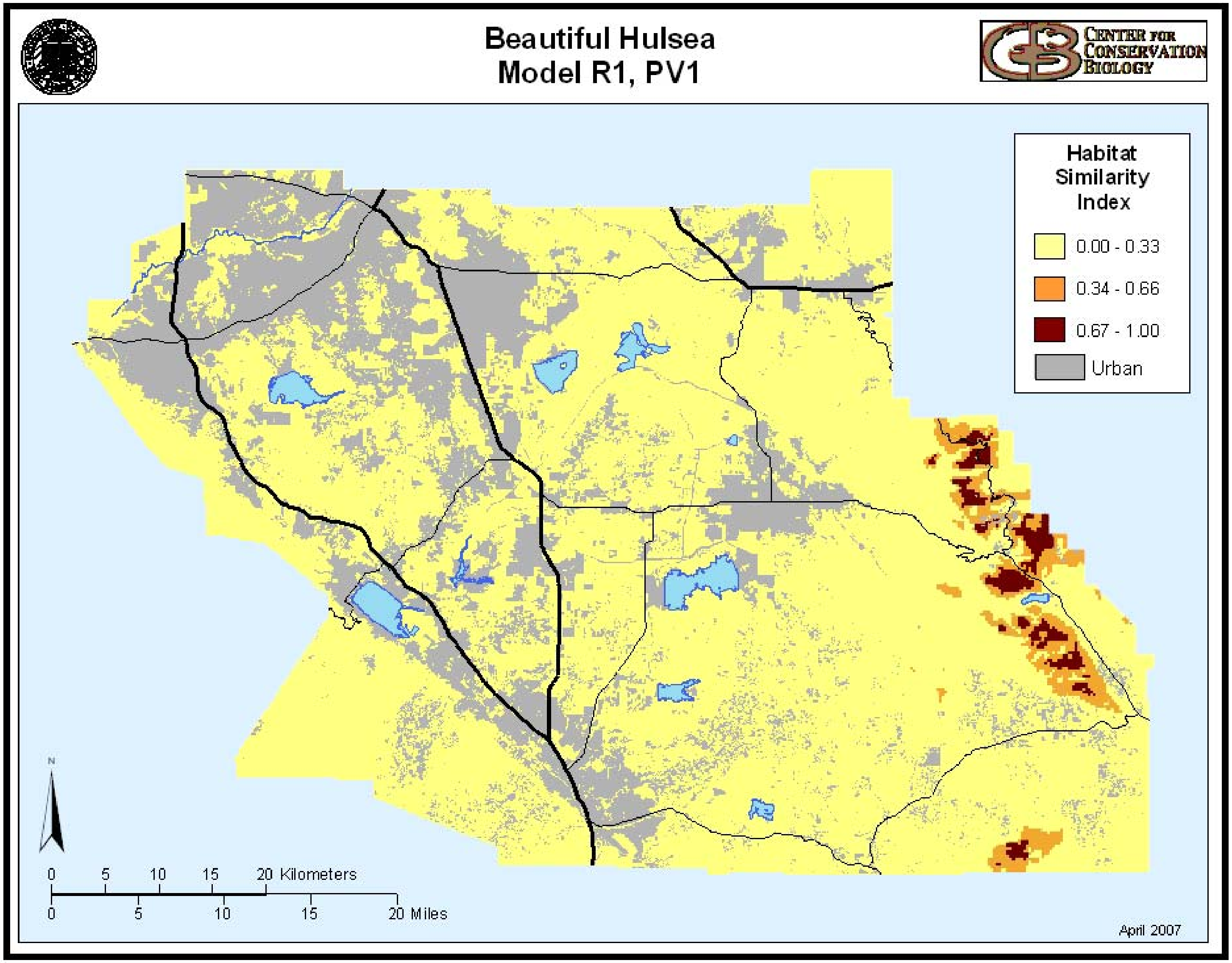


Figure 13. "HSI's" of habitat similarity for beautiful hulsea across the WRC MSHCP.
The higher the HSI, the greater the similarity to occupied habitat.

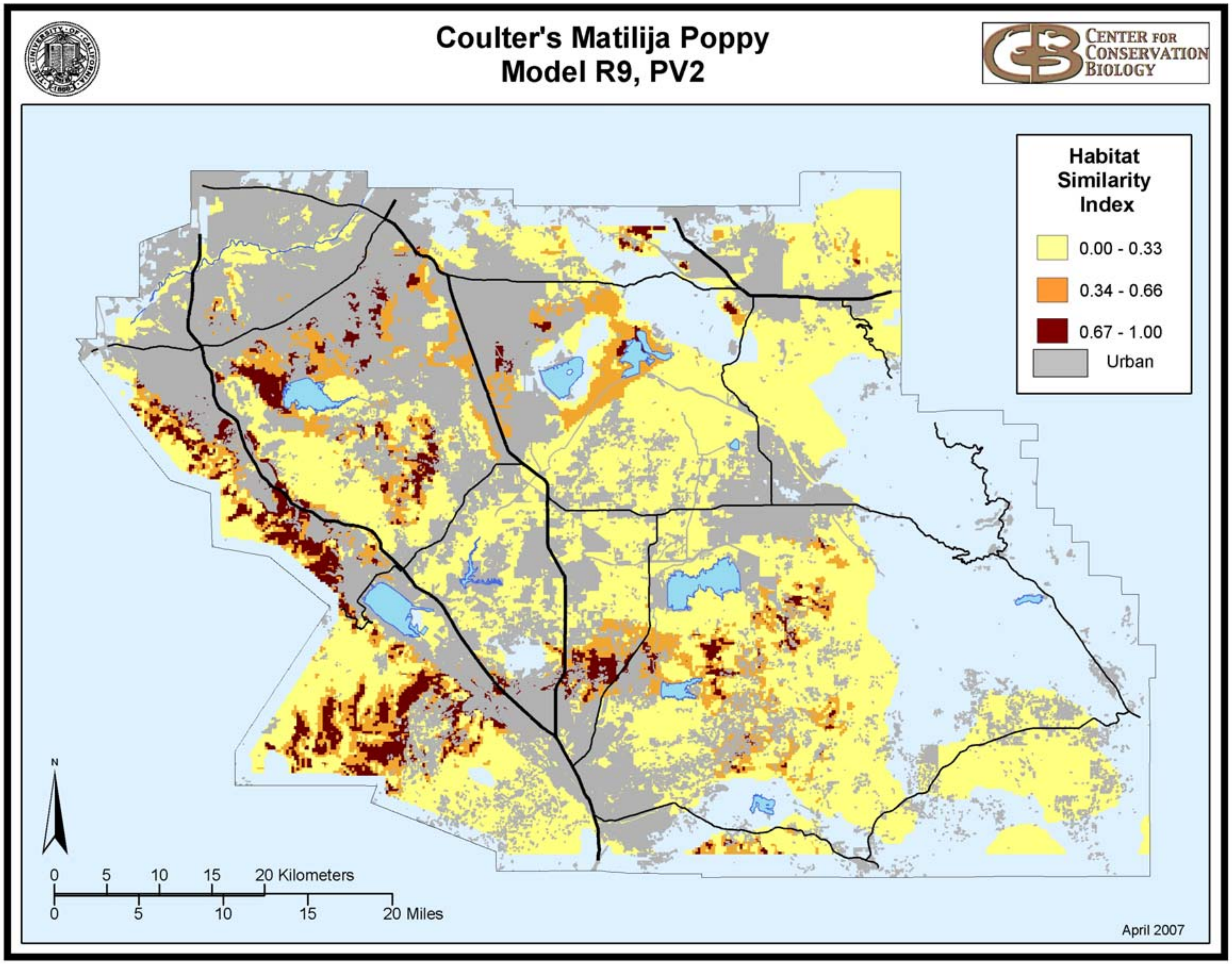


Figure 14. "HSI's" of habitat similarity for Coulter's matilija poppy across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

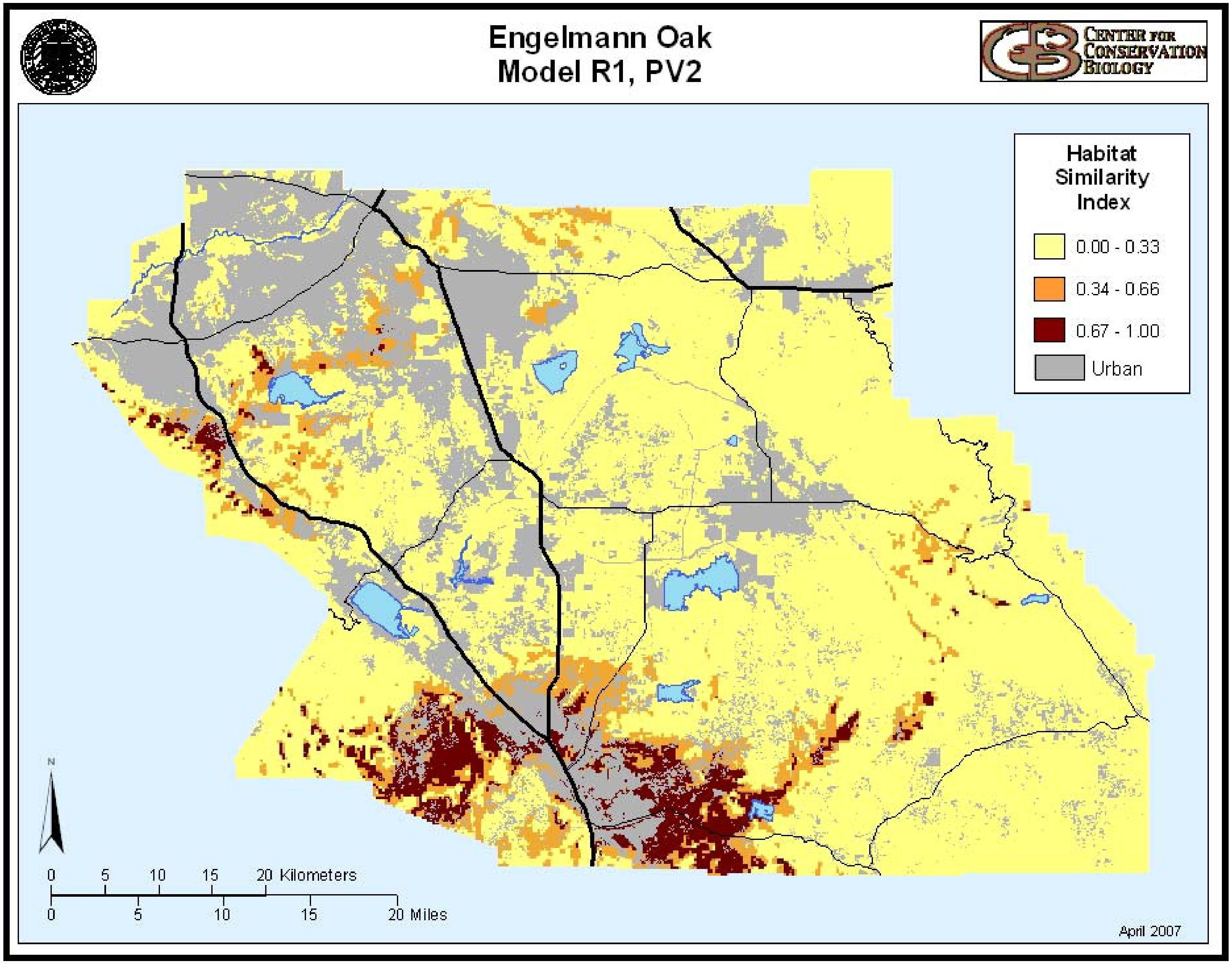


Figure 15. "HSI's" of habitat similarity for Engelmann oak across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

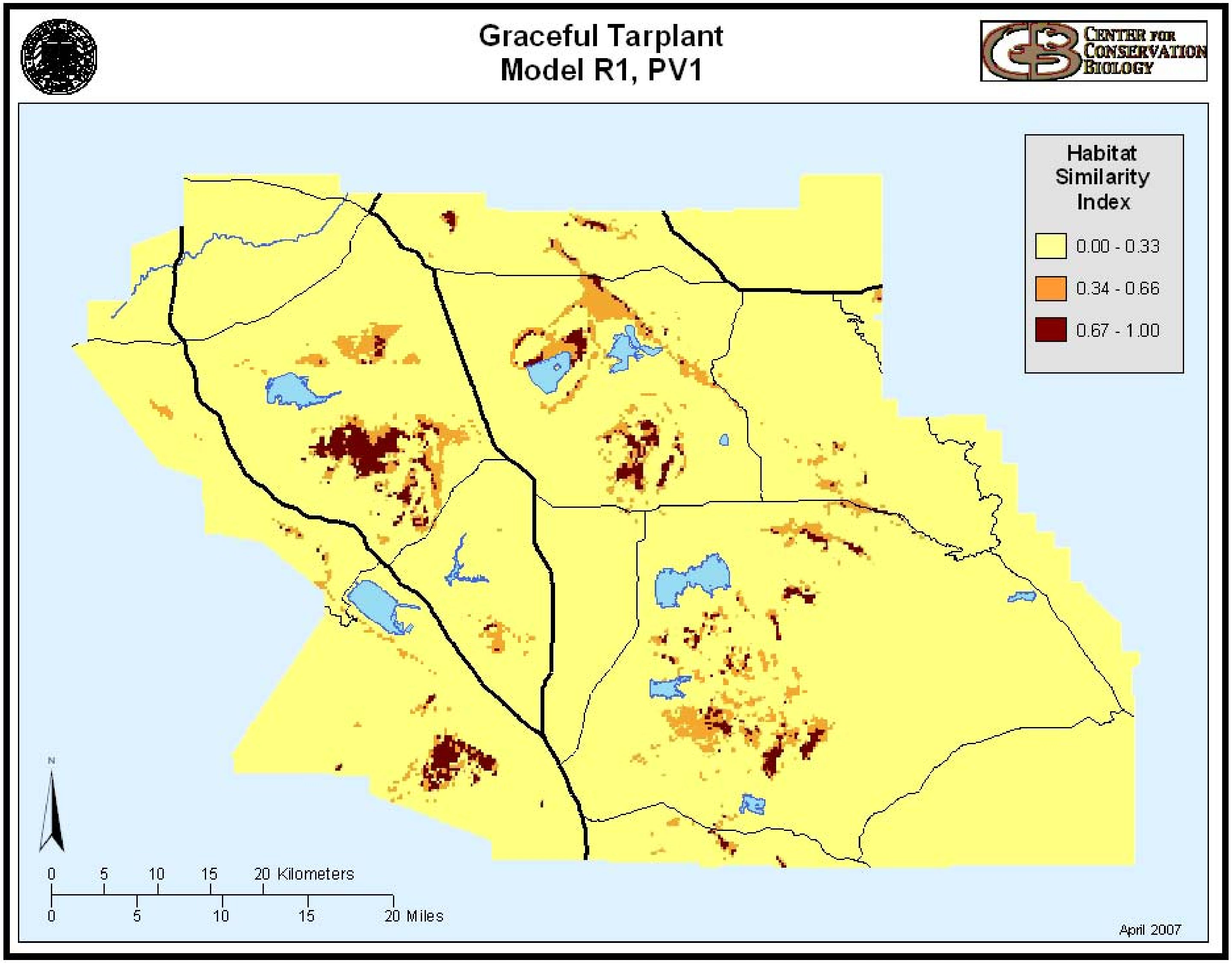


Figure 16. "HSI's" of habitat similarity for graceful tarplant across the WRC MSHCP.
The higher the HSI, the greater the similarity to occupied habitat.

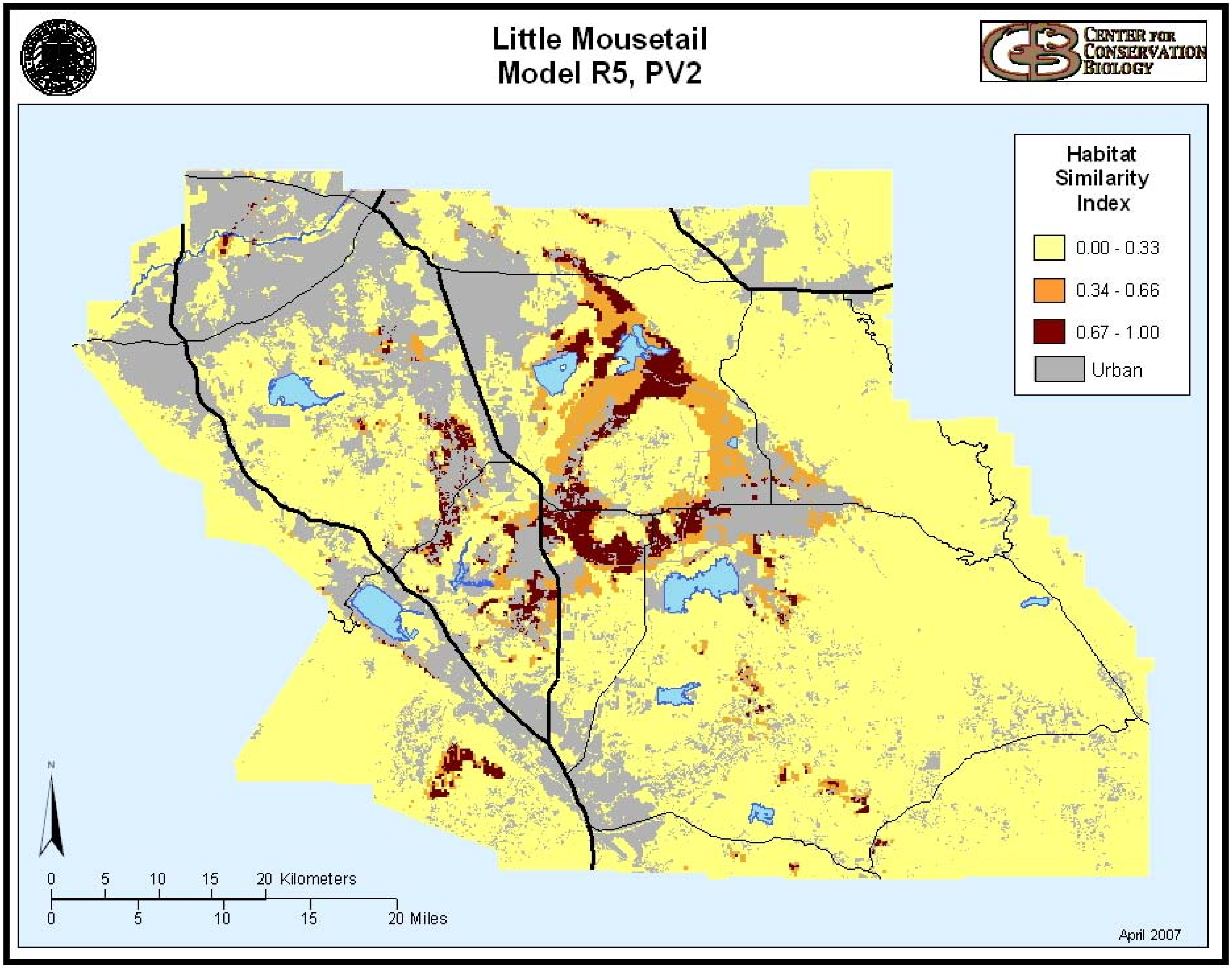


Figure 17. "HSI's" of habitat similarity for little mousetail across the WRC MSHCP.
The higher the HSI, the greater the similarity to occupied habitat.

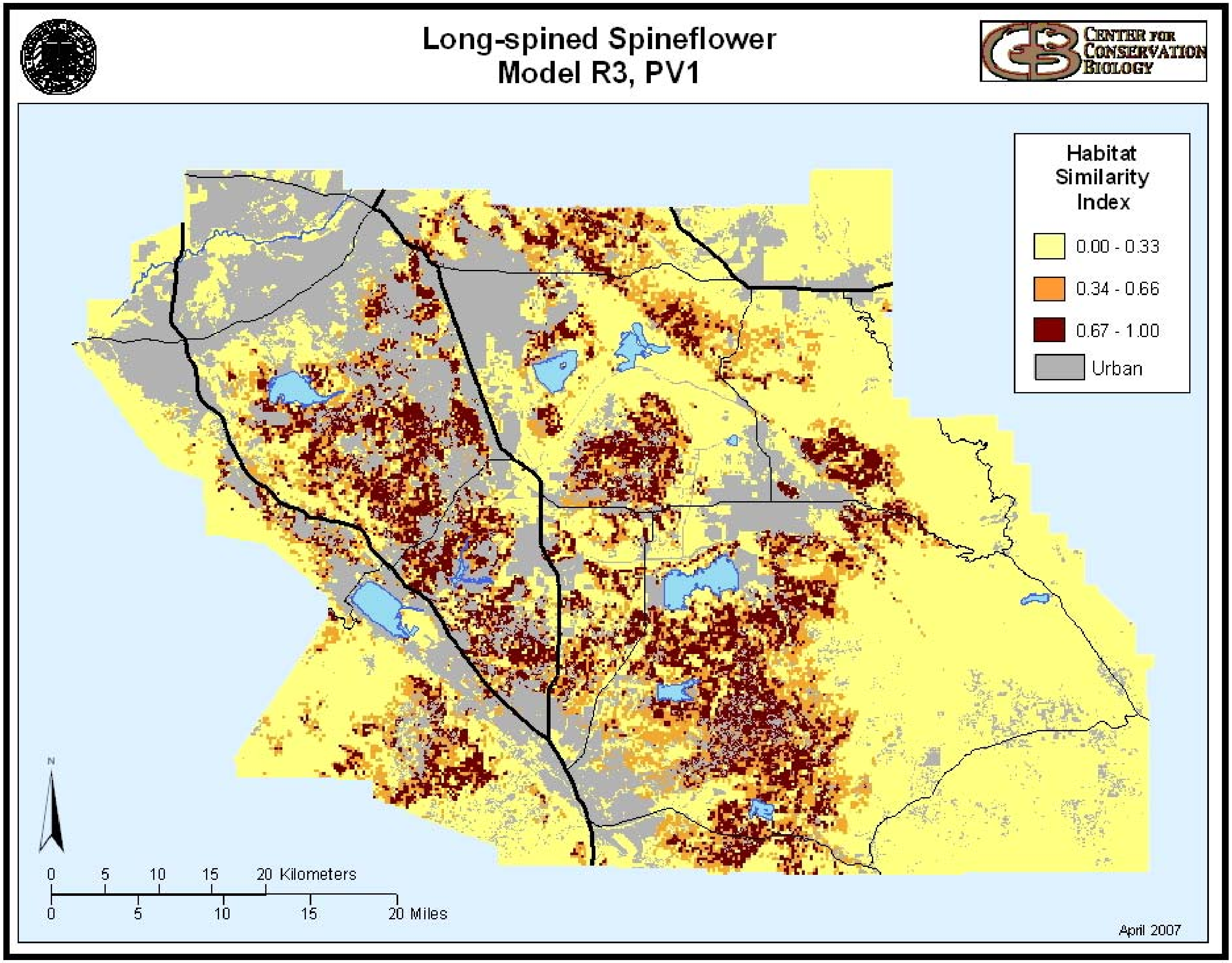


Figure 18. "HSI's" of habitat similarity for long-spined spineflower across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

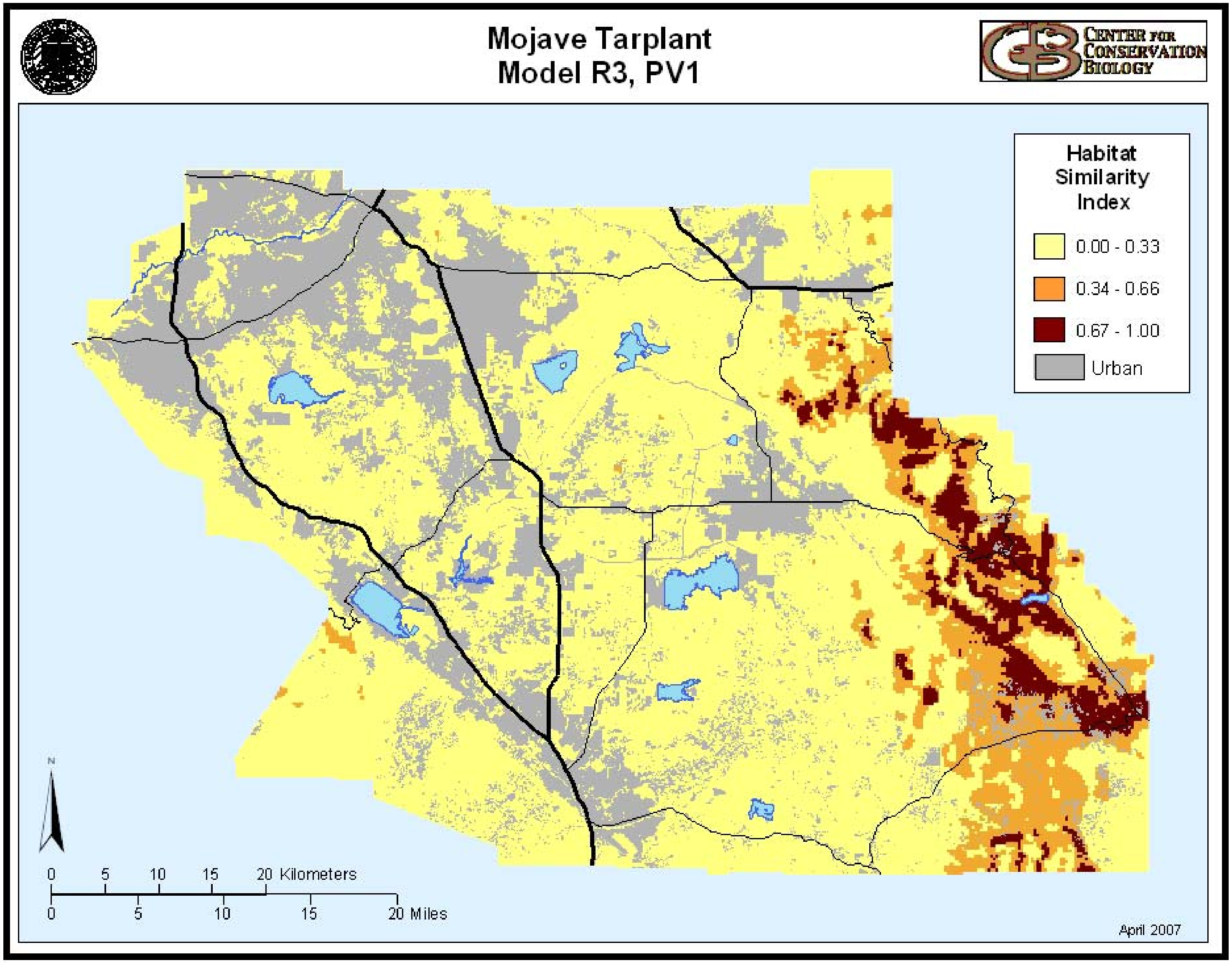


Figure 19. "HSI's" of habitat similarity for Mojave tarplant across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

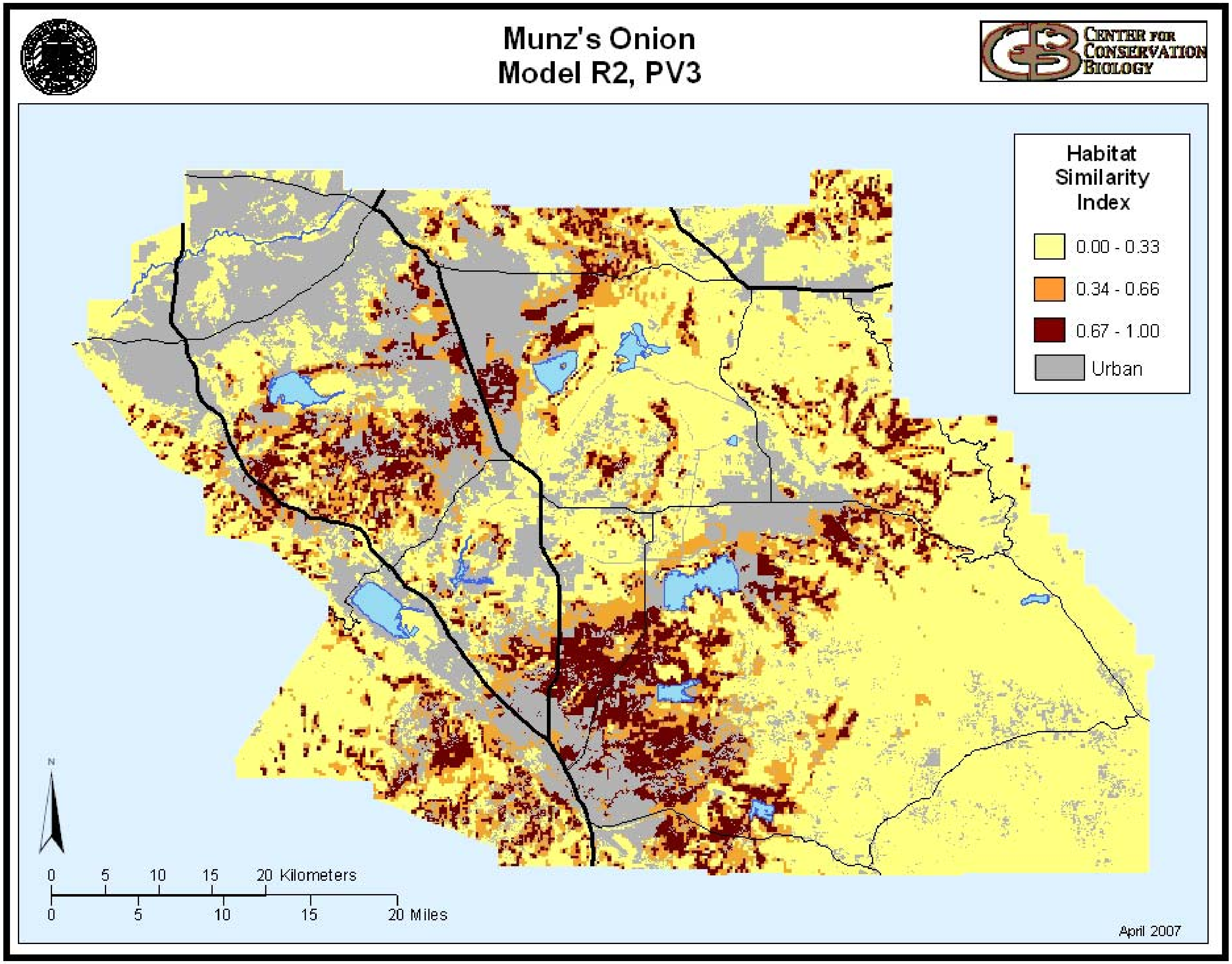


Figure 20. "HSI's" of habitat similarity for Munz's onion across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

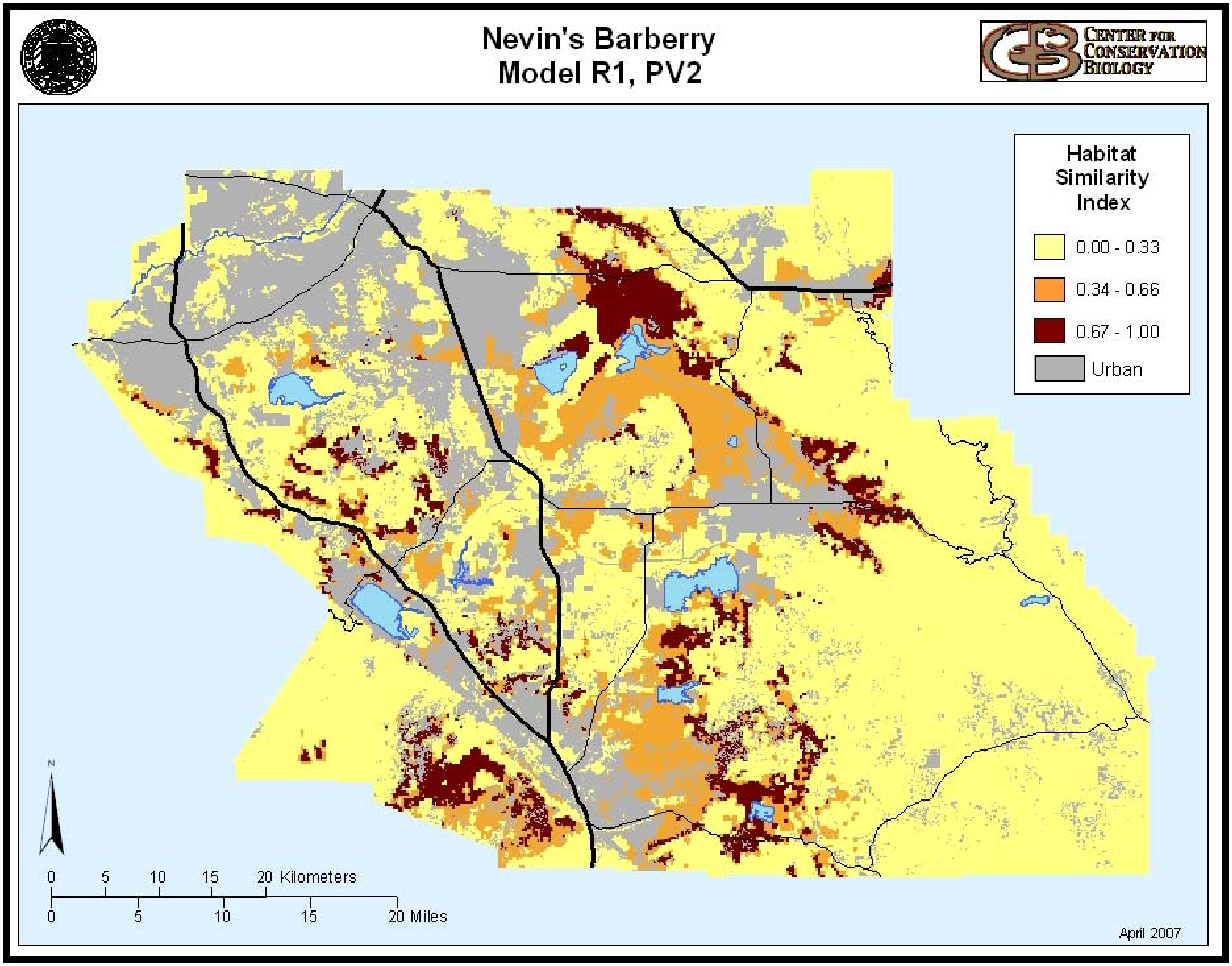


Figure 21. "HSI's" of habitat similarity for Nevin's barberry across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

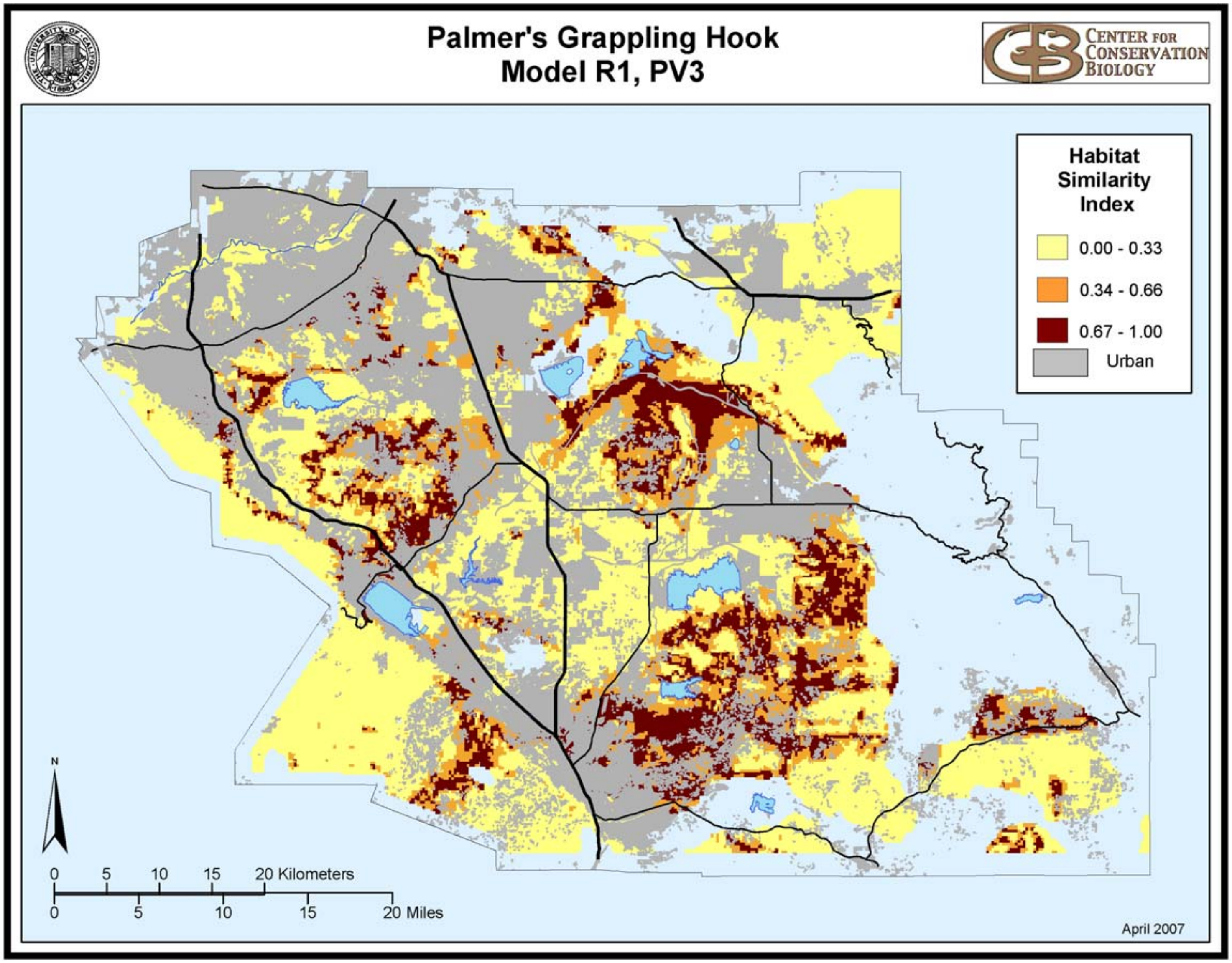


Figure 22. "HSI's" of habitat similarity for Palmer's grappling hook across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

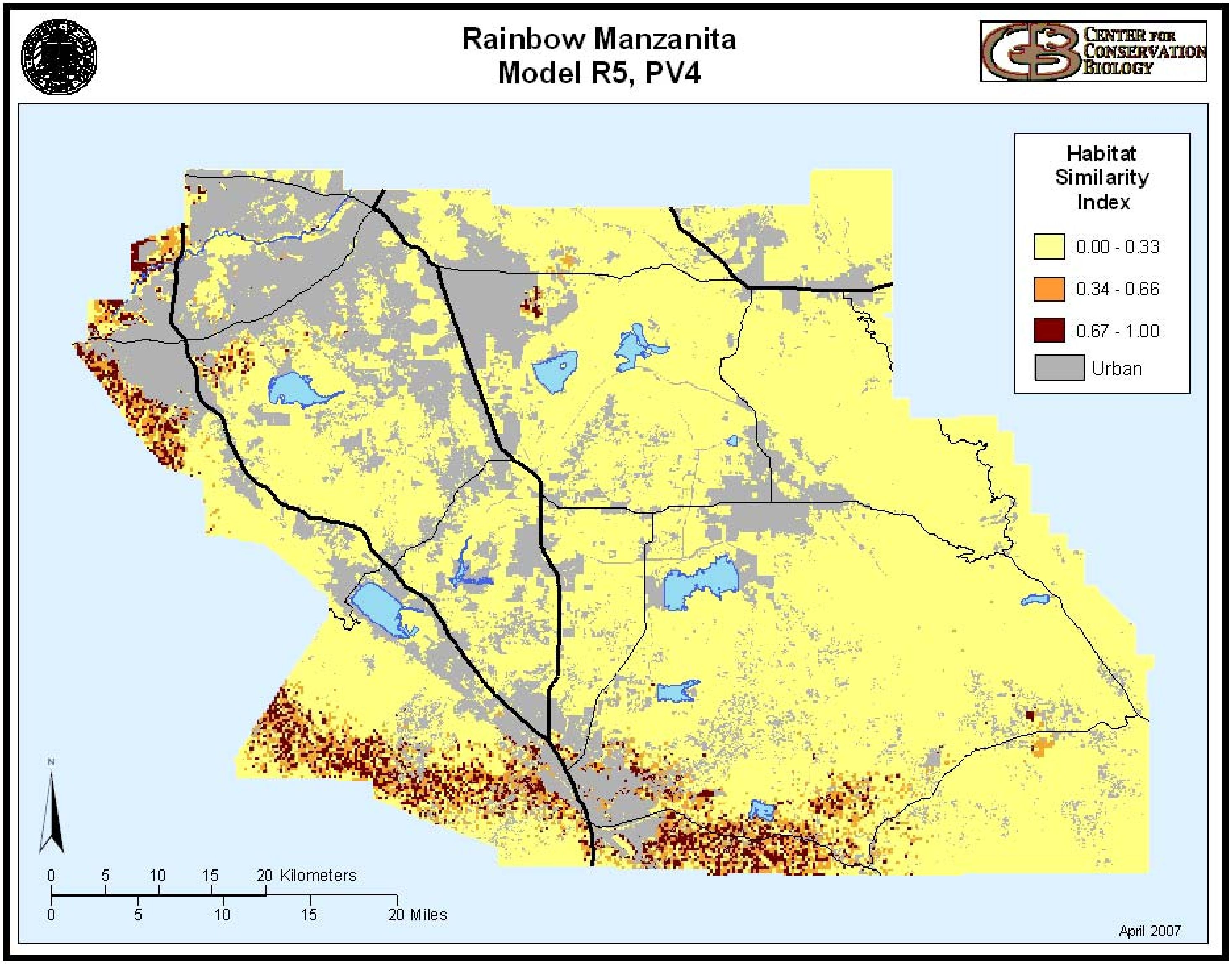


Figure 23. "HSI's" of habitat similarity for rainbow manzanita across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

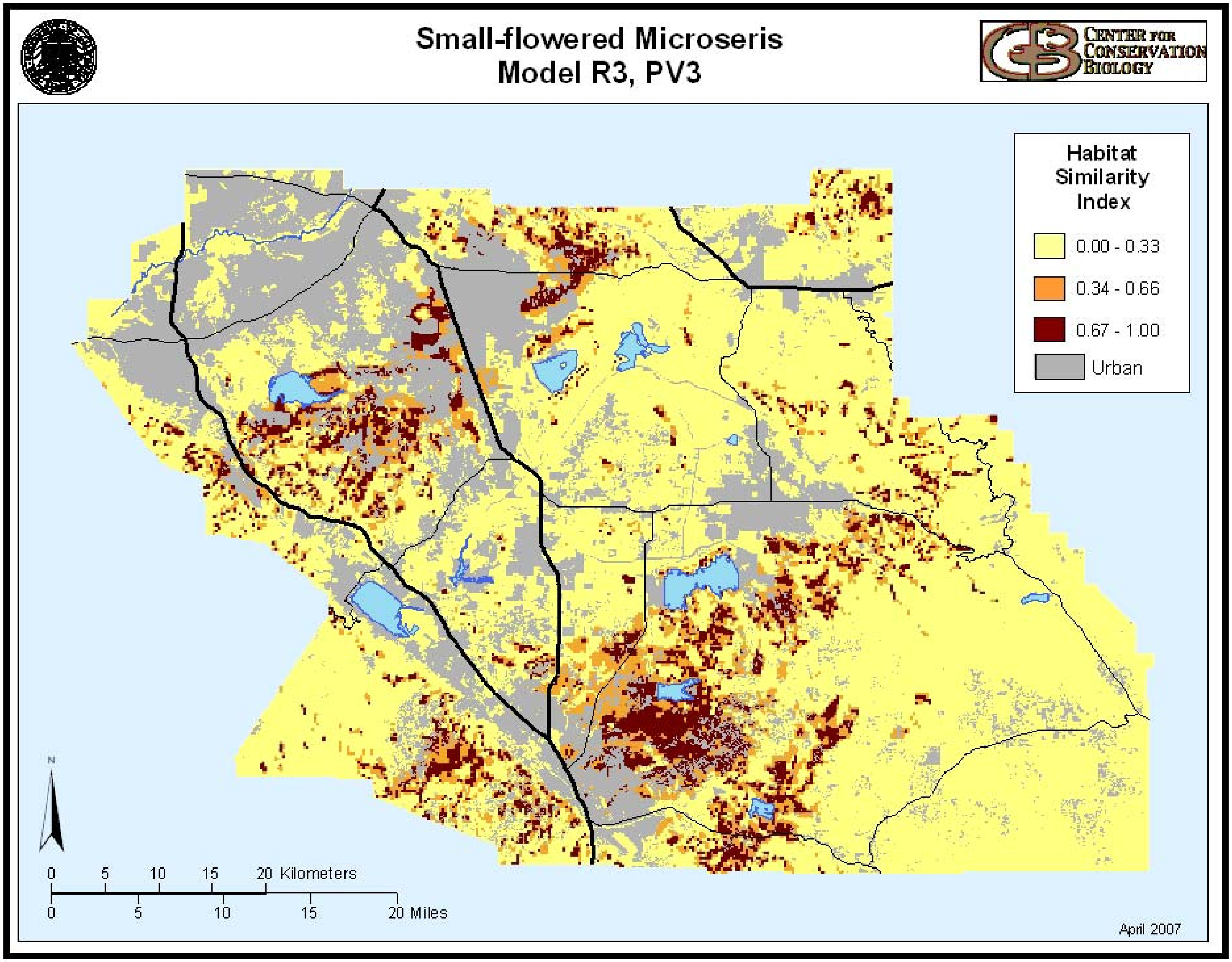


Figure 24. "HSI's" of habitat similarity for small-flowered microseris across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

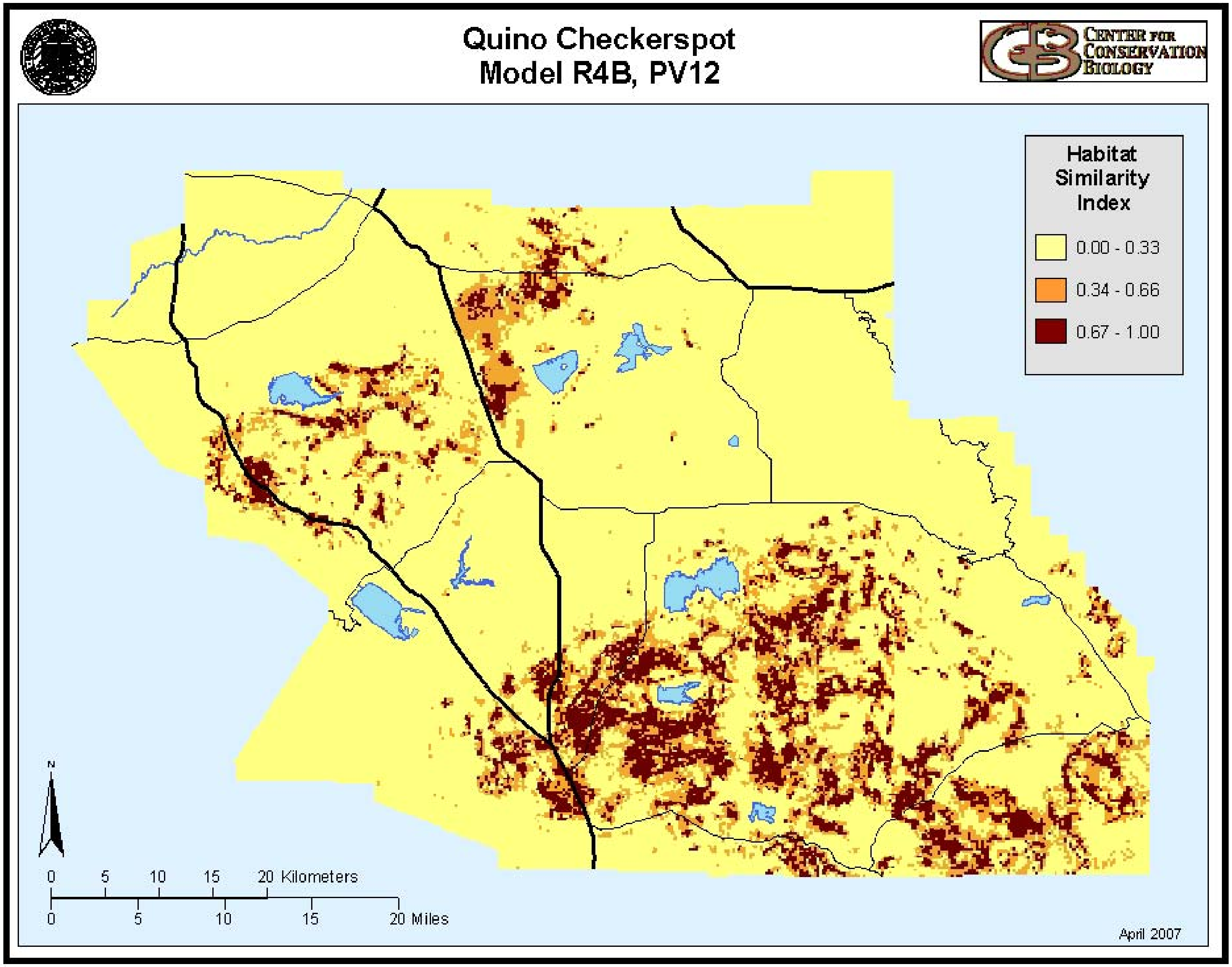


Figure 25. "HSI's" of habitat similarity for Quino checkerspot across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

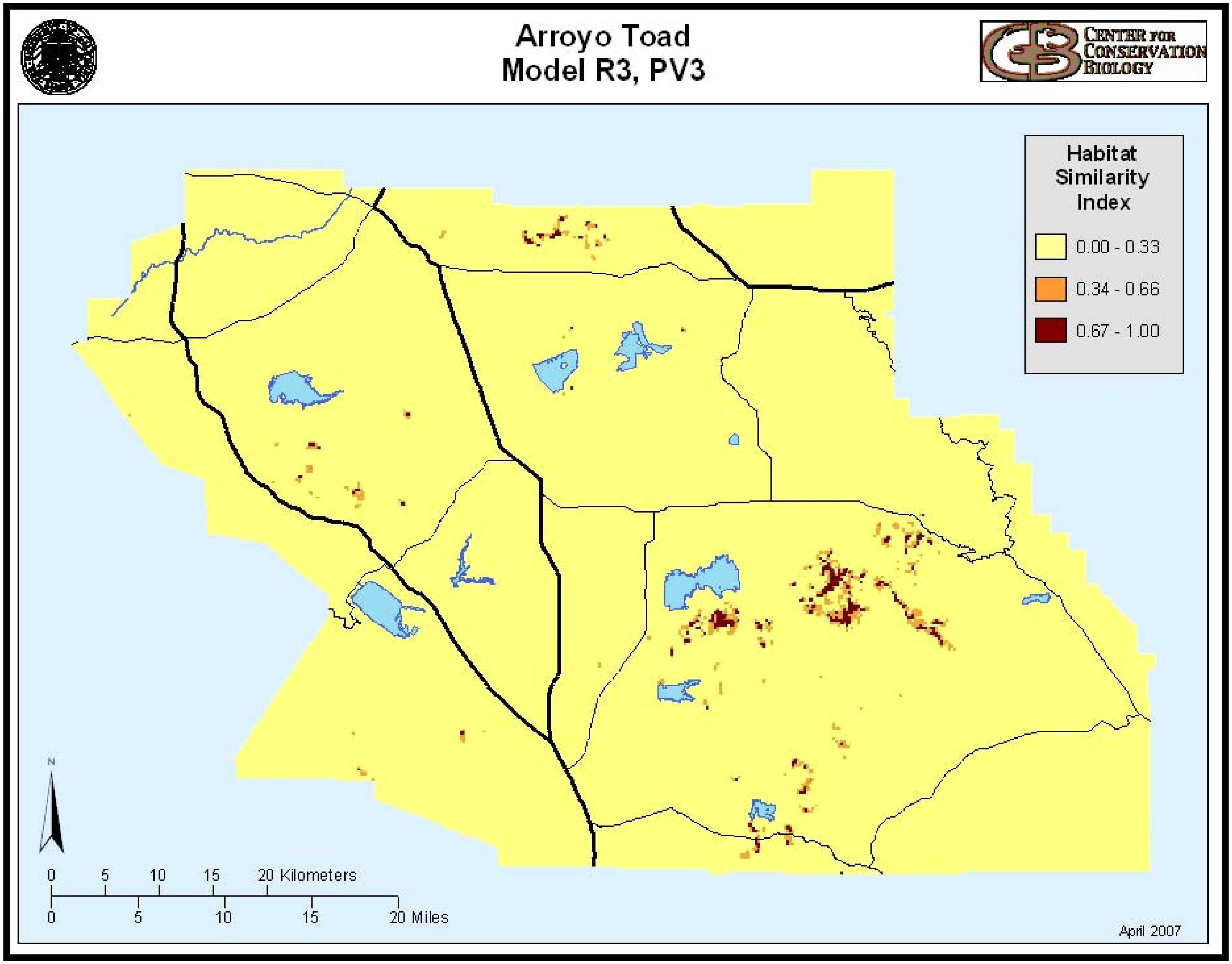


Figure 26. "HSI's" of habitat similarity for arroyo toad across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

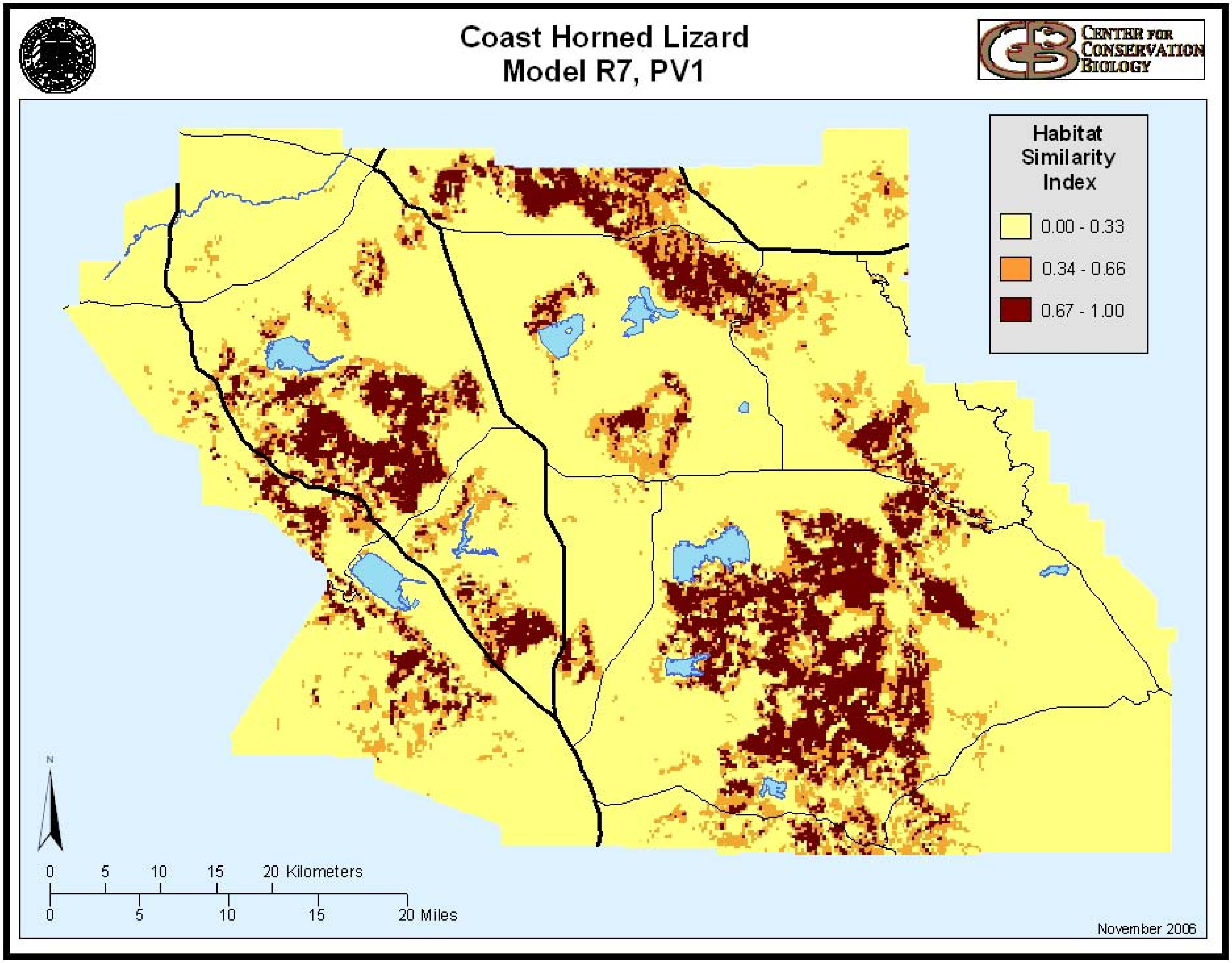


Figure 27. "HSI's" of habitat similarity for coast horned lizard across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

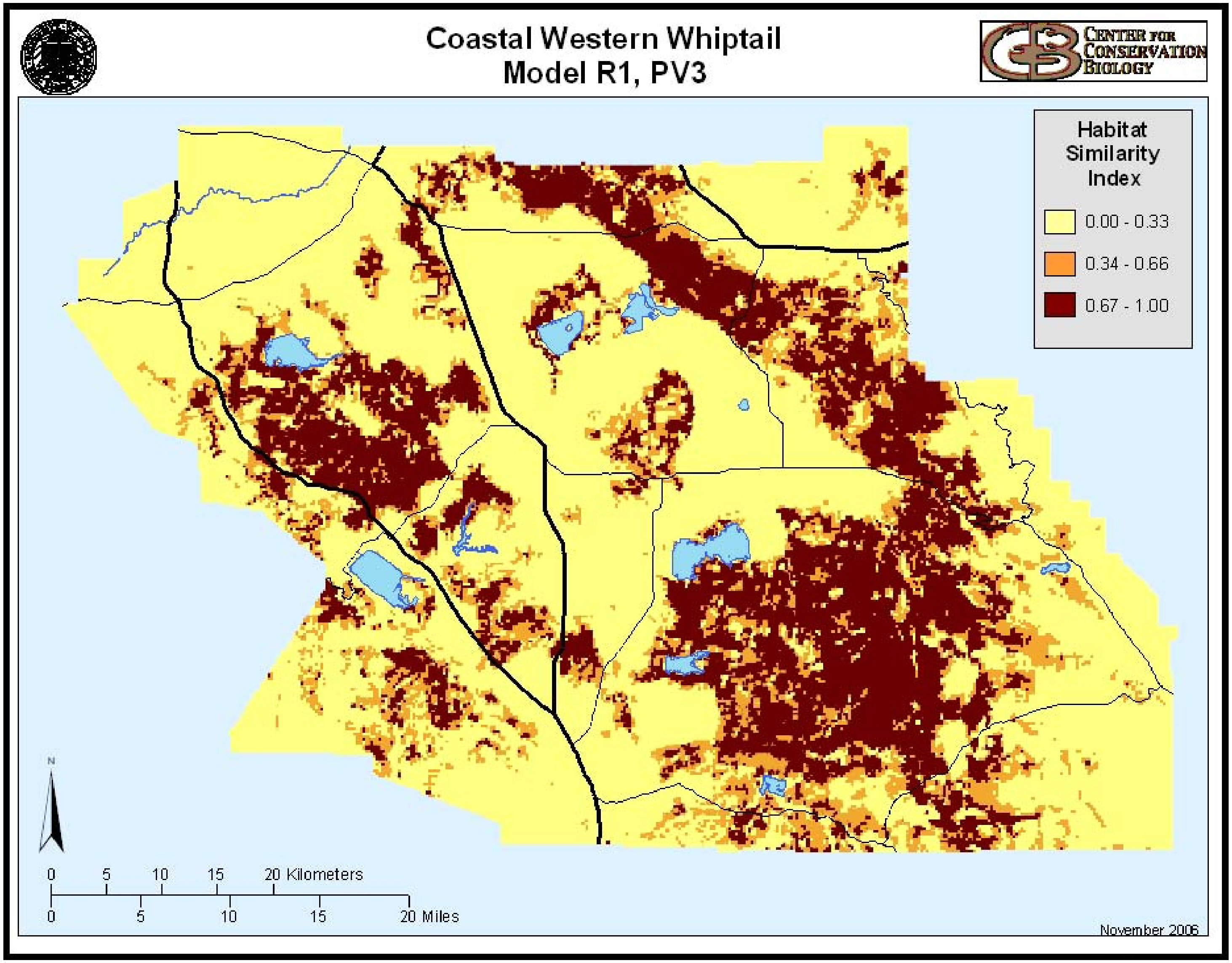


Figure 28. "HSI's" of habitat similarity for coastal western whiptail across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

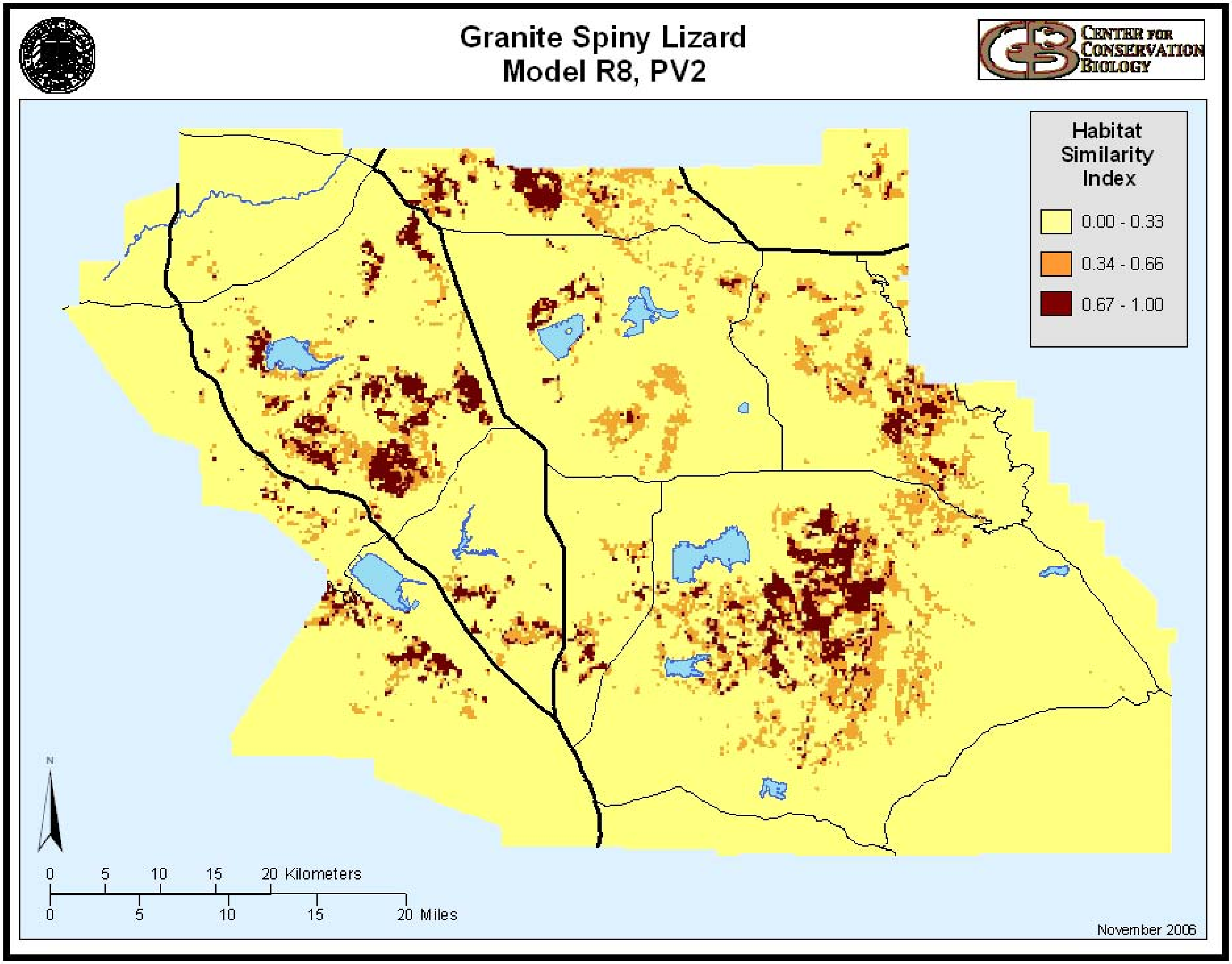


Figure 29. "HSI's" of habitat similarity for granite spiny lizard across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

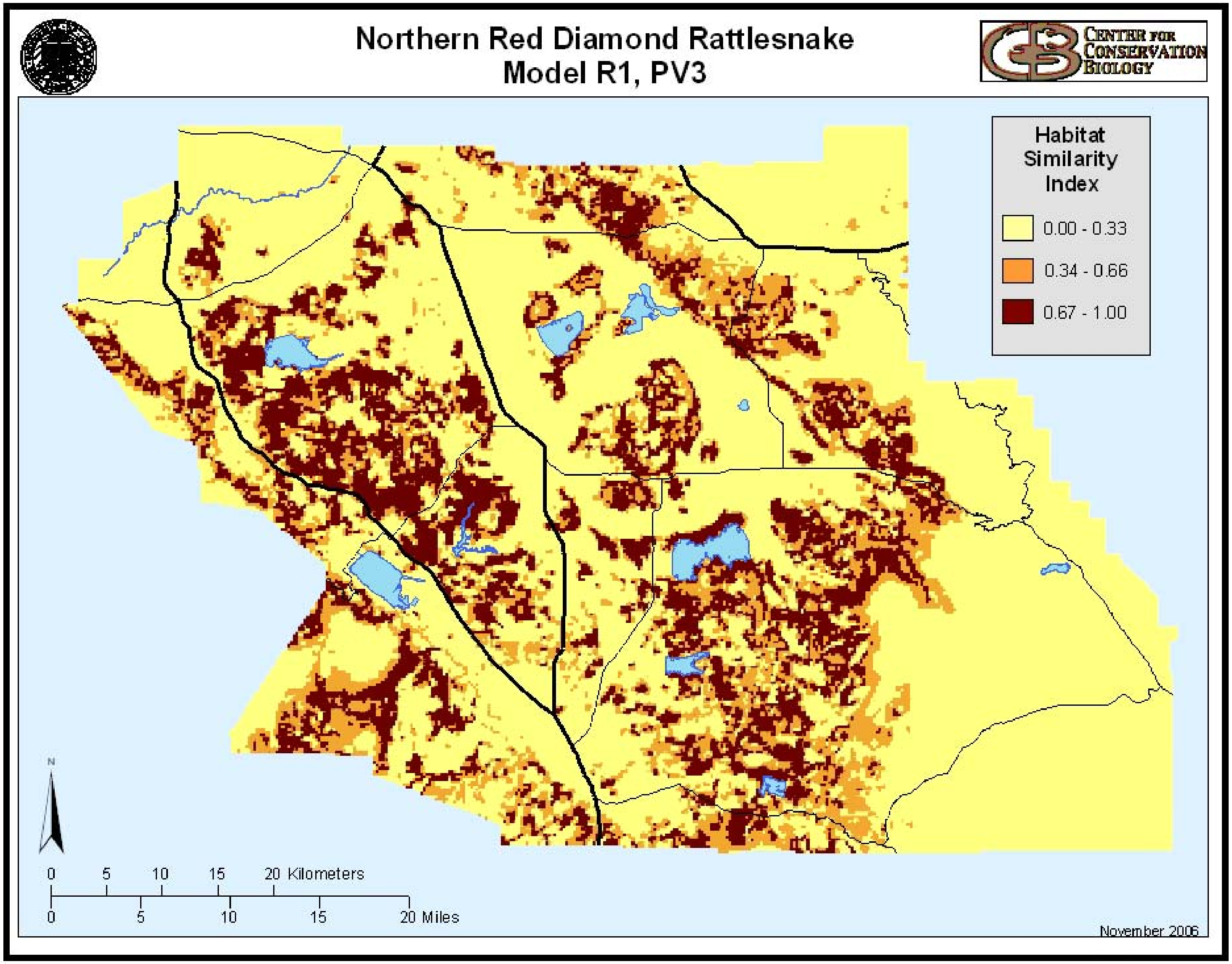


Figure 30. "HSI's" of habitat similarity for northern red diamond rattlesnake across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

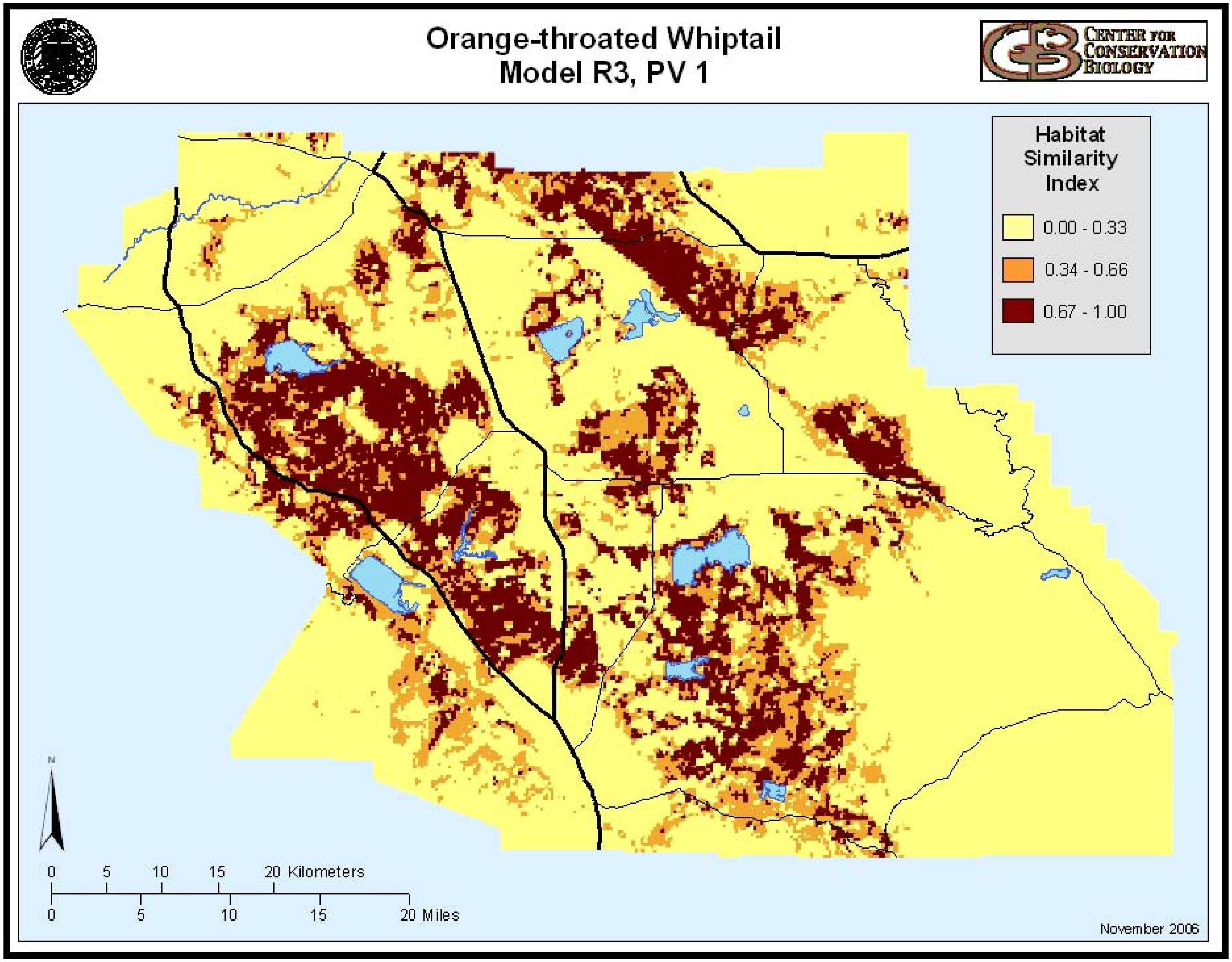


Figure 31. "HSI's" of habitat similarity for orange-throated whiptail across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

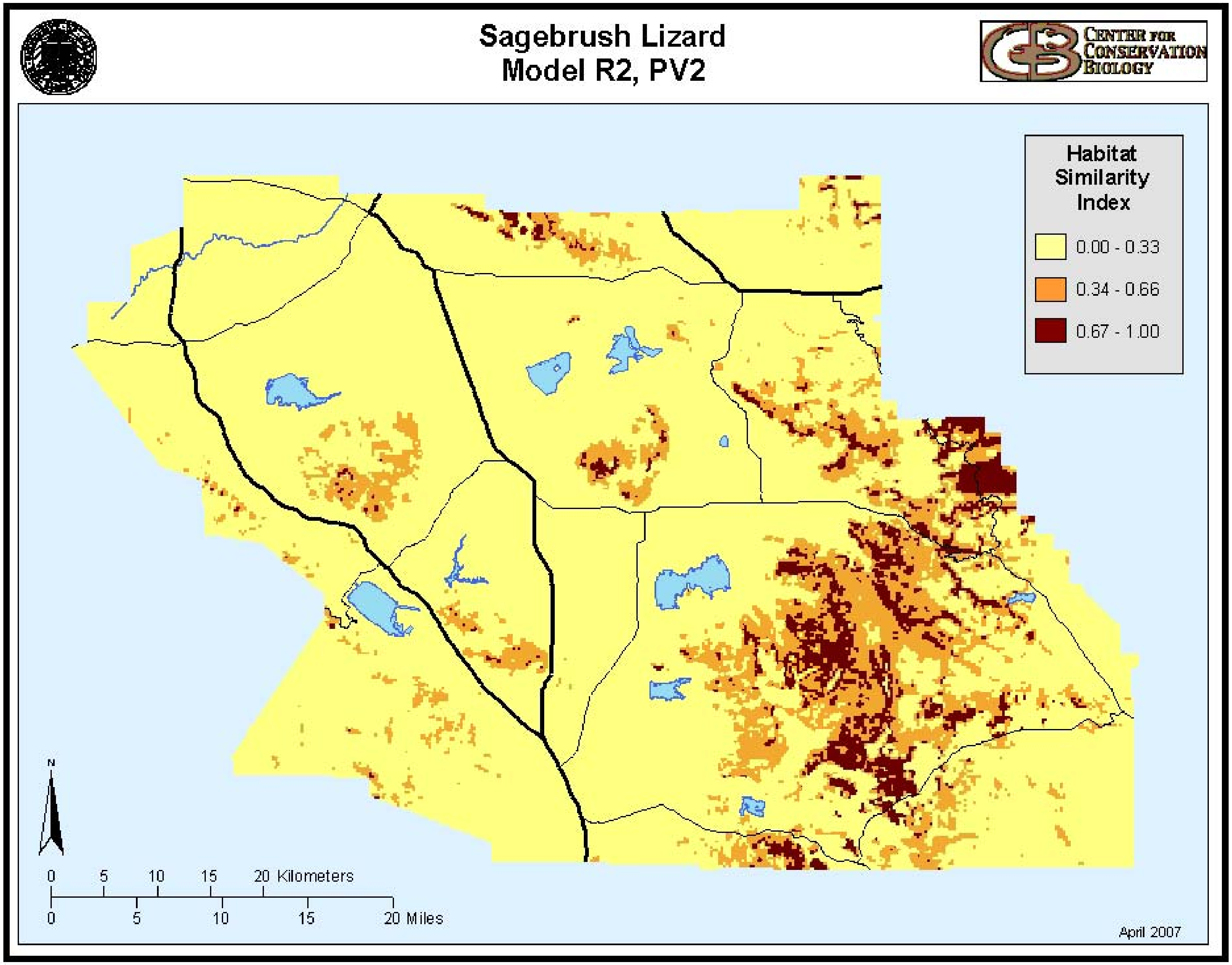


Figure 32. "HSI's" of habitat similarity for southern sagebrush lizard across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

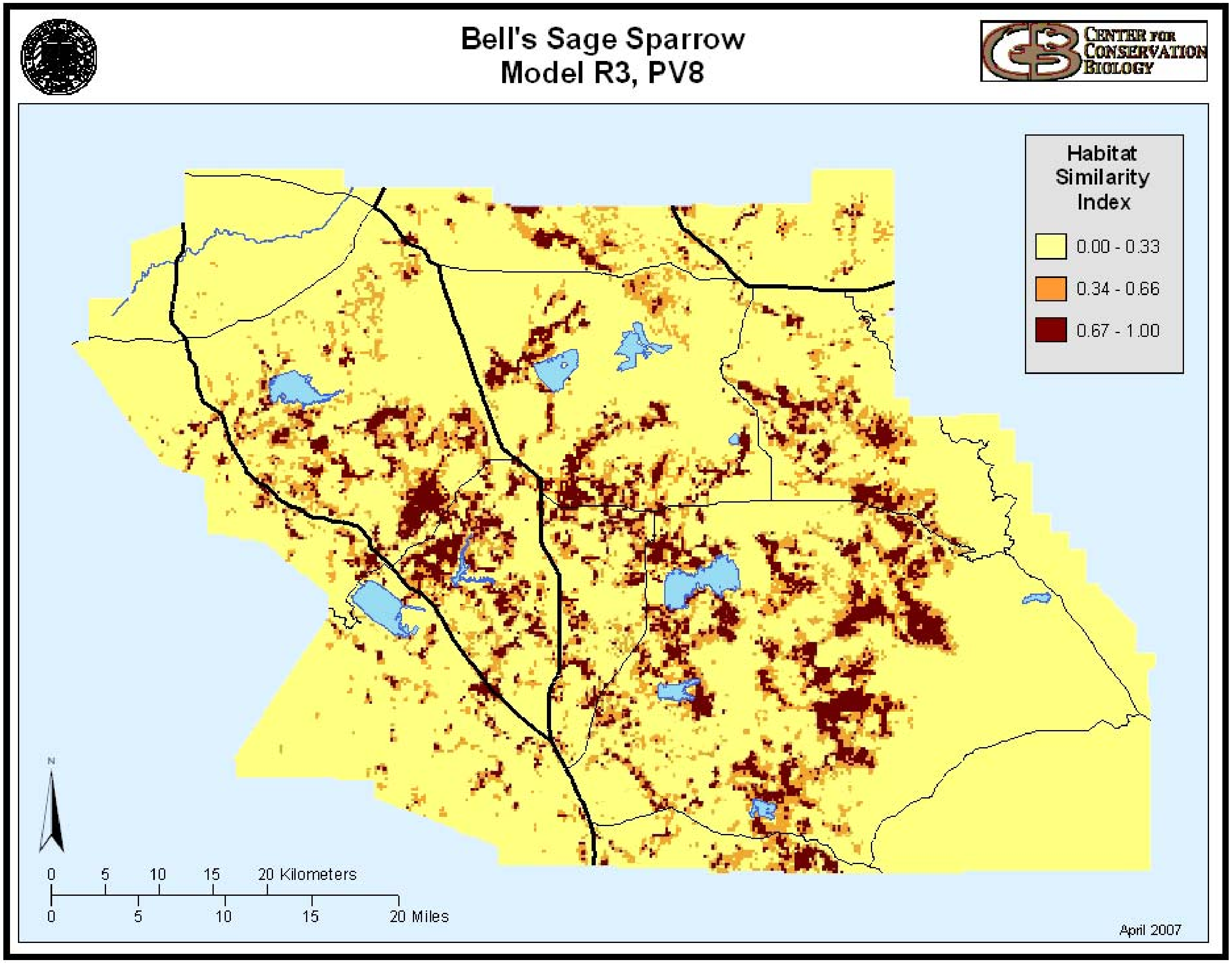


Figure 33. "HSI's" of habitat similarity for Bell's Sage Sparrow across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

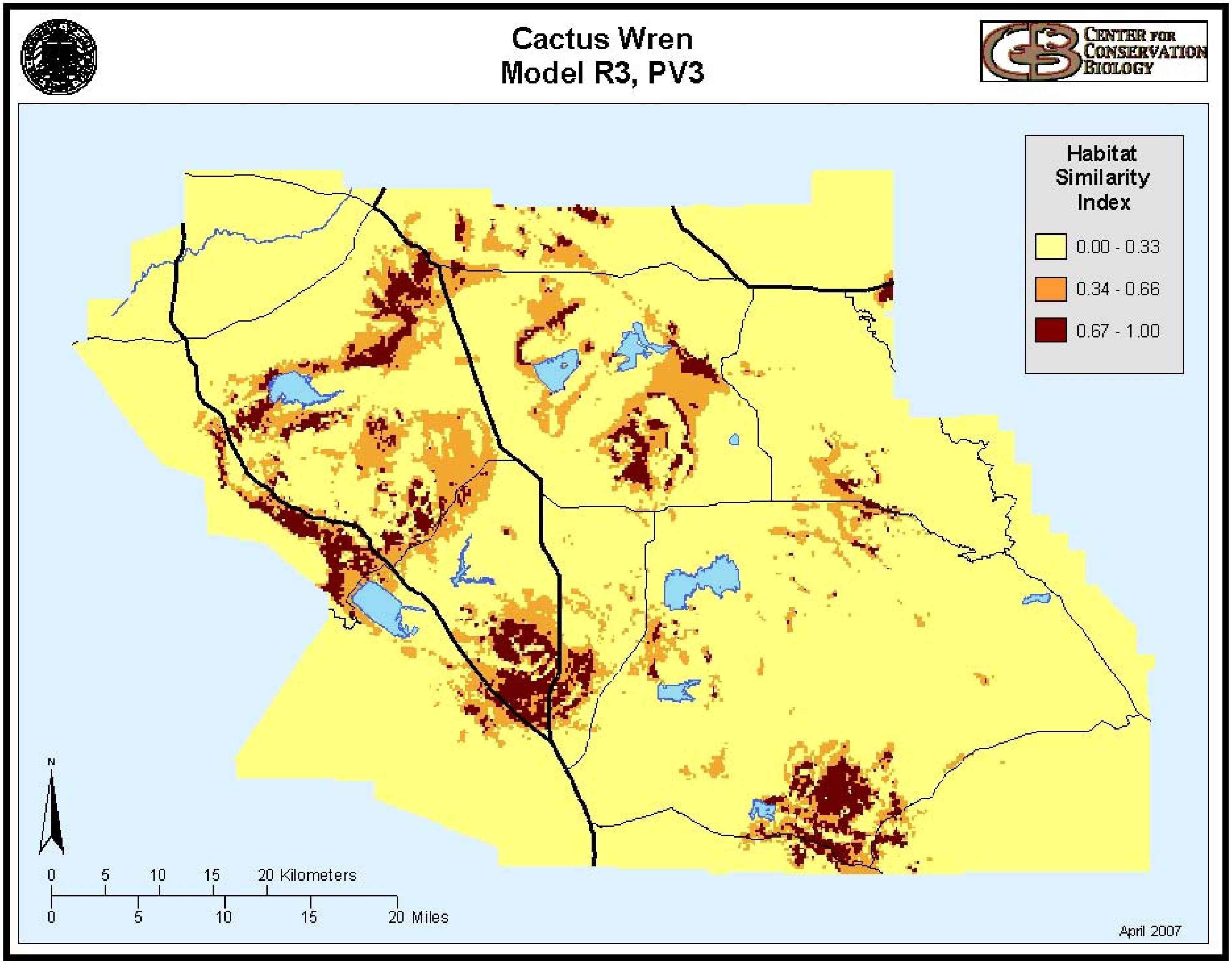


Figure 34. "HSI's" of habitat similarity for Cactus Wren across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

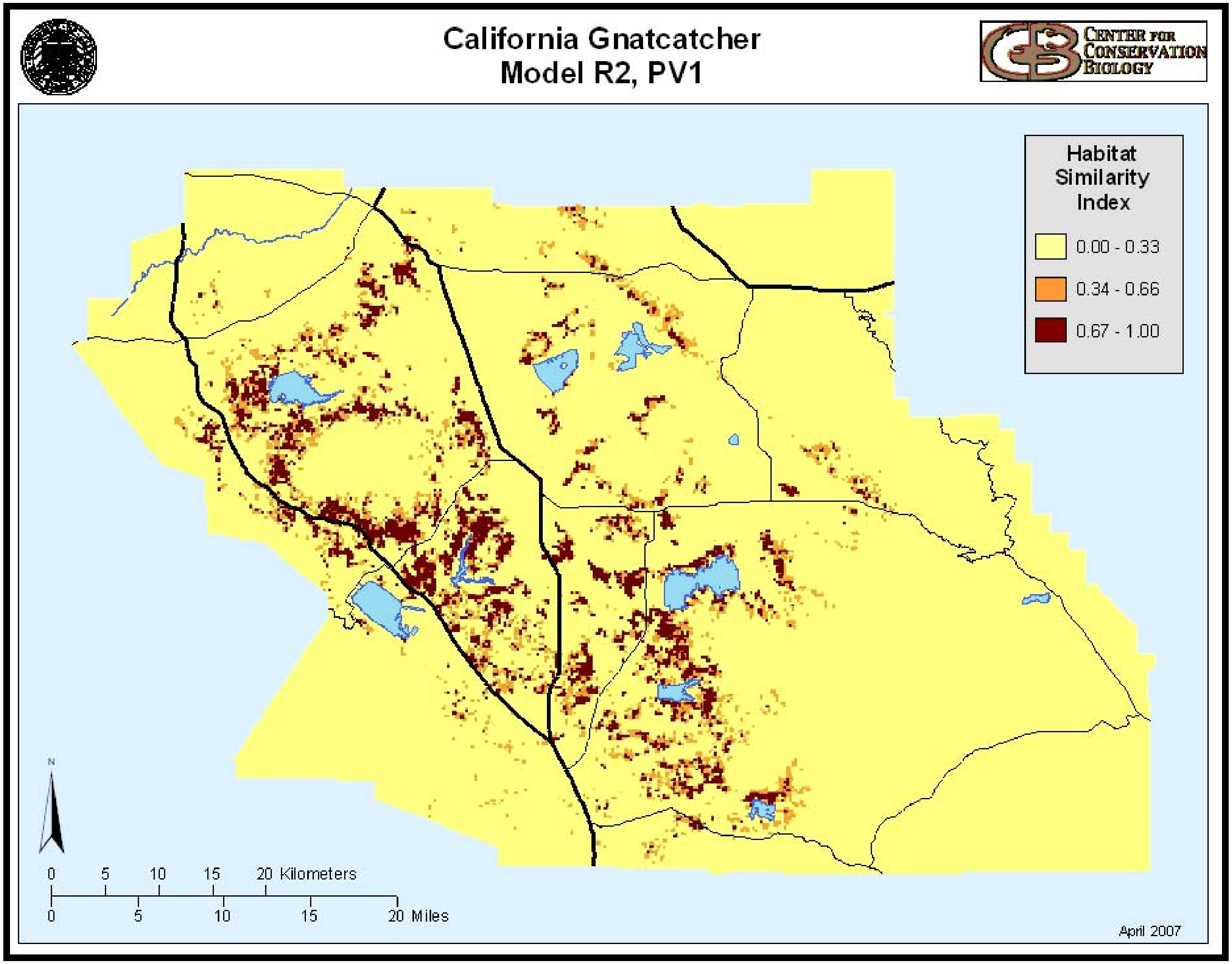


Figure 35. "HSI's" of habitat similarity for California Gnatcatcher across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

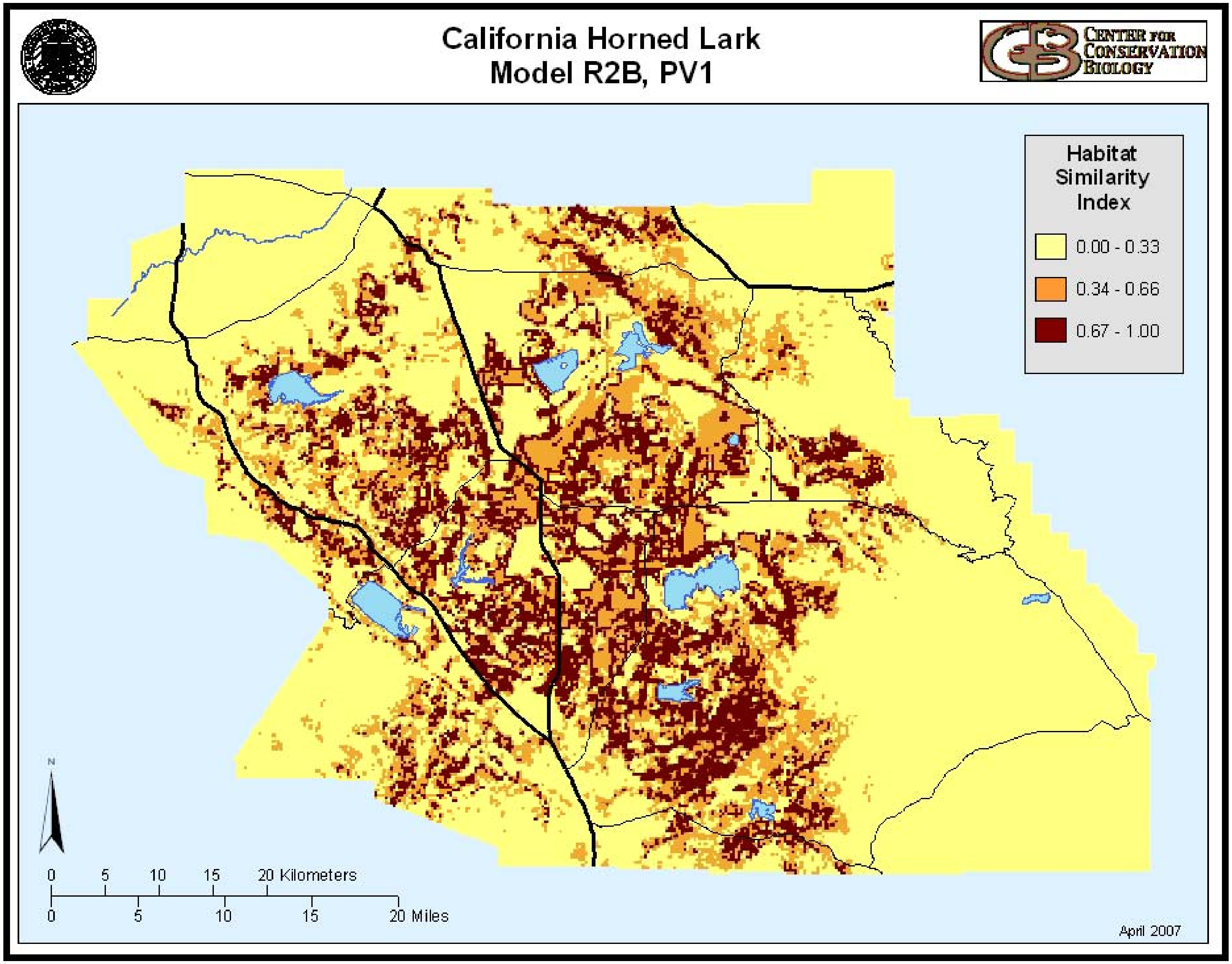


Figure 36. "HSI's" of habitat similarity for California Horned Lark across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

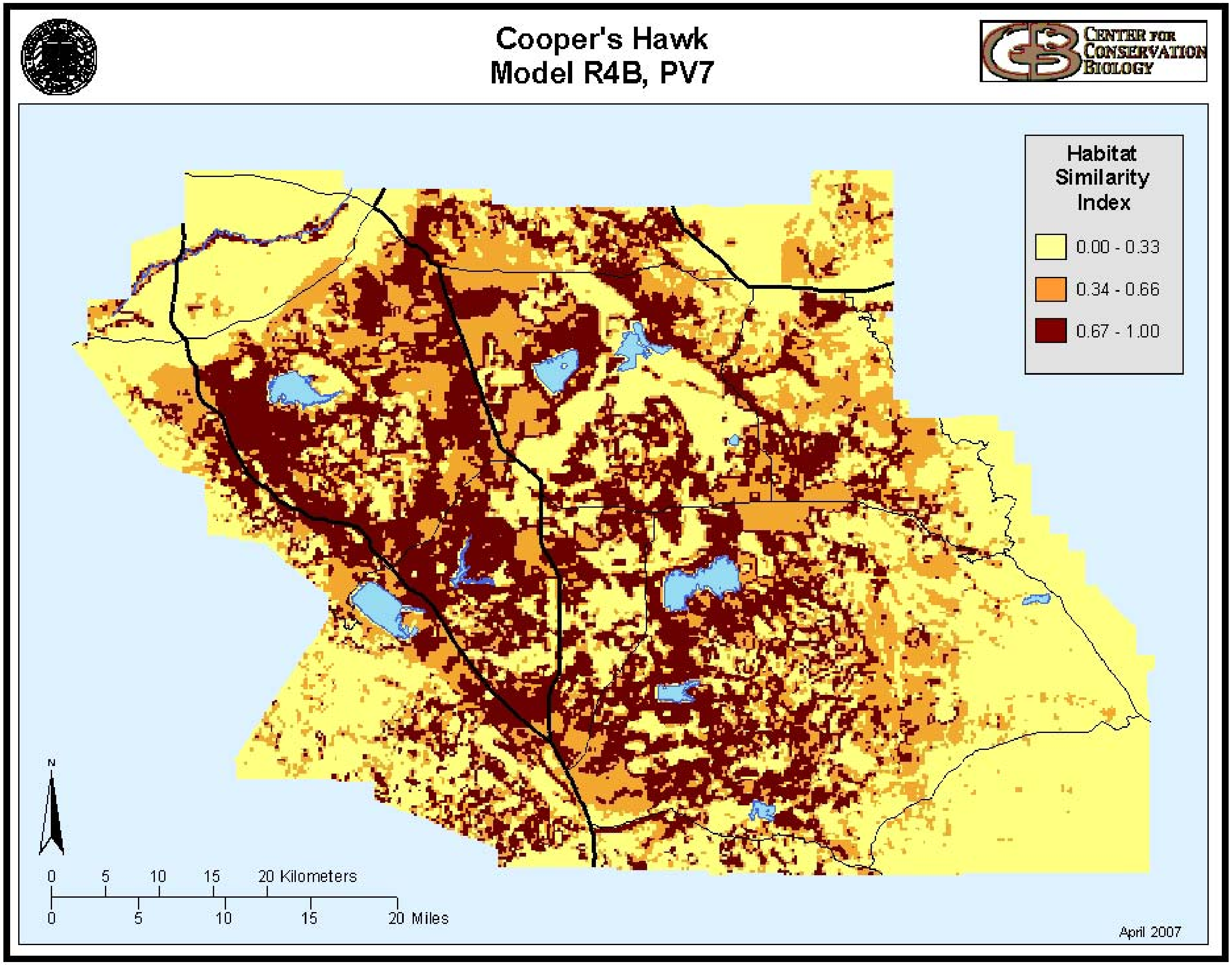


Figure 37. "HSI's" of habitat similarity for Cooper's Hawk across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

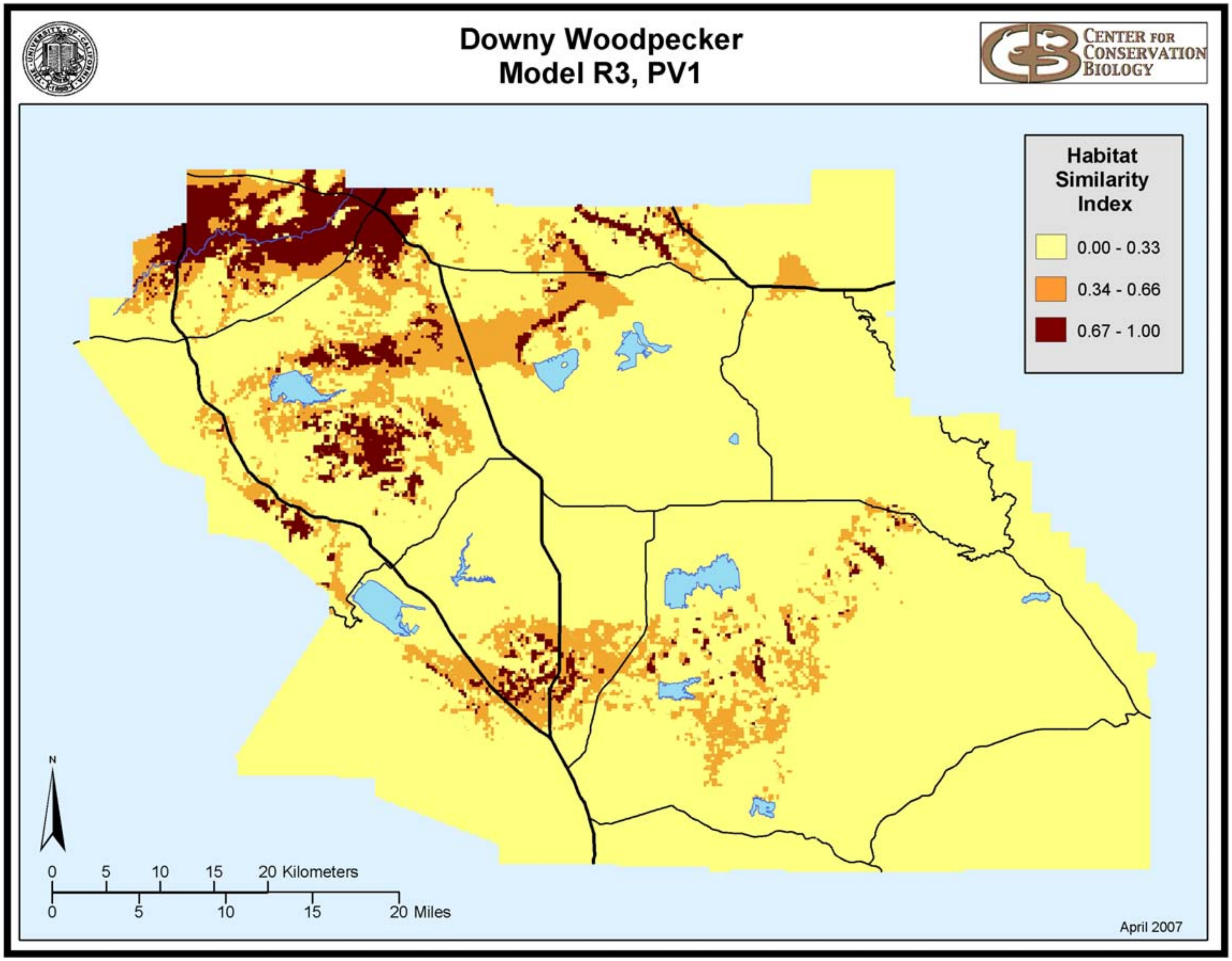


Figure 38. "HSI's" of habitat similarity for Downy Woodpecker across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

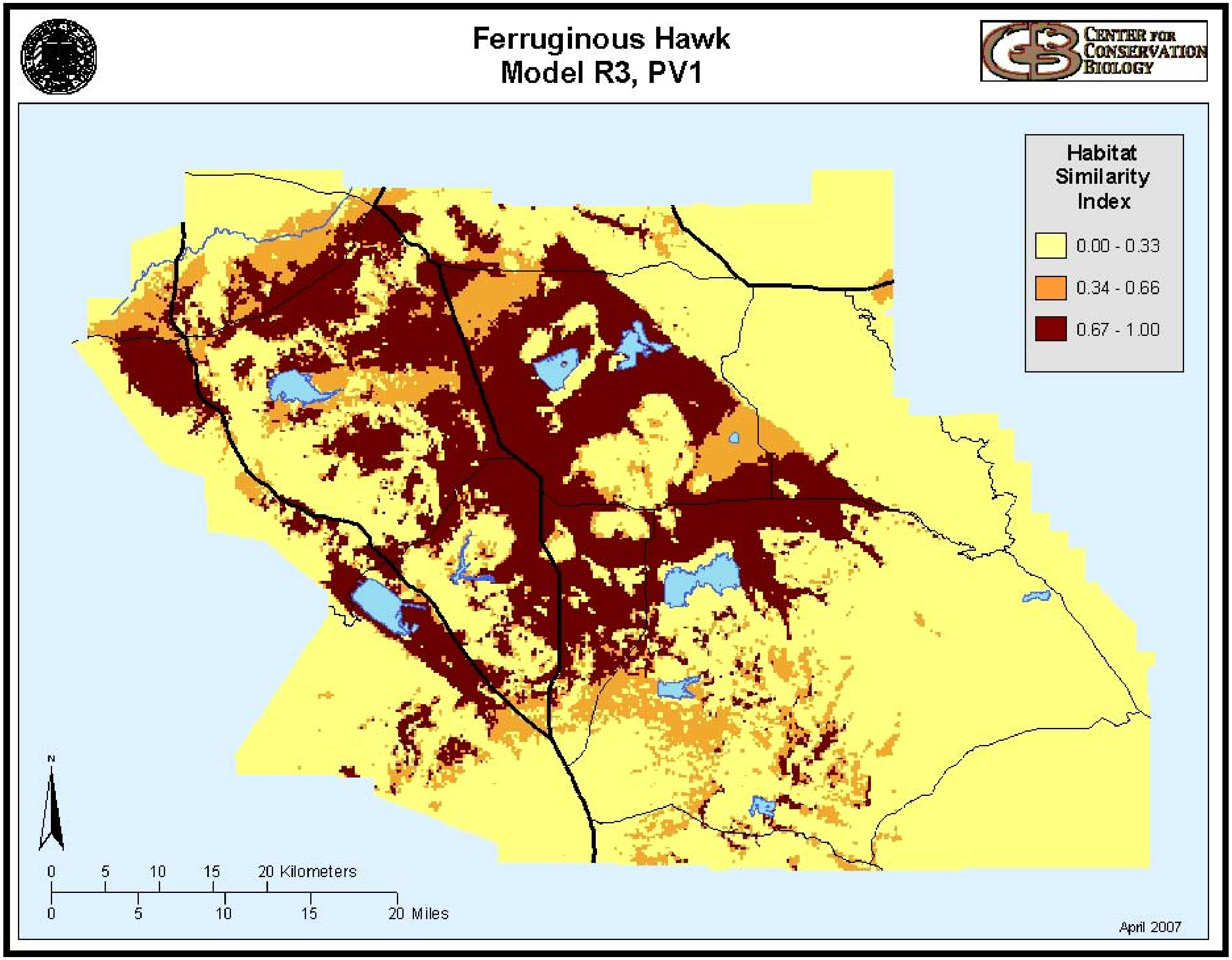


Figure 39. "HSI's" of habitat similarity for Ferruginous Hawk across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

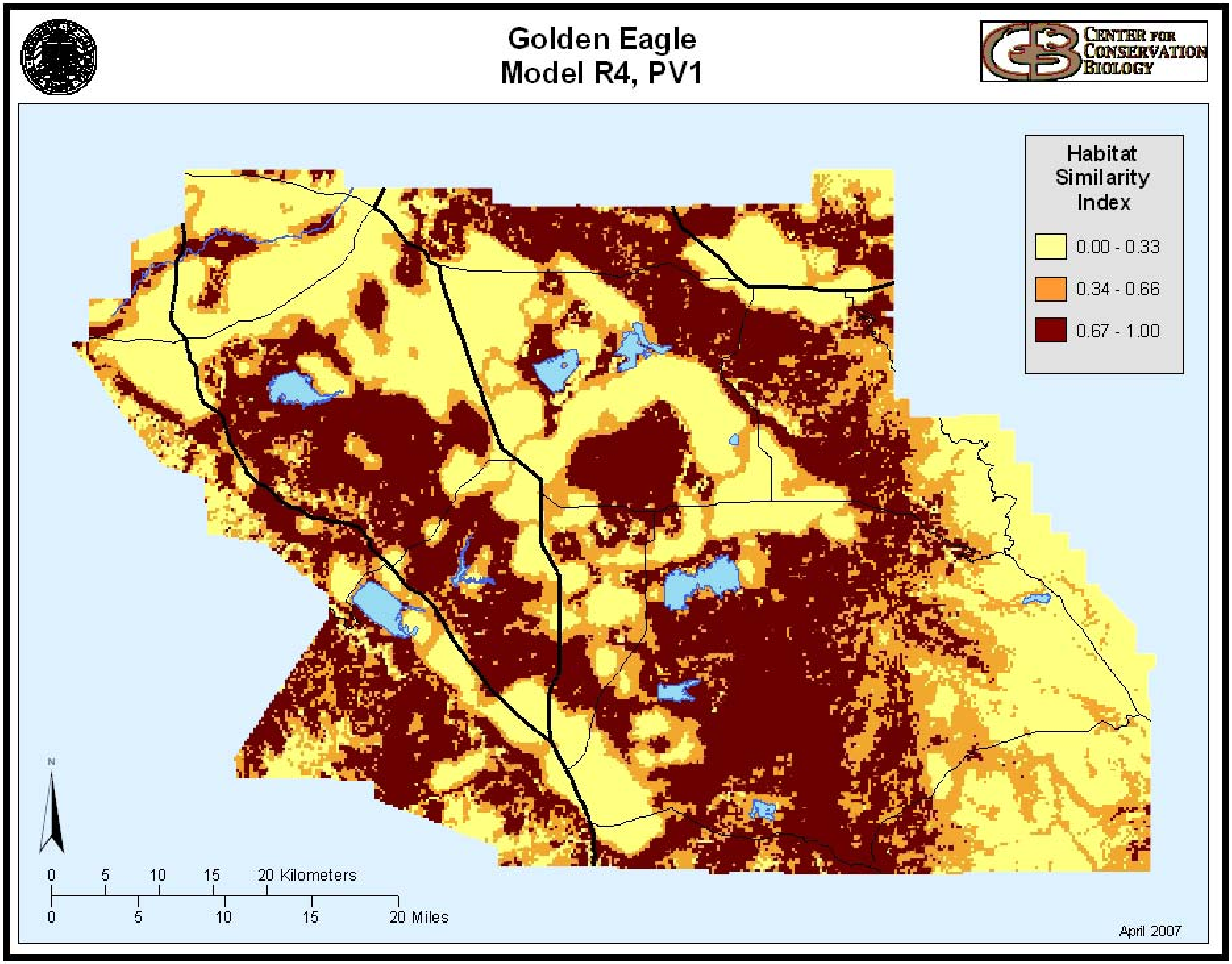


Figure 40. "HSI's" of habitat similarity for Golden Eagle across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

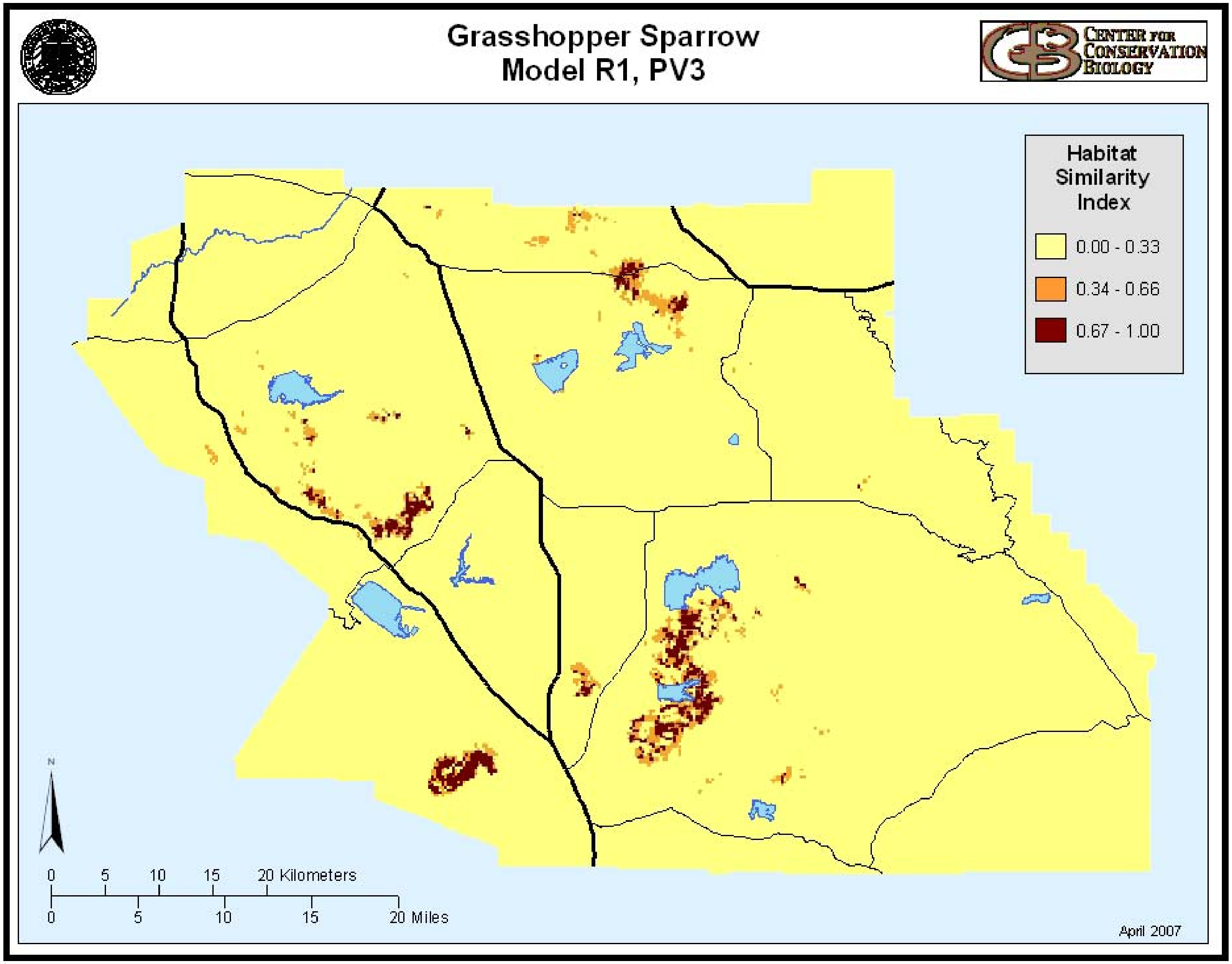


Figure 41. "HSI's" of habitat similarity for Grasshopper Sparrow across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

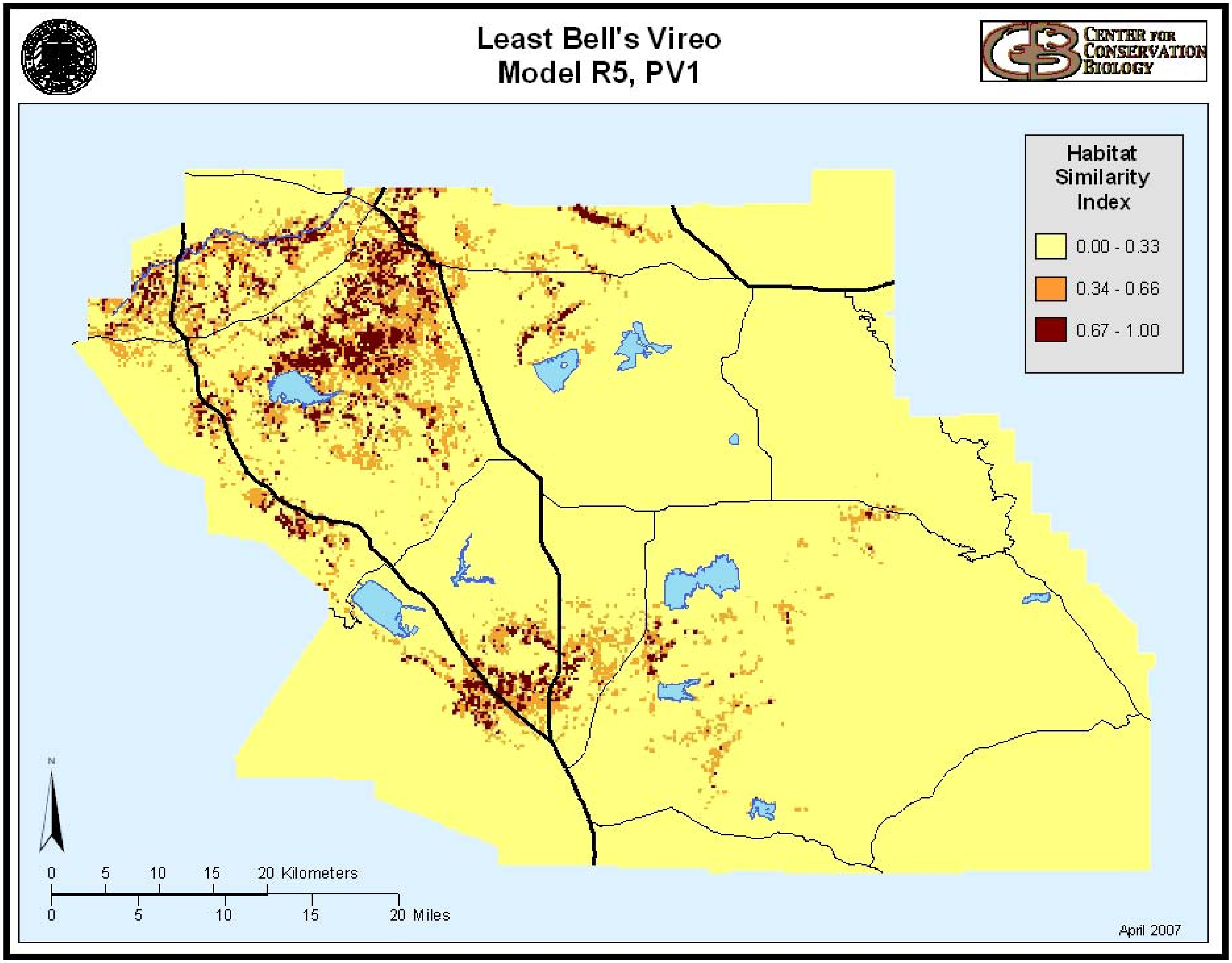


Figure 42. "HSI's" of habitat similarity for Least Bell's Vireo across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

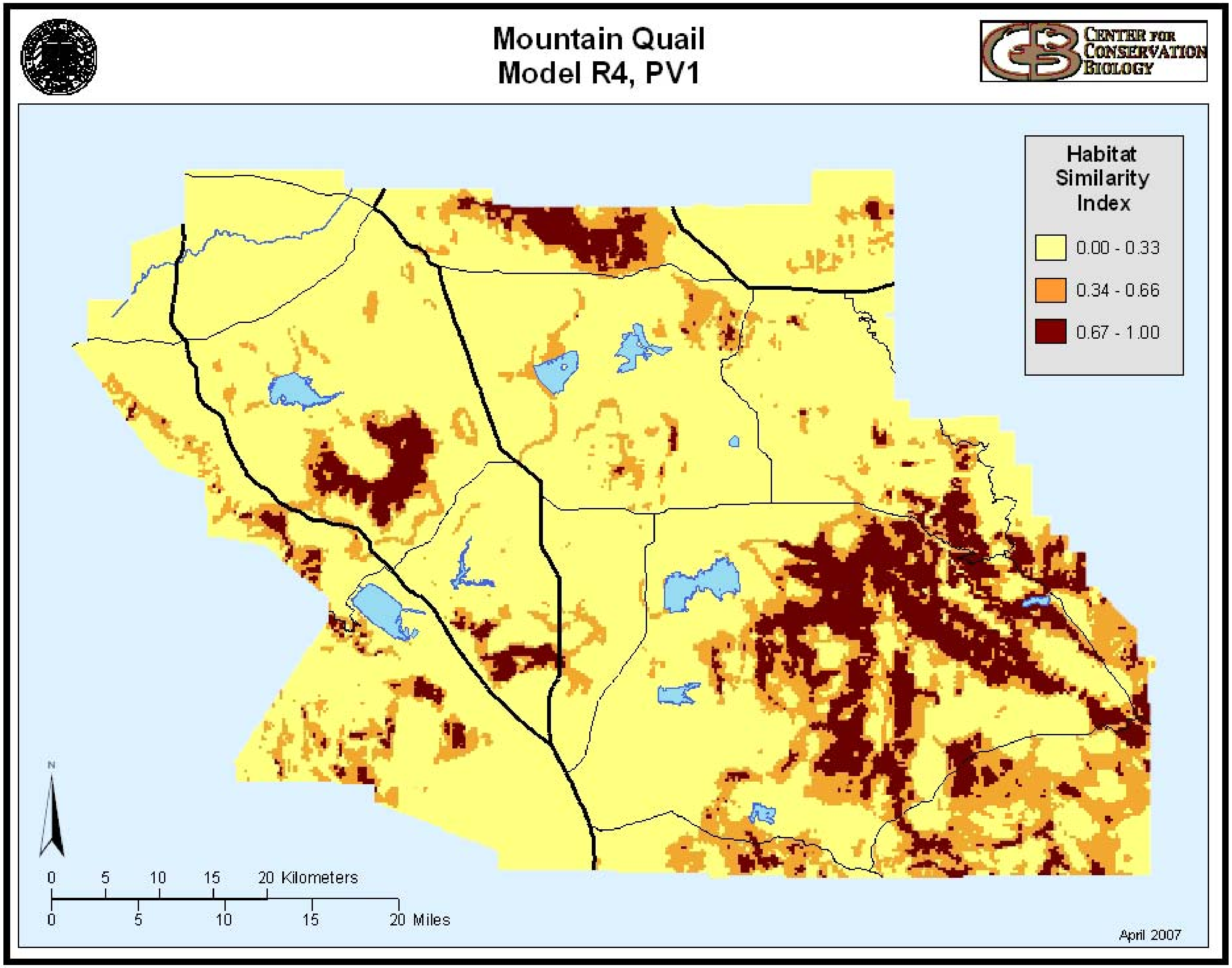


Figure 43. "HSI's" of habitat similarity for Mountain Quail across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

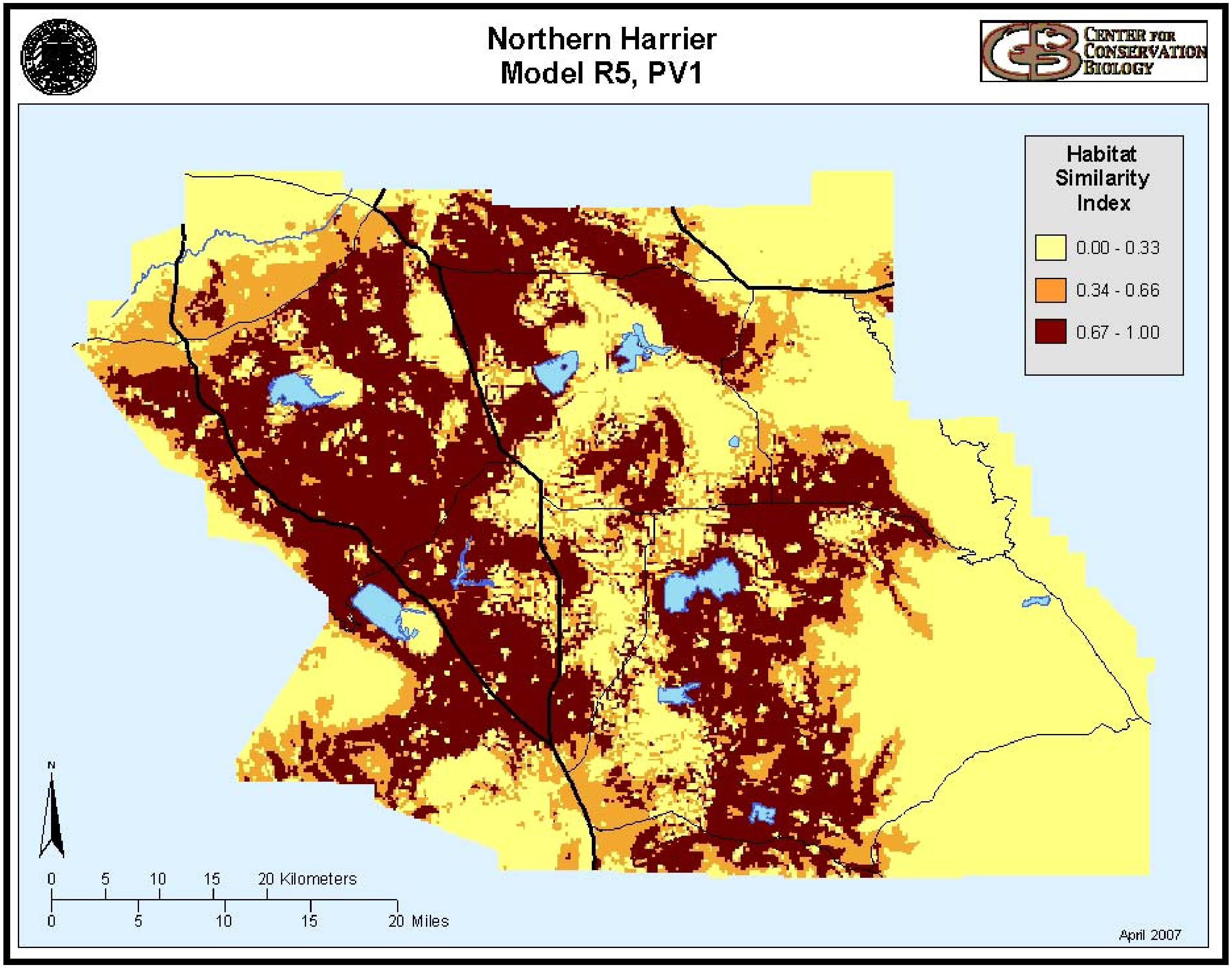


Figure 44. "HSI's" of habitat similarity for Northern Harrier across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

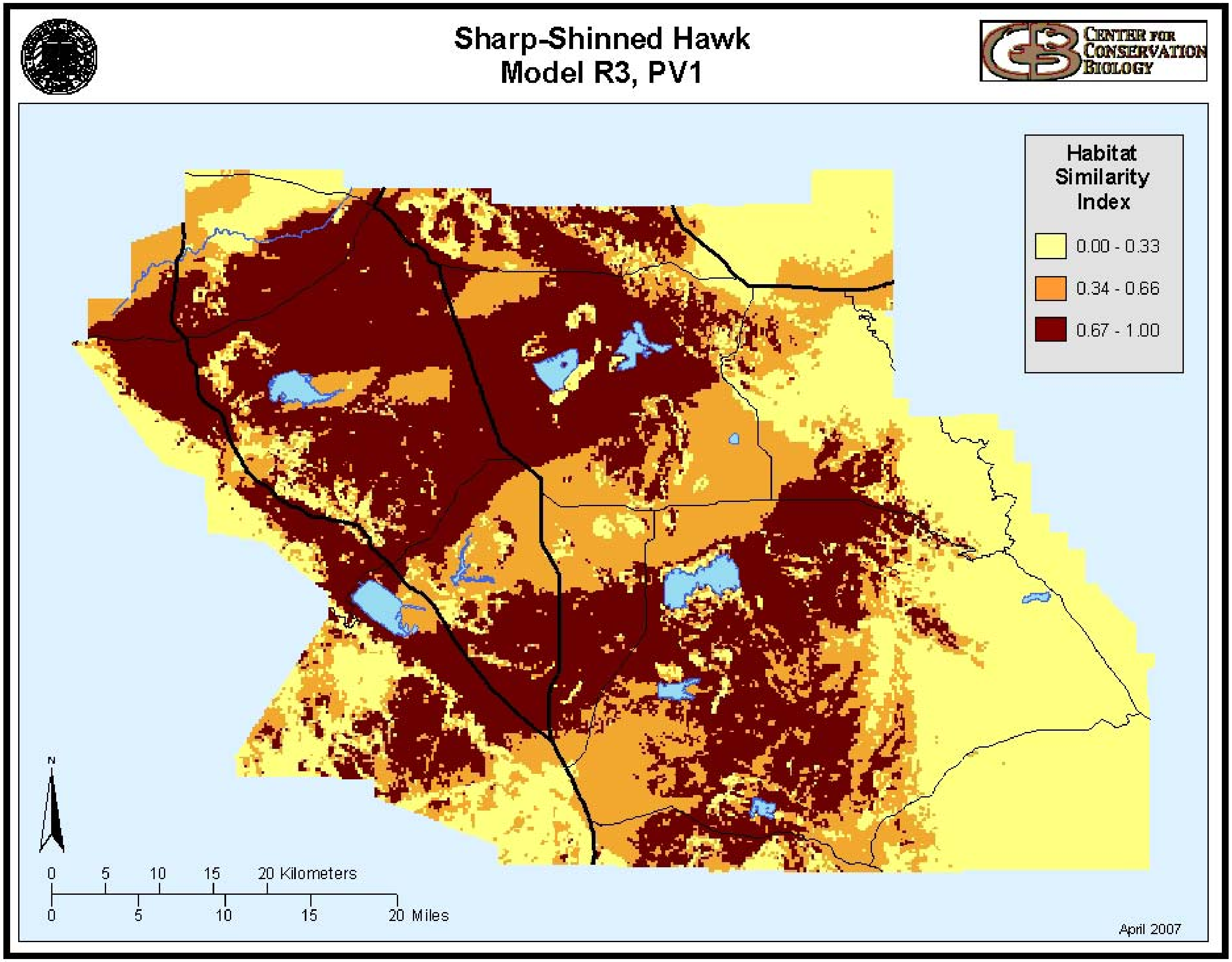


Figure 45. "HSI's" of habitat similarity for Sharp-shinned Hawk across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

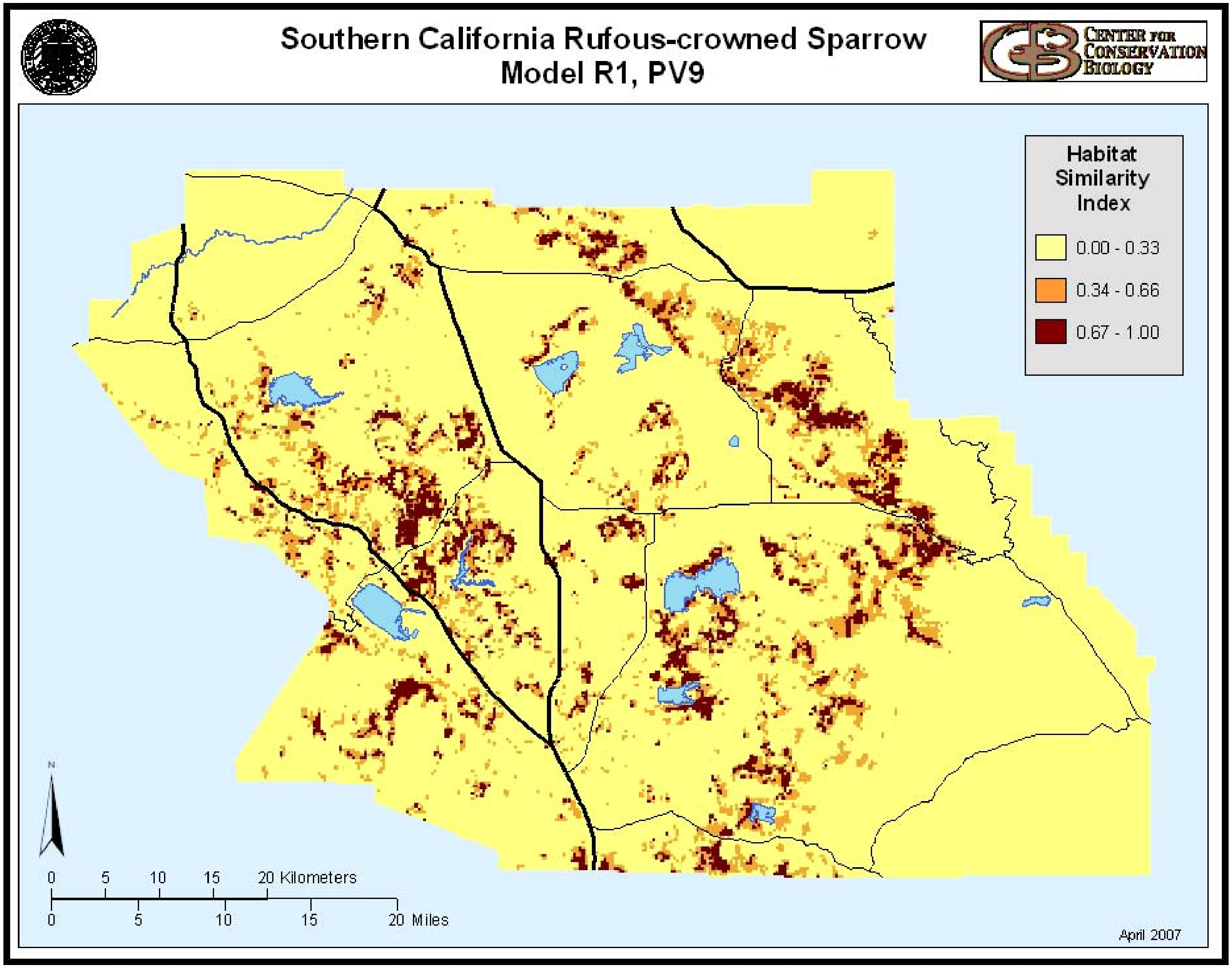


Figure 46. "HSI's" of habitat similarity for Southern California Rufous-crowned Sparrow across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

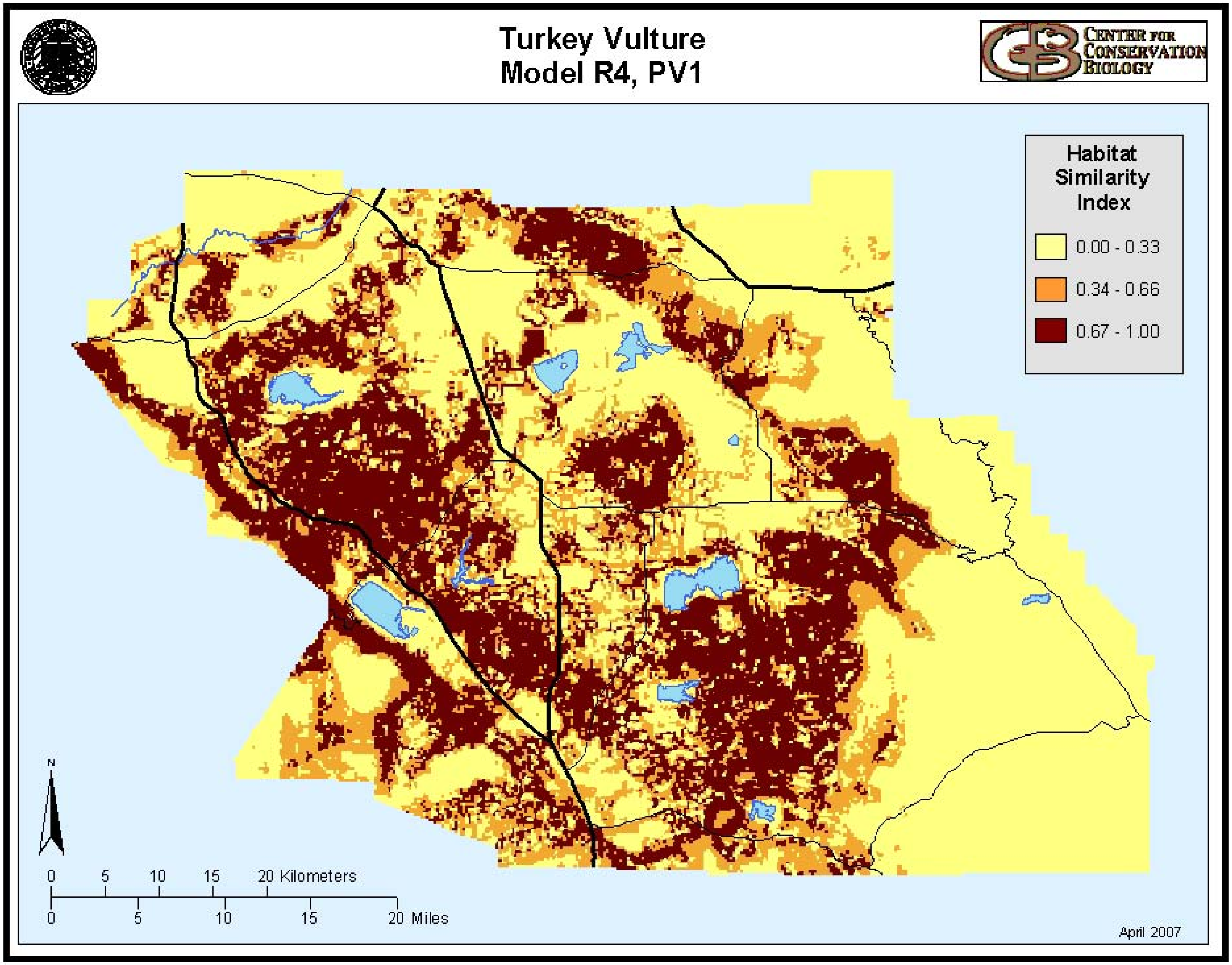


Figure 47. "HSI's" of habitat similarity for Turkey Vulture across the WRC MSHCP.
The higher the HSI, the greater the similarity to occupied habitat.

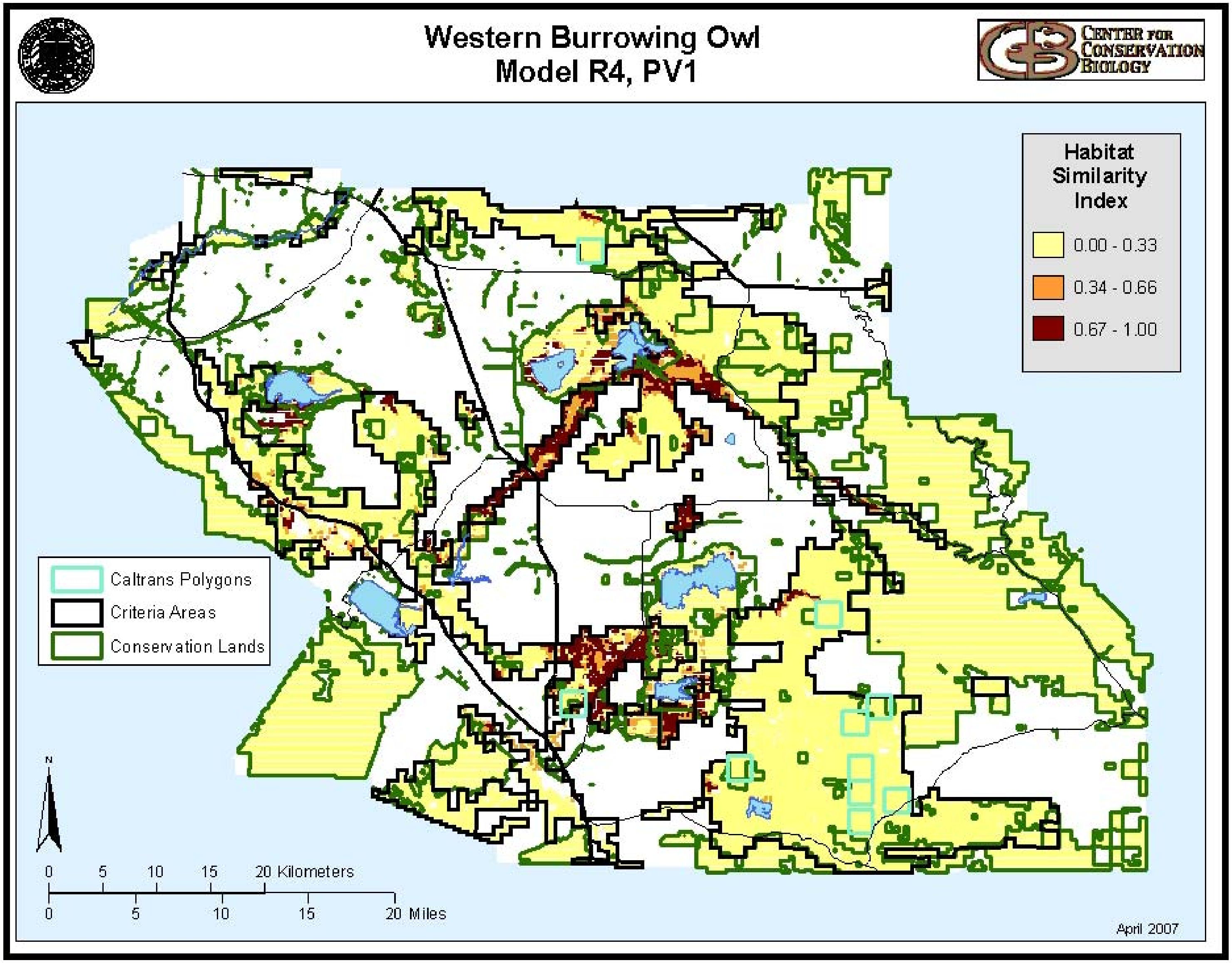


Figure 48. "HSI's" of habitat similarity for Western Burrowing Owl across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

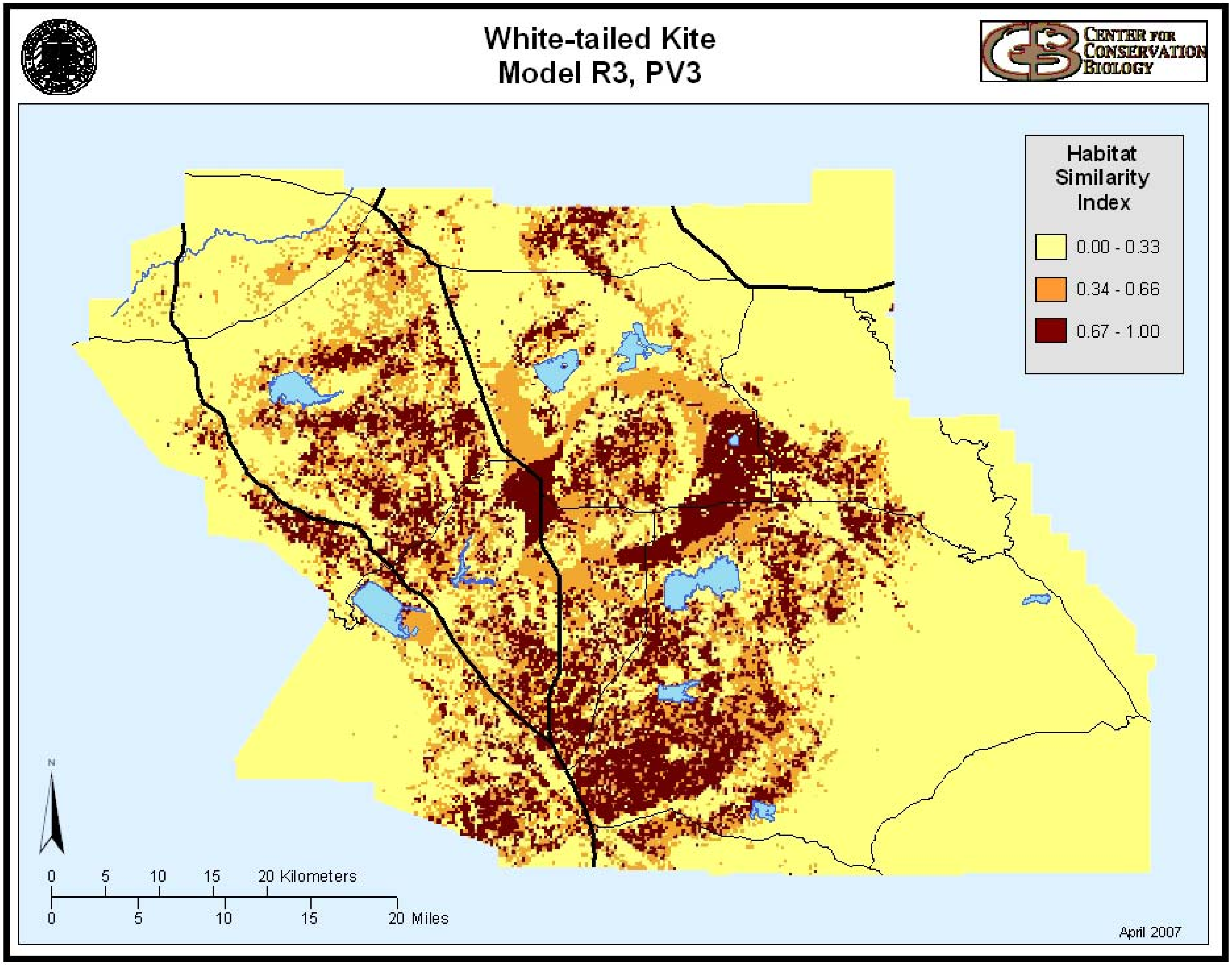


Figure 49. "HSI's" of habitat similarity for White-tailed Kite across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

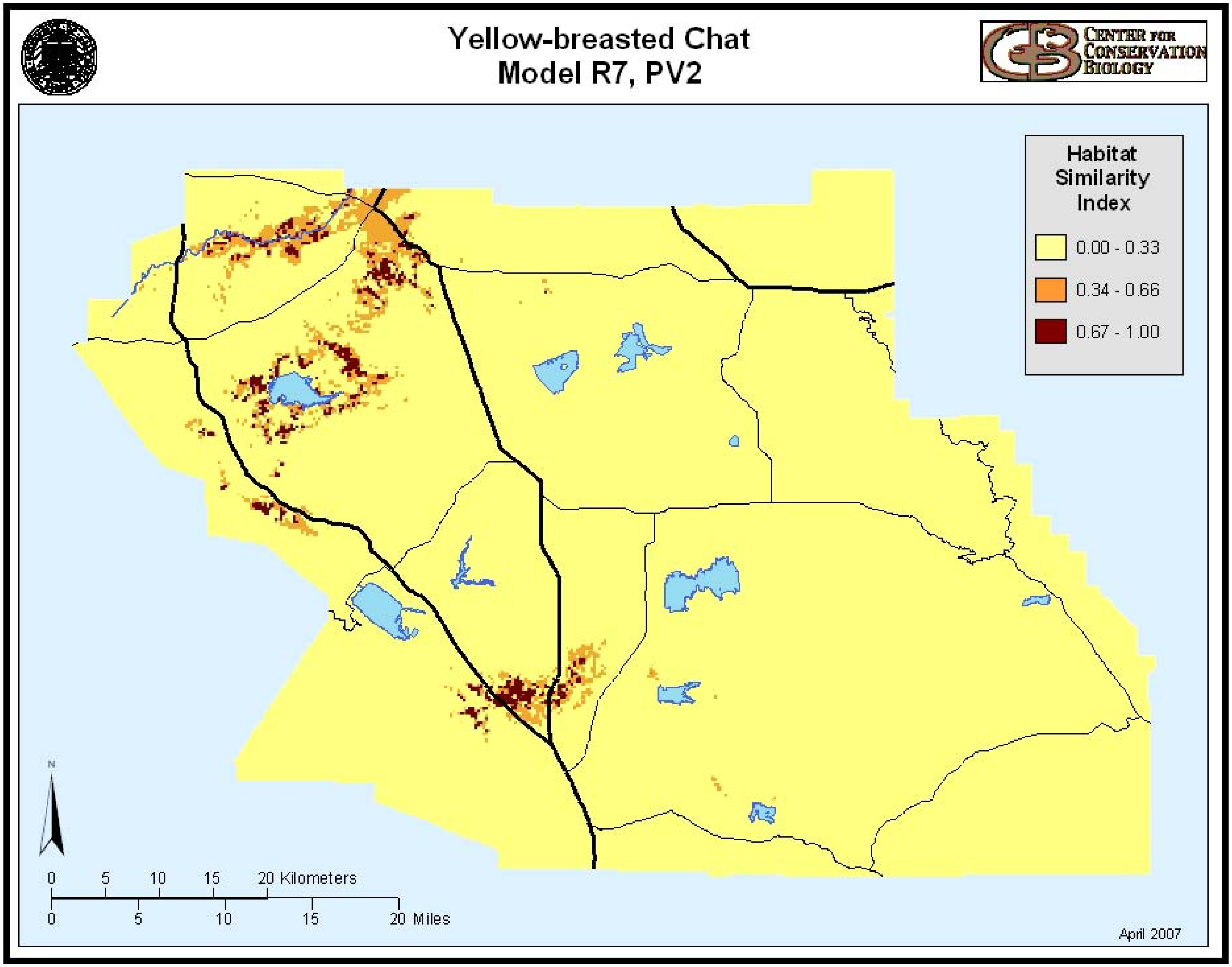


Figure 50. "HSI's" of habitat similarity for Yellow-breasted Chat across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

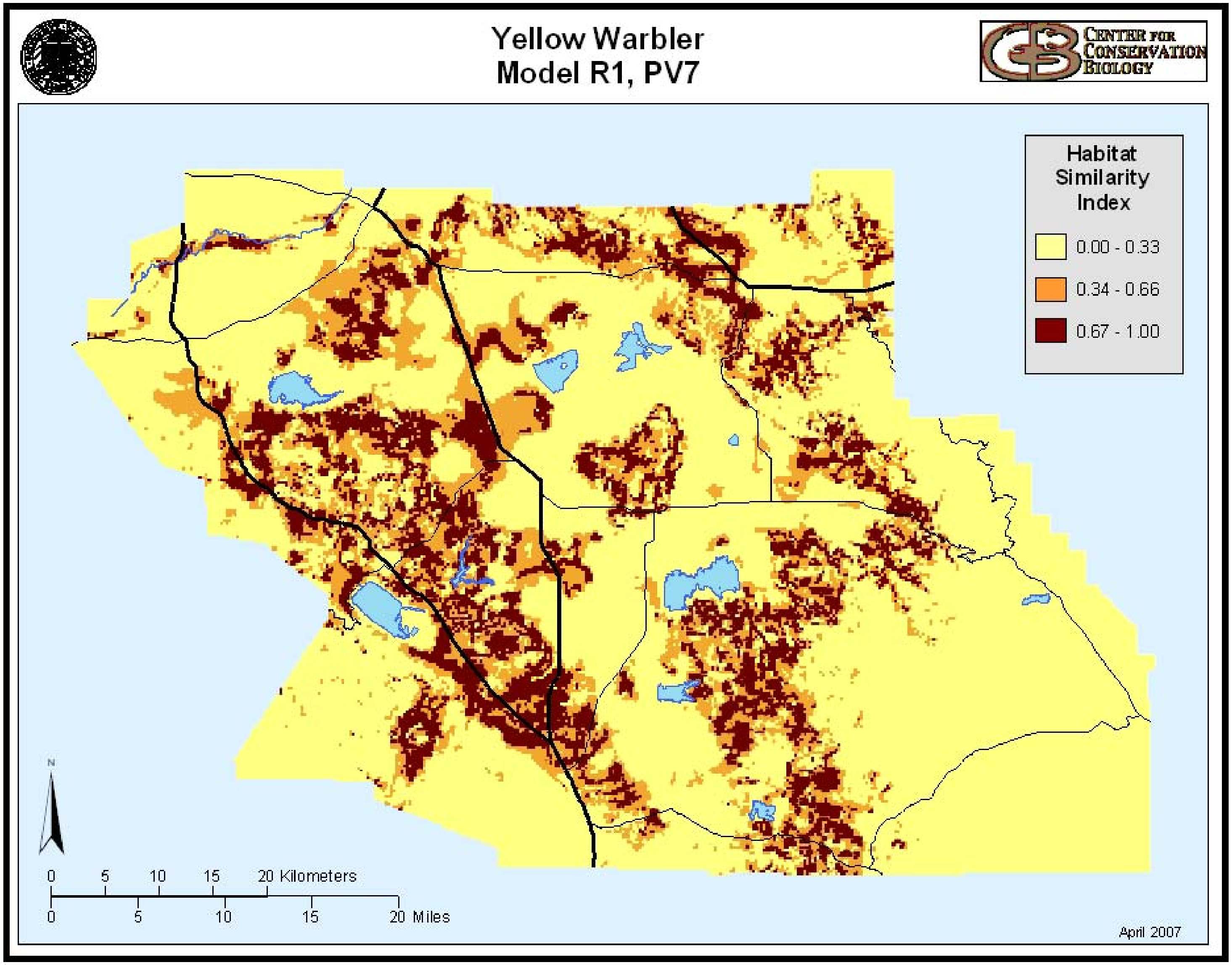


Figure 51. "HSI's" of habitat similarity for Yellow Warbler across the WRC MSHCP.
The higher the HSI, the greater the similarity to occupied habitat.

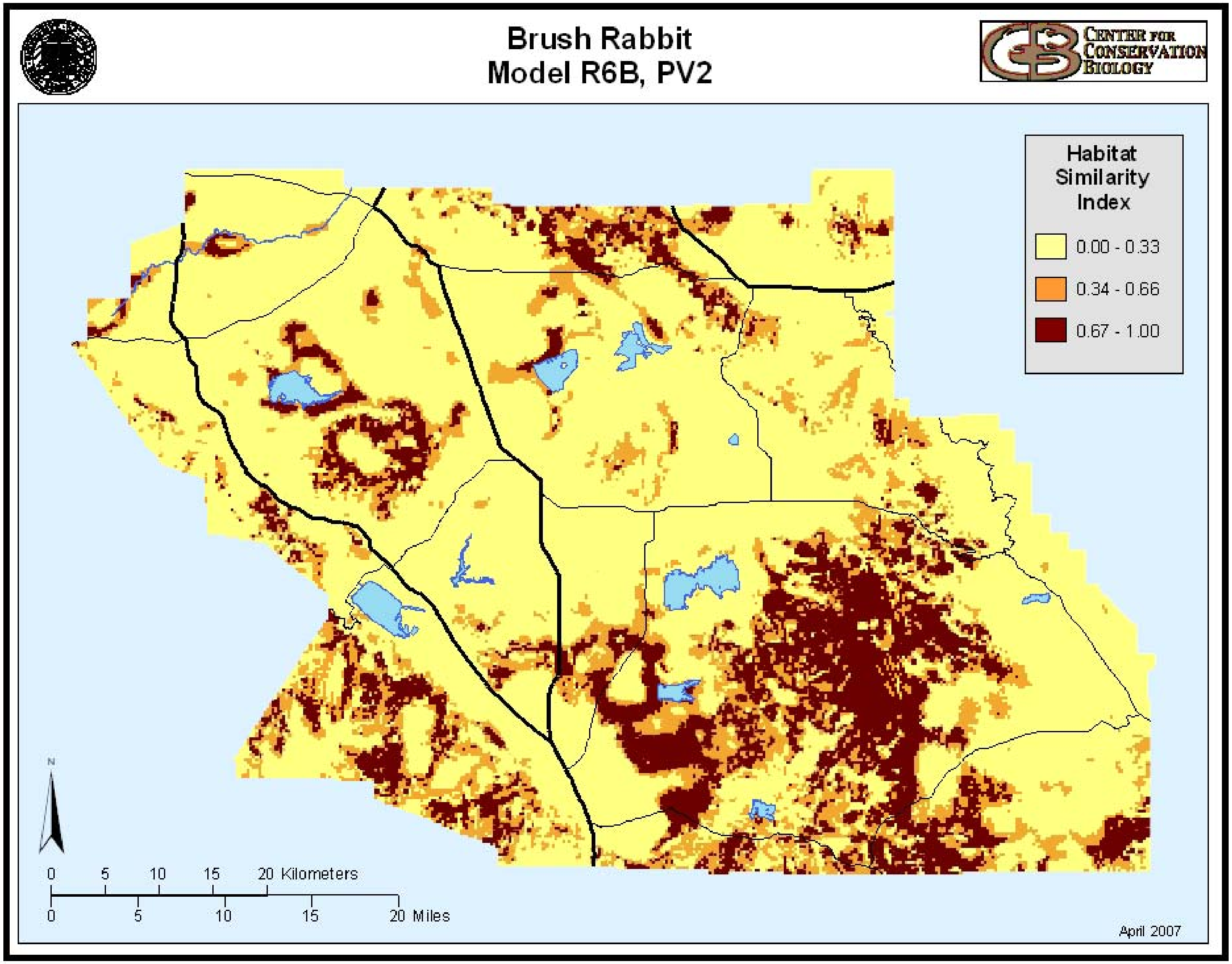


Figure 52. "HSI's" of habitat similarity for brush rabbit across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

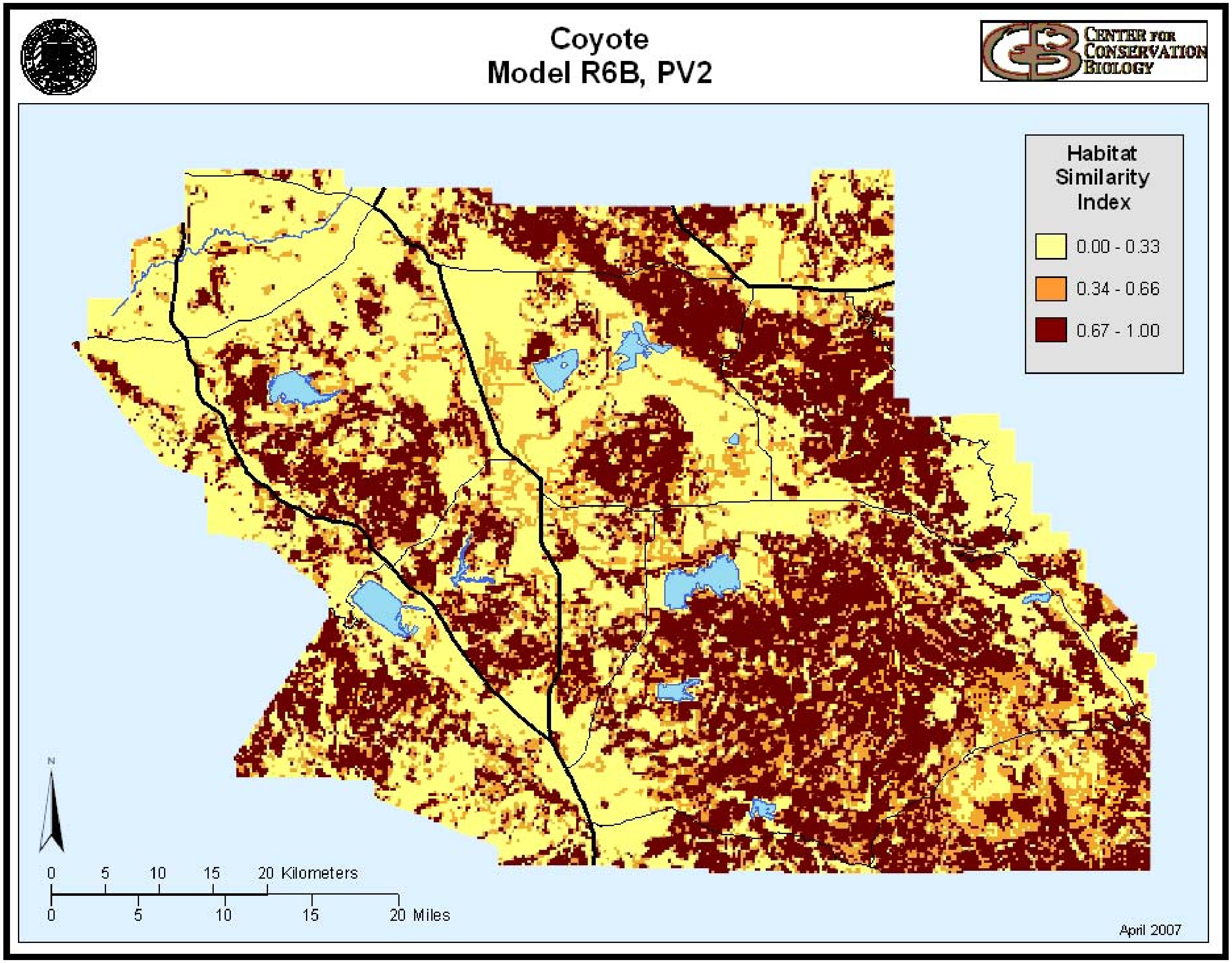


Figure 53. "HSI's" of habitat similarity for coyote across the WRC MSHCP.
The higher the HSI, the greater the similarity to occupied habitat.

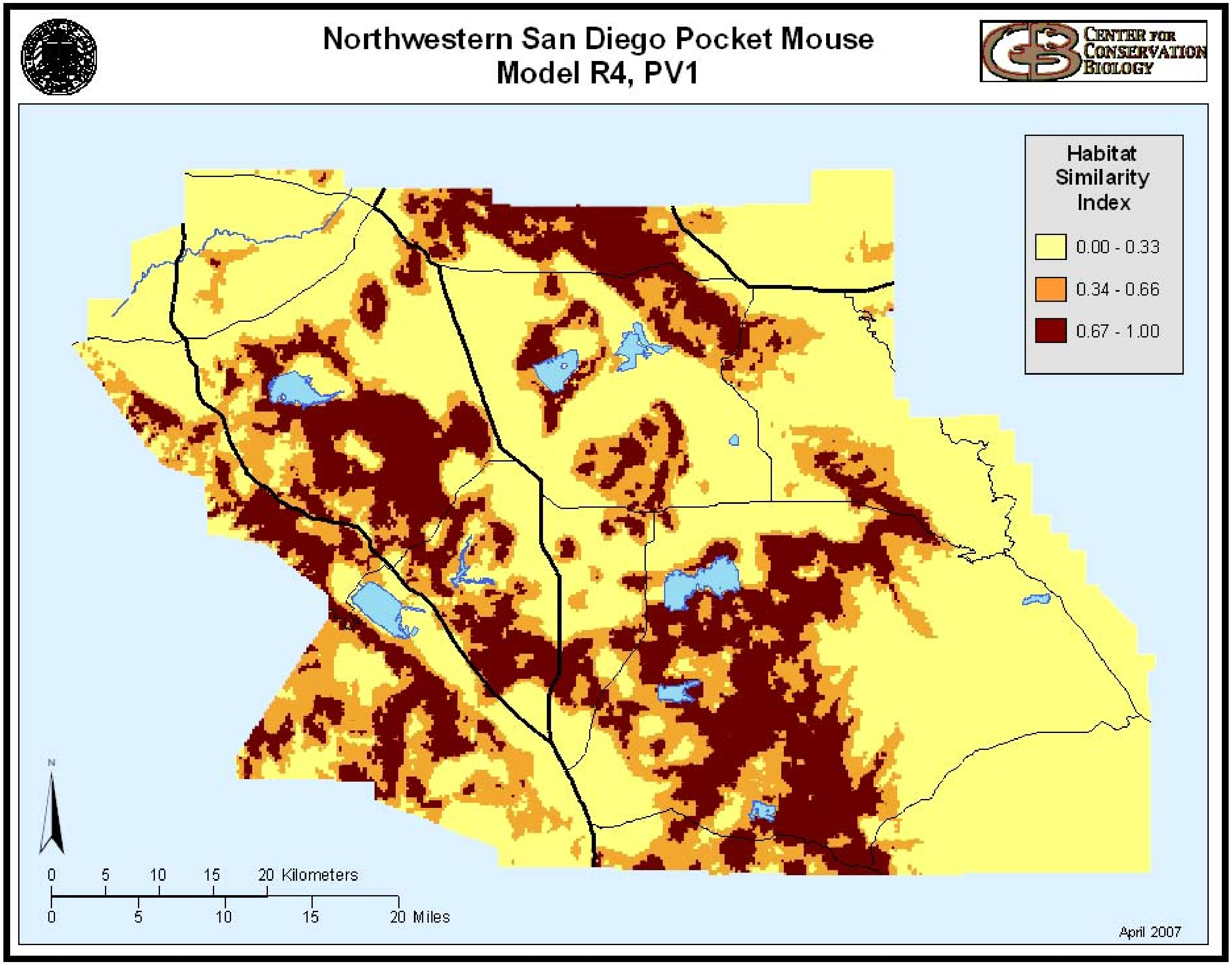


Figure 54. "HSI's" of habitat similarity for northwestern San Diego pocket mouse across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

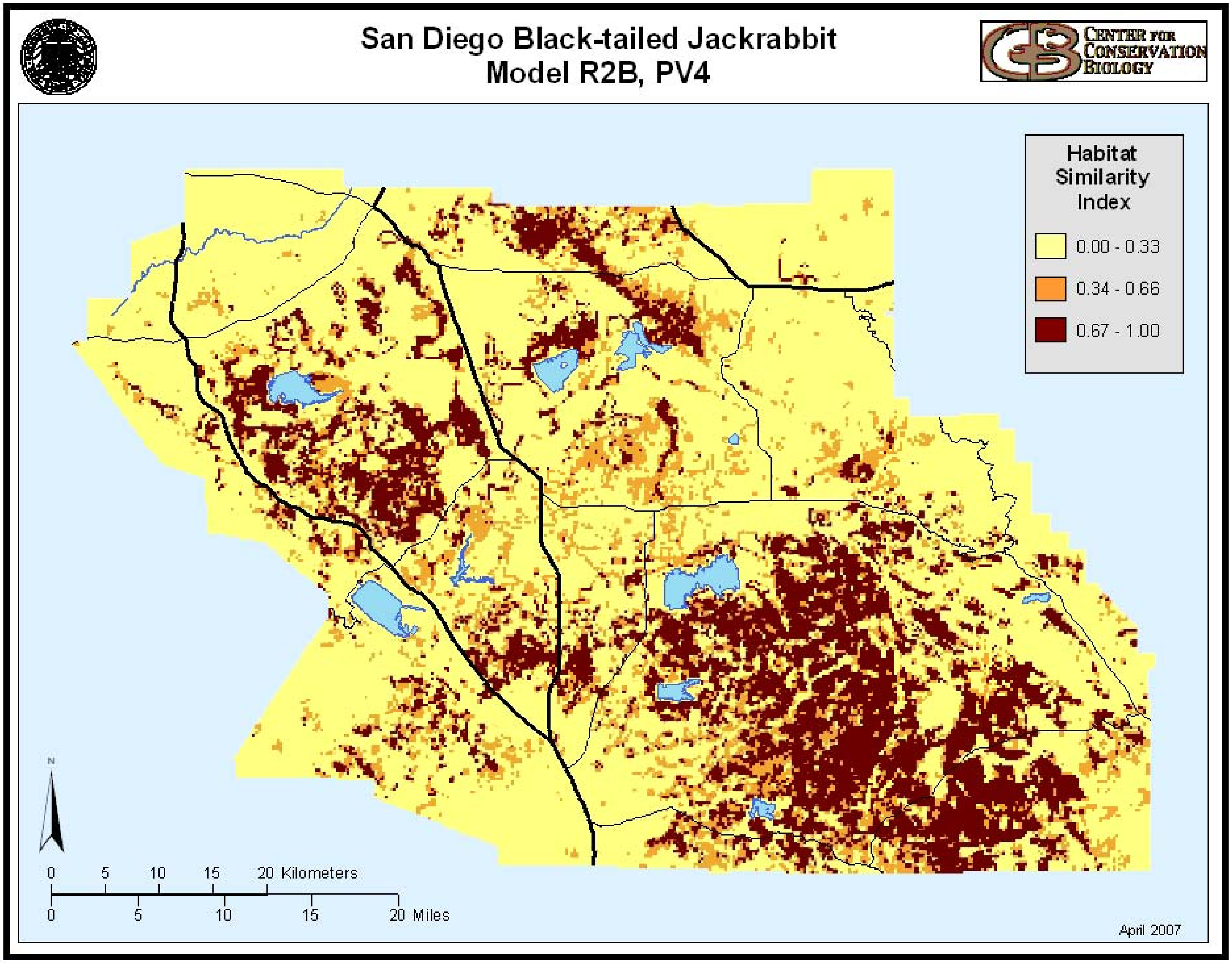


Figure 55. "HSI's" of habitat similarity for San Diego black-tailed jackrabbit across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

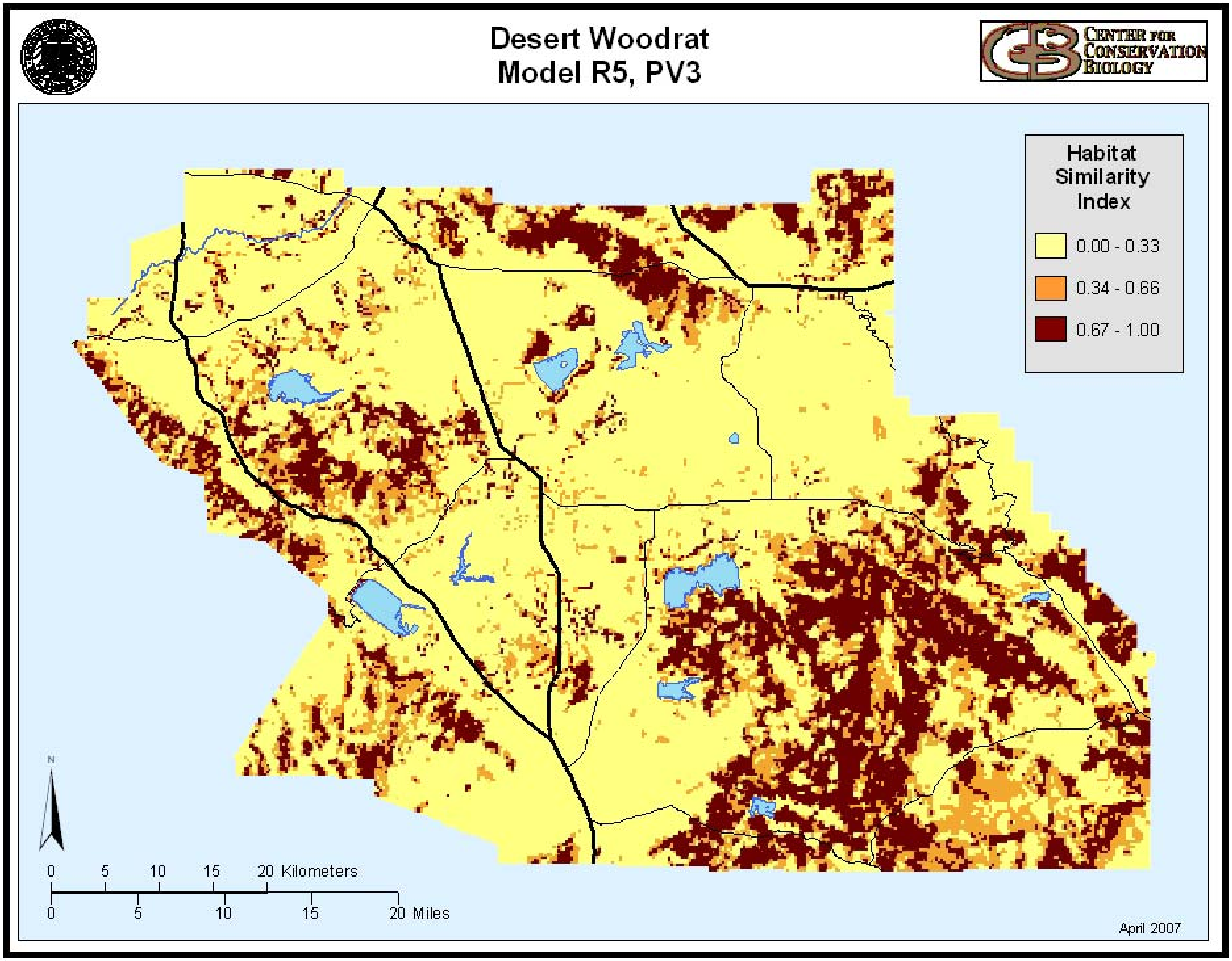


Figure 56. "HSI's" of habitat similarity for San Diego desert woodrat across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

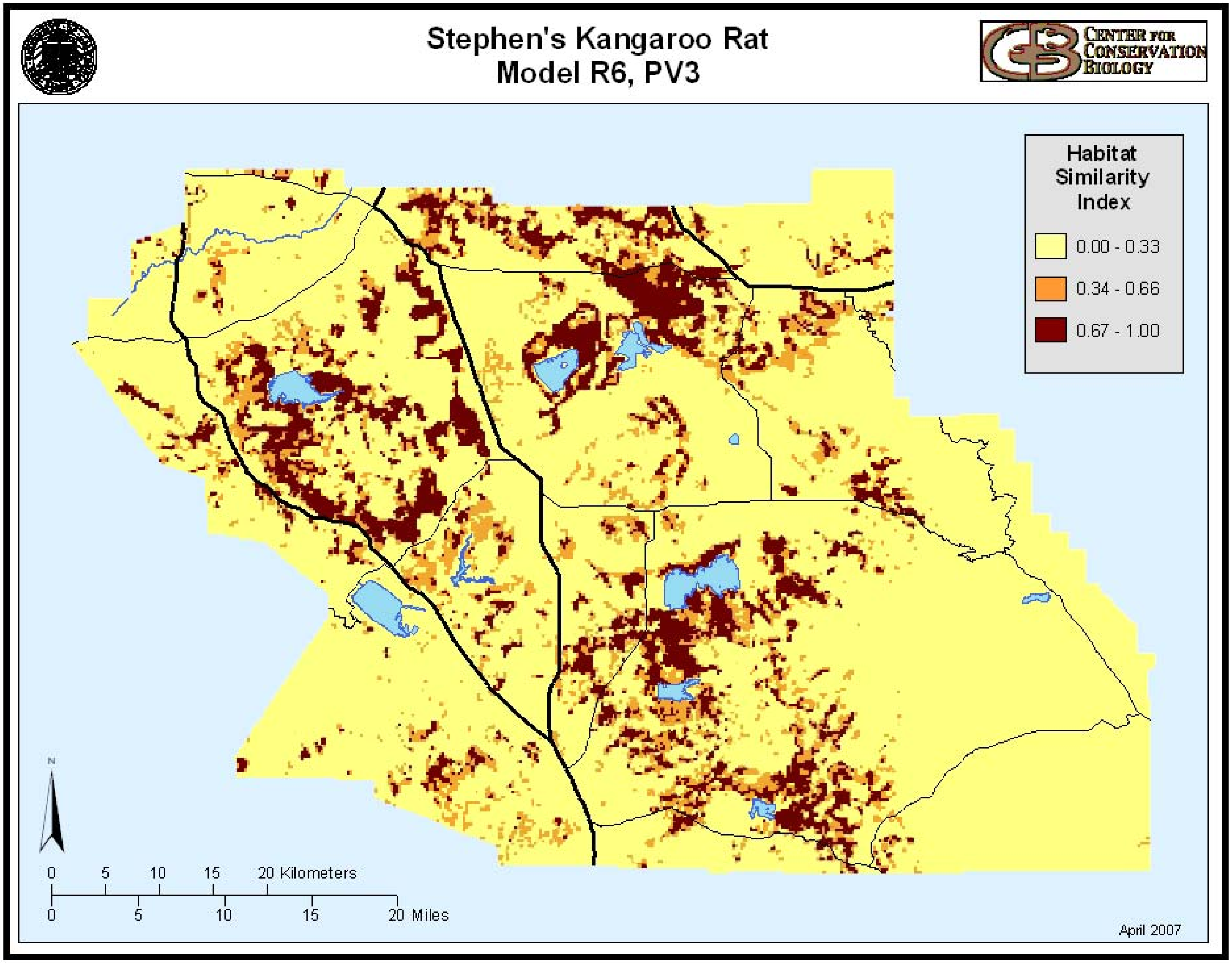


Figure 57. "HSI's" of habitat similarity for Stephens' kangaroo rat across the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

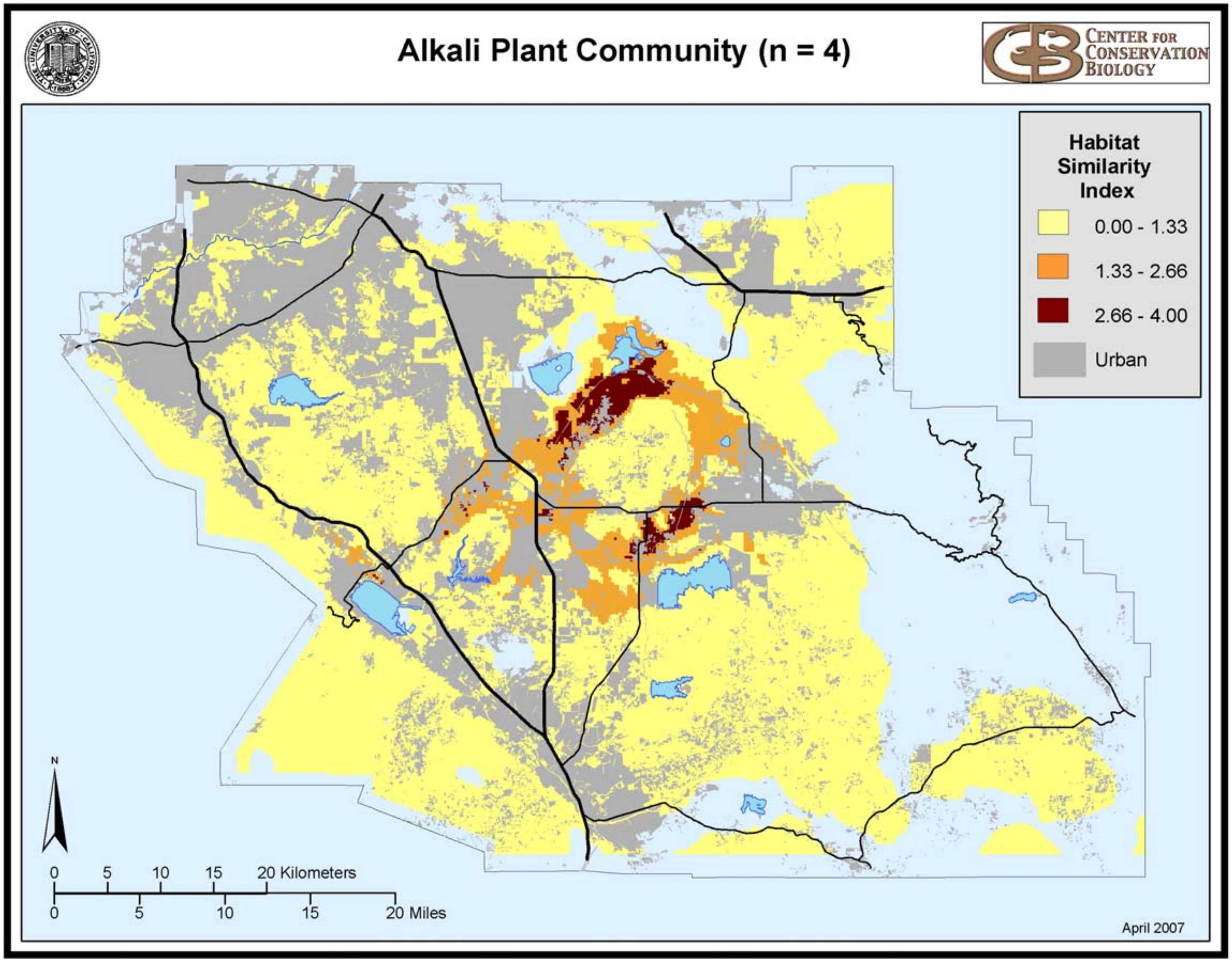


Figure 58. Cumulative habitat similarity index (HSI) values for four WRC MSHCP alkali plant species across undeveloped areas of the Plan. The higher the cumulative HSI, the greater the predicted habitat suitability for multiple plant species at that location.

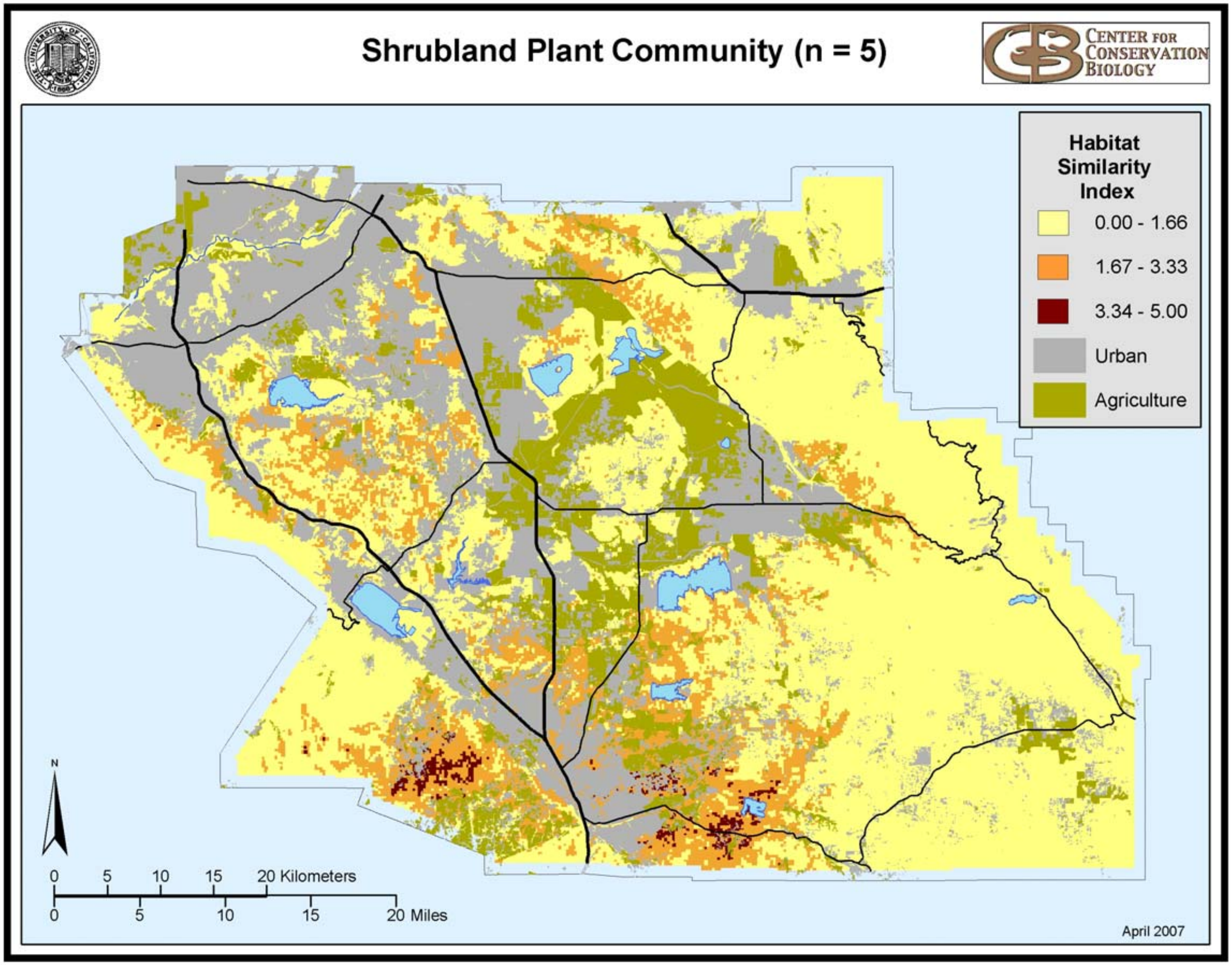


Figure 59. Cumulative habitat similarity index (HSI) values for five WRC MSHCP shrubland plant species across the Plan Area. The higher the cumulative HSI, the greater the predicted habitat suitability for multiple plant species at that location.

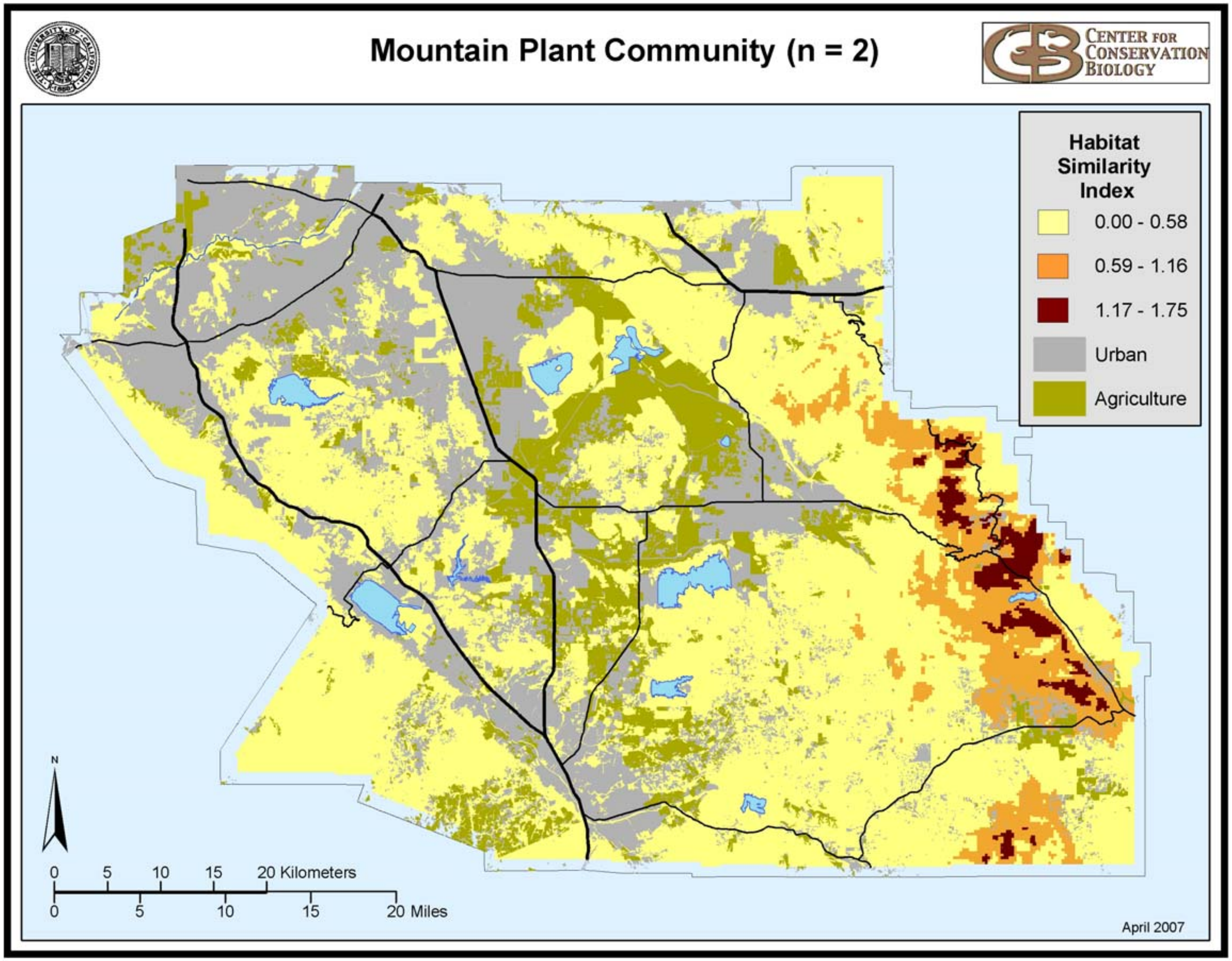


Figure 60. Cumulative habitat similarity index (HSI) values for two WRC MSHCP mountain plant species across the Plan Area. The higher the cumulative HSI, the greater the predicted habitat suitability for both plant species at that location.

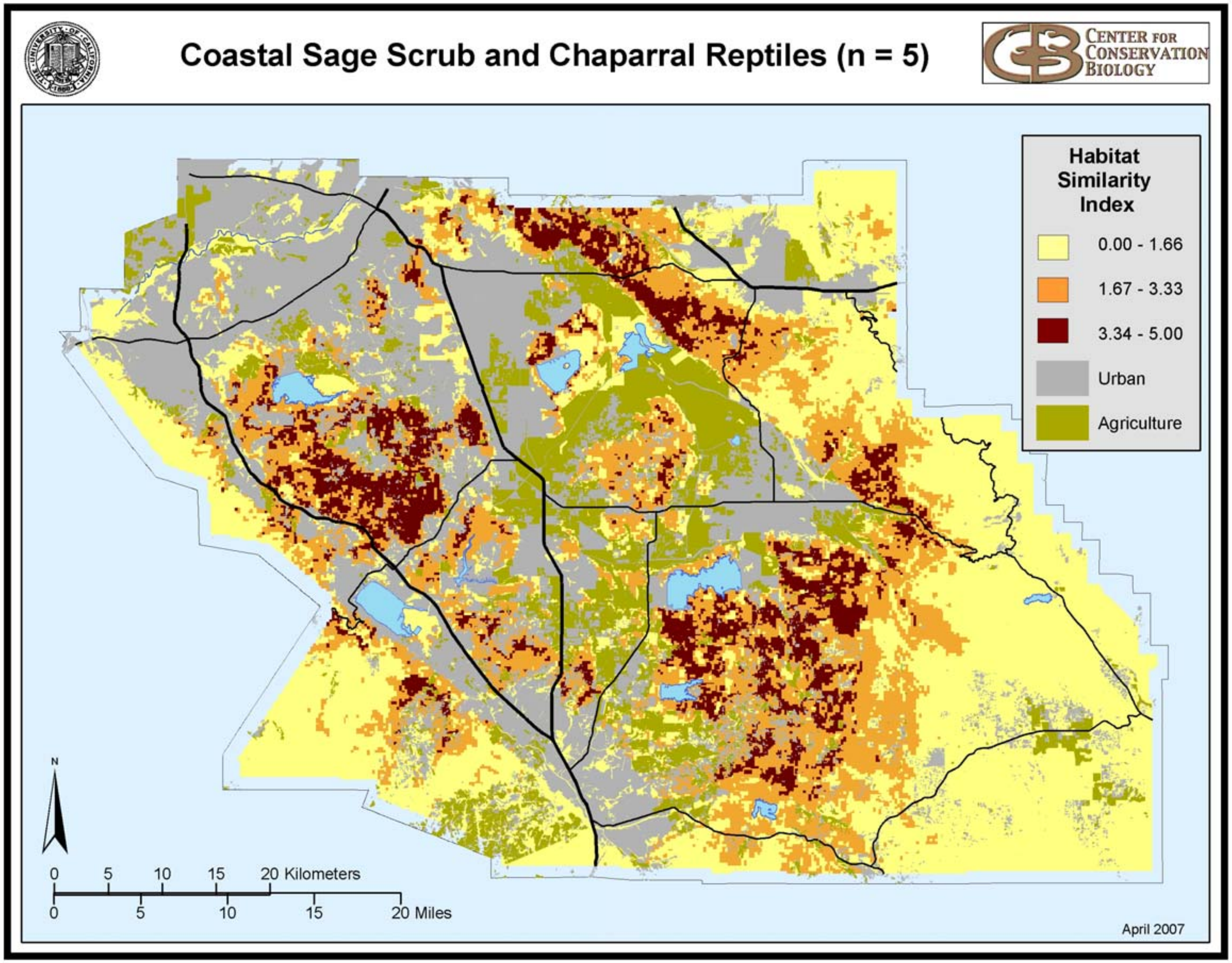


Figure 61. Cumulative habitat similarity index (HSI) values for five WRC MSCHP shrubland reptile species across the Plan Area. The higher the cumulative HSI, the greater the predicted habitat suitability for multiple reptile species at that location.

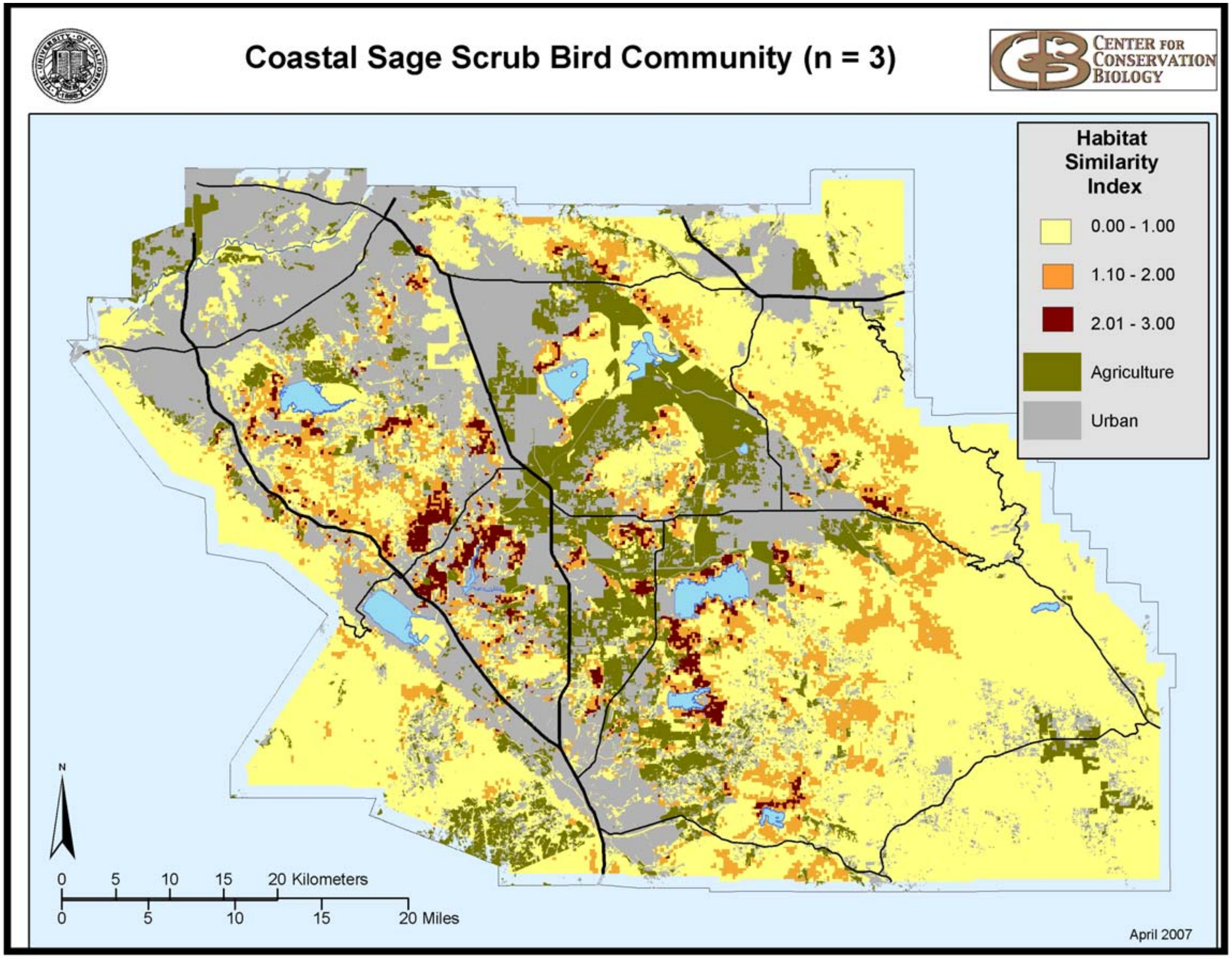


Figure 62. Cumulative habitat similarity index (HSI) values for three WRC MSHCP coastal sage scrub bird species across the Plan Area. The higher the cumulative HSI, the greater the predicted habitat suitability for multiple bird species at that location.

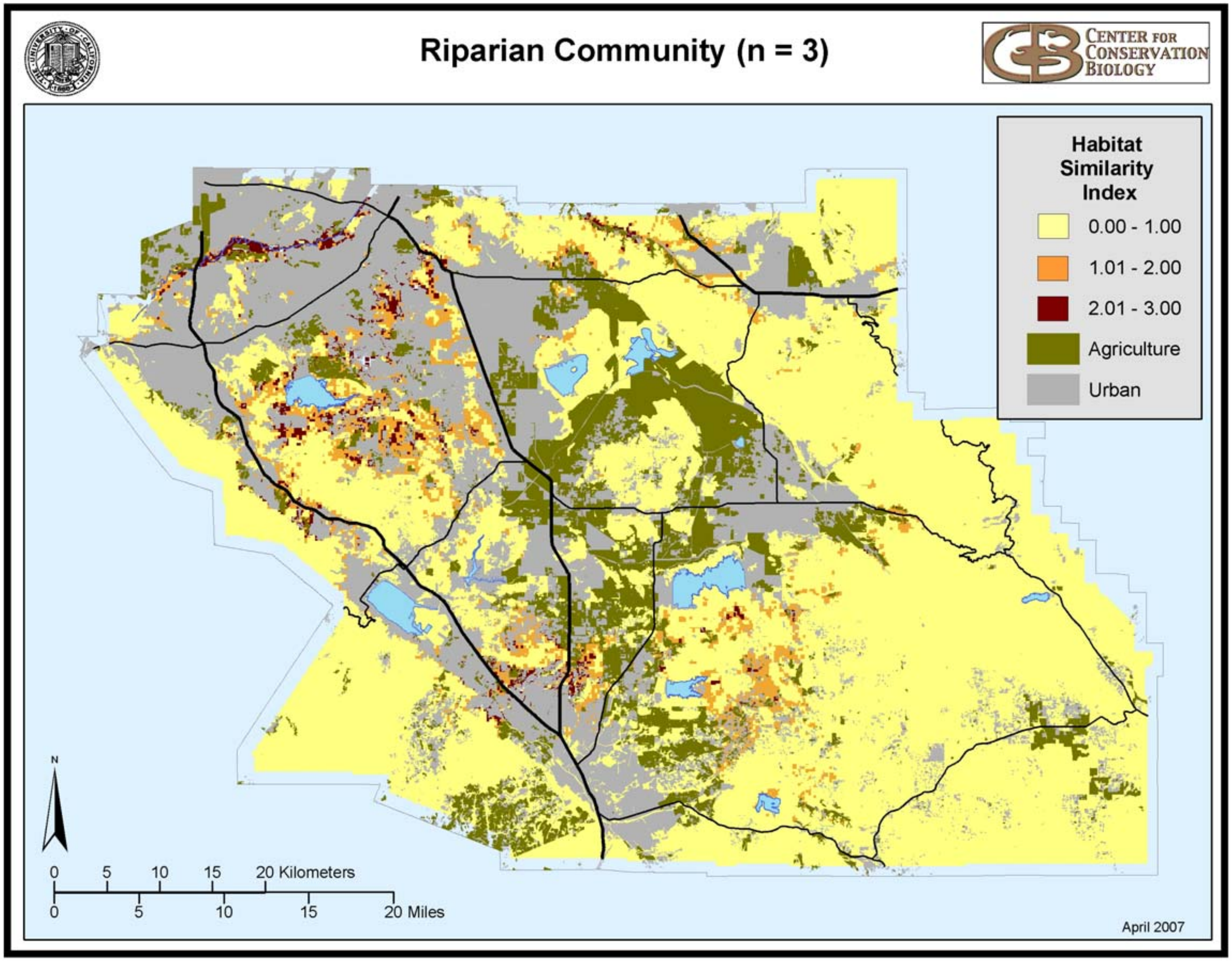


Figure 63. Cumulative habitat similarity index (HSI) values for four WRC MSHCP riparian bird species across the Plan Area. The higher the cumulative HSI, the greater the predicted habitat suitability for multiple bird species at that location.

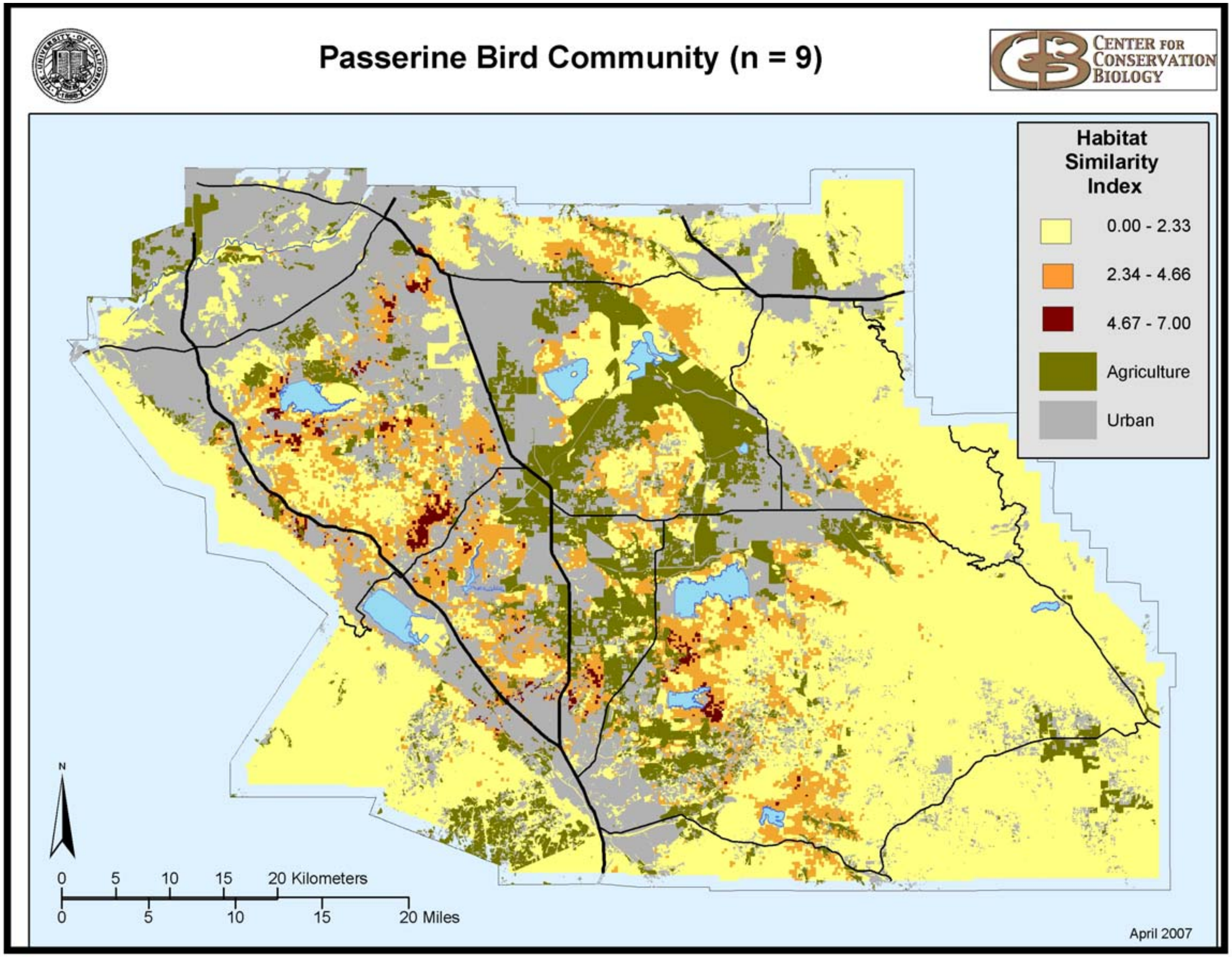


Figure 64. Cumulative habitat similarity index (HSI) values for nine WRC MSHCP songbird species across the Plan Area. The higher the cumulative HSI, the greater the predicted habitat suitability for multiple bird species at that location.

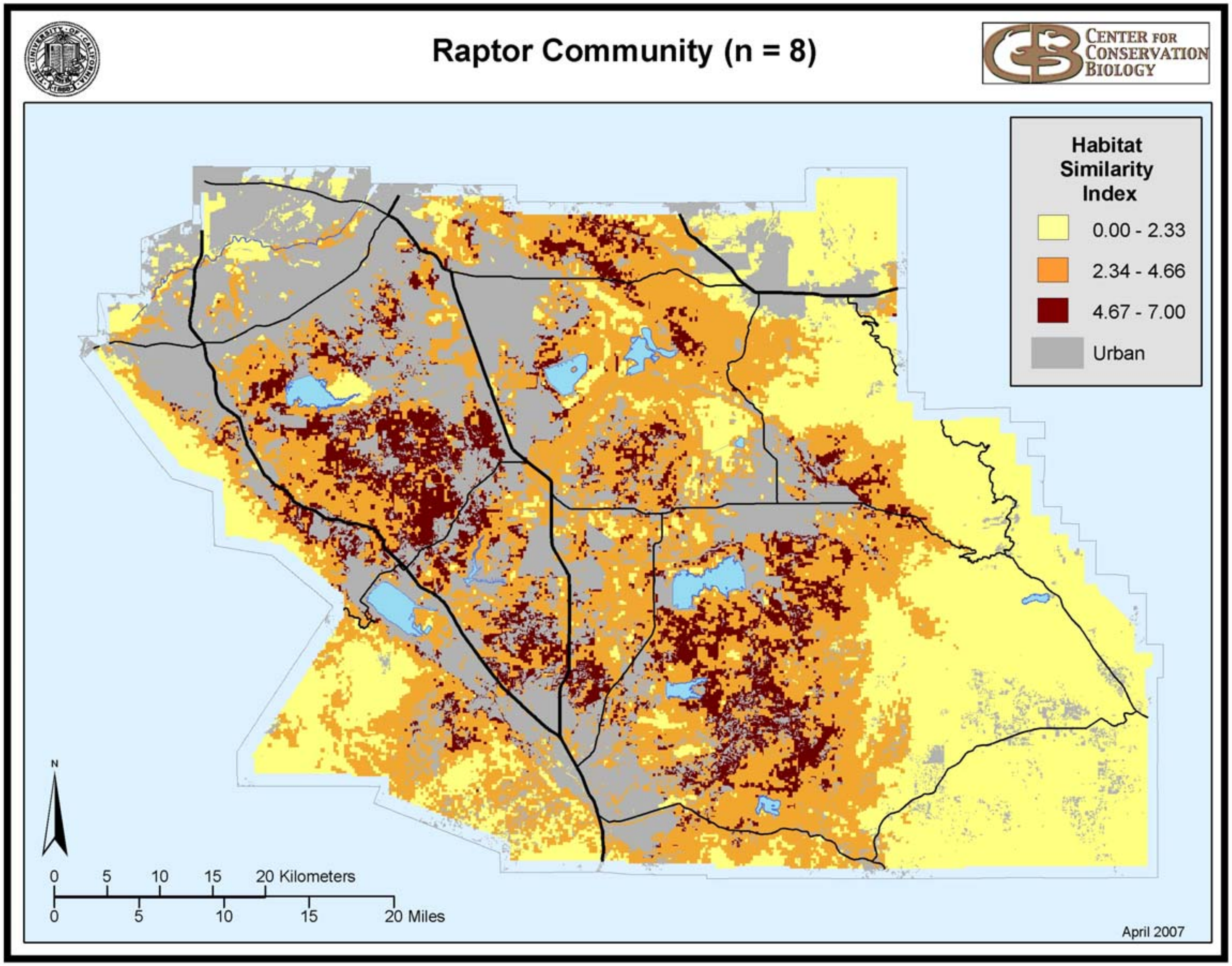


Figure 65. Cumulative habitat similarity index (HSI) values for eight WRC MSHCP raptor species across the Plan Area. The higher the cumulative HSI, the greater the predicted habitat suitability for multiple raptor species at that location.

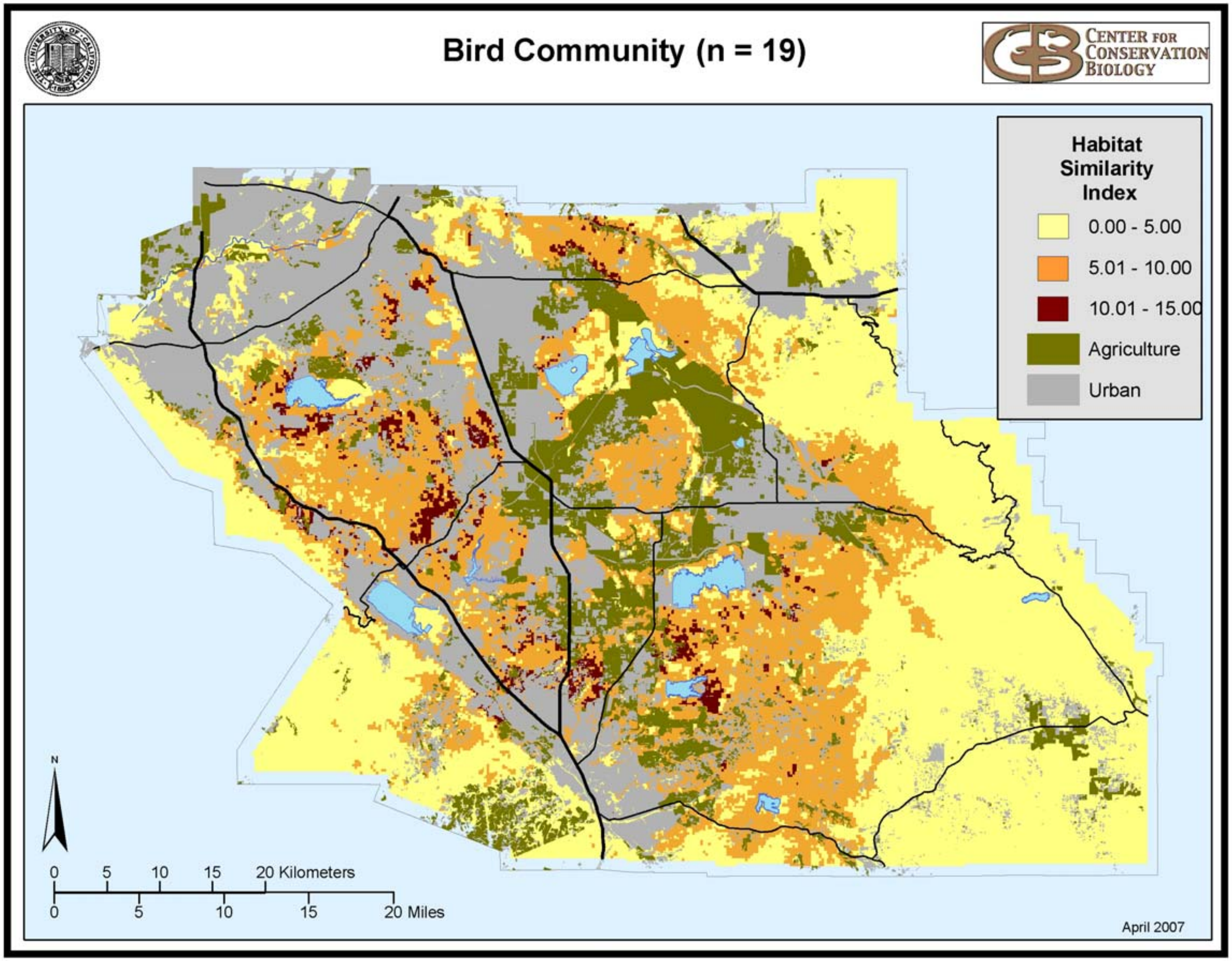


Figure 66. Cumulative habitat similarity index (HSI) values for nineteen WRC MSHCP bird species across the Plan Area. The higher the cumulative HSI, the greater the predicted habitat suitability for multiple bird species at that location.

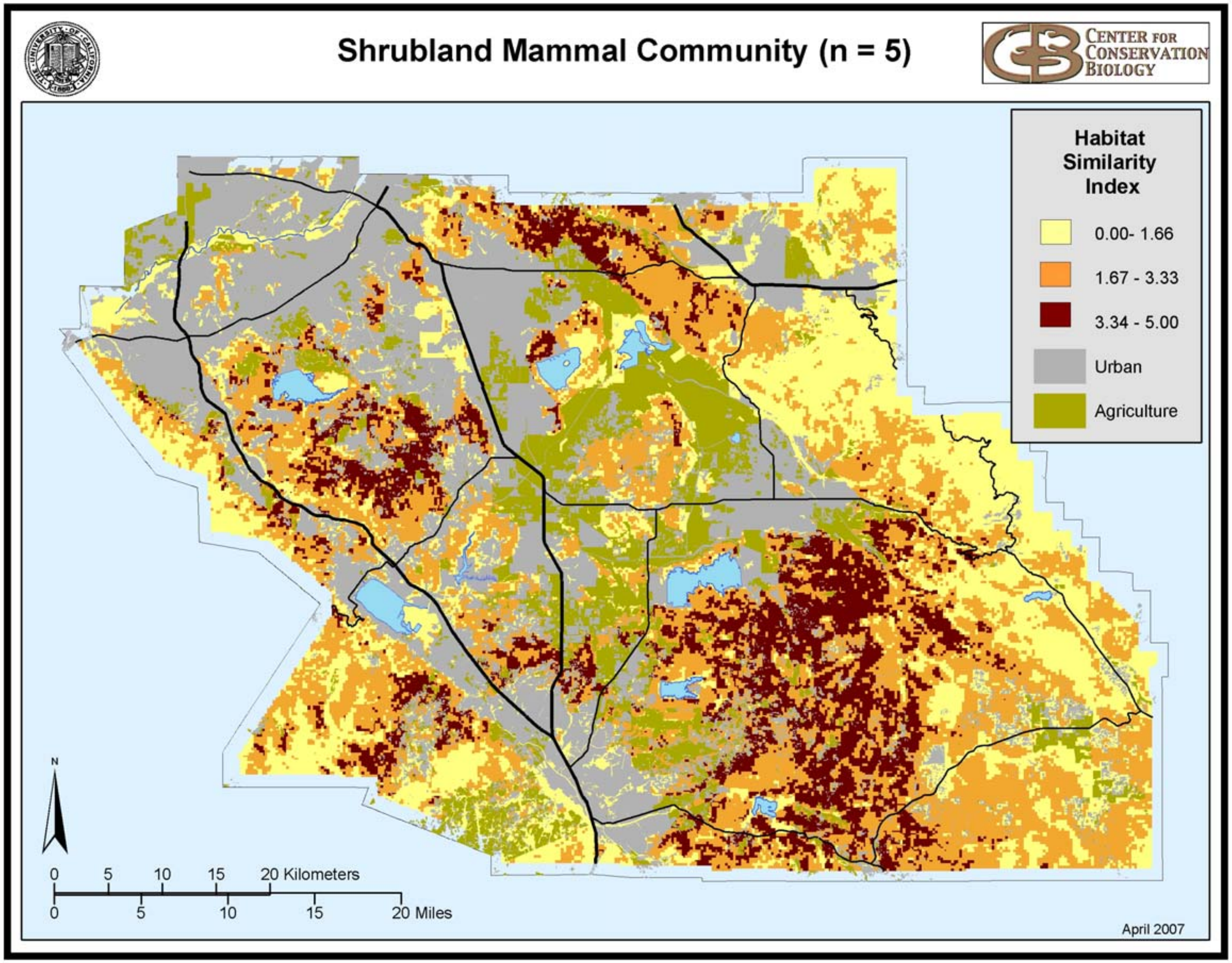


Figure 67. Cumulative habitat similarity index (HSI) values for five WRC MSHCP shrubland mammal species across the Plan Area. The higher the cumulative HSI, the greater the predicted habitat suitability for multiple mammal species at that location.

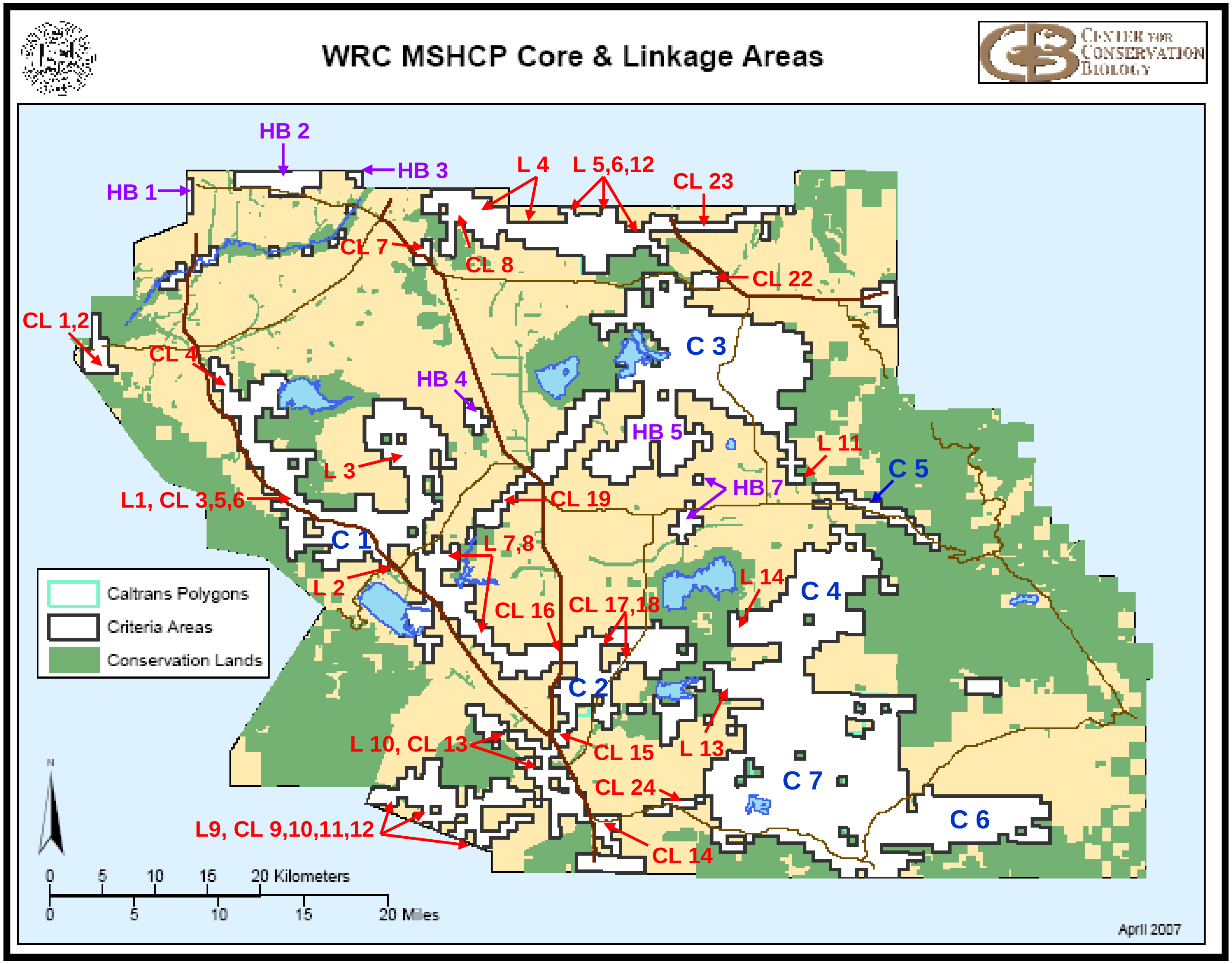


Figure 68. Criteria Area Cores and Linkages, existing Public/Quasi-Public conservation lands, and lands outside of the WRC MSHCP reserve system. C = Core Area, HB = Non-contiguous Habitat Block, CL = Constrained Linkage, and L = Linkage. Figure adapted from WRC MSHCP (County of Riverside 2003).

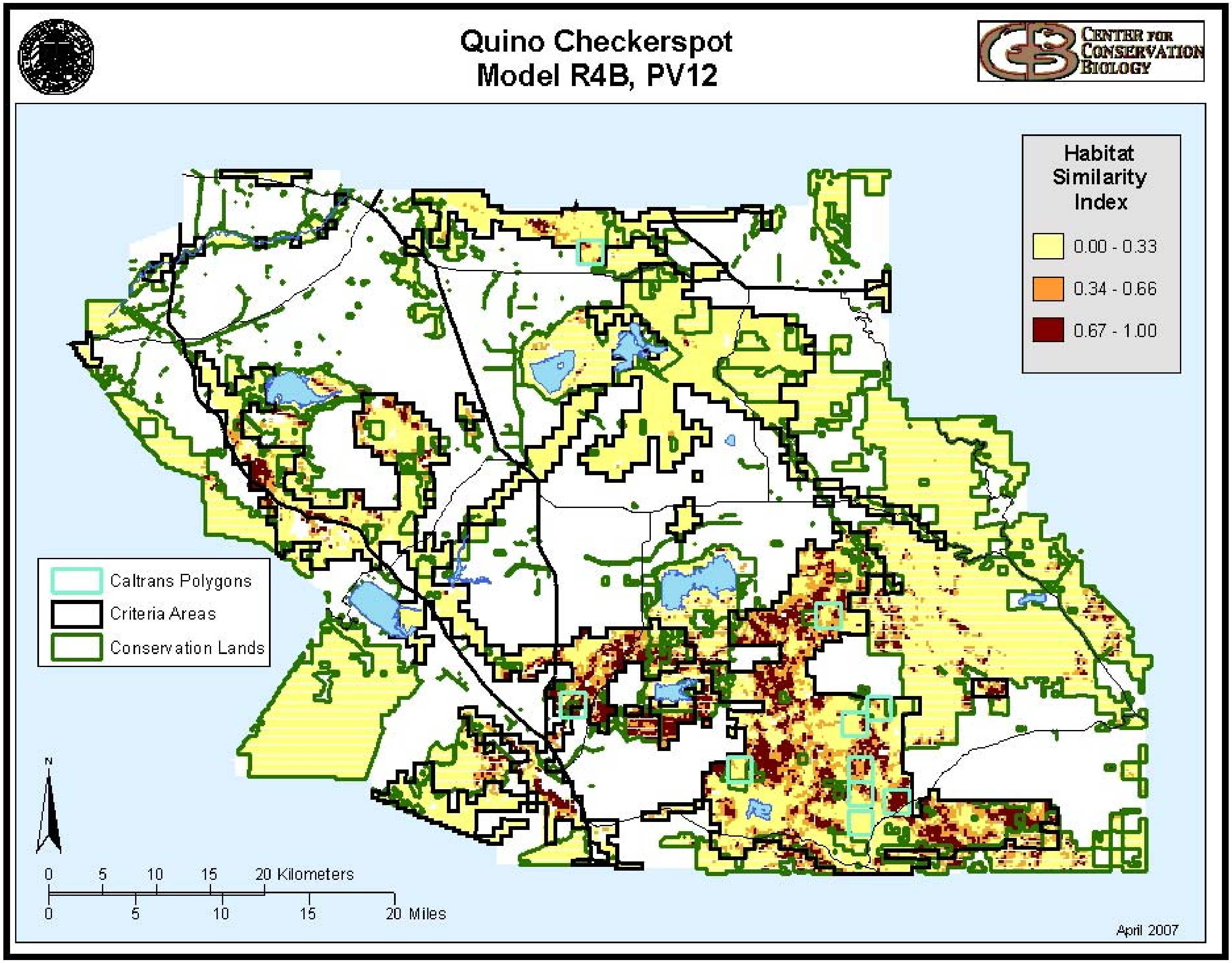


Figure 69. "HSI's" of habitat similarity for Quino checkerspot in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

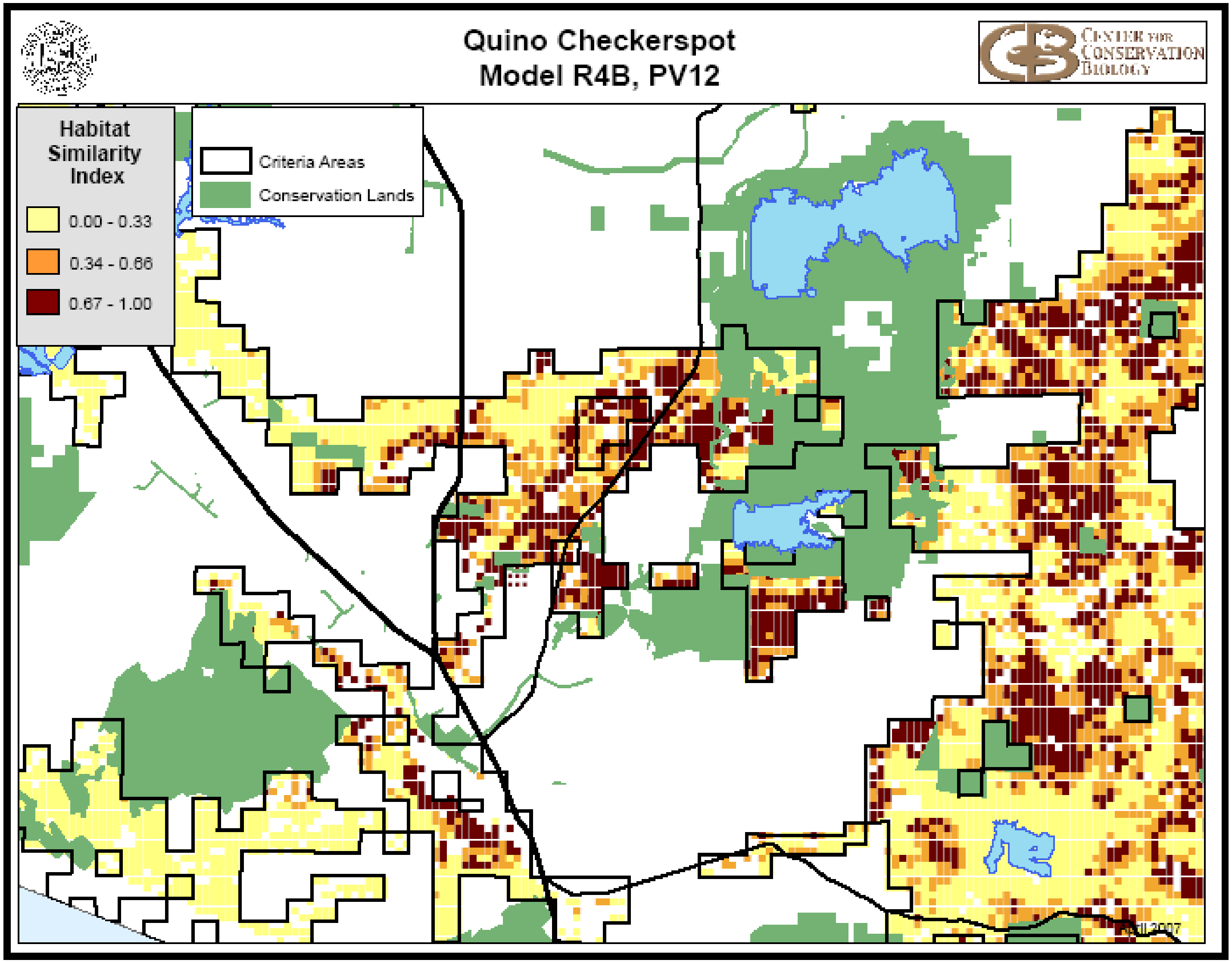


Figure 70. Quino checkerspot HSI values for Criteria Areas embedded within a matrix of already conserved Public/Quasi-Public lands, and lands outside of the WRC MSHCP reserve system (in white). White pixels within Criteria Areas represent developed lands. HSI values can be assessed to identify area for more in-depth evaluation and comparison of conservation potential.

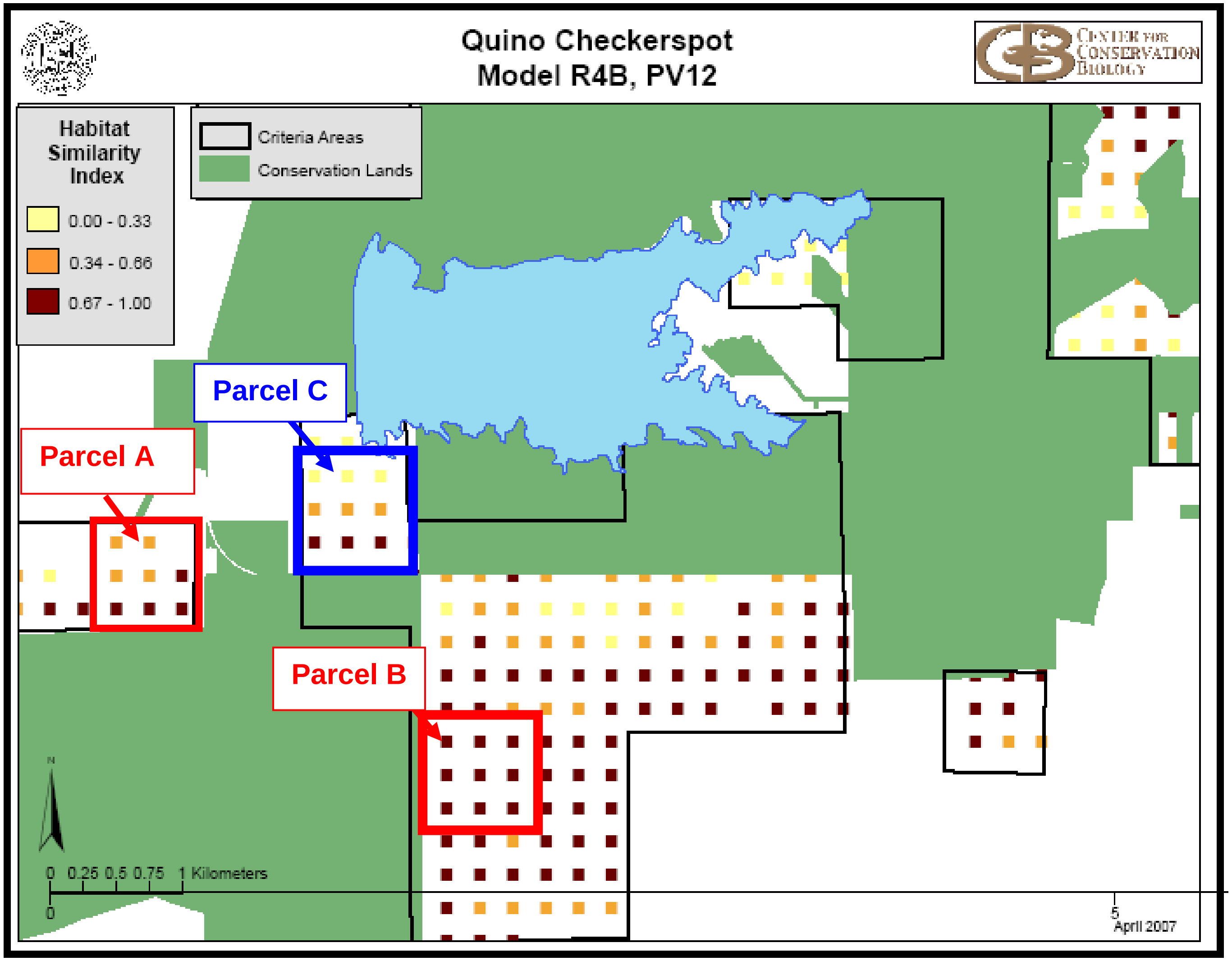


Figure 71. A close-up view of WRC MSHCP Criteria Areas with imaginary Parcels A, B, and C showing Quino checkerspot HSI values at individual map points. In comparing the conservation potential of the parcels; B has the highest mean HSI value followed by A and C. This example shows the importance of considering landscape context when evaluating conservation potential. Parcel C with lower HSI values may be important for enhancing connectivity between two conserved areas.

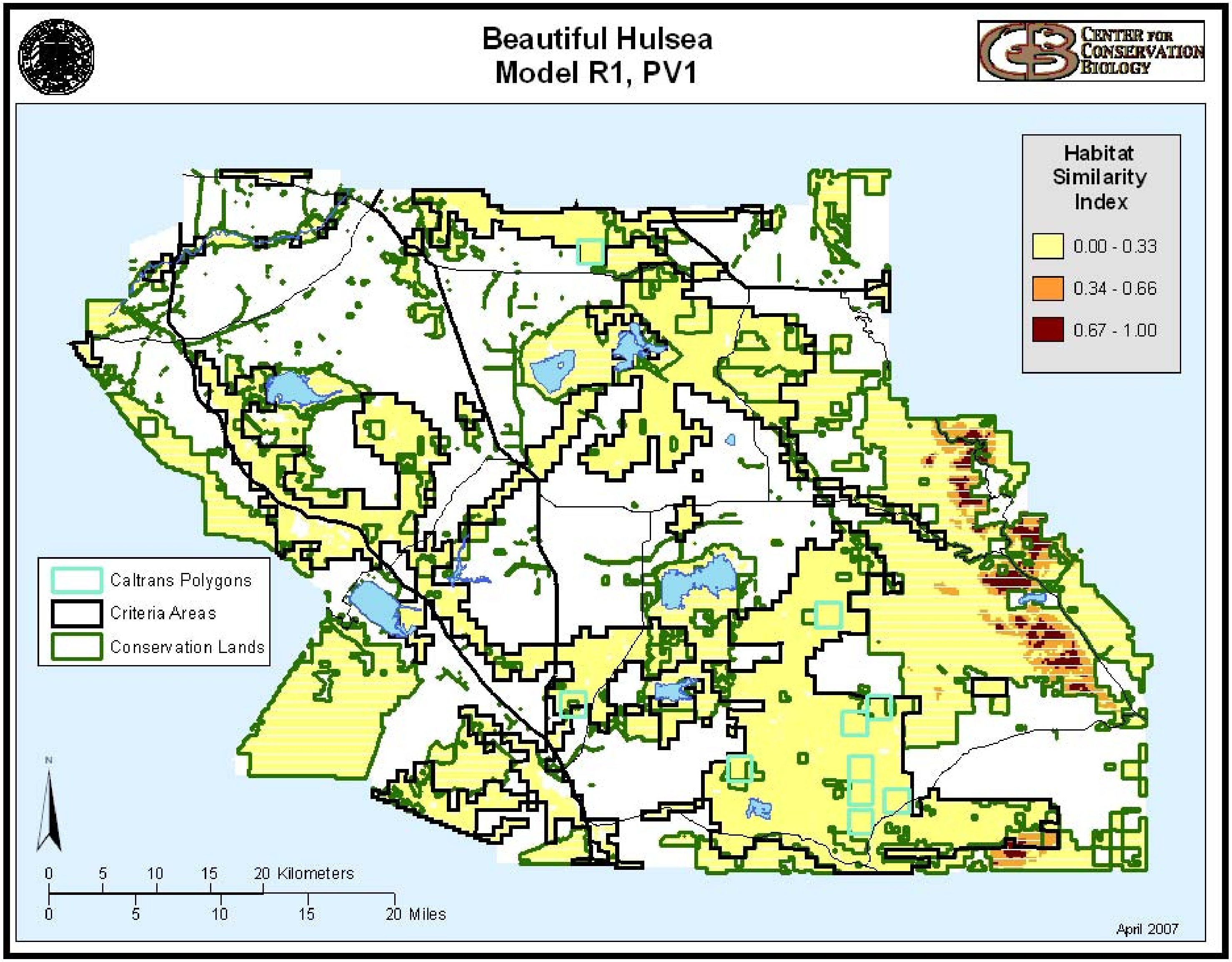


Figure 72. "HSI's" of habitat similarity for beautiful hulsea in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

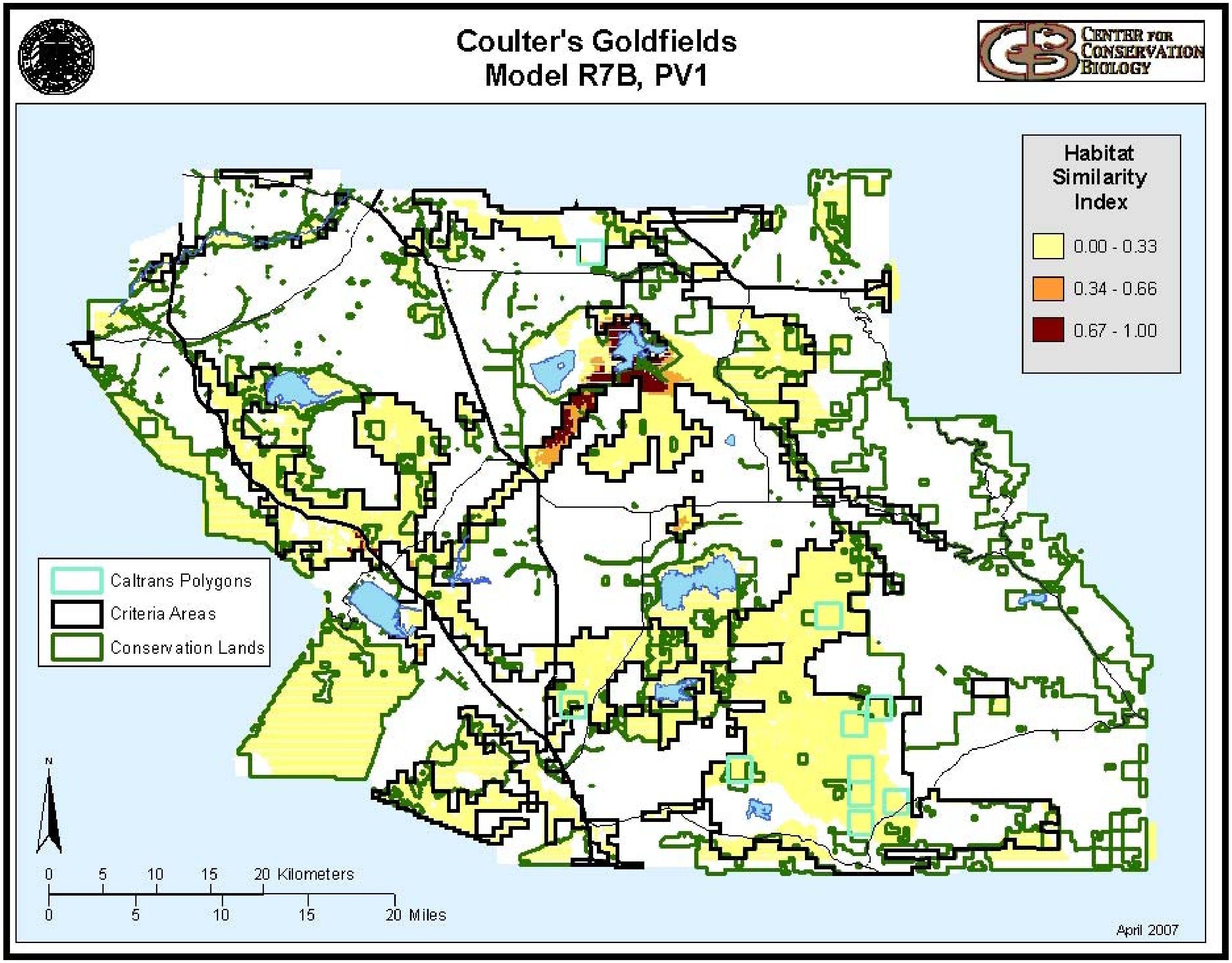


Figure 73. "HSI's" of habitat similarity for Coulter's goldfields in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

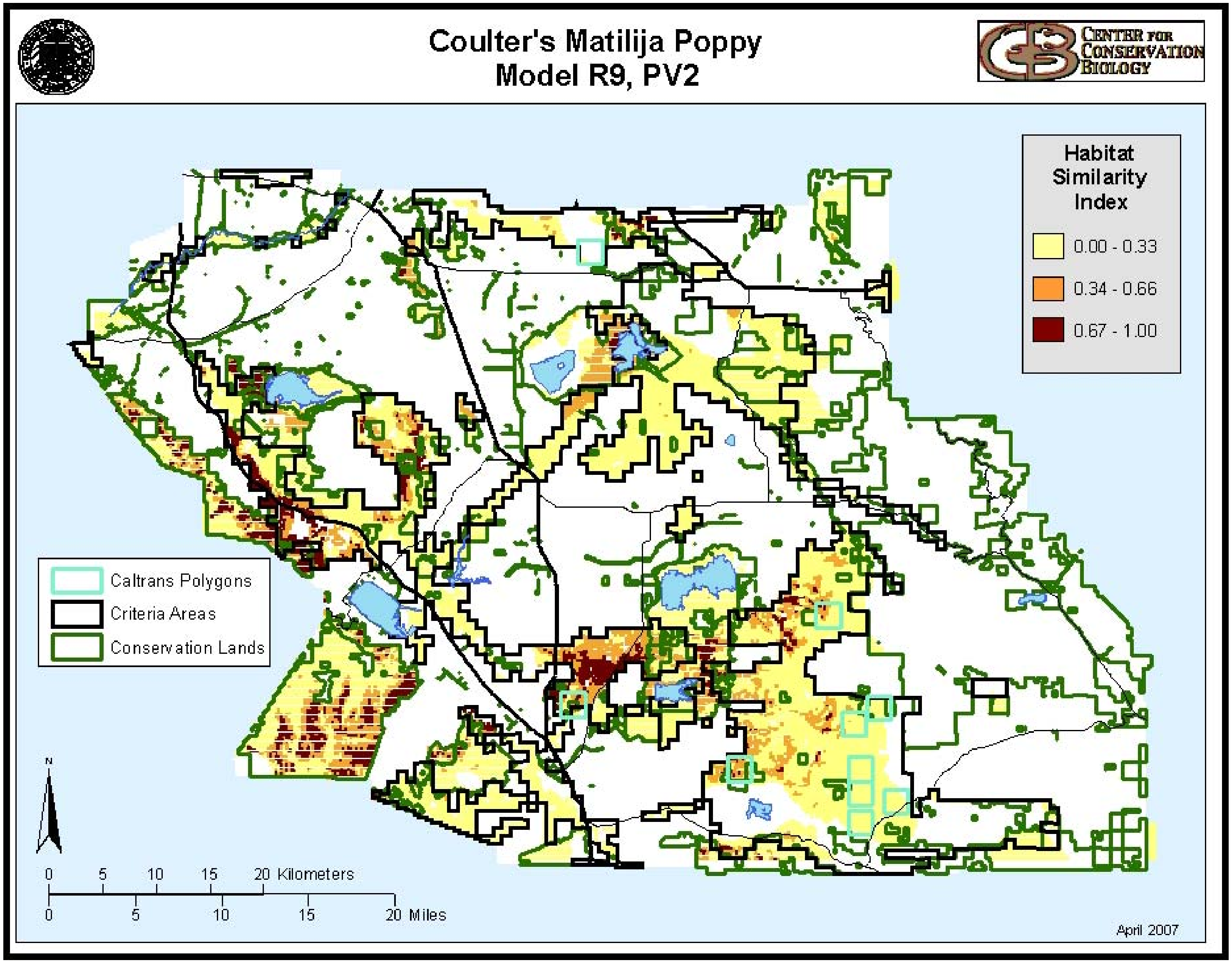


Figure 74. "HSI's" of habitat similarity for Coulter's matilija poppy in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

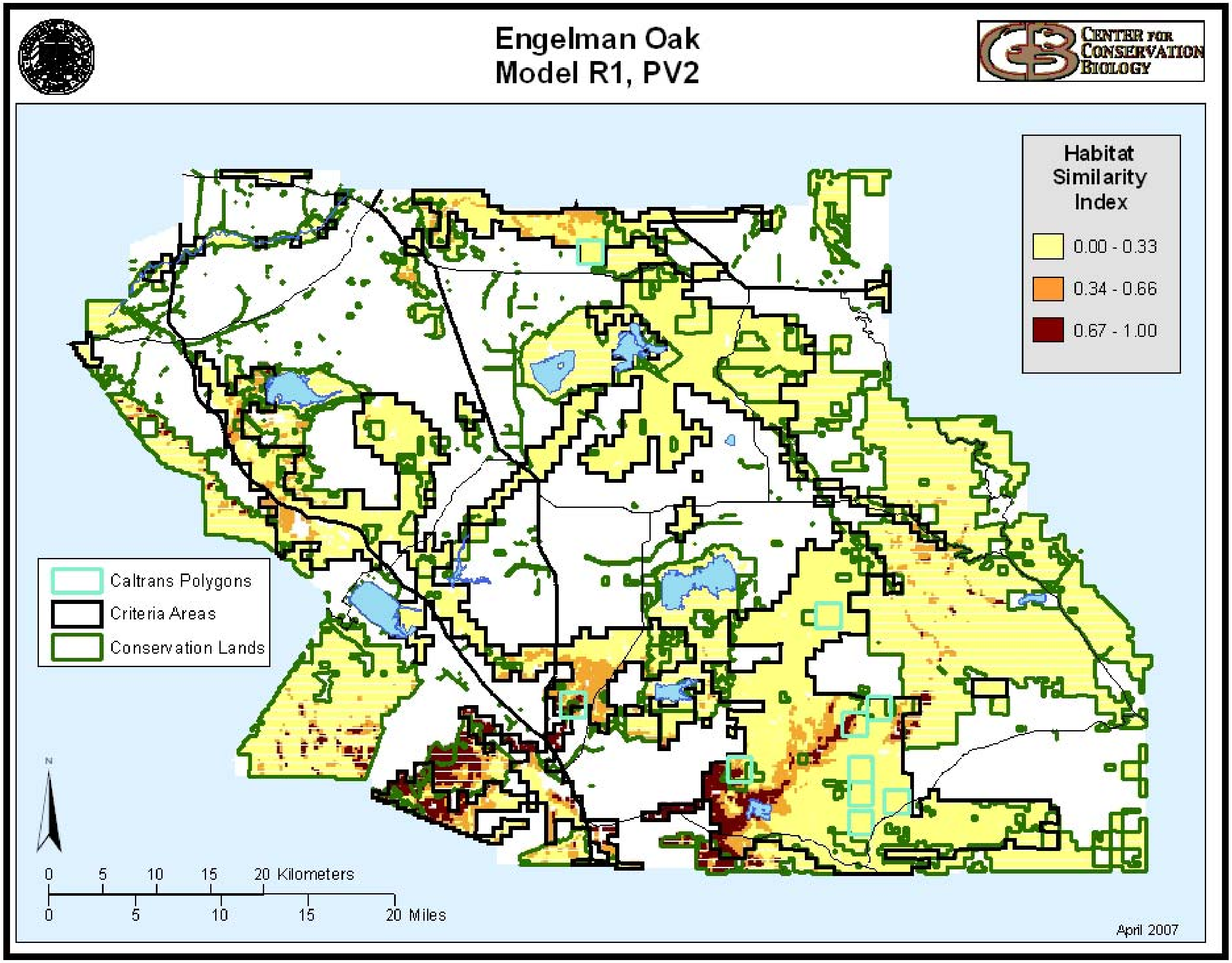


Figure 75. "HSI's" of habitat similarity for Engelmann oak in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

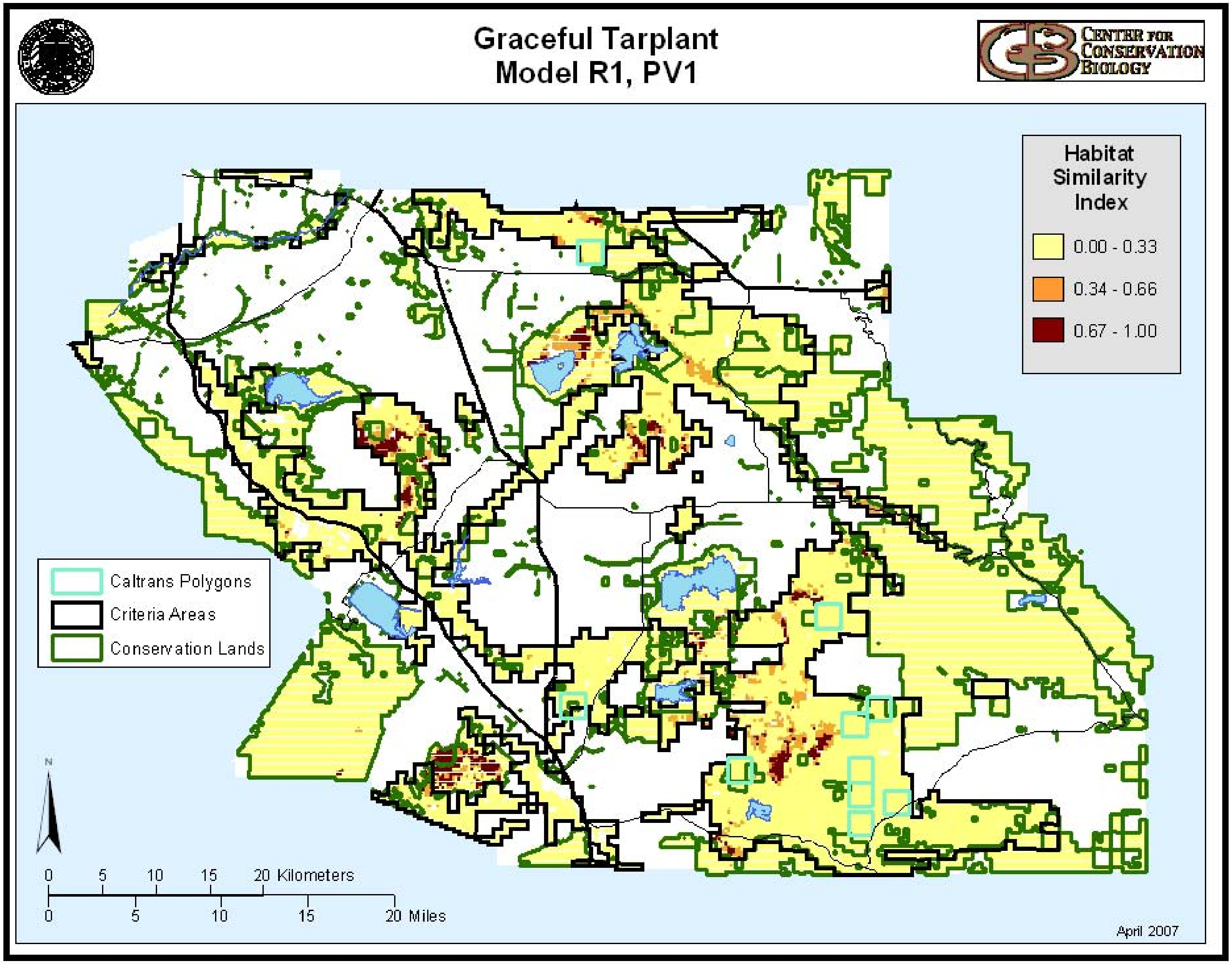


Figure 76. "HSI's" of habitat similarity for graceful tarplant in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

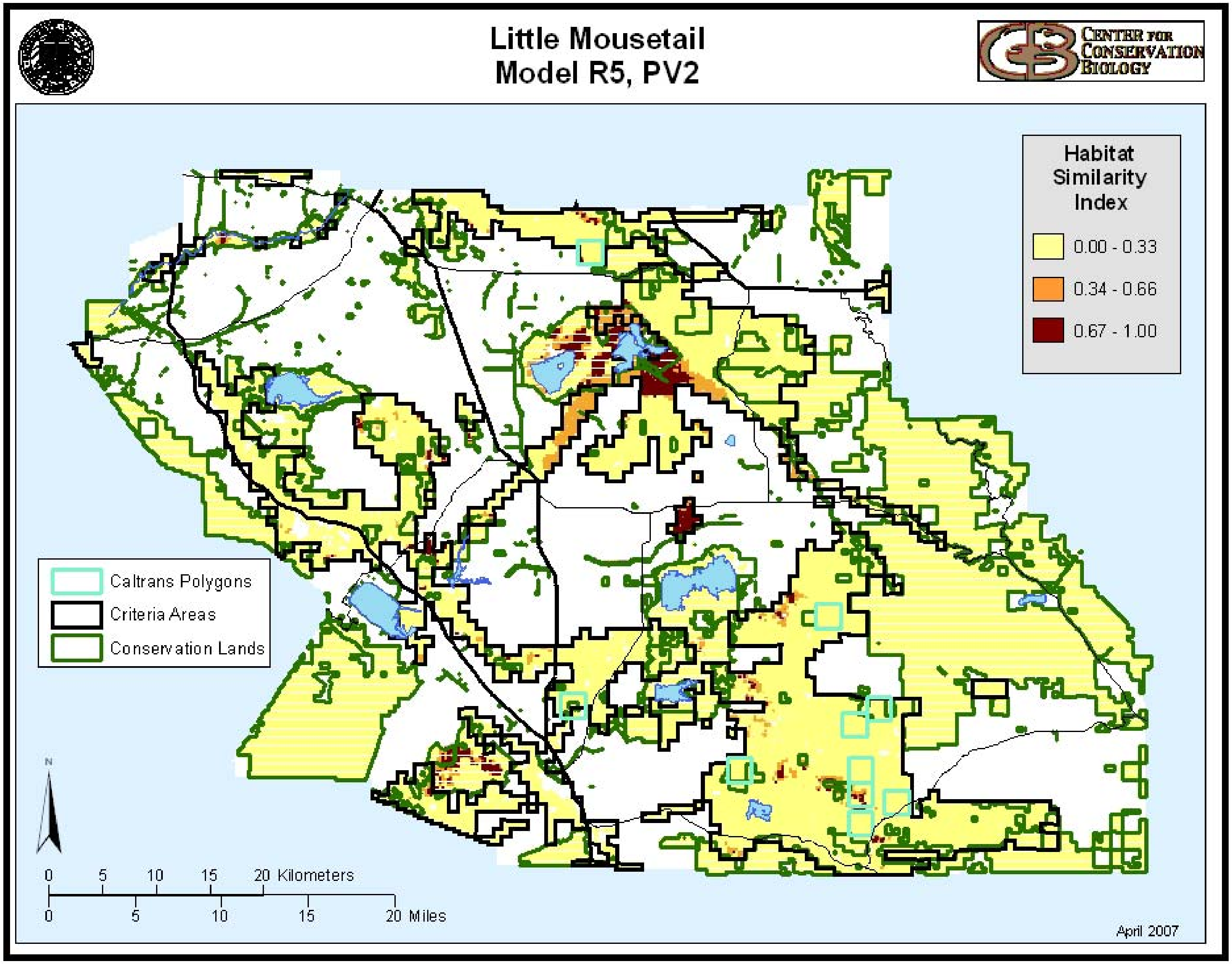


Figure 77. "HSI's" of habitat similarity for little mousetail in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

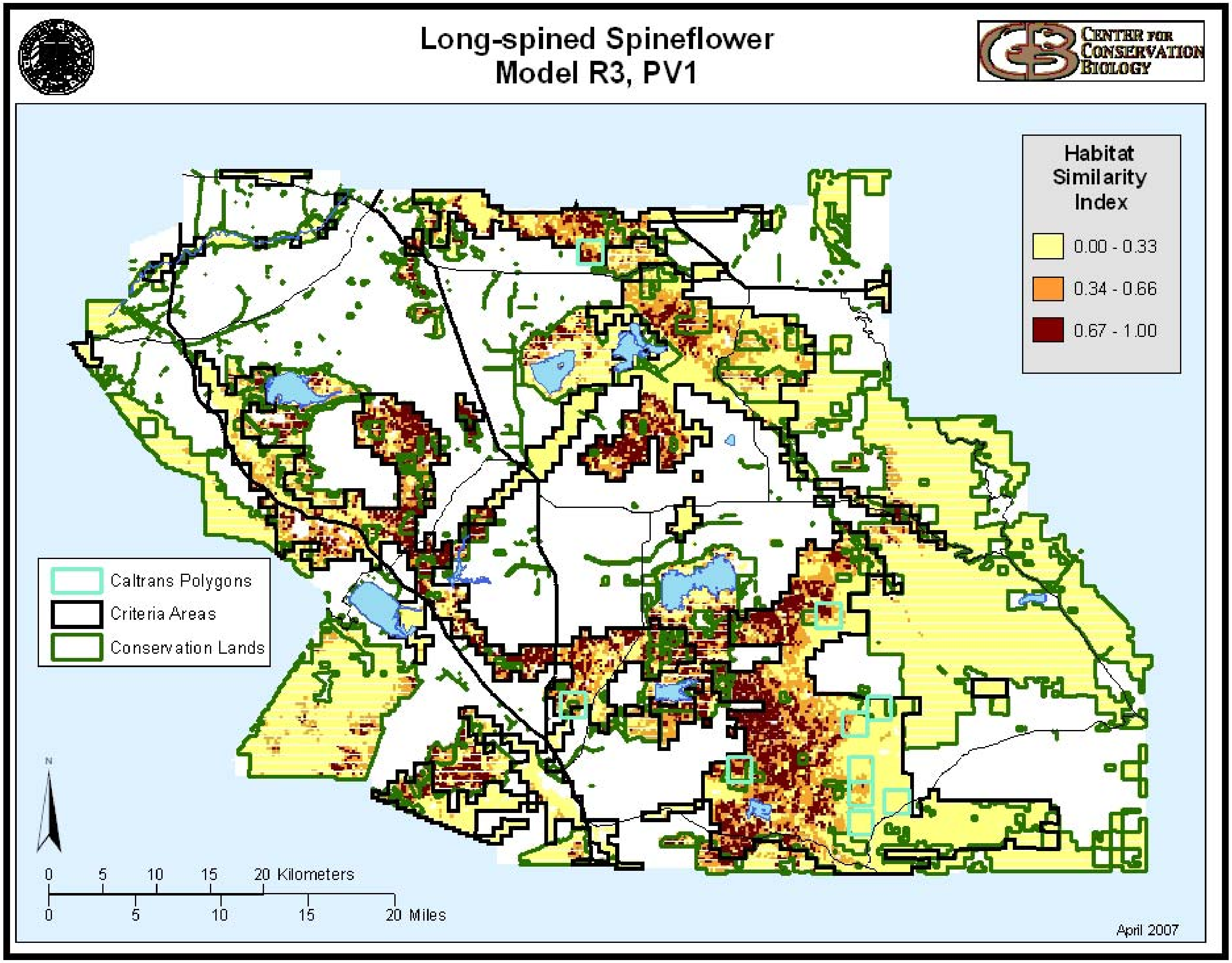


Figure 78. "HSI's" of habitat similarity for long-spined spineflower in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

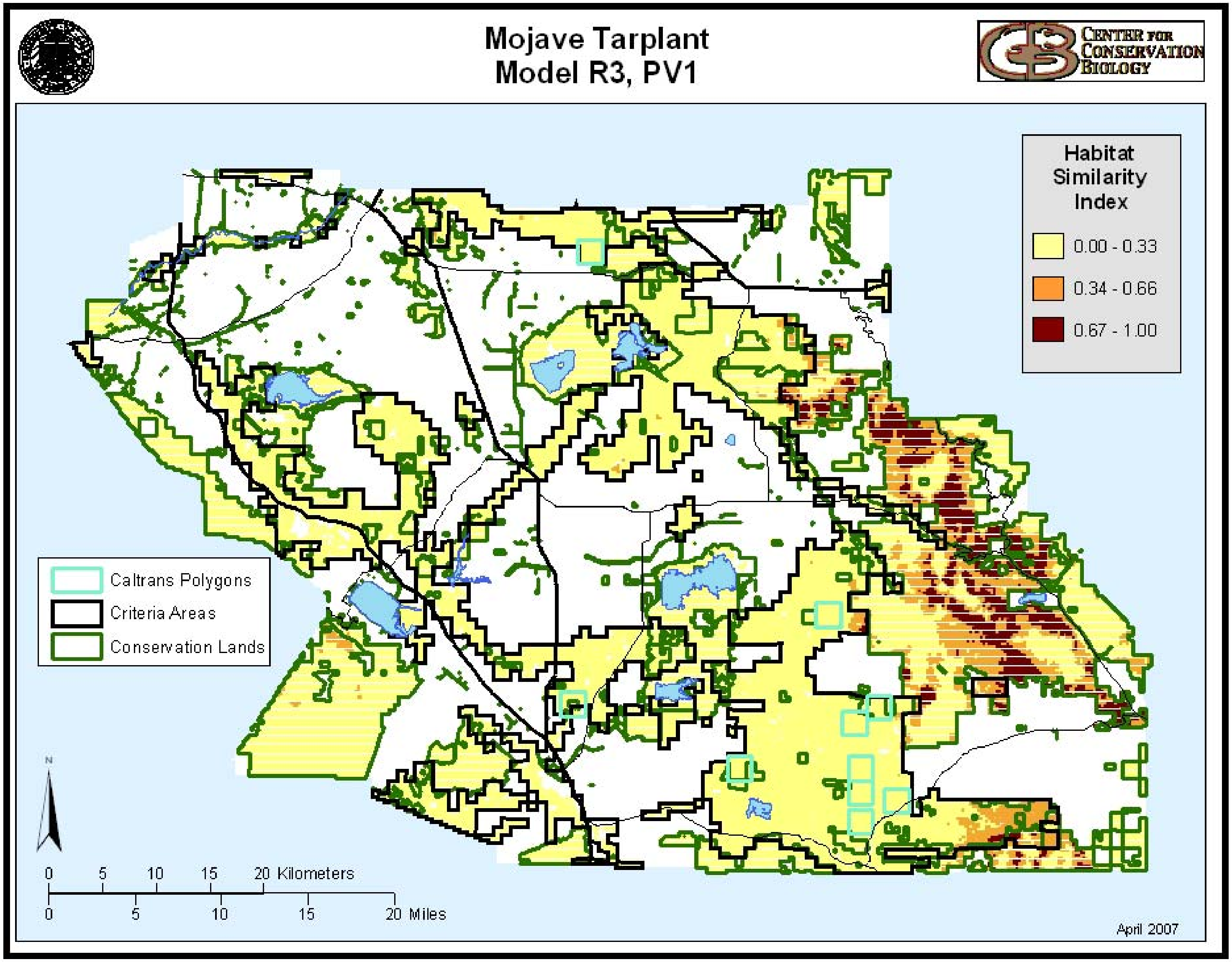


Figure 79. "HSI's" of habitat similarity for Mojave tarplant in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

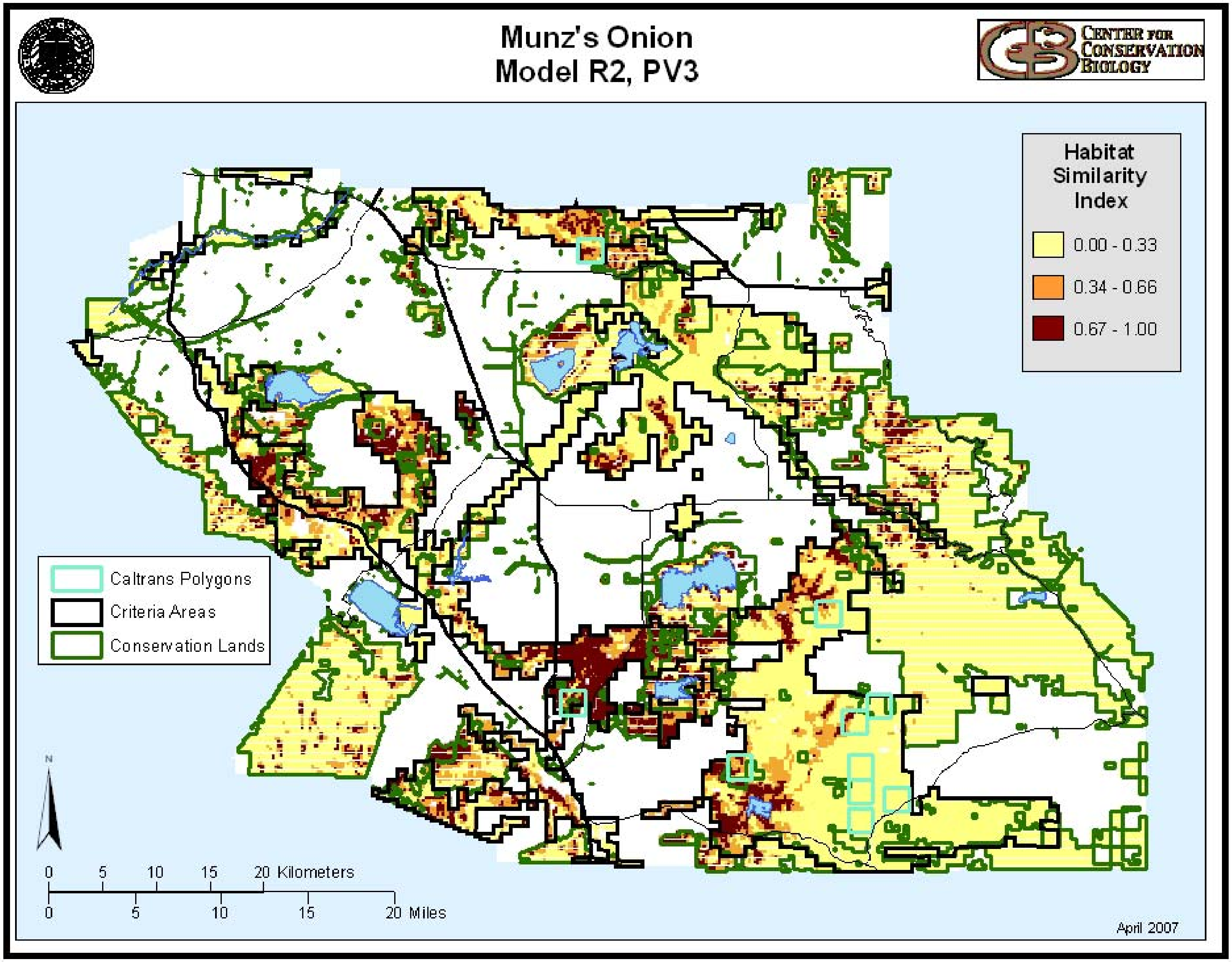


Figure 80. "HSI's" of habitat similarity for Munz's onion in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

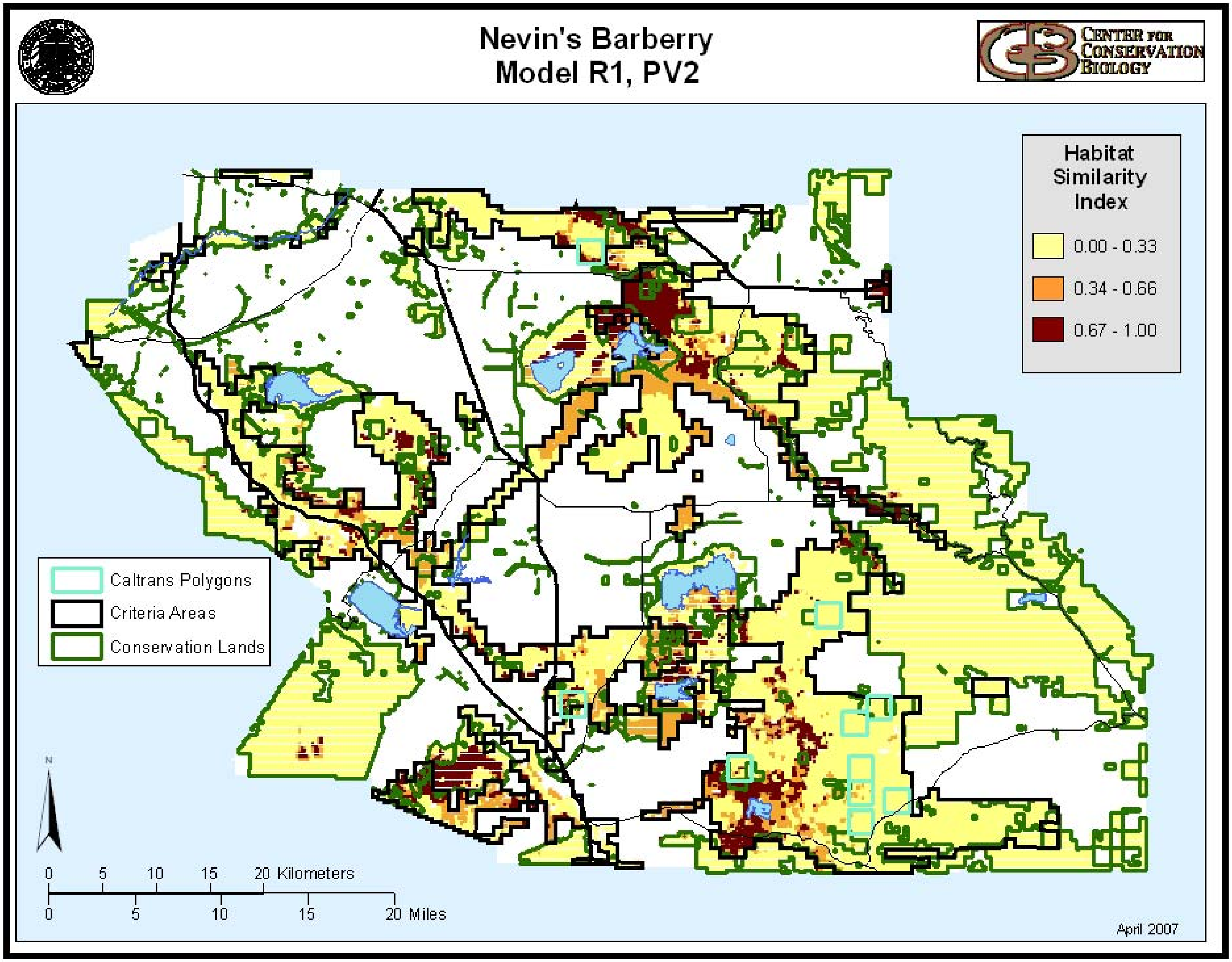


Figure 81. "HSI's" of habitat similarity for Nevin's barberry in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

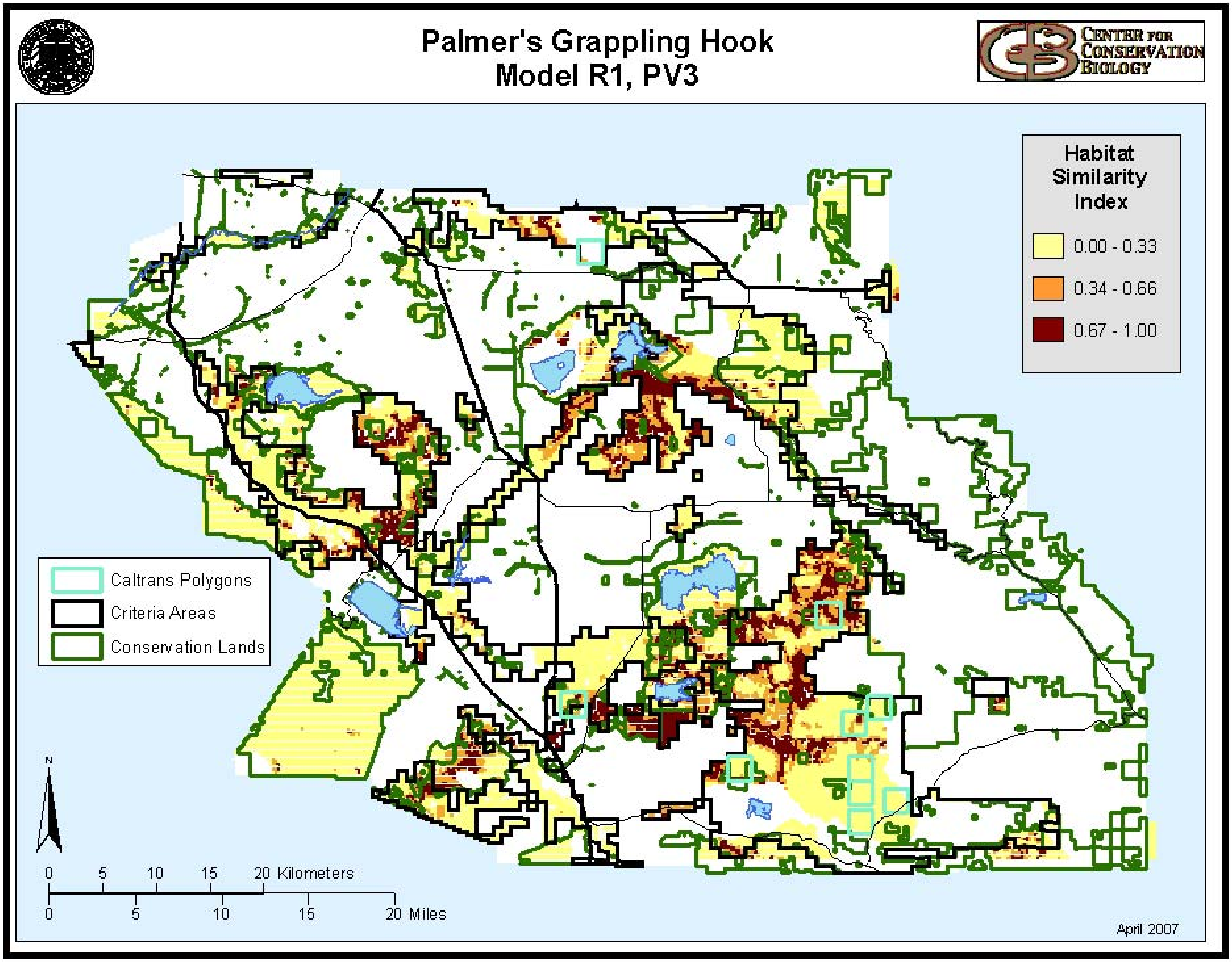


Figure 82. "HSI's" of habitat similarity for Palmer's grappling hook in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

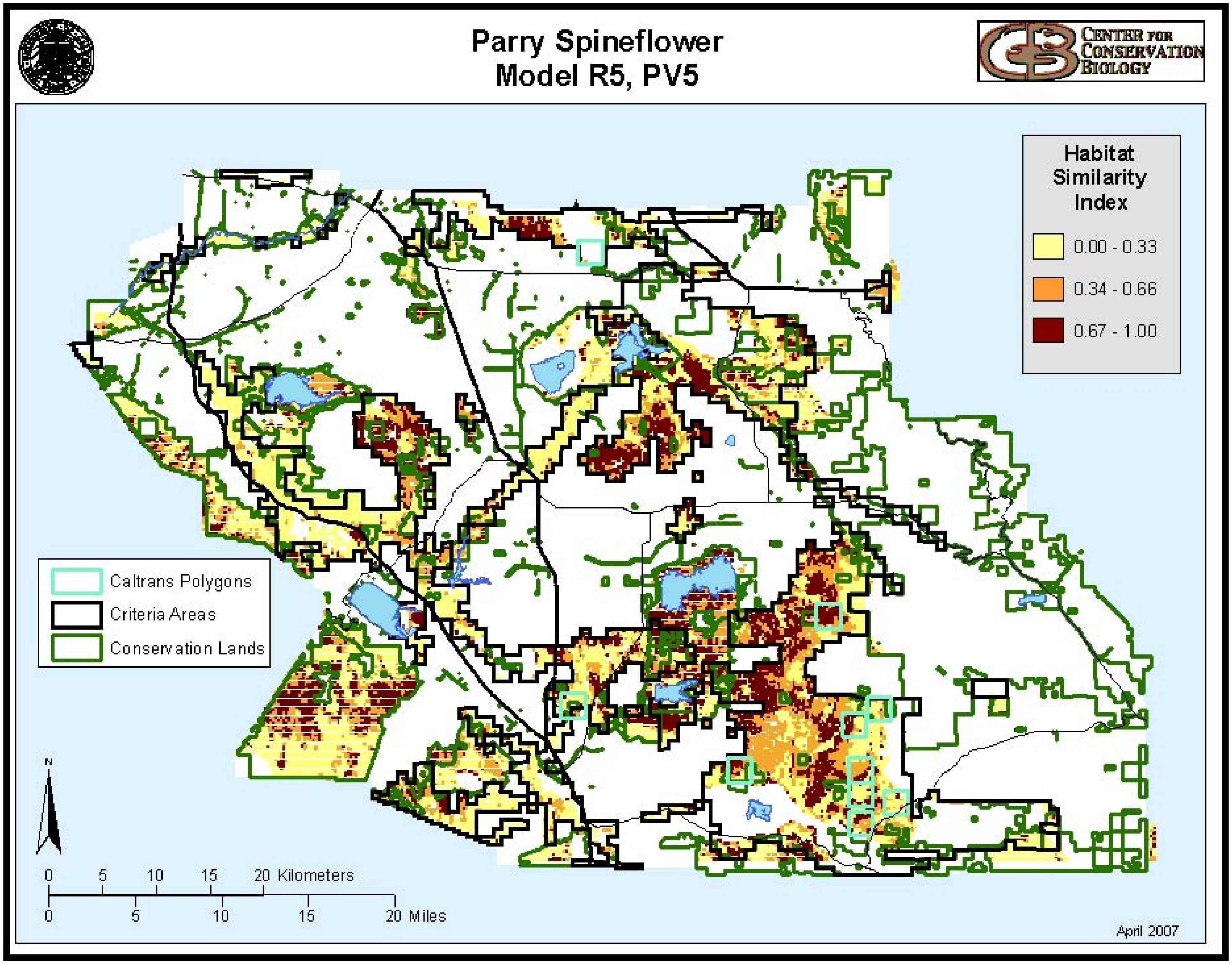


Figure 83. "HSI's" of habitat similarity for Parry's spineflower in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

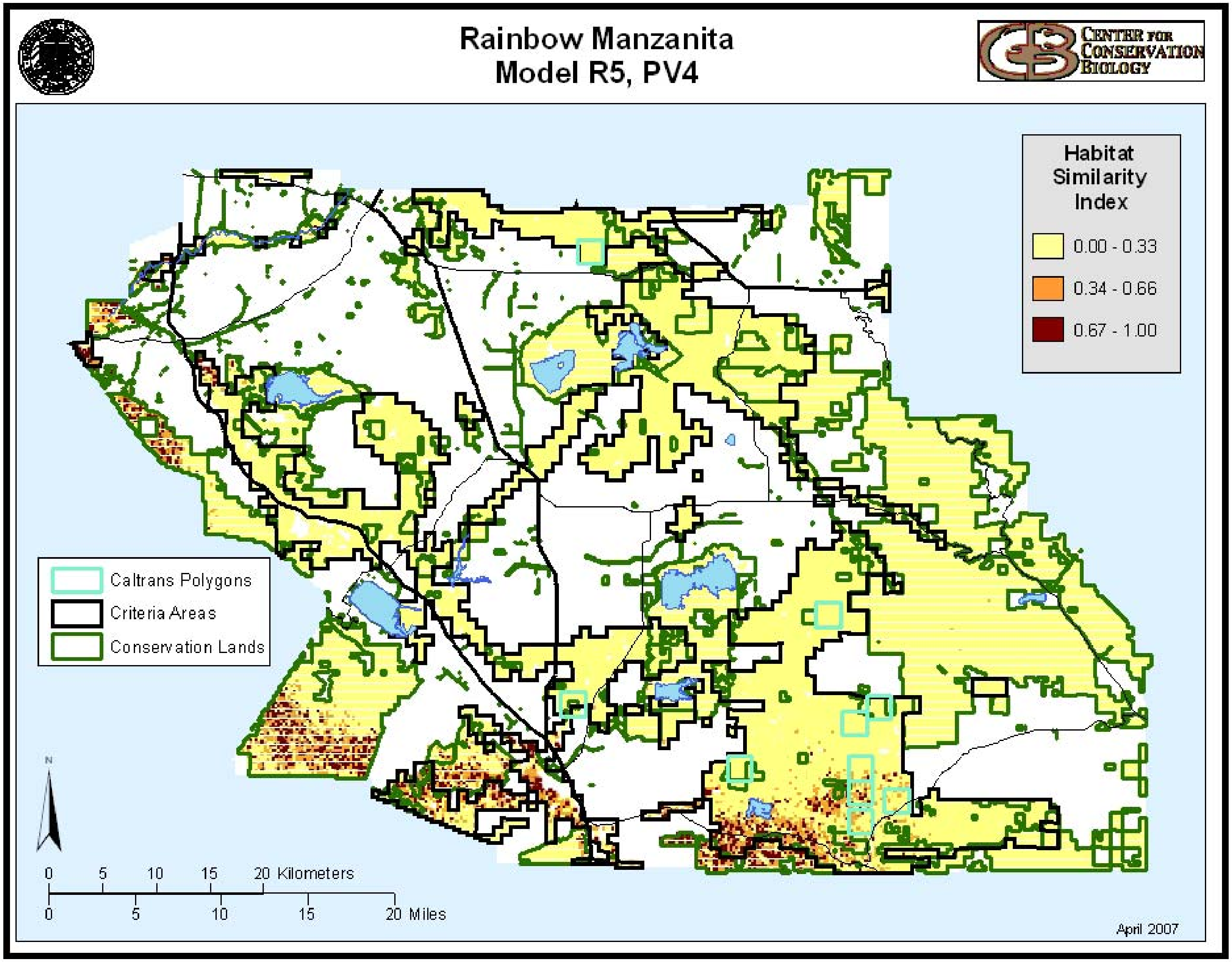


Figure 84. "HSI's" of habitat similarity for Rainbow manzanita in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

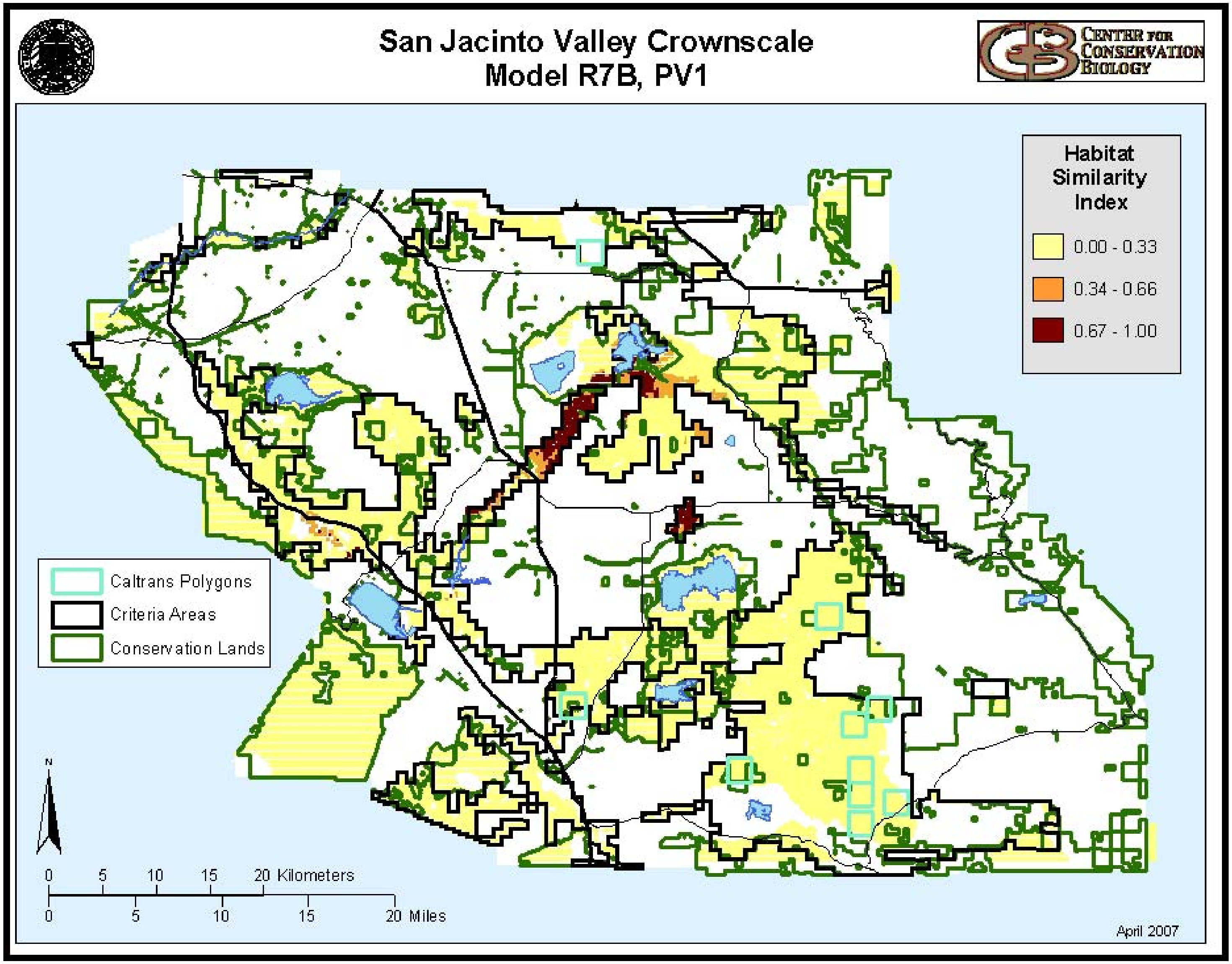


Figure 85. "HSI's" of habitat similarity for San Jacinto Valley crownscale in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

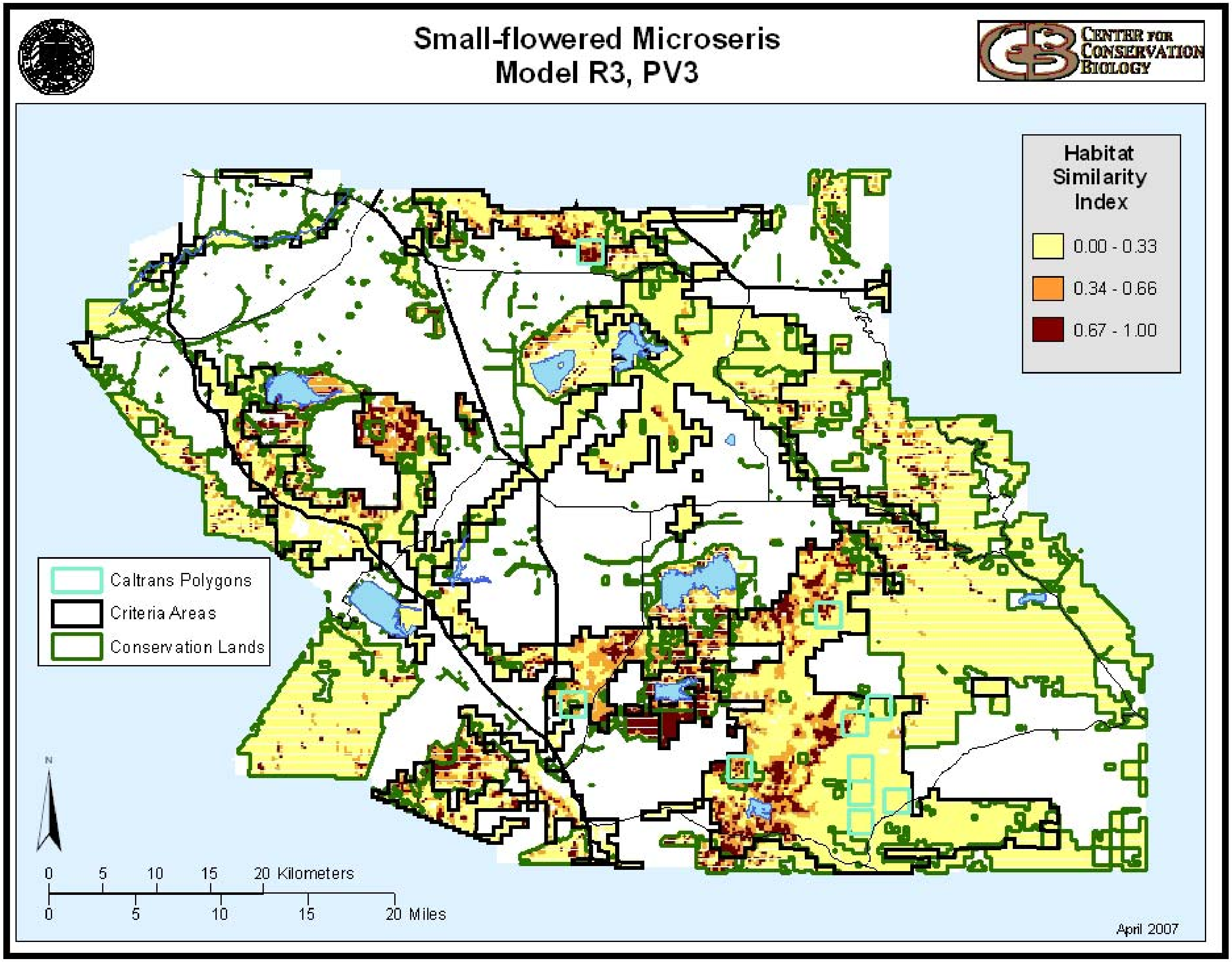


Figure 86. "HSI's" of habitat similarity for small-flowered microseris Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

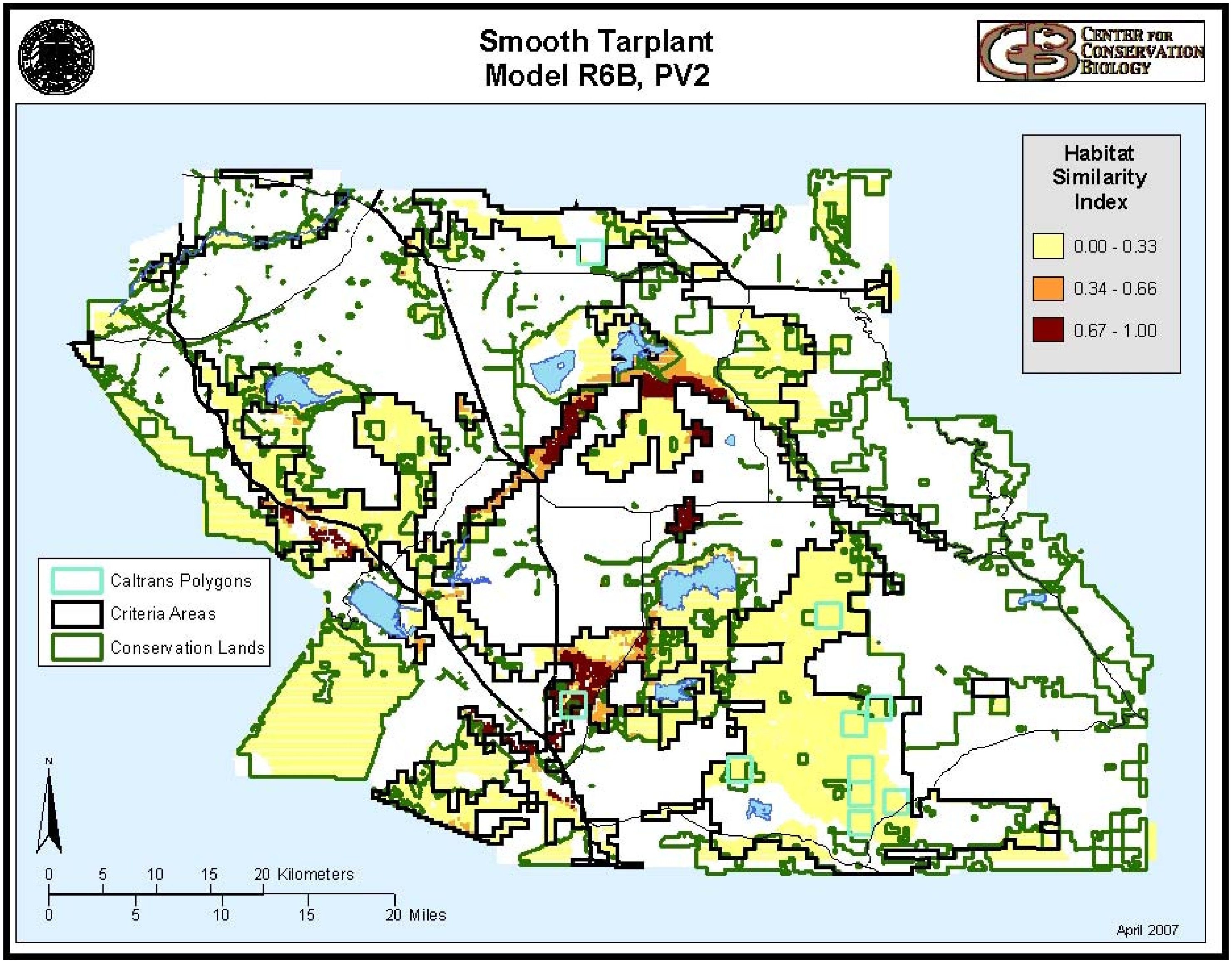


Figure 87. "HSI's" of habitat similarity for smooth tarplant in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

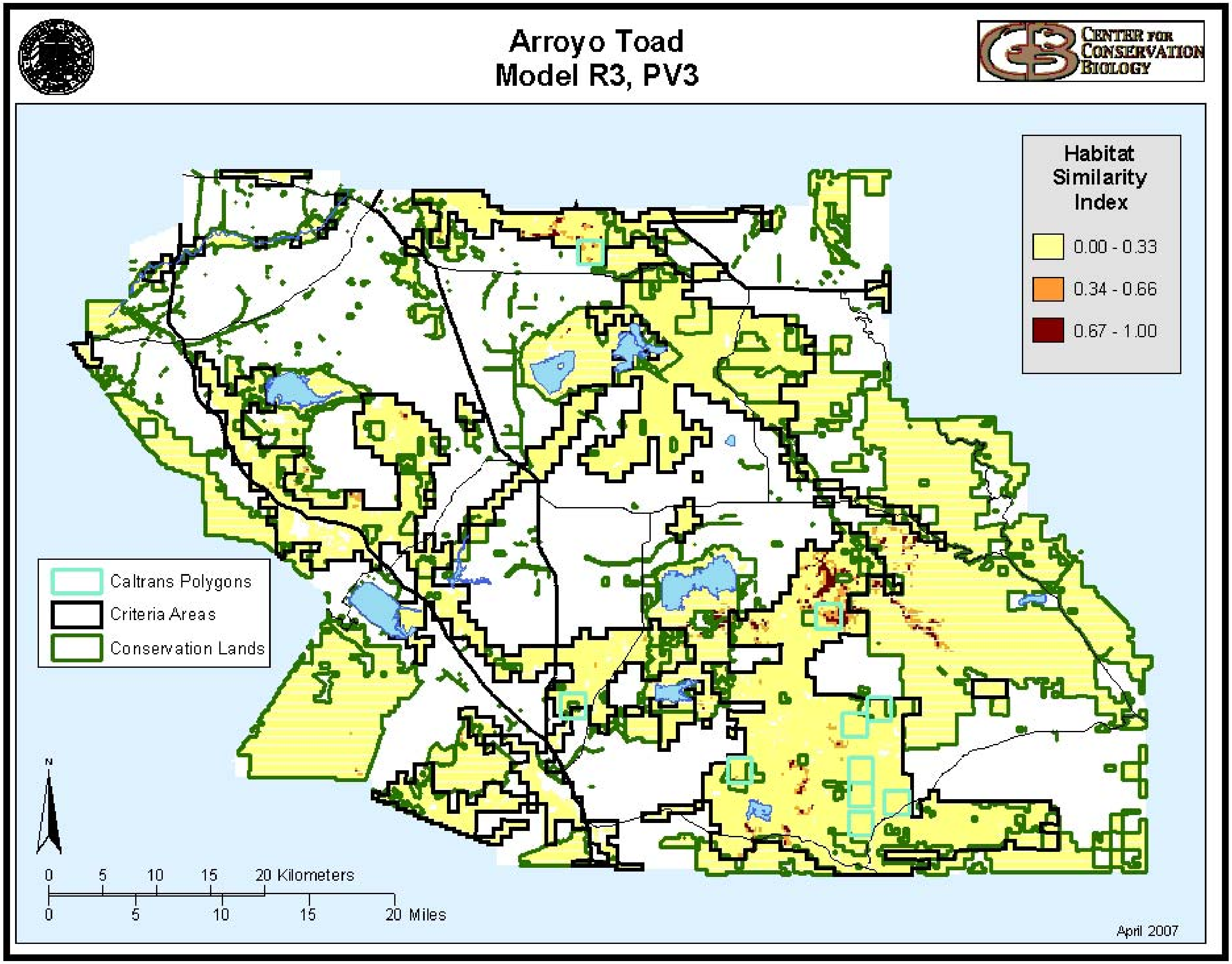


Figure 88. "HSI's" of habitat similarity for arroyo toad in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

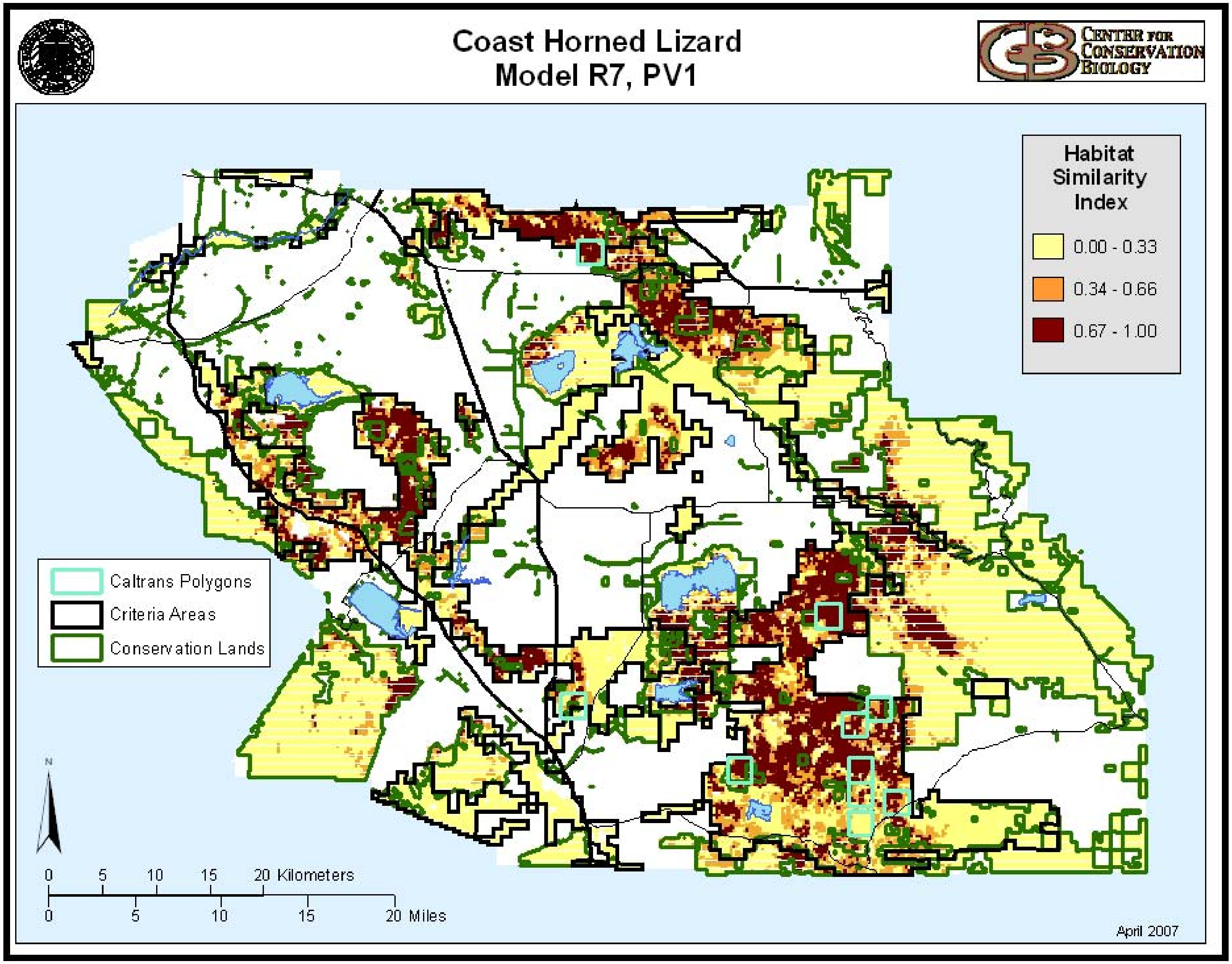


Figure 89. "HSI's" of habitat similarity for coast horned lizard in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

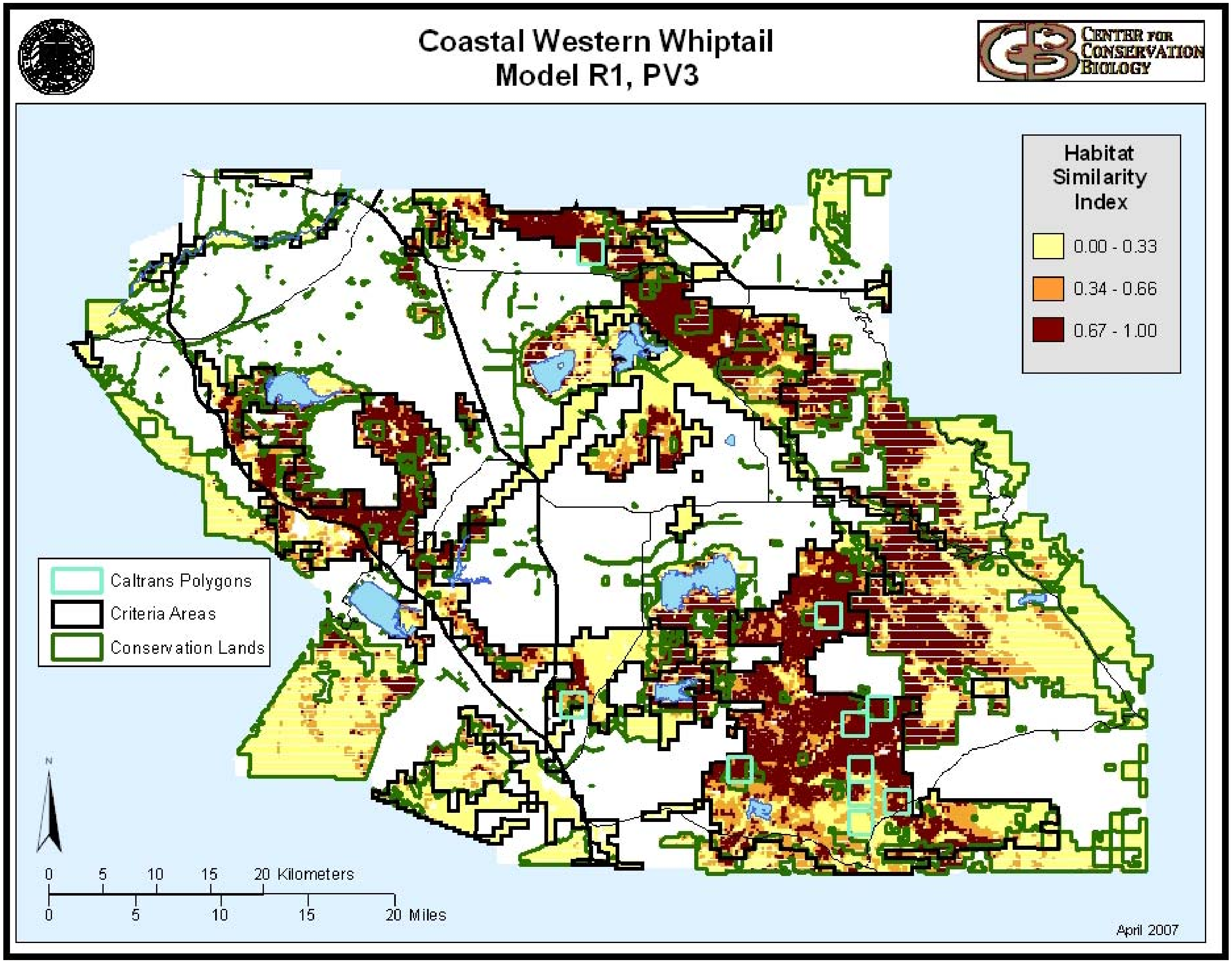


Figure 90. "HSI's" of habitat similarity for coastal western whiptail in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

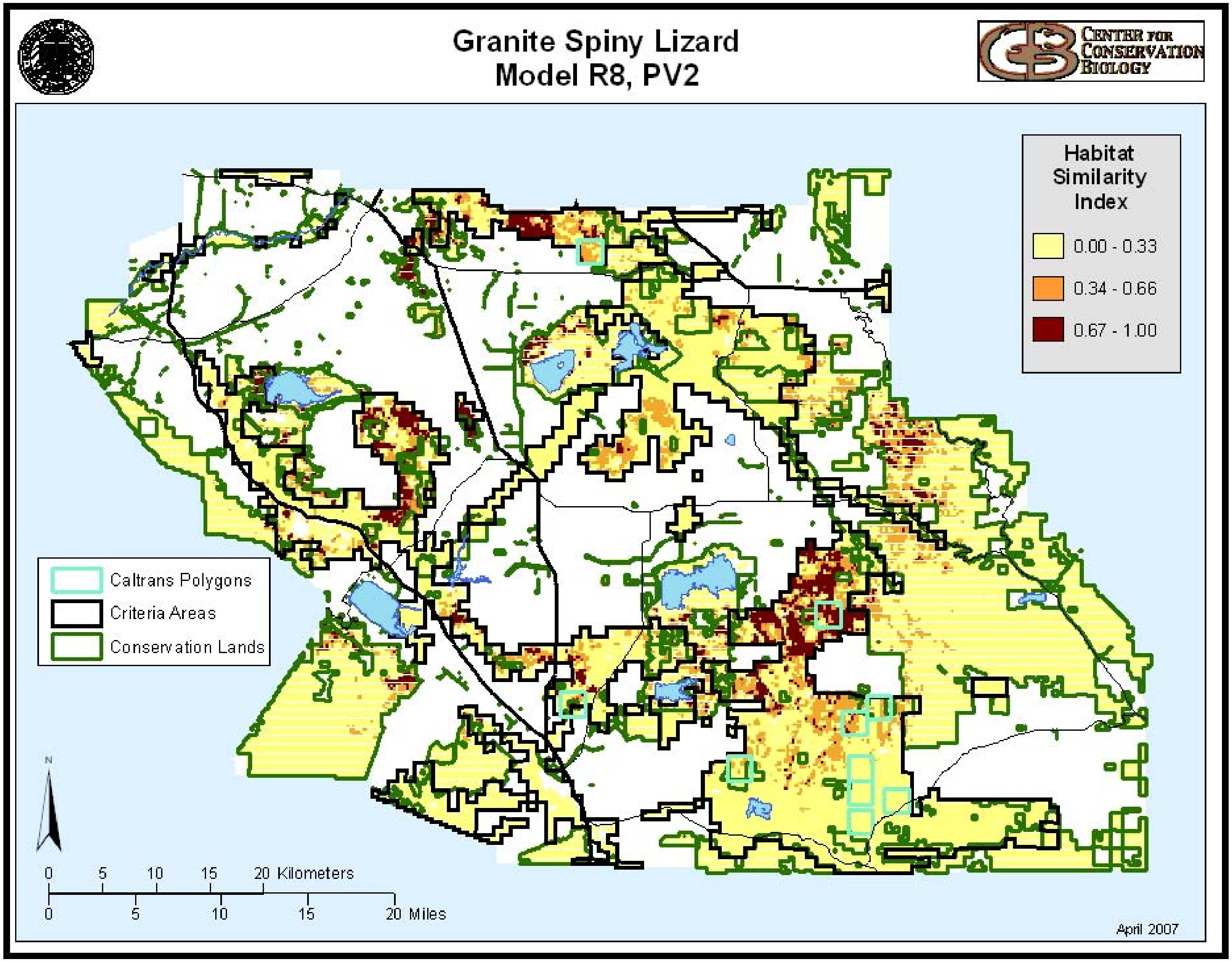


Figure 91. "HSI's" of habitat similarity for granite spiny lizard in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

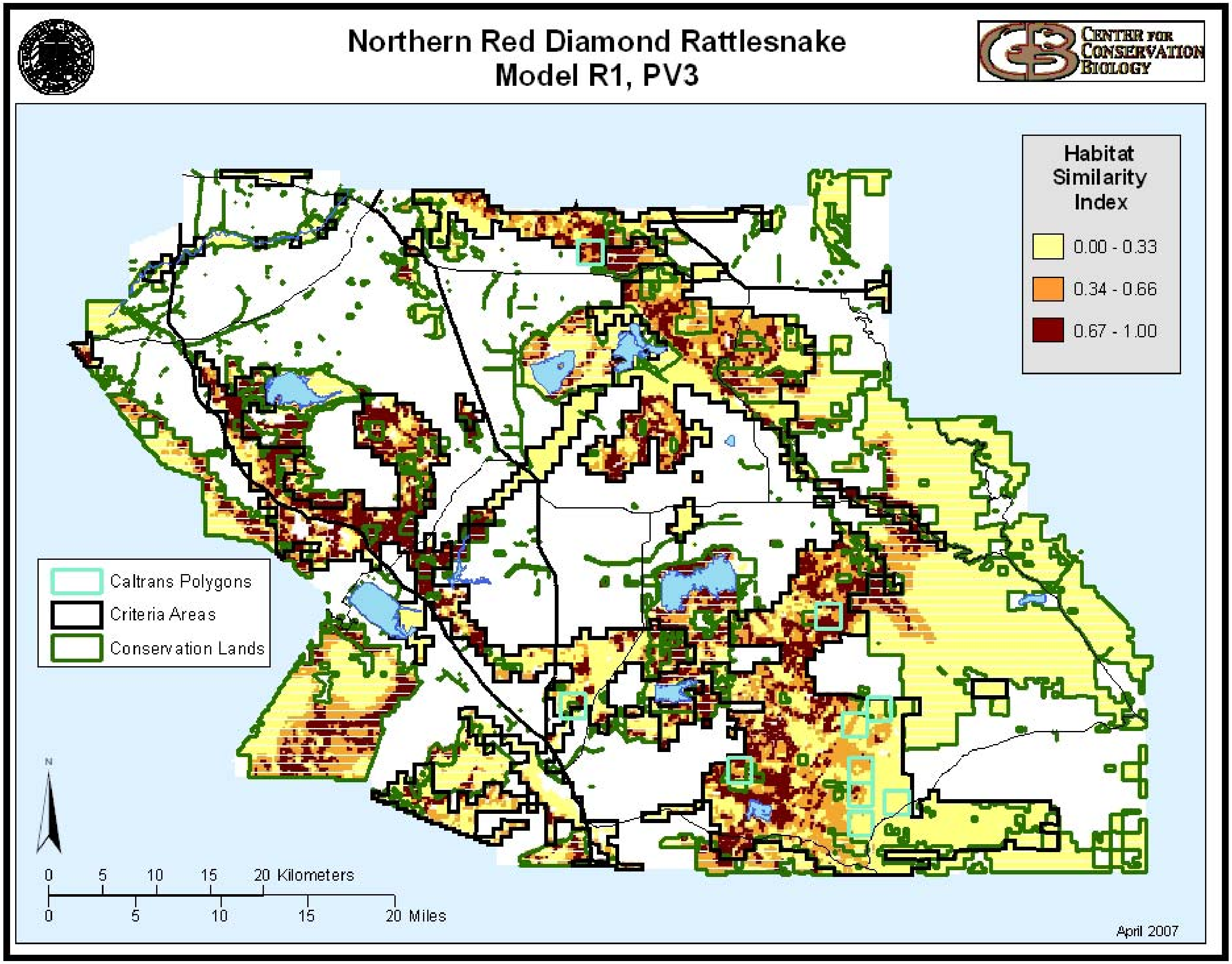


Figure 92. "HSI's" of habitat similarity for northern red diamond rattlesnake in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

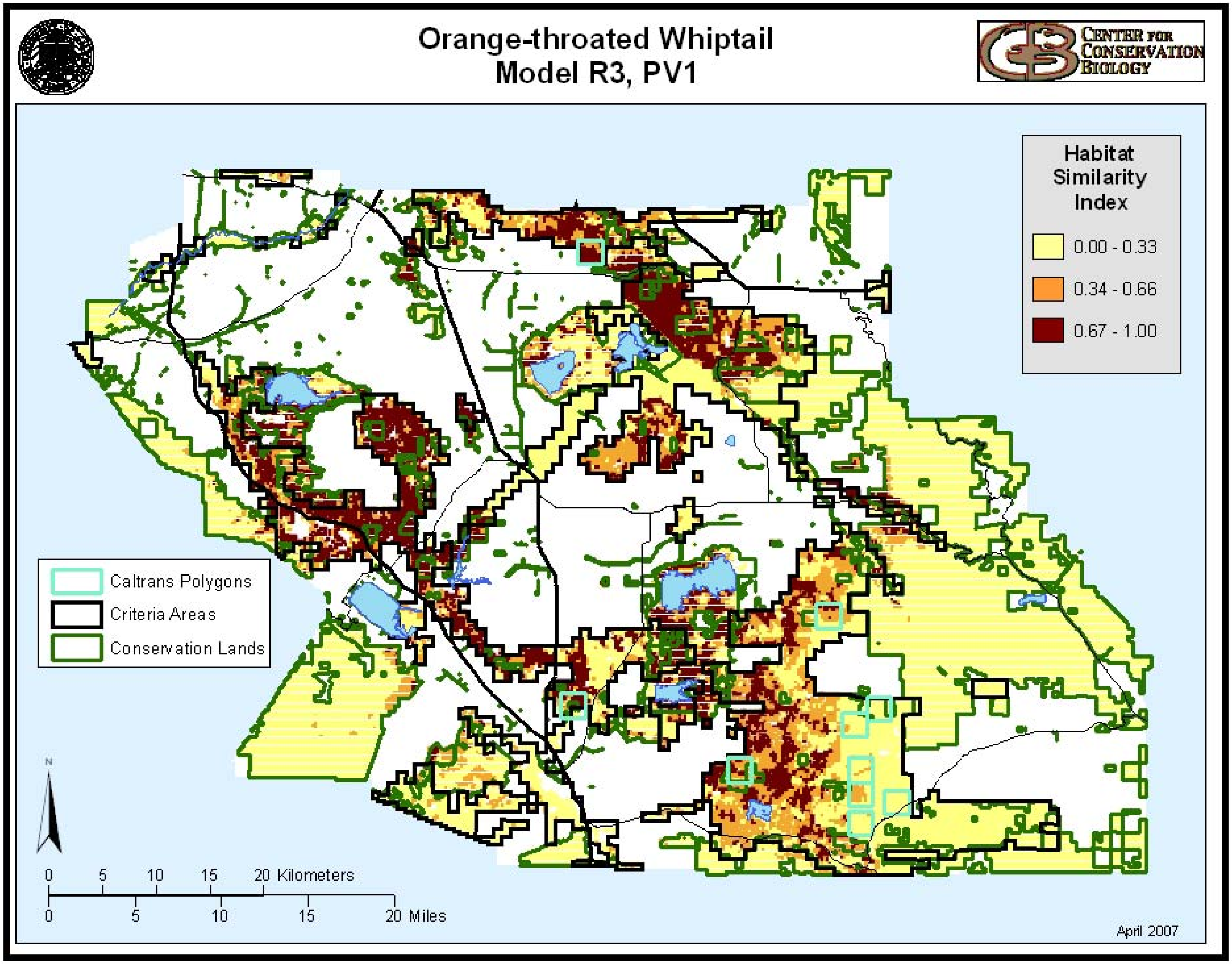


Figure 93. "HSI's" of habitat similarity for orange-throated whiptail in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

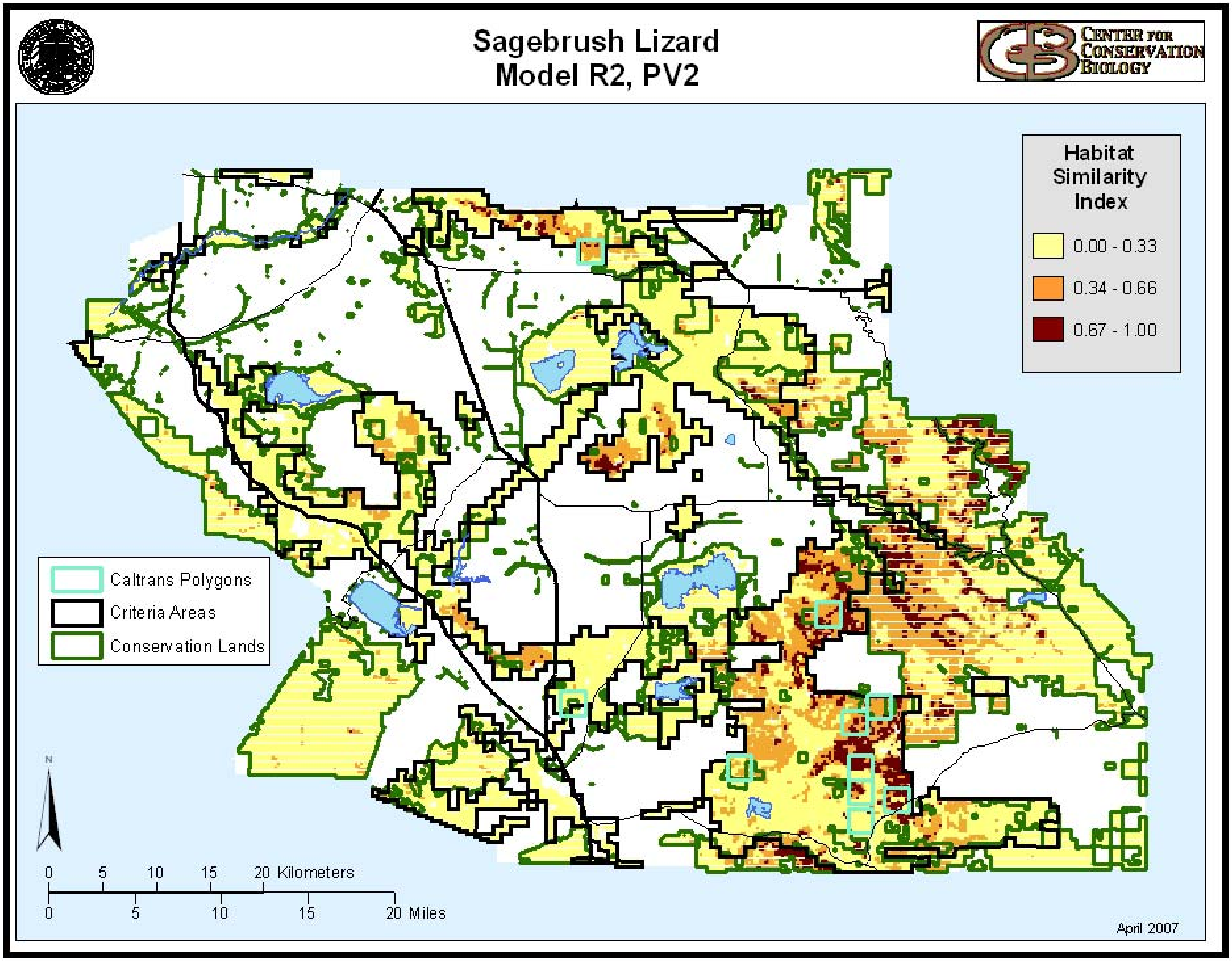


Figure 94. "HSI's" of habitat similarity for southern sagebrush lizard in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

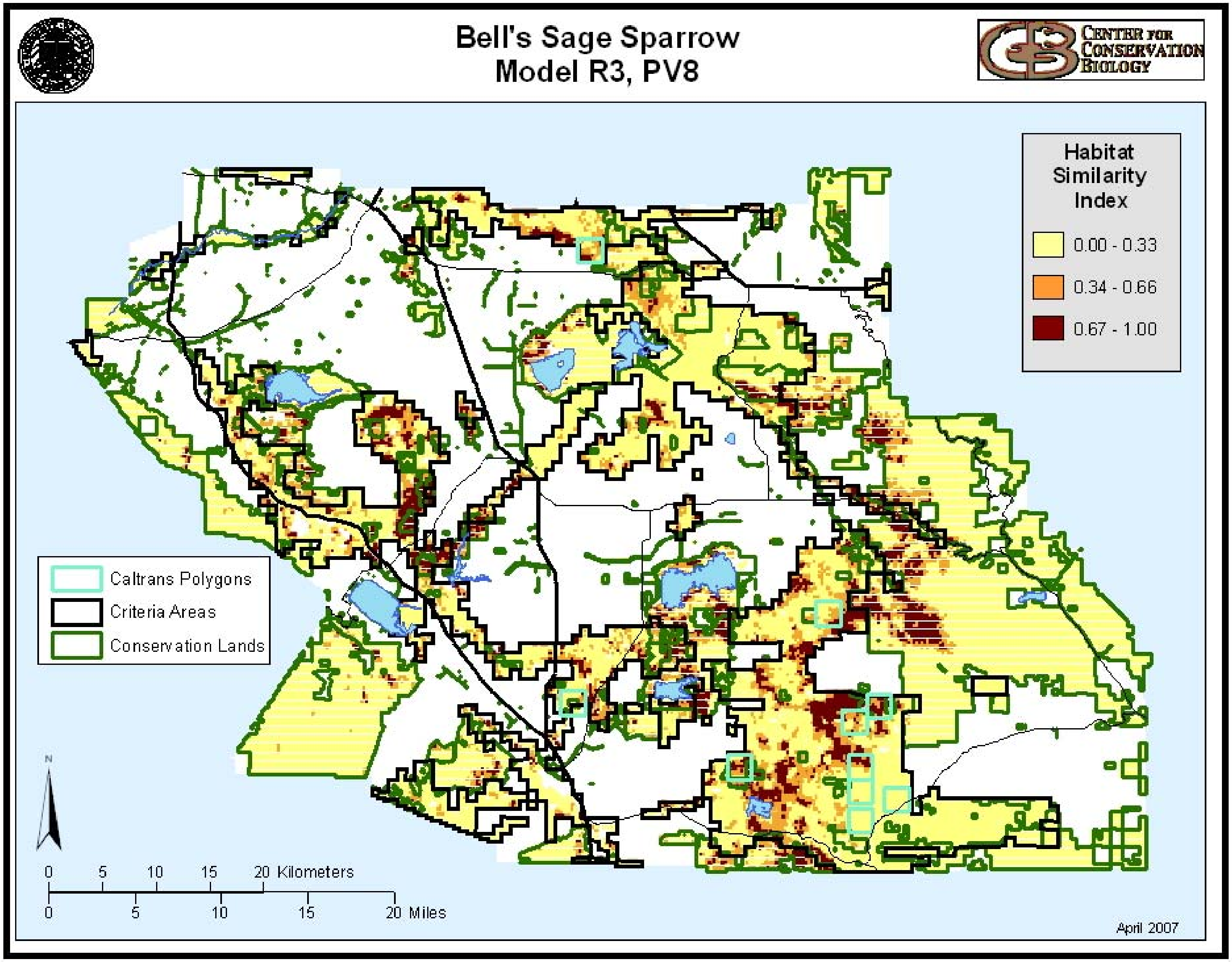


Figure 95. "HSI's" of habitat similarity for Bell's Sage Sparrow in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

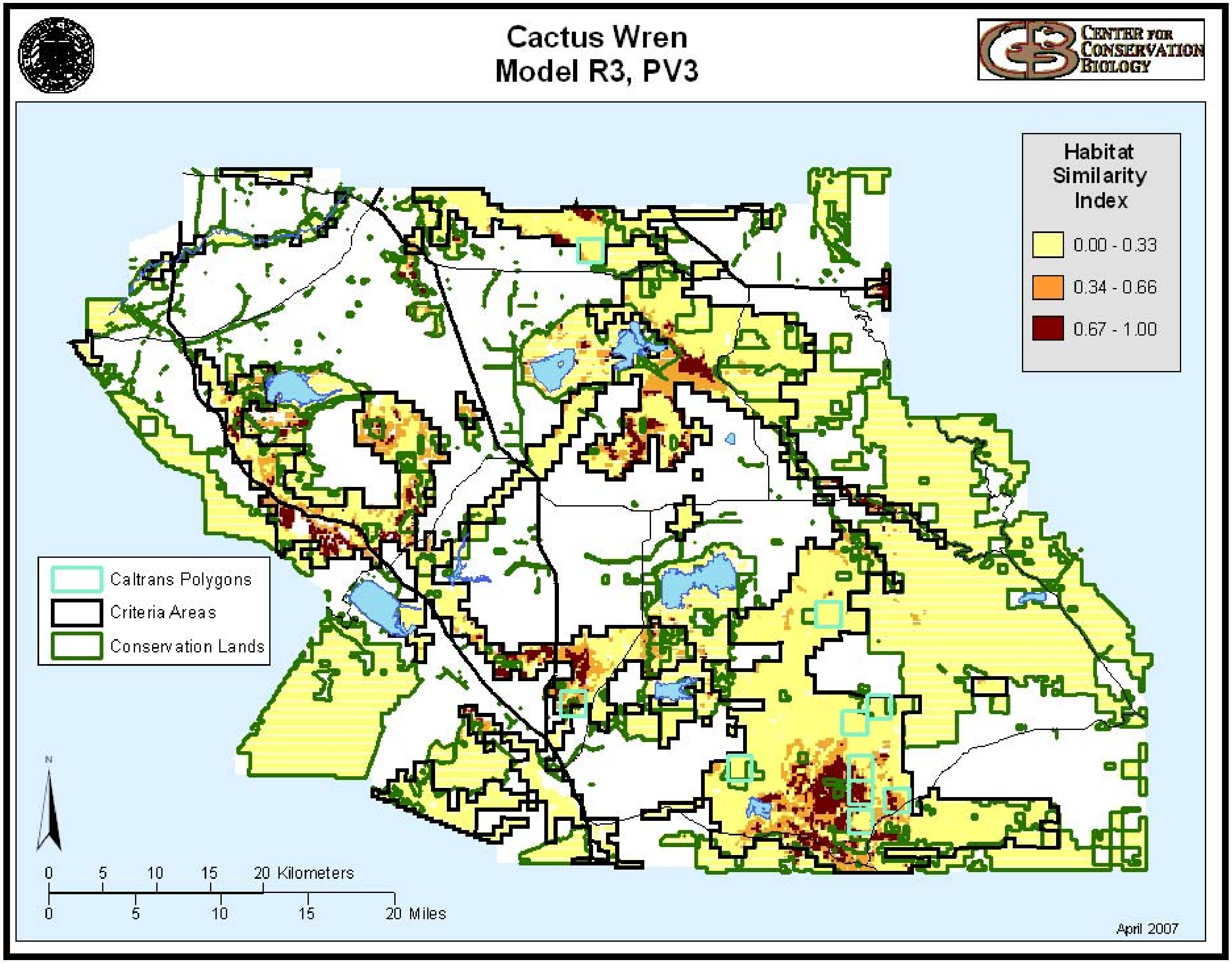


Figure 96. "HSI's" of habitat similarity for Cactus Wren in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

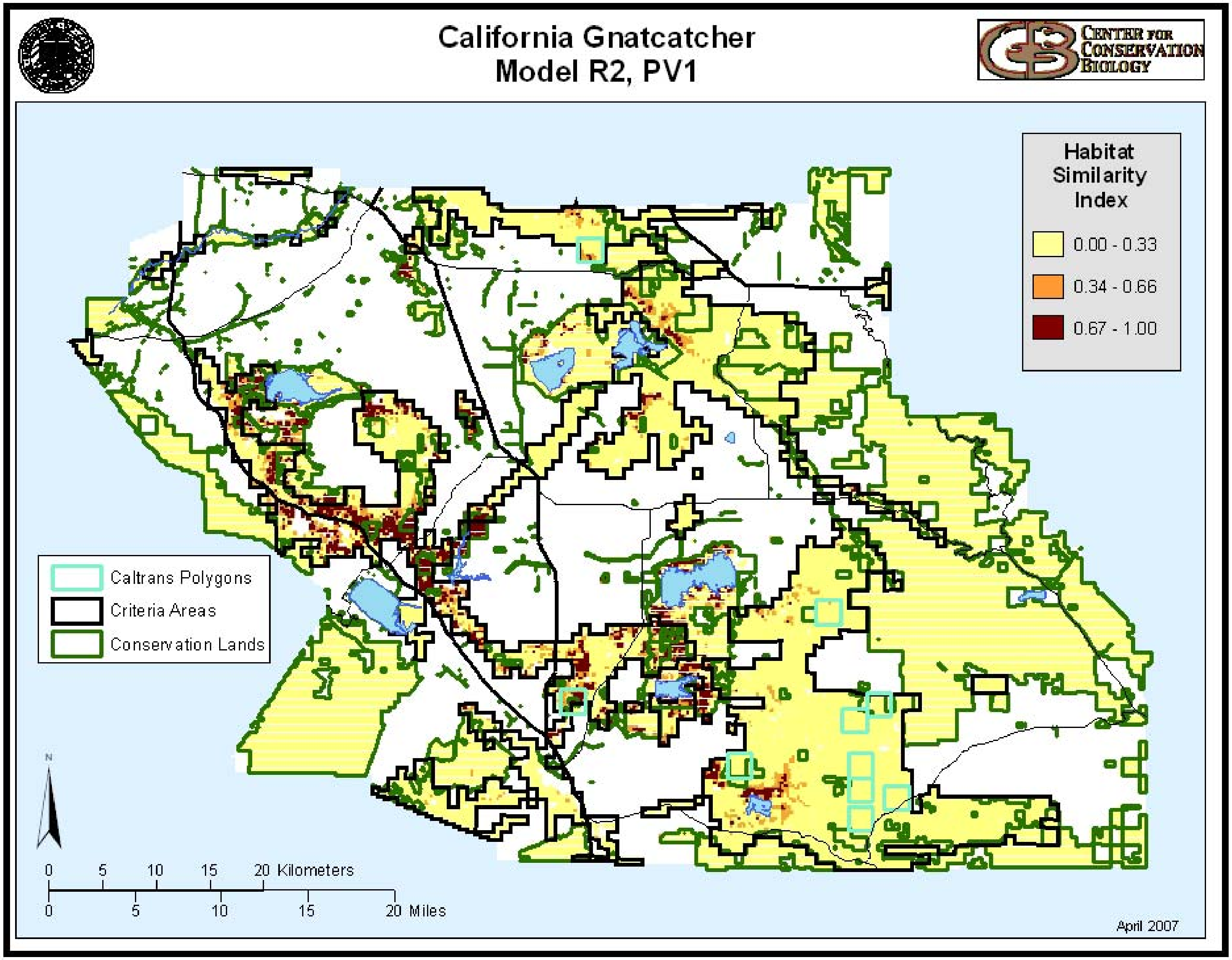


Figure 97. "HSI's" of habitat similarity for California Gnatcatcher in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

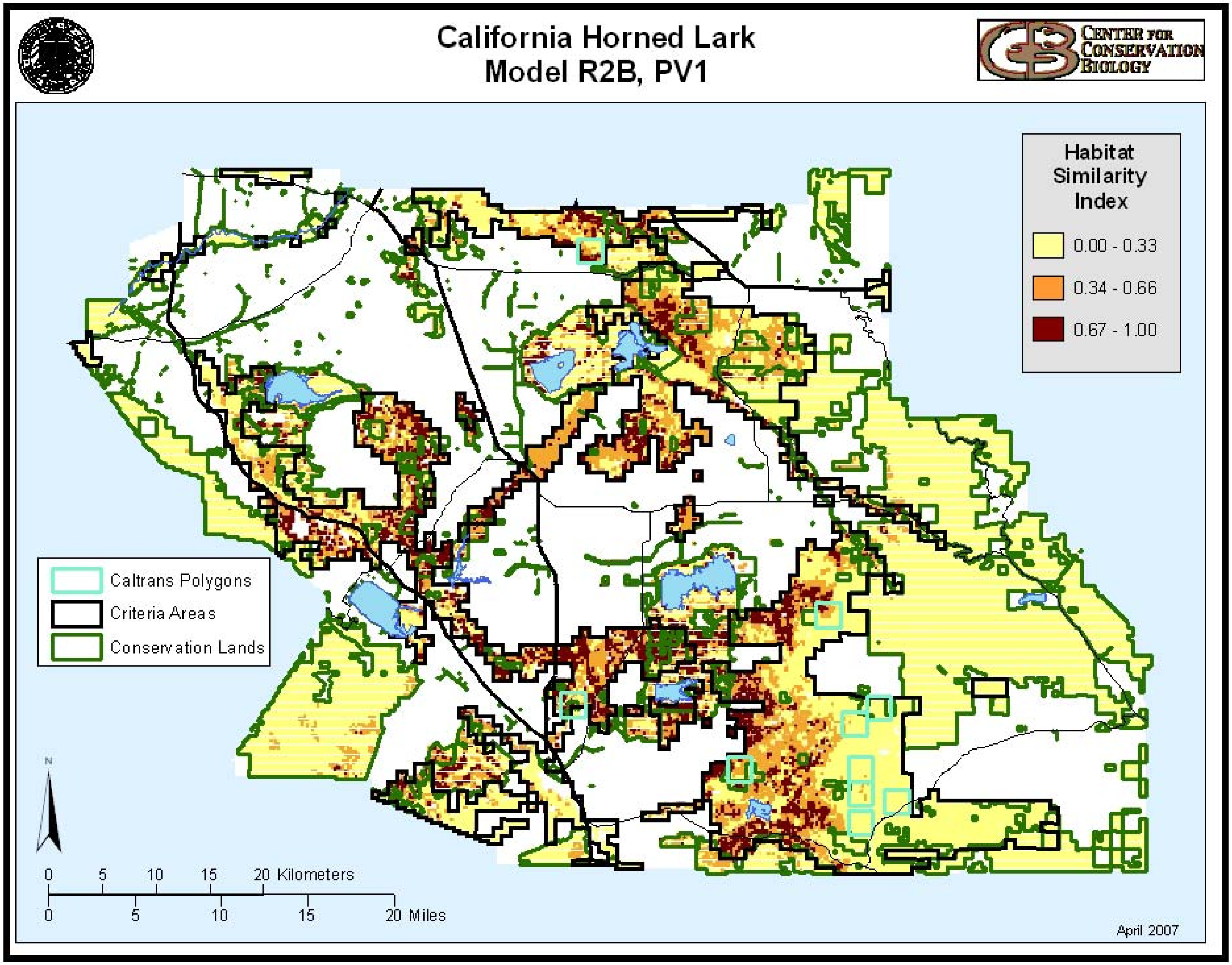


Figure 98. "HSI's" of habitat similarity for California Horned Lark in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

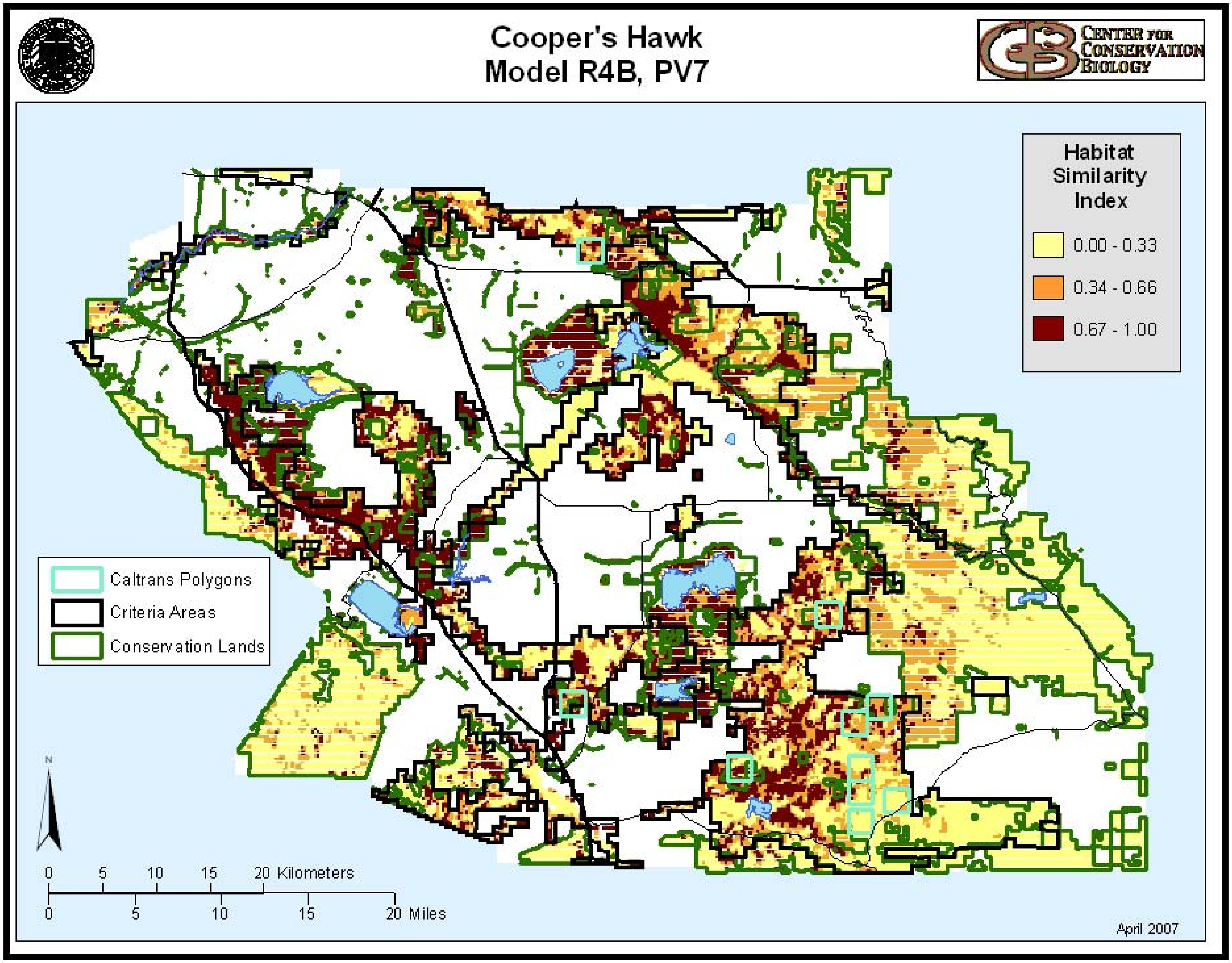


Figure 99. "HSI's" of habitat similarity for Cooper's Hawk in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

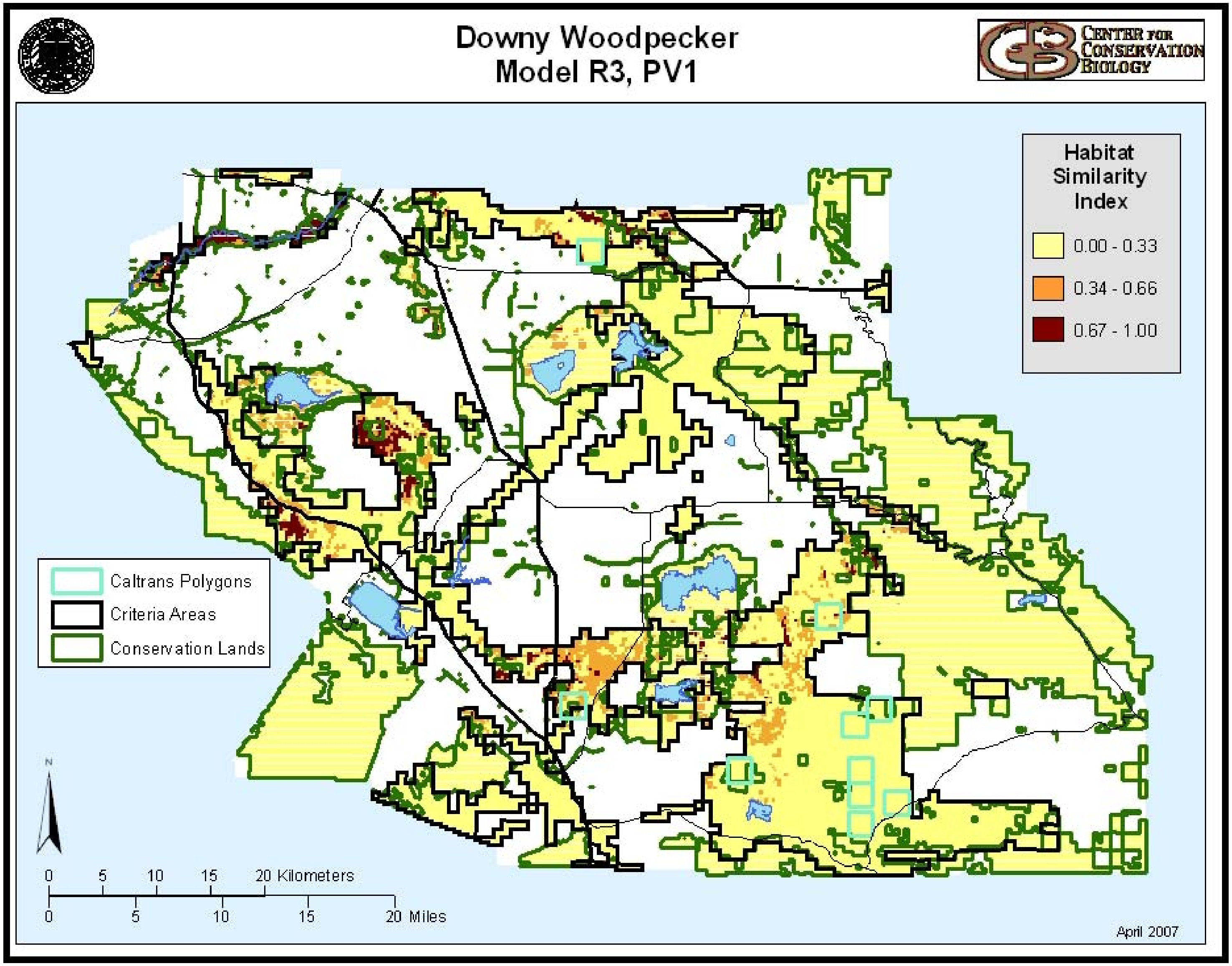


Figure 100. "HSI's" of habitat similarity for Downy Woodpecker in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

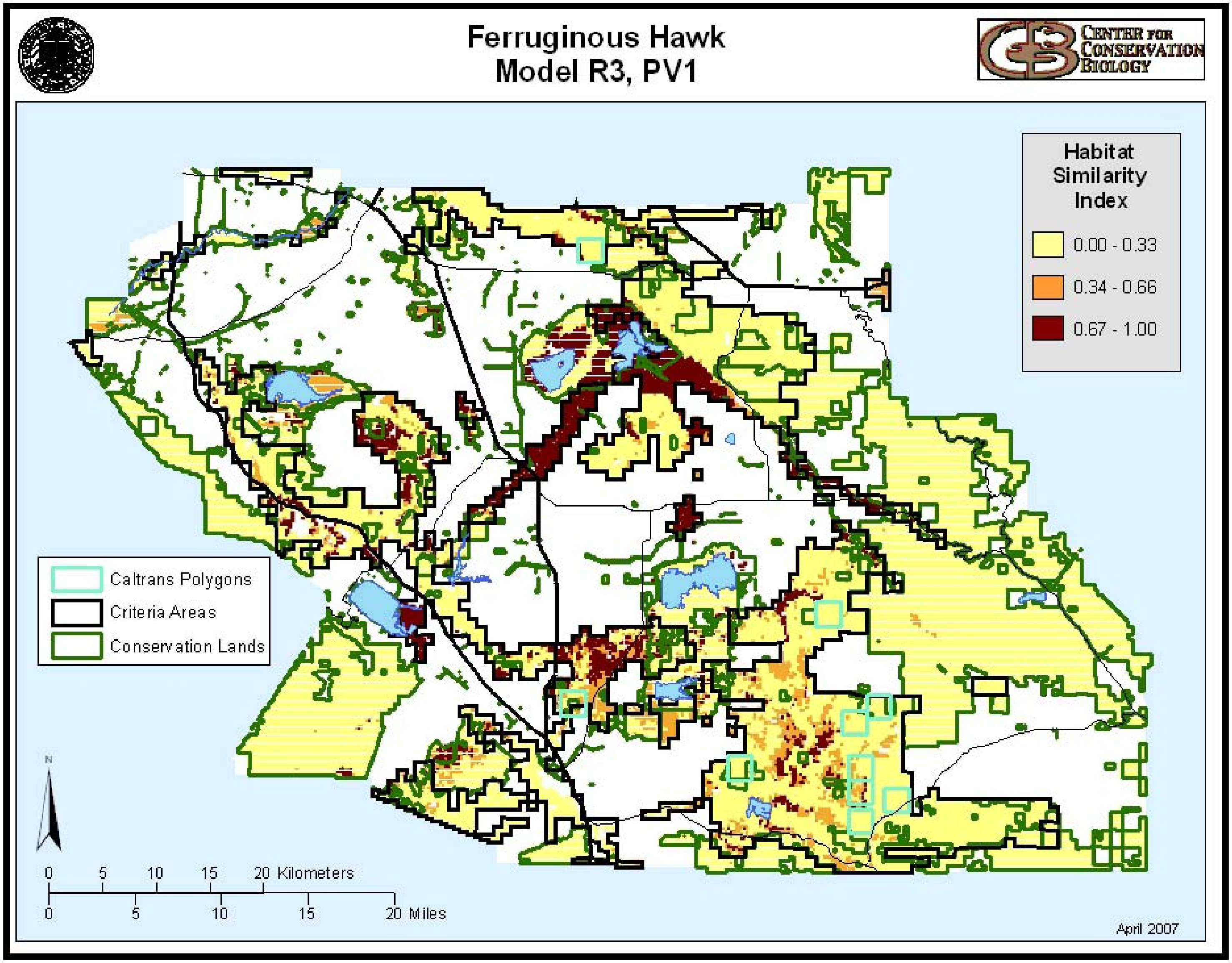


Figure 101. "HSI's" of habitat similarity for Ferruginous Hawk in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

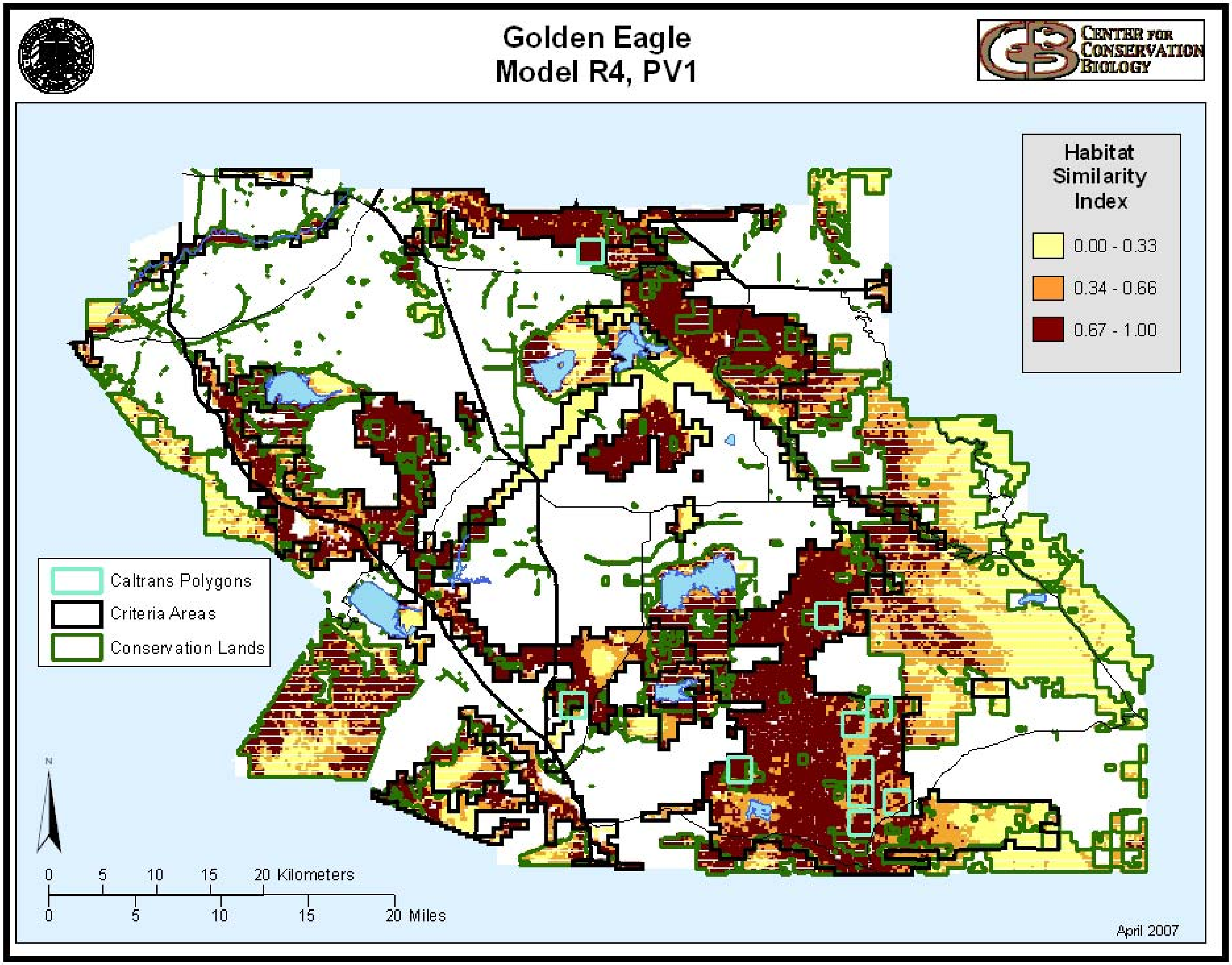


Figure 102. "HSI's" of habitat similarity for Golden Eagle in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

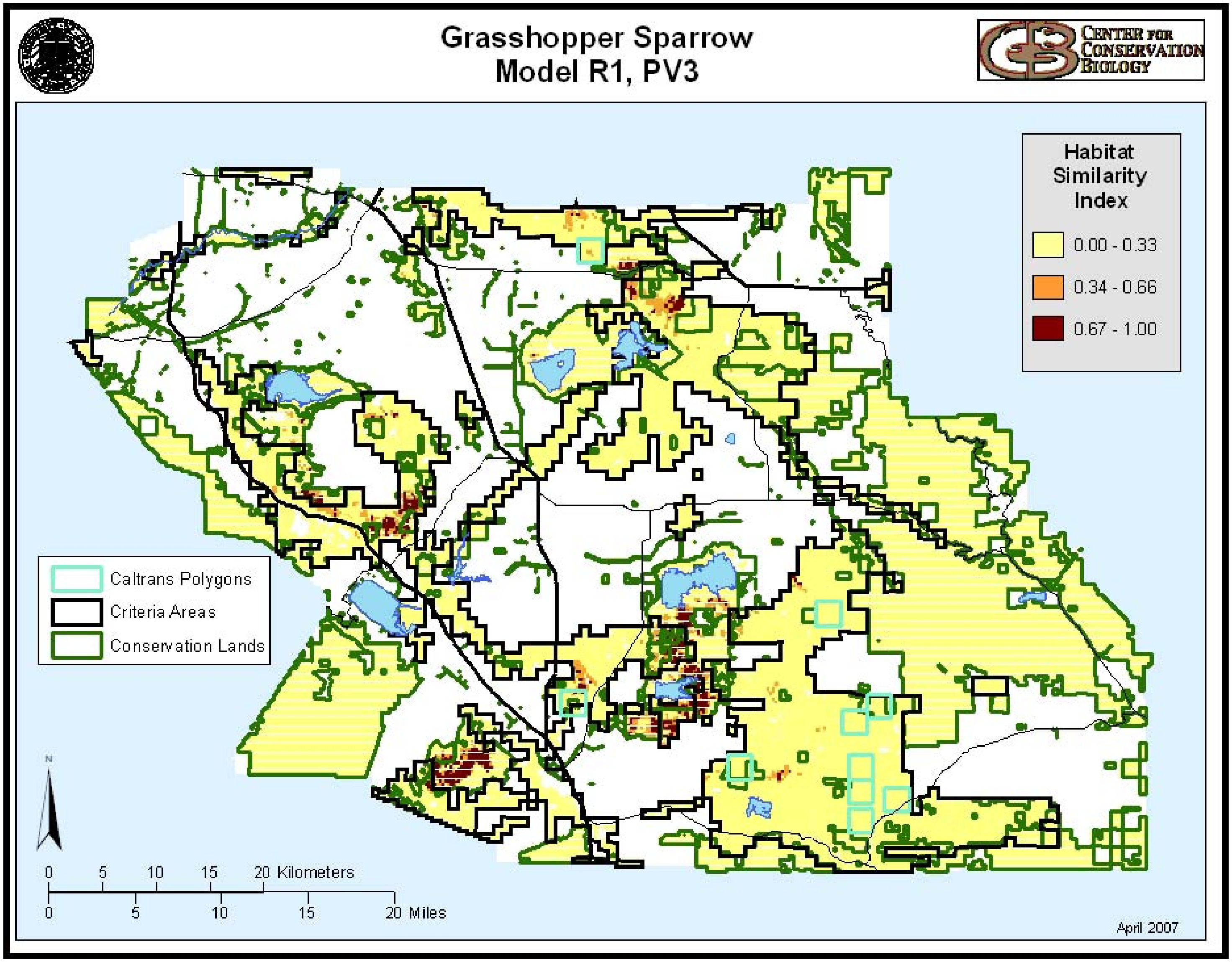


Figure 103. "HSI's" of habitat similarity for Grasshopper Sparrow in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

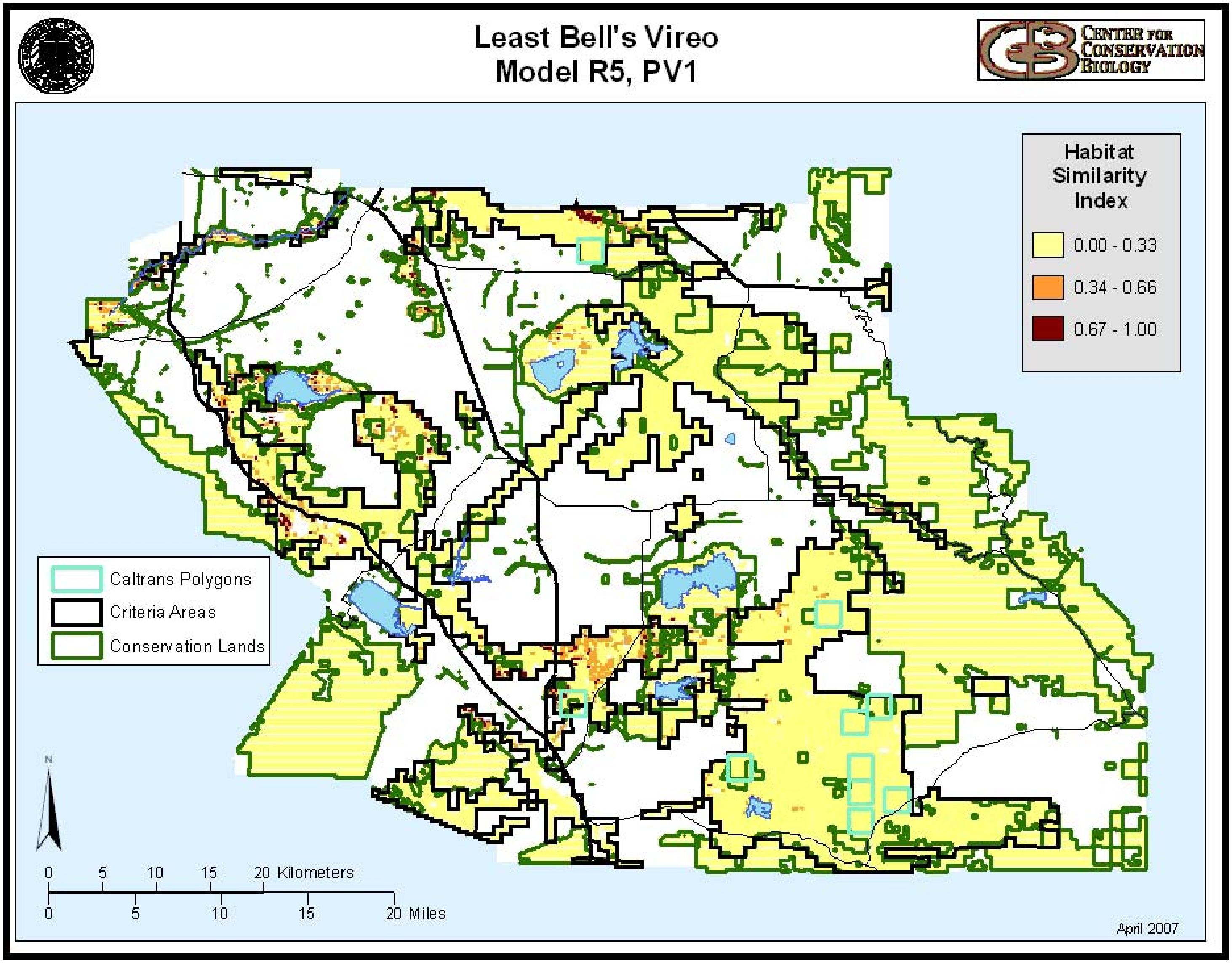


Figure 104. "HSI's" of habitat similarity for Least Bell's Vireo in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

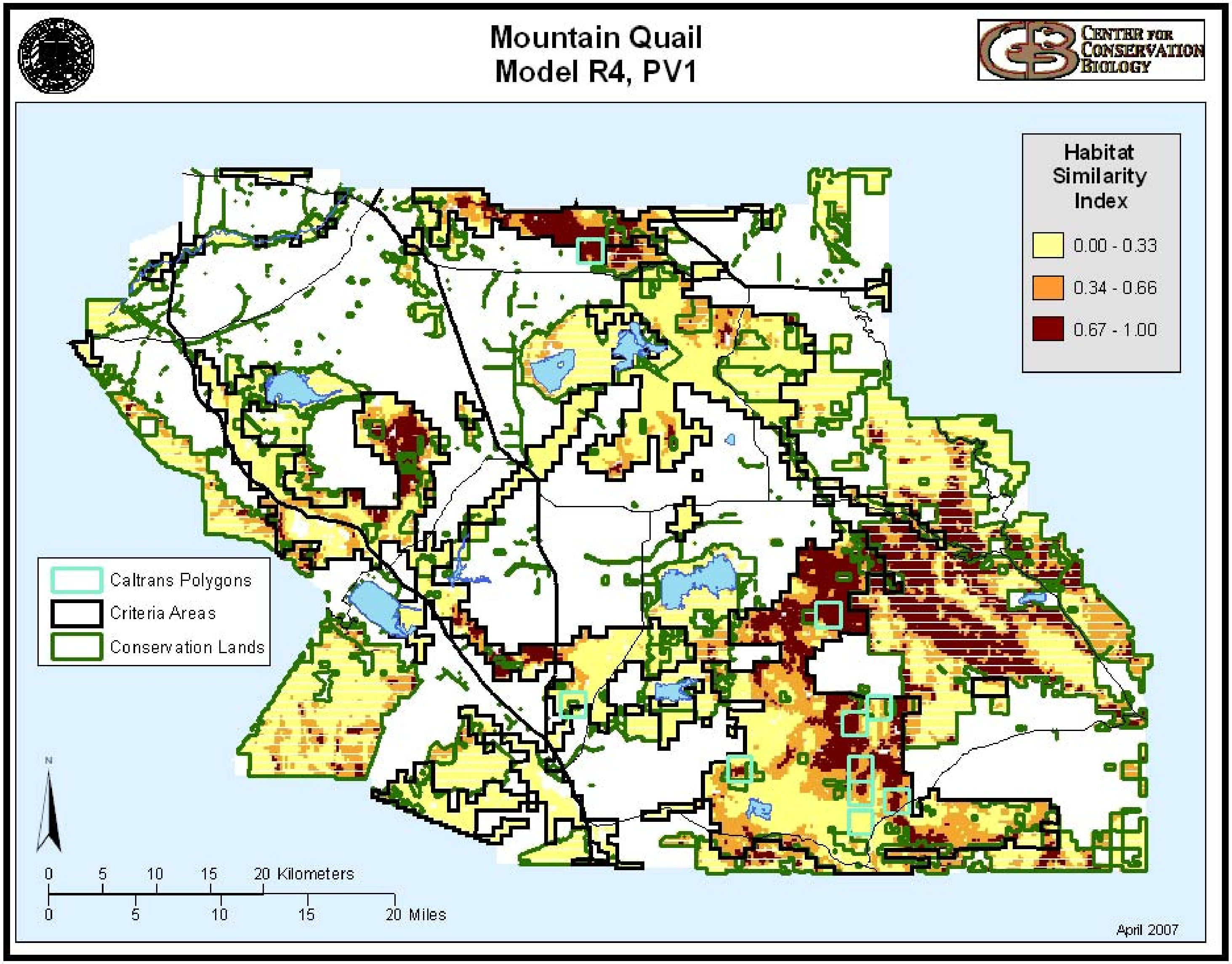


Figure 105. "HSI's" of habitat similarity for Mountain Quail in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

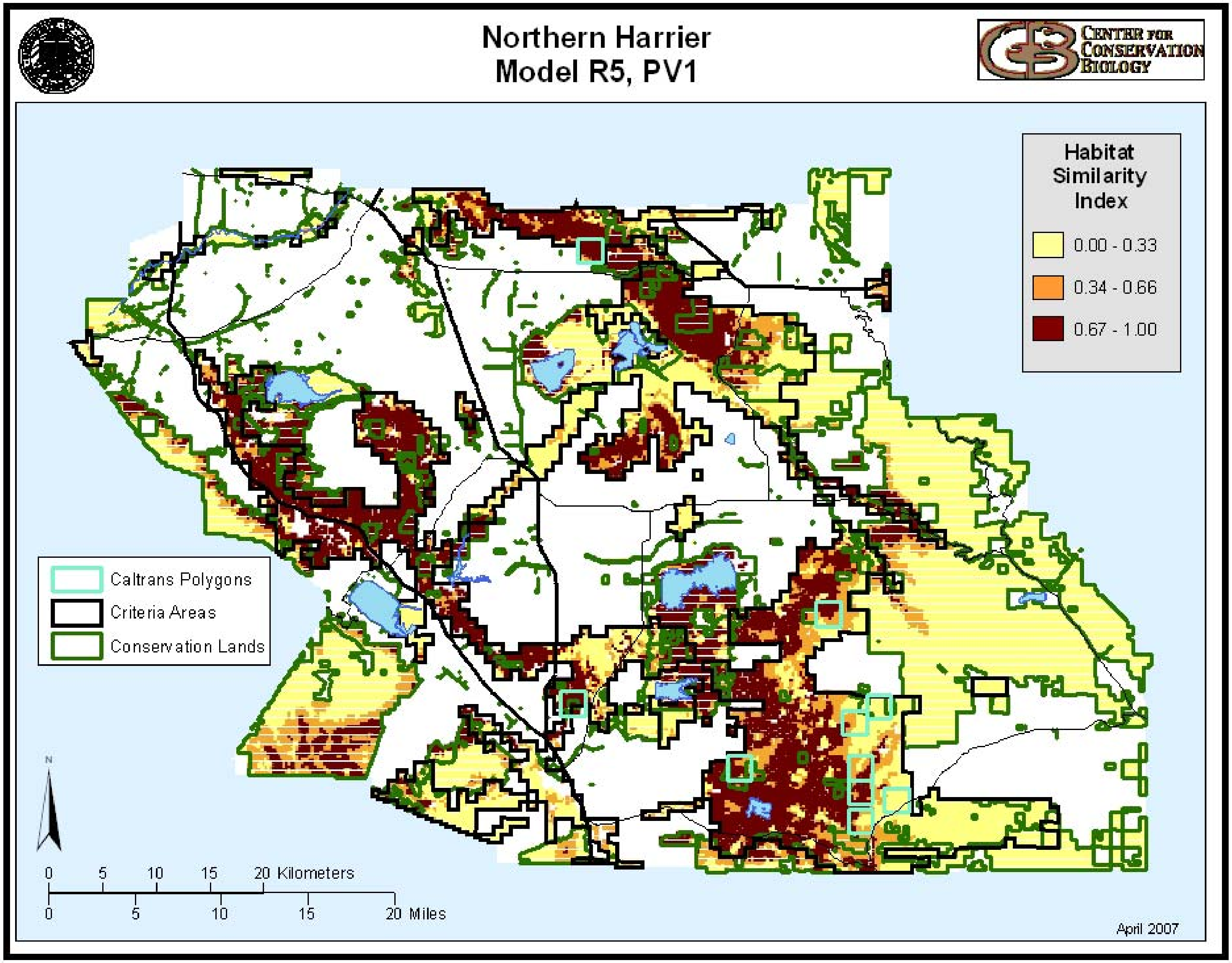


Figure 106. "HSI's" of habitat similarity for Northern Harrier in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

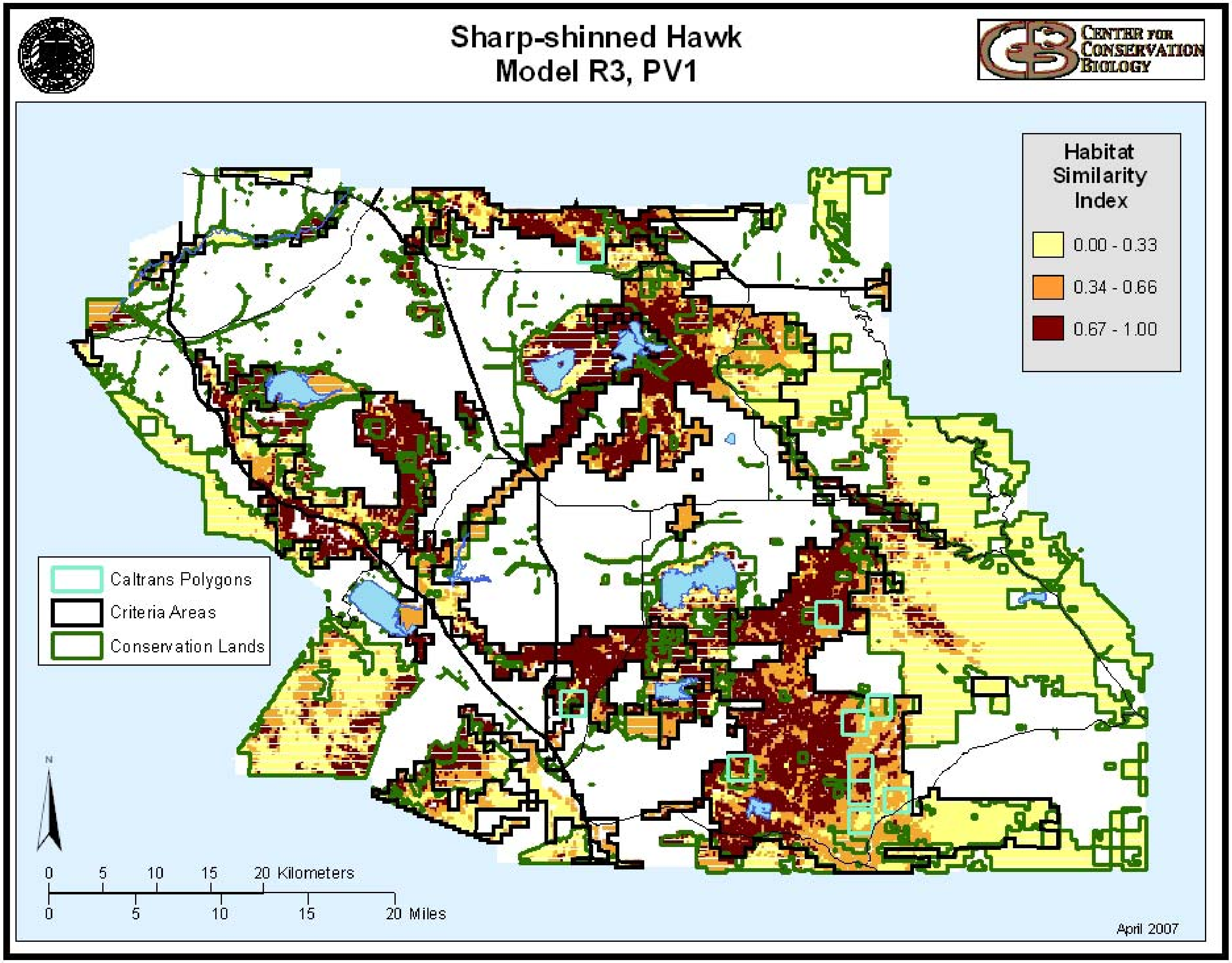


Figure 107. "HSI's" of habitat similarity for Sharp-shinned Hawk in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

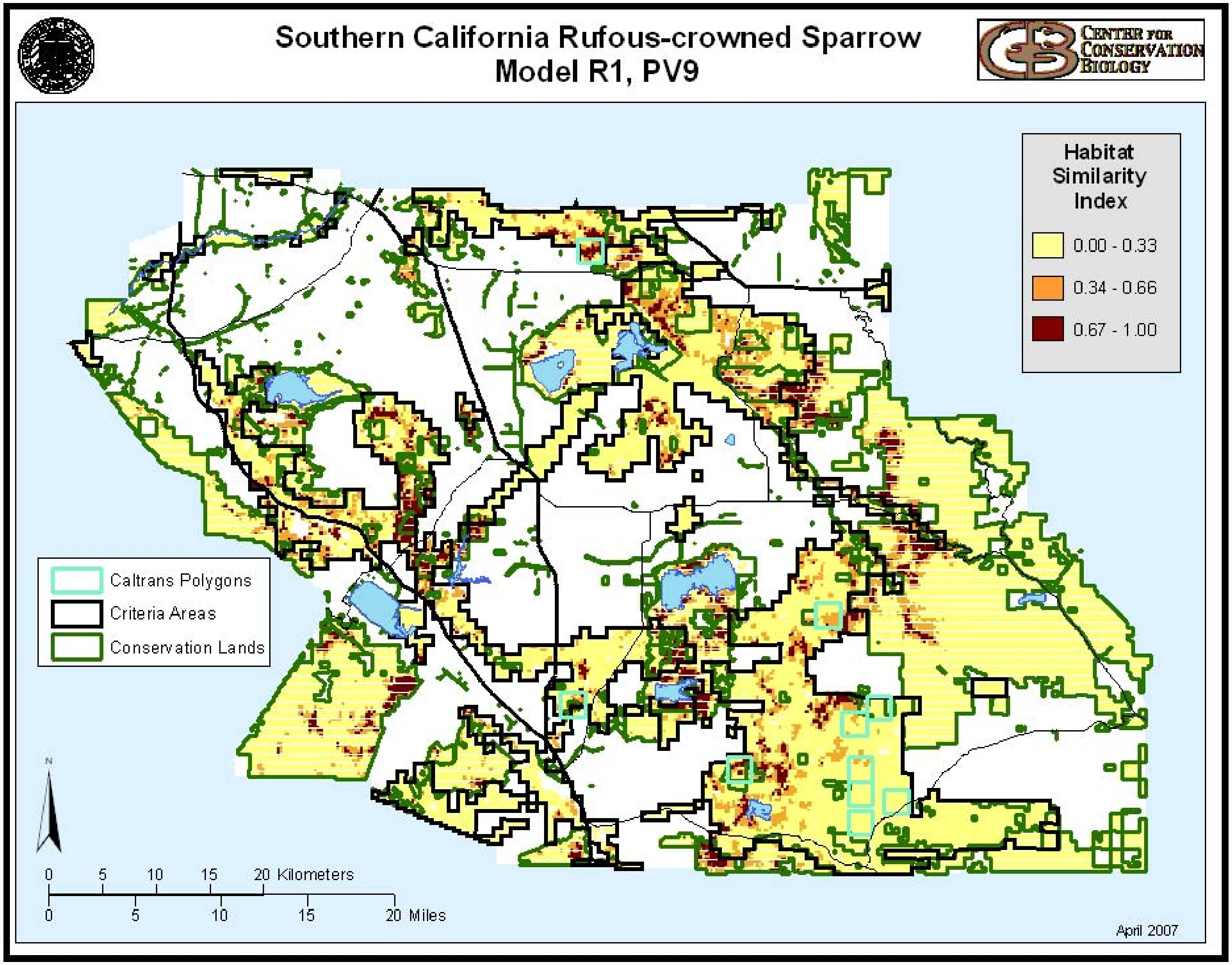


Figure 108. "HSI's" of habitat similarity for Southern California Rufous-crowned Sparrow in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

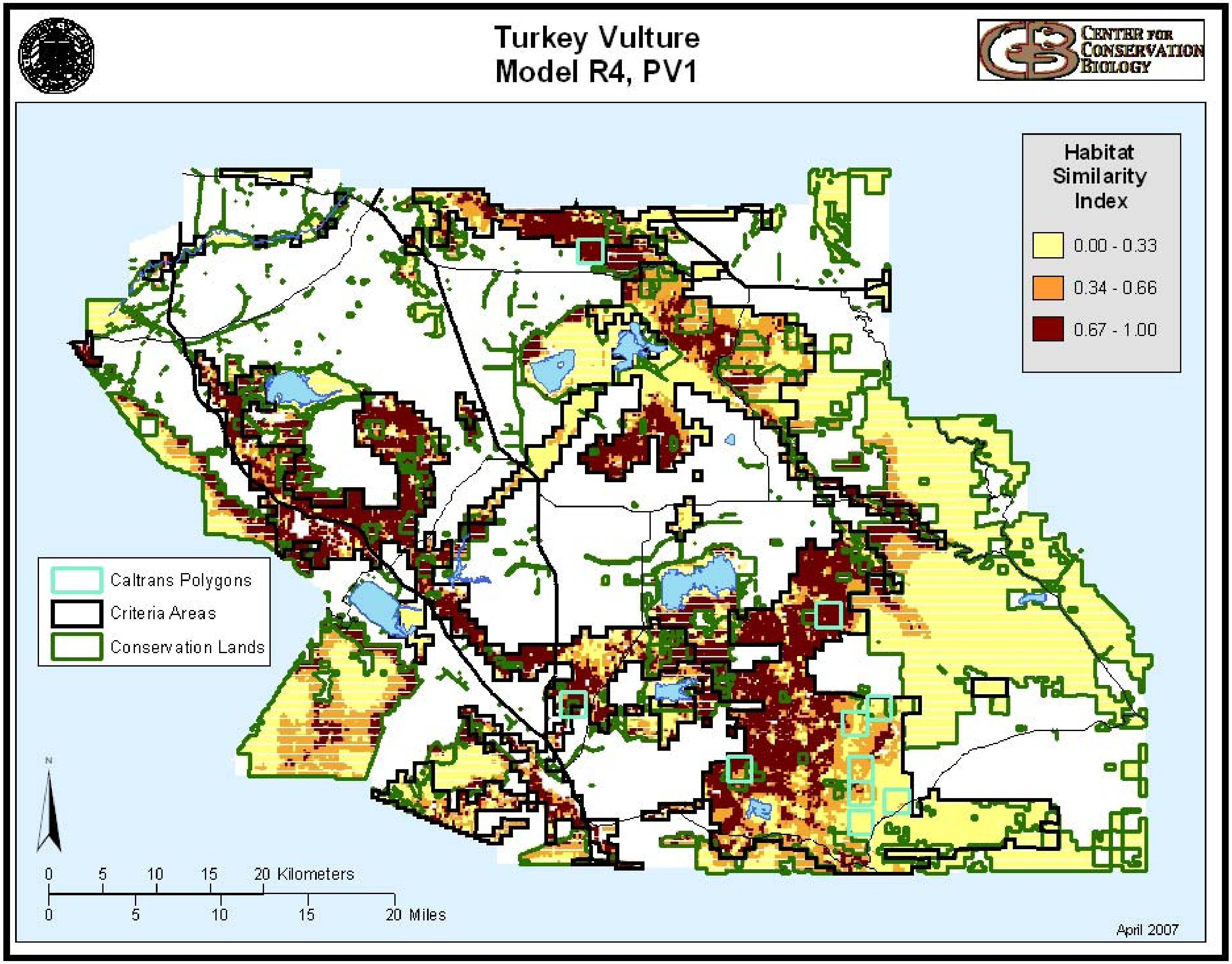


Figure 109. "HSI's" of habitat similarity for Turkey Vulture in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

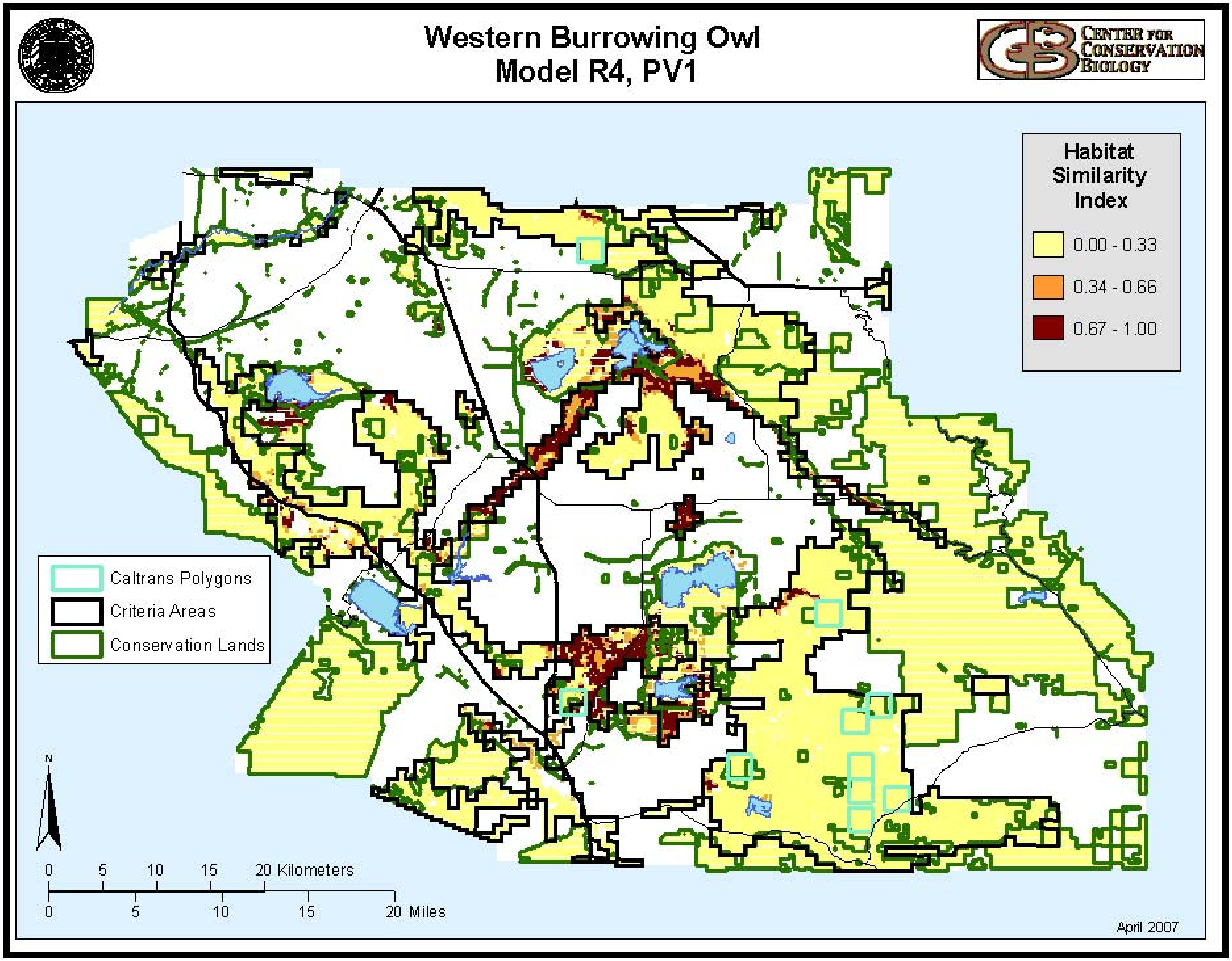


Figure 110. "HSI's" of habitat similarity for Western Burrowing Owl in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

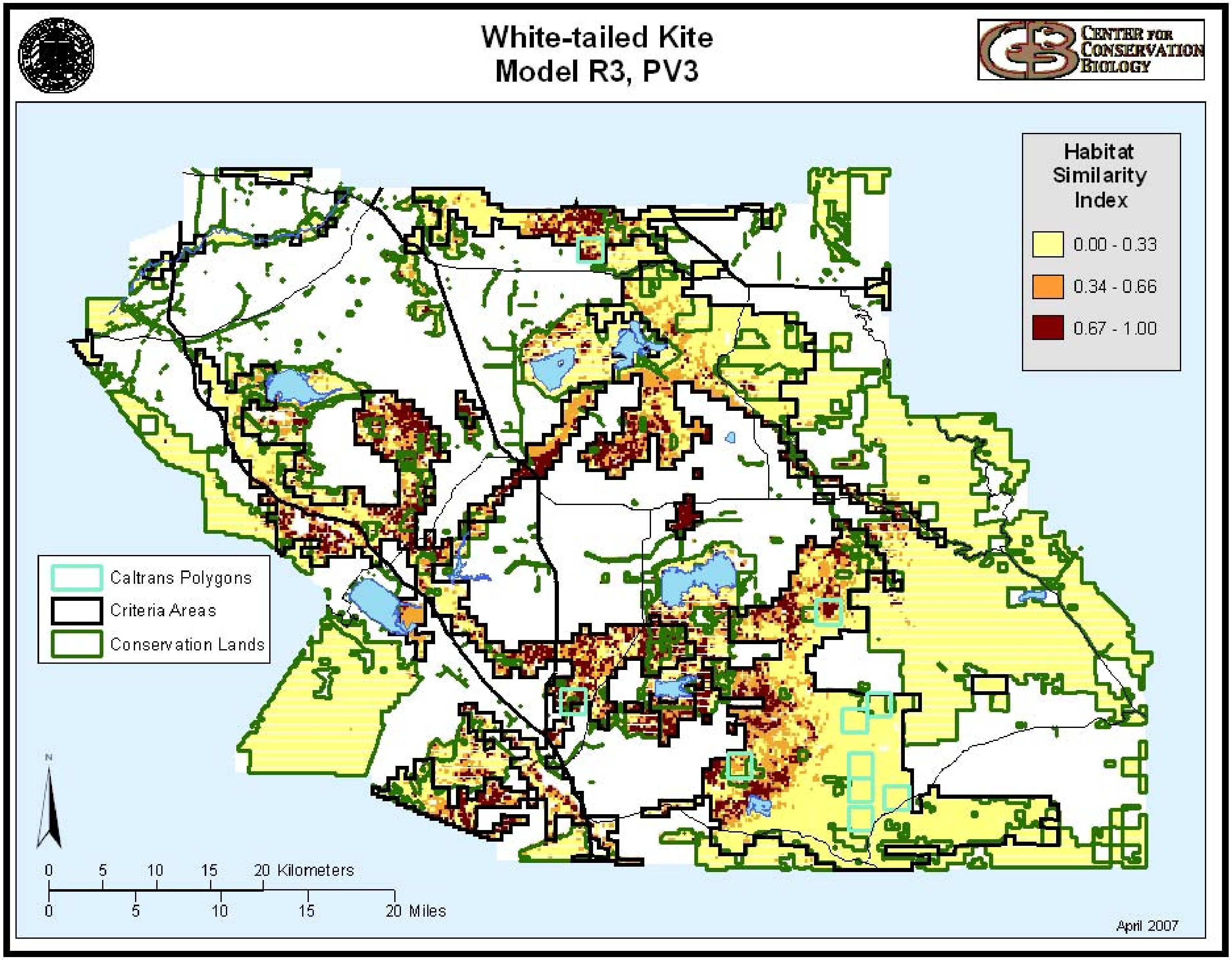


Figure 111. "HSI's" of habitat similarity for White-tailed Kite in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

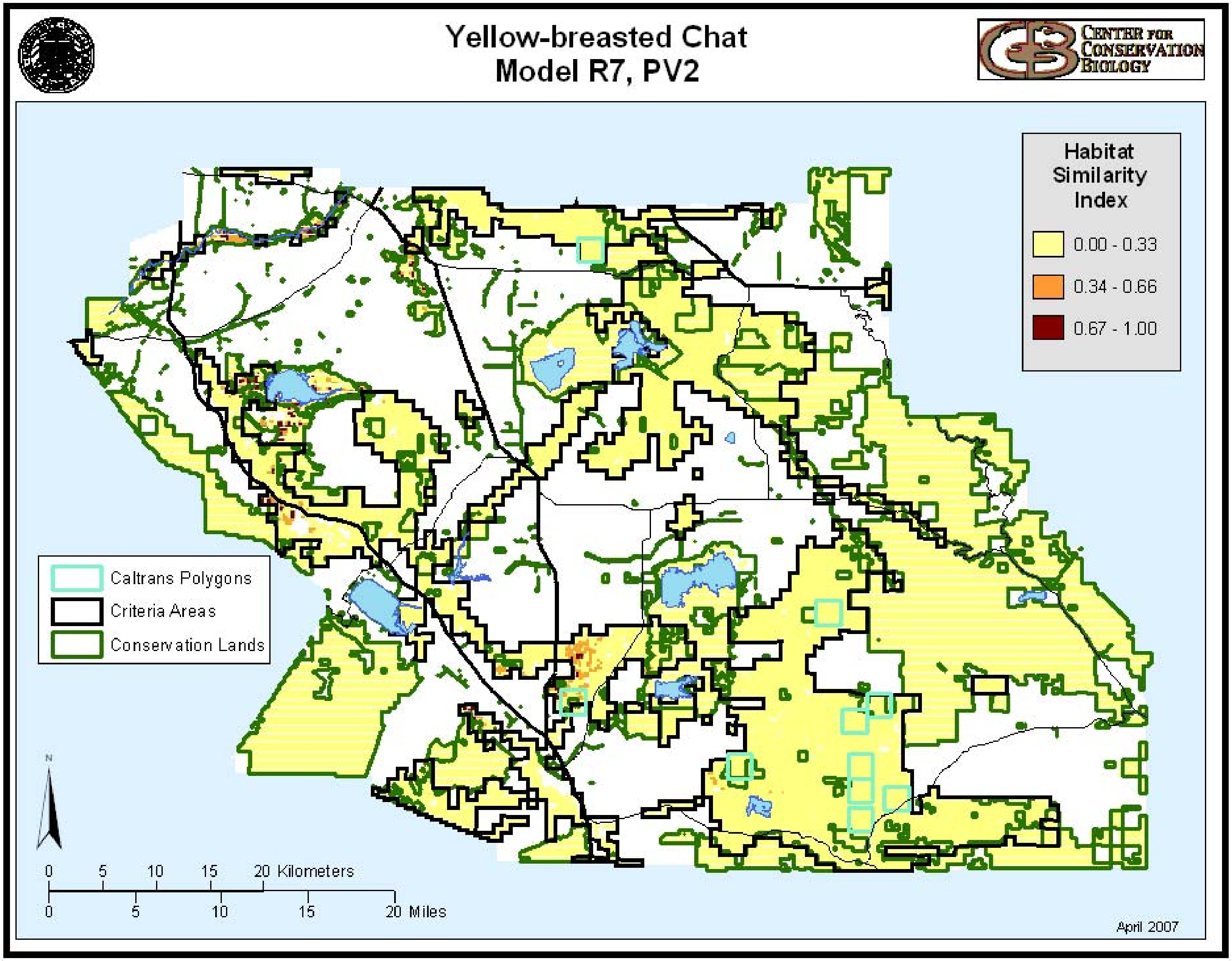


Figure 112. "HSI's" of habitat similarity for Yellow-breasted Chat in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

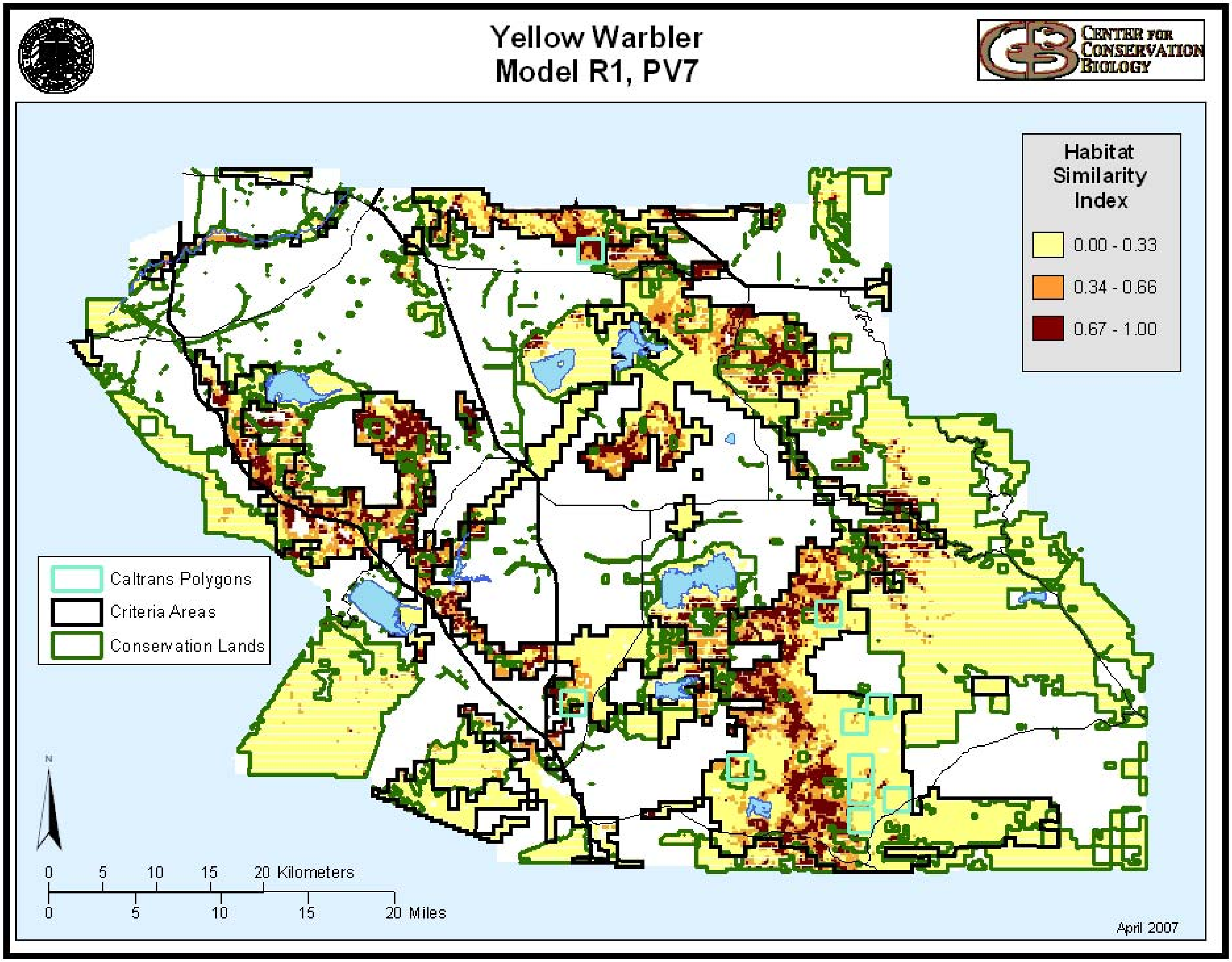


Figure 113. "HSI's" of habitat similarity for Yellow Warbler in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

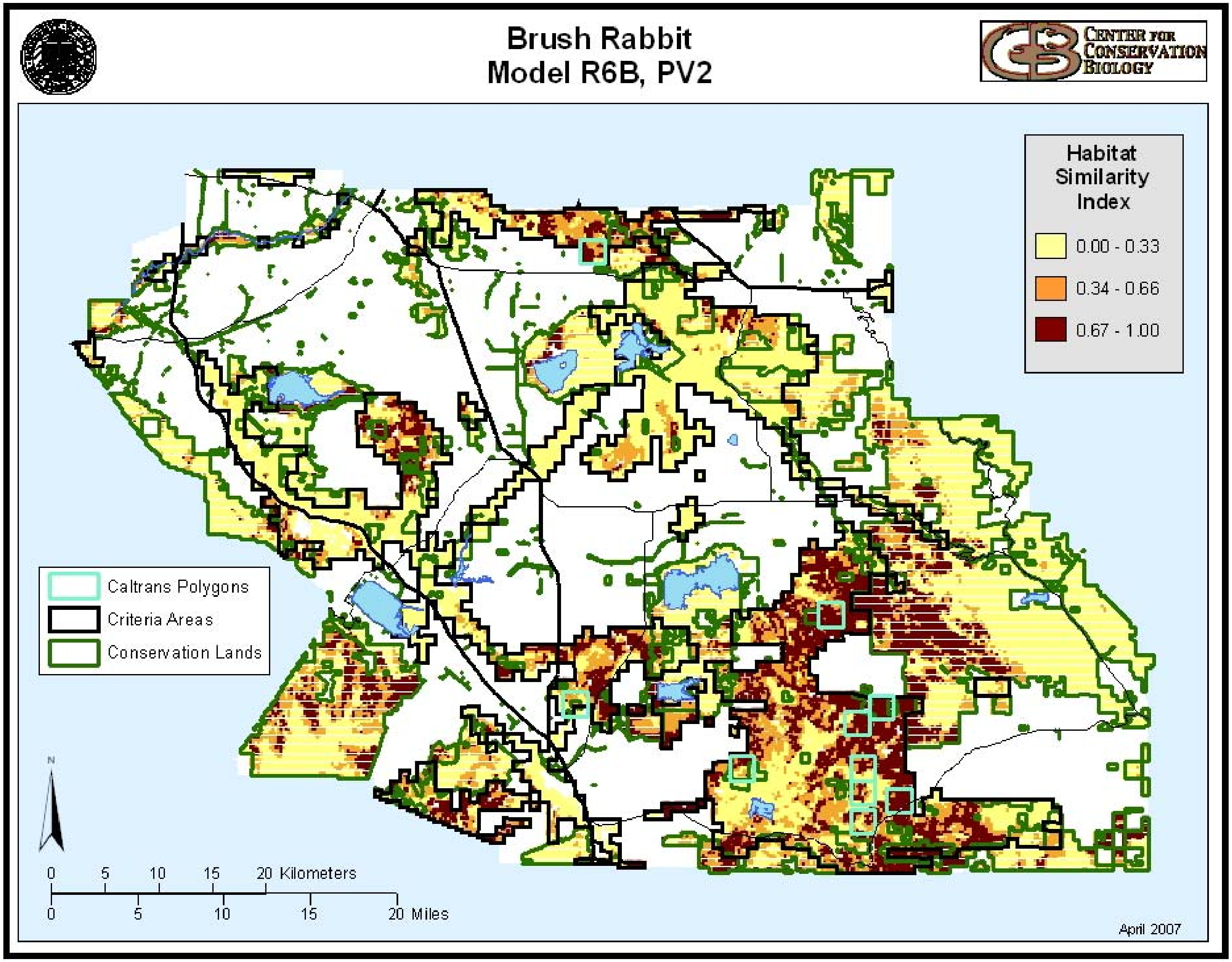


Figure 114. "HSI's" of habitat similarity for brush rabbit in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

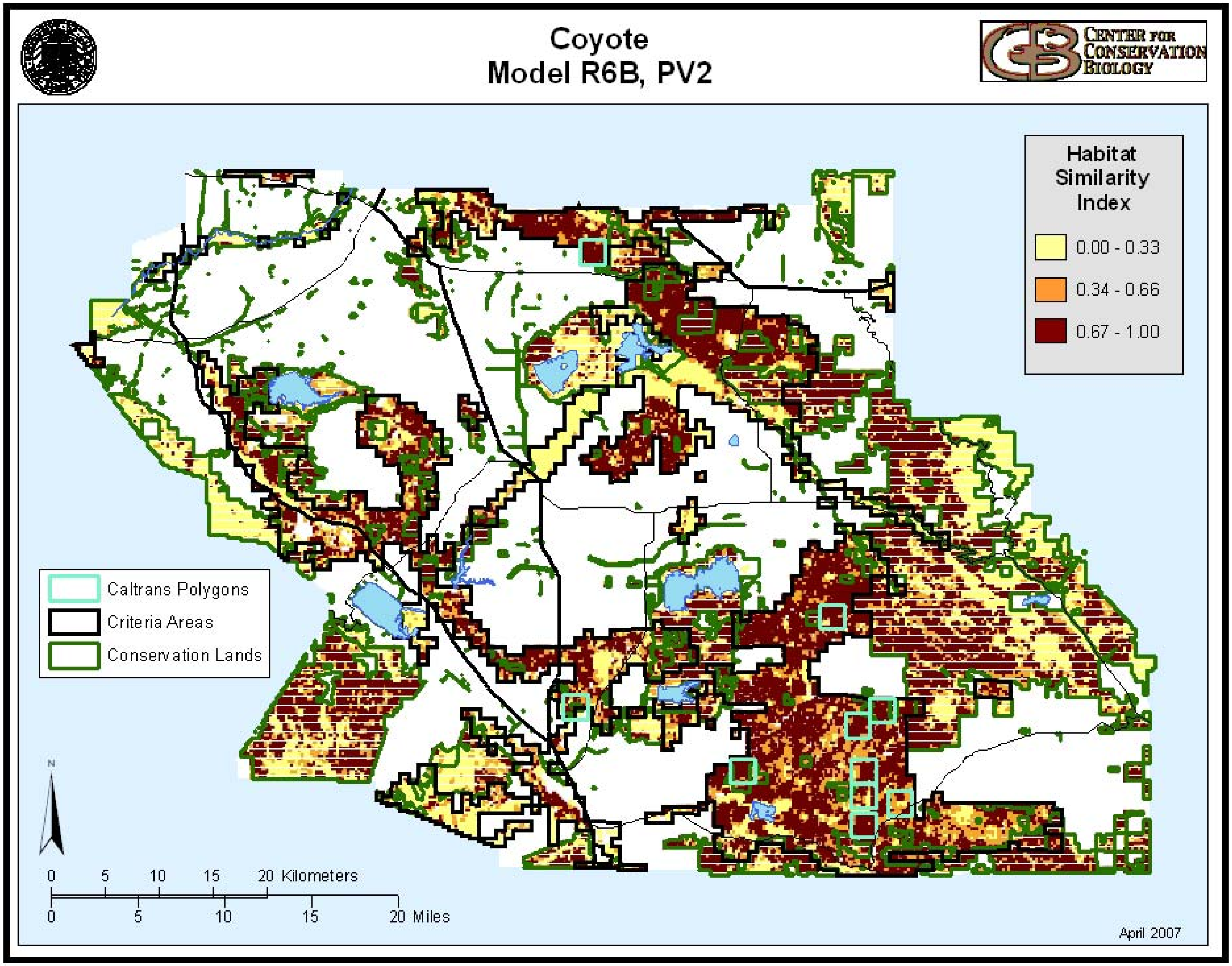


Figure 115. "HSI's" of habitat similarity for coyote in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

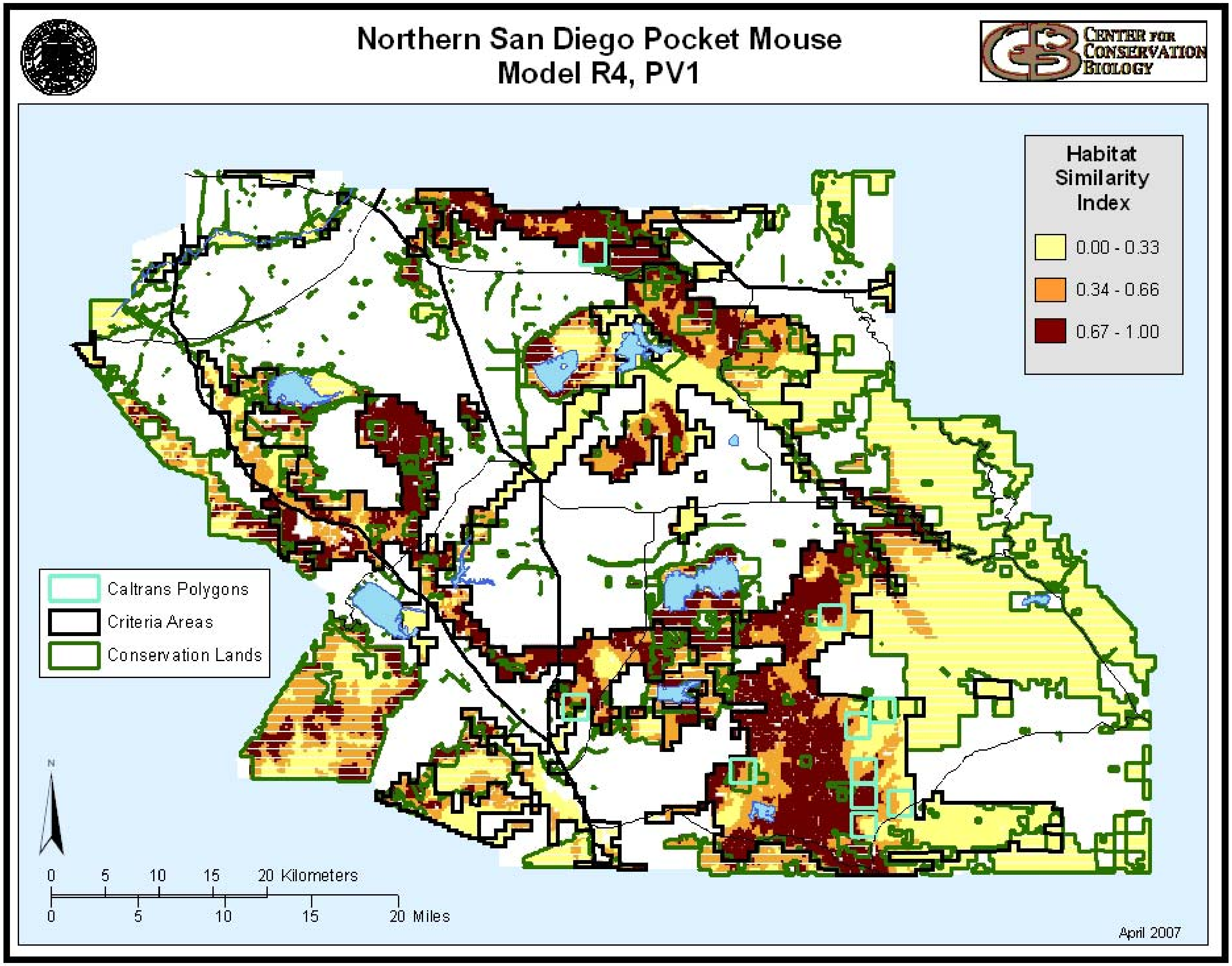


Figure 116. "HSI's" of habitat similarity for northwestern San Diego pocket mouse in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

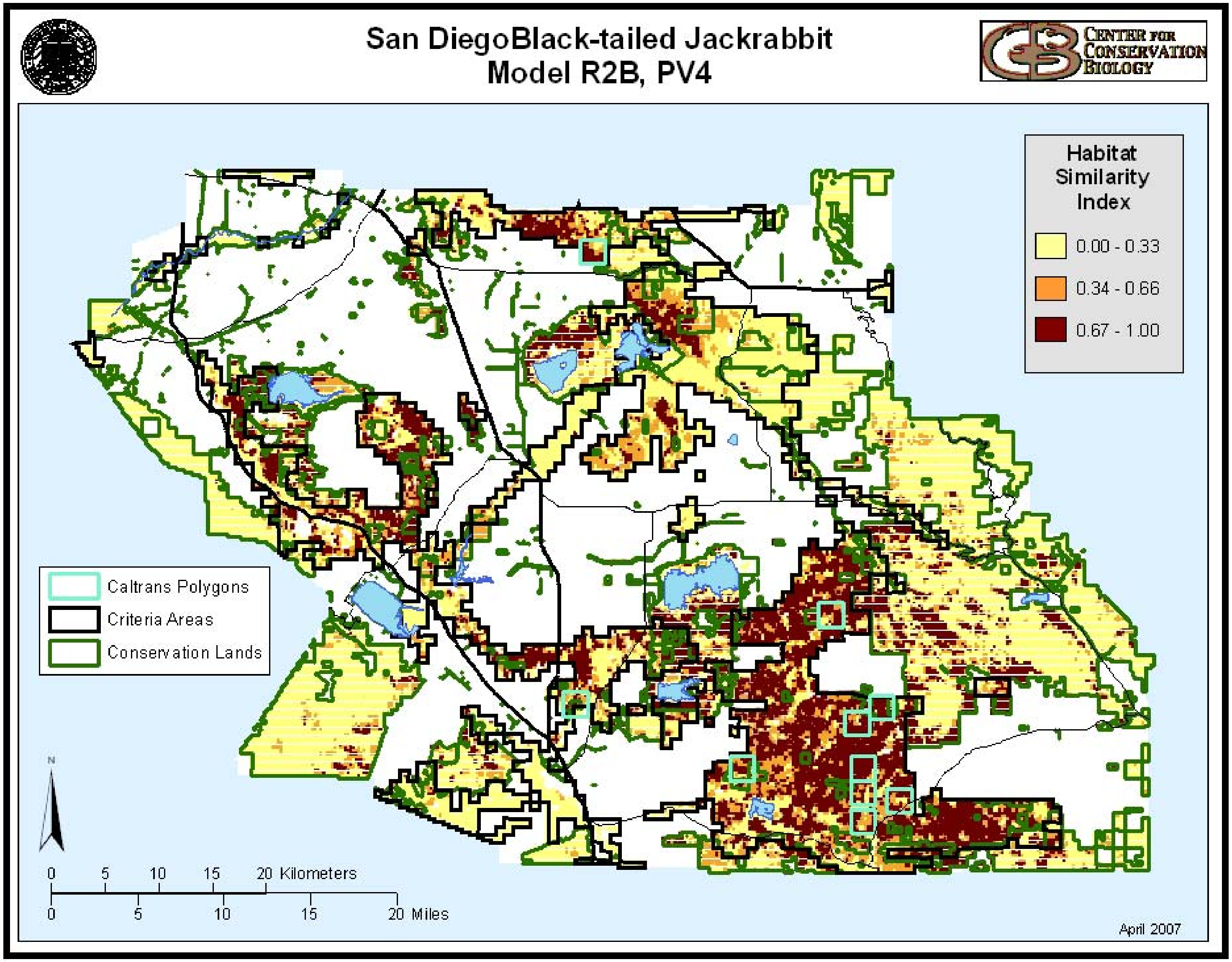


Figure 117. "HSI's" of habitat similarity for San Diego black-tailed jackrabbit in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

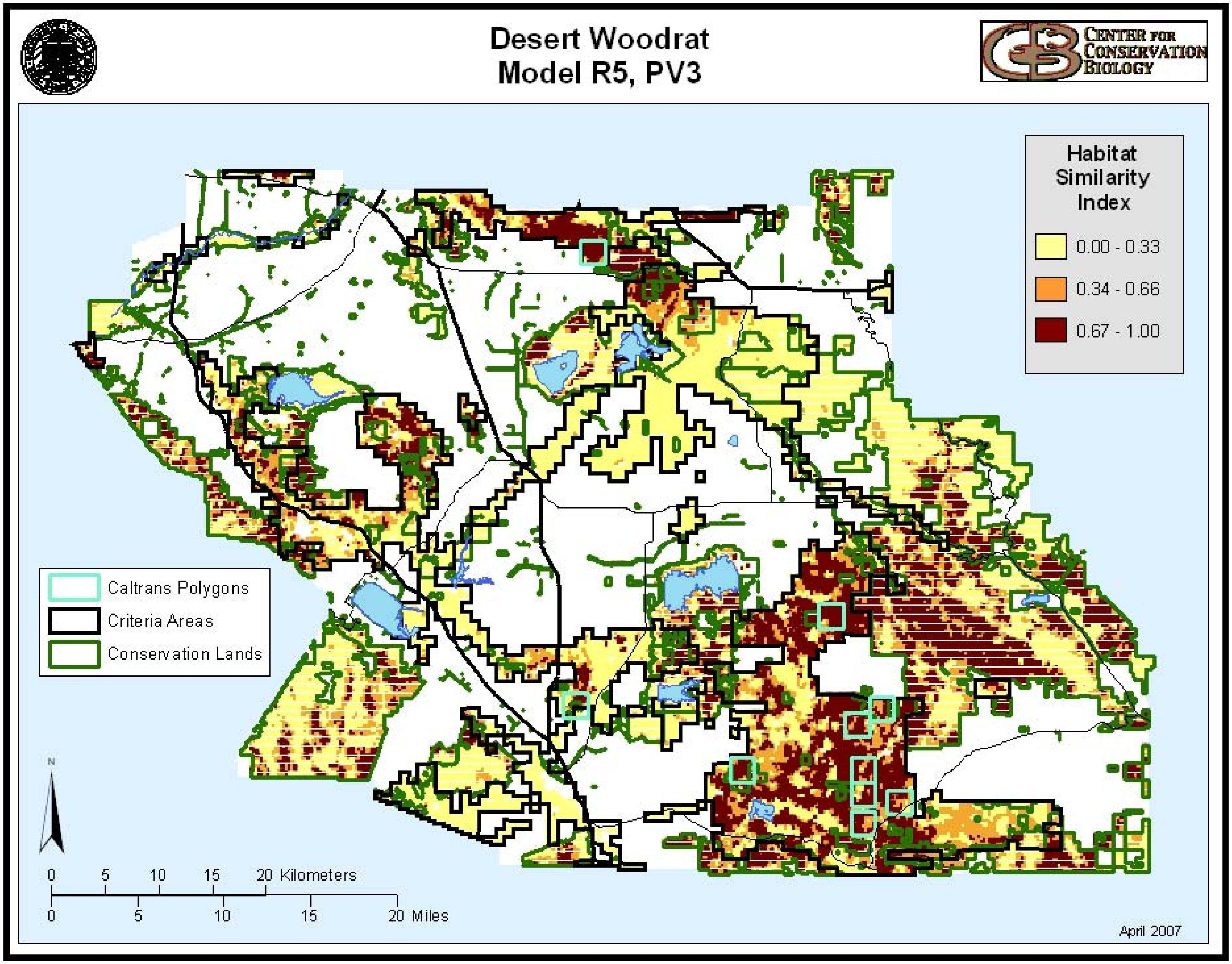


Figure 118. "HSI's" of habitat similarity for San Diego desert woodrat in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

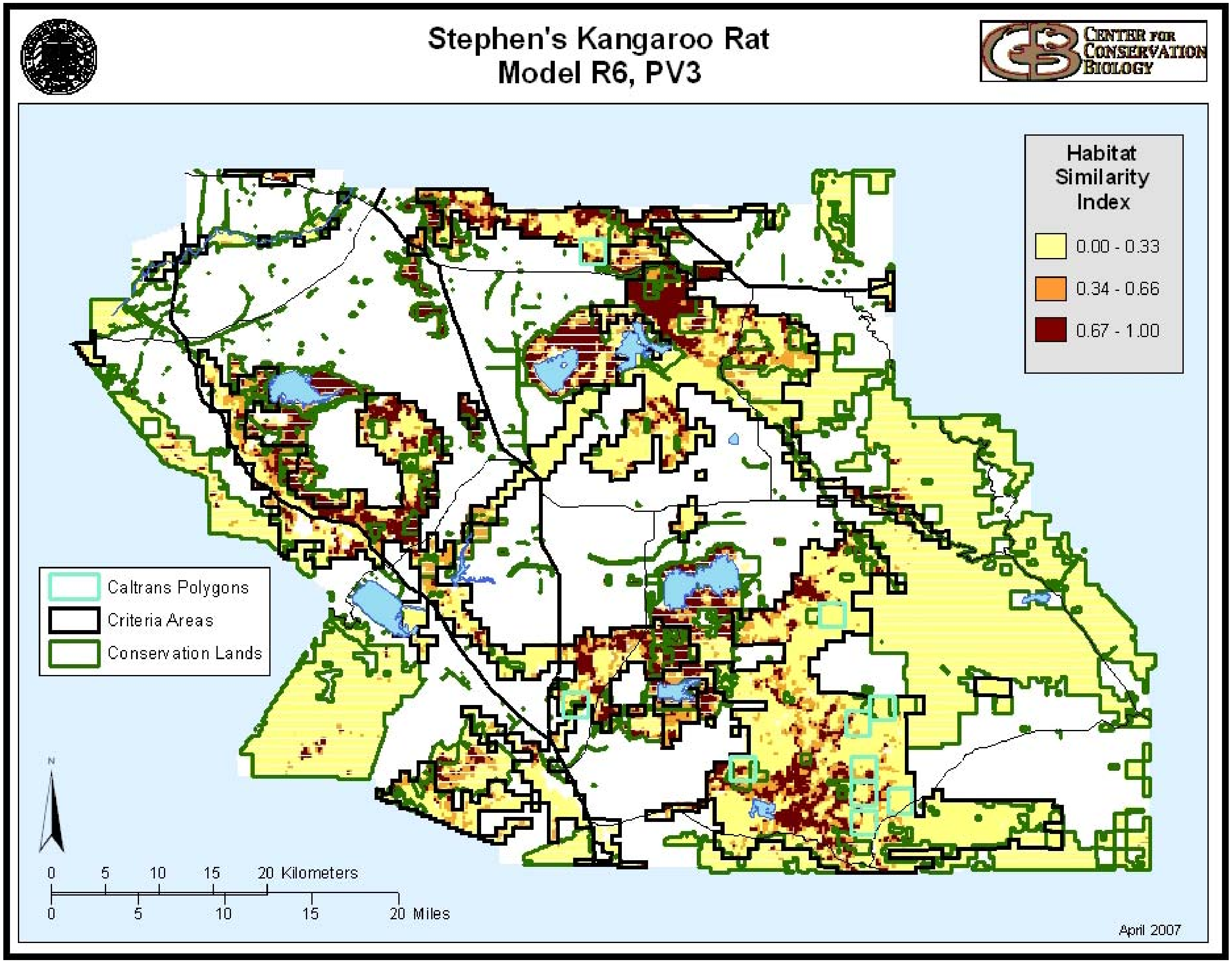


Figure 119. "HSI's" of habitat similarity for Stephens' kangaroo rat in Criteria Areas, conserved lands and in areas surrounding Caltrans-identified parcels in the WRC MSHCP. The higher the HSI, the greater the similarity to occupied habitat.

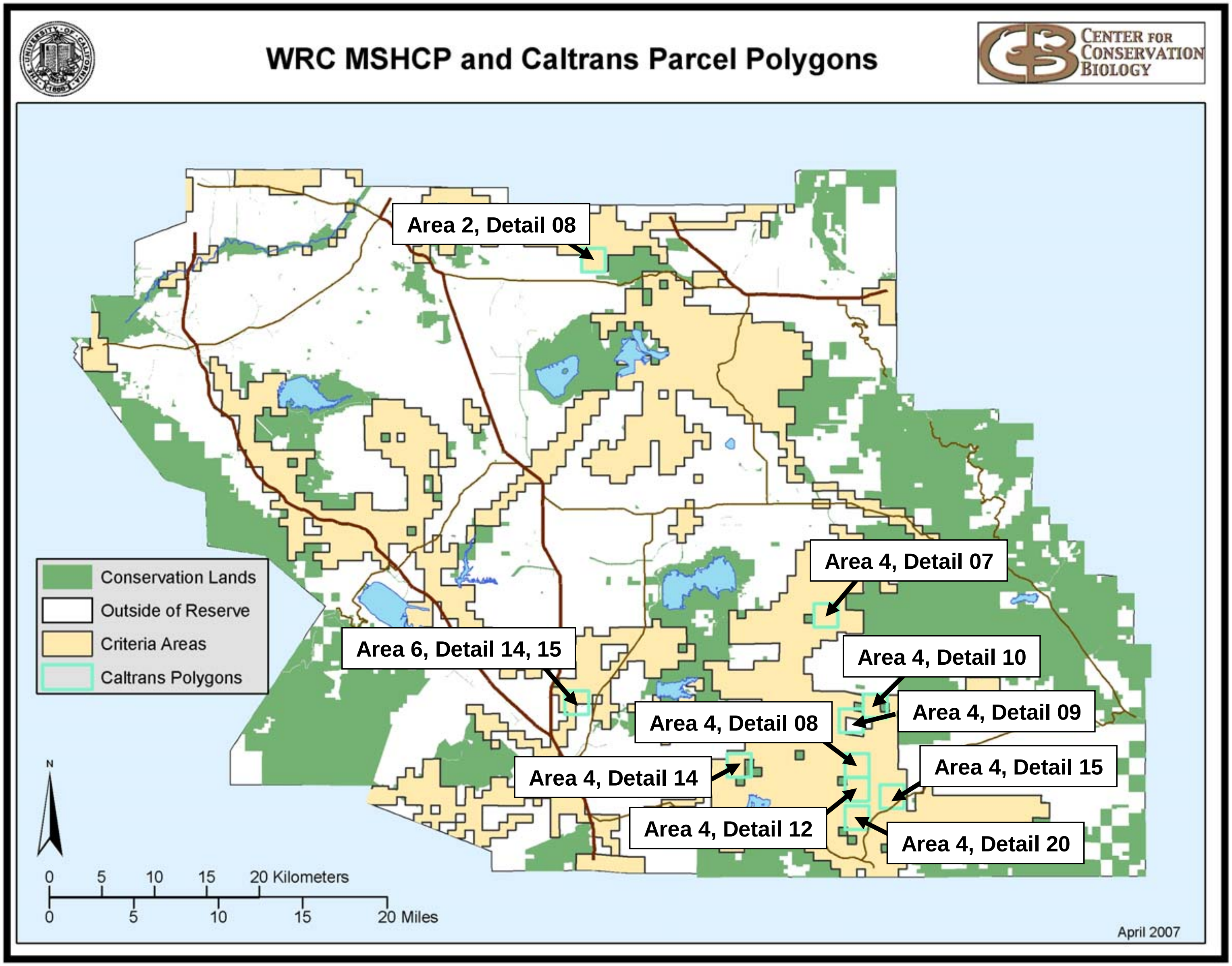


Figure 120. Caltrans identified parcel polygons for conservation evaluation.

Appendix Table 1. Environmental variables used to construct WRC MSHCP Covered Species niche models.

Climatic Variables
PRECIP: Average annual precipitation. Unit: millimeters.
MAXT: Average maximum temperature for month of July from model. Values stored in raster with 1 km resolution. Unit: degrees Fahrenheit.
MAXTJUL: Maximum temperature for month of July. Values stored in raster with 847.9 m resolution. Unit: degrees Celsius.
MINT: Average minimum temperature for month of January from model. Values stored in raster with 1 km resolution. Unit: degrees Fahrenheit.
MINTJAN: Minimum temperature for month of January. Values stored in raster with 847.9 m resolution. Unit: degrees Celsius.
TMIAPMY: Average minimum temperature April-May. Unit: degrees Celsius.
TMIDCAP: Average minimum temperature December-April. Unit: degrees Celsius.
TMIDCJA: Average minimum temperature December-January. Unit: degrees Celsius.
TMIFBMR: Average temperature February-March. Unit: degrees Celsius
TMIJLSP: Average minimum temperature July-September. Unit: degrees Celsius
TMXAPMY: Average maximum temperature April-May. Unit: degrees Celsius
TMXDCAP: Average maximum temperature December-April. Unit: degrees Celsius
TMXDCJA: Average maximum temperature December-January. Unit: degrees Celsius
TMXFBMR: Average maximum temperature February-March. Unit: degrees Celsius
TMXJLSP: Average maximum temperature July-September. Unit: degrees Celsius
TSEASON: Standard deviation of the monthly average temperature expressed as percentage of the annual average temperature. Average in degrees Kelvin is used to avoid the possibility of having to divide by zero.
RDECJAN: Average monthly radiation December-March. Unit: watts/m^2.
RFEBMAR: Average monthly radiation February-March. Unit: watts/m^2.
RAPRMAY: Average monthly radiation April-May. Unit: watts/m^2.
RJULSEP: Average monthly radiation July-September. Unit: watts/m^2.
RSEASON: Standard deviation of average monthly radiation as percentage of annual average radiation. Unit: watts/m^2.
PDECMAR: Average monthly precipitation December-March. Unit: millimeters.
PNOVMAY: Average monthly precipitation November-May. Unit: millimeters.
PJUNNOV: Average monthly precipitation June-November. Unit: millimeters.
PSEASON: Standard deviation of average monthly precipitation as percentage of annual average precipitation. Unit: millimeters.
MAXT: Average maximum temperature for month of July from model. Values stored in raster with 1 km resolution. Unit: degrees Fahrenheit.
MAXTJUL: Maximum temperature for month of July. Values stored in raster with 847.9 m resolution. Unit: degrees Celsius.
MINT: Average minimum temperature for month of January from model. Values stored in raster with 1 km resolution. Unit: degrees Fahrenheit.
MINTJAN: Minimum temperature for month of January. Values stored in raster with 847.9 m resolution. Unit: degrees Celsius.
PRECIP: Mean annual precipitation. Values stored in raster with 847.9m. Unit: millimeters.
Topographic Variables
EAST: Local scale representation of eastern aspect using 8 x 8 neighborhood at 30 m resolution. Domain: -0.999 to 0.998.

ELEV: Landscape scale representation of elevation above mean sea level. Lists the average value for 8 x 8 neighborhood at 30 m resolution. Unit: meters.
NORTH: Local scale representation of northern aspect using 8 x 8 neighborhood at 30 m resolution. Domain: -0.999 to 1.
SLOPE: Local scale representation of slope using an 8 x 8 neighborhood at 30 m resolution. Unit: degrees above horizontal.
UTM27E: Easting value of map point coordinate. Given in Universal Transverse Mercator, Zone 11 North, North American Datum 1927. Unit: meters.
UTM27N: Northing value of map point coordinate. Given in Universal Transverse Mercator, Zone 11 North, North American Datum 1927. Unit: meters.
Edaphic Variables
CLAY: Local scale representation of clay quantity in soil that is the average value of a 16 x 16 neighborhood of cells with 30 m resolution. Unit: percent volume.
ELEC : Local scale representation of soil salinity that is expressed in terms of electrical conductivity. The value is calculated as the average value of a 16 x 16 neighborhood of cells with 30 m resolution. Unit: millimhos per centimeter (mmhos/cm). NOTE: A total dissolved salt concentration of about 700 ppm in water produces an electrical conductivity of 1.0 mmhos/cm.
ORGM: Local scale representation of quantity of organic material in soil. It is the average value of a 16 x 16 neighborhood of cells with 30 m resolution. Unit: percent volume.
PH: Local scale representation of soil ph (acidity/alkalinity). It is the average value of a 16 x 16 neighborhood of cells with 30m resolution. Unit: pH value.
SAND: Local scale representation of sand quantity in soil that is the average value of a 16 x 16 neighborhood of cells with 30 m resolution. Unit: percent volume.
SILT: Local scale representation of silt quantity in soil that is the average value of a 16 x 16 neighborhood of cells with 30 m resolution. Unit: percent volume.
WHC: Local scale representation of water holding capacity in soil that is the average value of a 16 x 16 neighborhood of cells with 30 m resolution. Unit: Millimeters per centimeter (mm of water/cm of soil).
Vegetation Variables
<u>VEG# Series, Local-Scale Vegetation, 250 m x 250 m Resolution:</u>
Local scale representation of vegetation class using 8 x 8 neighborhood of values with 30 m resolution. For use with map points having a resolution of 250 m x 250 m and calibration points with a resolution of 240 m x 240 m.
VEG1: Local scale representation of <u>agriculture</u> land use.
VEG3: Local scale representation of <u>open water.</u>
VEG4: Local scale representation of <u>developed</u> land.
VEG5: Local scale representation of <u>riparian</u> land cover.
VEG6: Local scale representation of <u>coastal sage scrub</u> land cover.
VEG7: Local scale representation of <u>other [desert] shrubland</u> cover.
VEG8: Local scale representation of <u>chaparral</u> land cover.
VEG9: Local scale representation of <u>grassland</u> cover.
VEG10: Local scale representation of <u>woodland</u> ground cover.
VEG11: Local scale representation of <u>habitat</u> land cover.
VEG13: Local scale representation of <u>valley and foothill grassland</u> cover.
VEG14: Local scale representation of <u>non-native grassland</u> cover.
VEG15: Local scale representation of <u>vernal pool or playa</u> land cover.
VEG16: Local scale representation of <u>oak woodland</u> land cover.
VEG17: Local scale representation of <u>juniper woodland/scrub</u> land cover.

VEG18: Local scale representation of broadleaf and oak forest land cover.
VEG19: Local scale representation of coniferous forest land cover.
SHRUBLAND: 250 m x 250 m neighborhood amount VEG6 + VEG8.
V#_16 Series, Local-Scale Vegetation, 500 m x 500 m Resolution:
Local scale representation of vegetation class using 16 x 16 neighborhood of values with 30 m resolution. Used for calibration points with a resolution of 500 m x 500 m.
V1_16: Local scale representation of agriculture land use.
V3_16: Local scale representation of open water.
V4_16: Local scale representation of developed land.
V5_16: Local scale representation of riparian land cover.
V6_16: Local scale representation of coastal sage scrub land cover.
V7_16: Local scale representation of other [desert] shrubland cover.
V8_16: Local scale representation of chaparral land cover.
V9_16: Local scale representation of grassland cover.
V10_16: Local scale representation of woodland ground cover.
V11_16: Local scale representation of other habitat land cover.
V13_16: Local scale representation of valley and foothill grassland cover.
V14_16: Local scale representation of non-native grassland cover.
V15_16: Local scale representation of vernal pool or playa land cover.
V16_16: Local scale representation of oak woodland land cover.
V17_16: Local scale representation of juniper woodland/scrub land cover.
V18_16: Local scale representation of broadleaf and oak forest land cover.
V19_16:Local scale representation of coniferous forest land cover
V16_SHRUB: All local shrubland at 500 m scale: V6_16 + V7_16 + v8_16.
Other Local-Scale Variables
CSSDENS1: 250 m x 250 m neighborhood amount CSS with >60% Shrub Density.
CSSDENS2: 250 m x 250 m neighborhood amount CSS with 40-60% Shrub Density.
CSSDENS3: 250 m x 250 m neighborhood amount CSS with 25-40% Shrub Density.
CSSDENS4: 250 m x 250 m neighborhood amount CSS with 10-25% Shrub Density.
CSSDENS5: 250 m x 250 m neighborhood amount CSS with 2-10% Shrub Density.
CSSEXOTIC0: 250 m x 250 m neighborhood amount CSS with <5% Exotic Cover
CSSEXOTIC1: 250 m x 250 m neighborhood amount CSS with 5-25% Exotic Cover
CSSEXOTIC2: 250 m x 250 m neighborhood amount CSS with 25-50% Exotic Cover.
CSSEXOTIC3: 250 m x 250 m neighborhood amount CSS with >50% Exotic Cover.
CSSHIEXOT: 250 m x 250 m neighborhood amount CSS with >25% Exotic Cover.
CSSLOWDEN: 250 m x 250 m neighborhood amount CSS with <25% Shrub Density.
CSSLOWEXOT: 250 m x 250 m neighborhood amount CSS with <25% Exotic Cover.
CSSMEDDEN: 250 m x 250 m neighborhood amount CSS with 25-60% Shrub Density.
ROCKSUM8X8: Local scale representation for amount of rock exposure using an 8 x 8 neighborhood at 30 m resolution.
PERV# Series, Landscape Scale Vegetation
Percent of vegetation/land cover at the for each class in a 2,250 m x 2,250 m neighborhood (75 x 75 neighborhood with 30 m resolution).
PERV1: Percent of agriculture in landscape.
PERV3: Percent of open water in landscape.
PERV4: Percent of developed in landscape.
PERV5: Percent of riparian in landscape.

PERV6: Percent of coastal sage scrub in landscape.
PERV7: Percent of other [desert] shrubland in landscape.
PERV8: Percent of chaparral in landscape.
PERV9: Percent of grassland in landscape.
PERV10: Percent of woodland in landscape.
PERV11: Percent of other habitat in landscape.
PERV13:Percent of valley and foothill grassland in landscape.
PERV14: Percent of non-native grassland in landscape.
PERV15: Percent of vernal pool or playa in landscape.
PERV16: Percent of oak woodland in landscape.
PERV17: Percent of juniper woodland/scrub in landscape.
PERV18: Percent of broadleaf and oak forest in landscape.
PERV19: Percent of coniferous forest in landscape.
Other Landscape-Scale Variables
EDGE: Landscape scale representation of natural/urban edge using 225 x 225 neighborhood at 10 m resolution. Unit: 10 meters.
PERSHRUB: Percent of coastal sage scrub and chaparral shrublands at 2,250 m x 2,250 m scale (= PERV6 + PERV8).
Land Use Variables
LU# Series, Local Scale Land Use
Local scale representation of generalized land use using 8 x 8 neighborhood at 30 m resolution.
LU1: Local scale representation of agricultural land use.
LU2: Local scale representation of land covered by open water.
LU3: Local scale representation of land use for other development.
LU4: Local scale representation of rural residential land use.
LU5: Local scale representation of undeveloped land use.
LU6: Local scale representation of unknown land use.
LU7: Local scale representation of urban/suburban residential land use.
PERLU#- Series, Landscape Scale Land Use
Percent of land use for each class in a landscape size neighborhood (2,250 m x 2,250 m).
PERLU1: Percent of agriculture land use.
PERLU2: Percent of land covered by open water.
PERLU3: Percent of land use for other development.
PERLU4: Percent of land use for rural residential.
PERLU5: Percent of undeveloped land use.
PERLU6: Percent of unknown land use.
PERLU7: Percent of urban/suburban residential land use.
Distance Variables
The Euclidean distance measured from each map point to the nearest edge of a polygon representing the specified land cover (vegetation, water, or land use) class. Positive values represent distance values from a point outside a land cover class. Negative values represent distance from a point within a polygon of land cover to the nearest edge of the polygon it is contained within. Unit: meter.
D_DRAIN: Euclidean distance from point to nearest major drainage. Unit: meter.
D_ROCK: Euclidean distance from point to nearest rock outcrop. Unit: meter
DV# Series, Distance to Nearest Vegetation Type
DV1: Euclidean distance to nearest edge of agriculture land use.

DV3: Euclidean distance to nearest edge of open water.
DV4: Euclidean distance to nearest edge of developed land.
DV5: Euclidean distance to nearest edge of riparian land cover.
DV6: Euclidean distance to nearest edge of coastal sage scrub land cover.
DV7: Euclidean distance to nearest edge of other [desert] shrubland cover.
DV8: Euclidean distance to nearest edge of chaparral land cover.
DV9: Euclidean distance to nearest edge of grassland cover.
DV10: Euclidean distance to nearest edge of woodland ground cover.
DV11: Euclidean distance to nearest edge of other habitat land cover.
DV13: Euclidean distance to nearest edge of valley and foothill grassland cover.
DV14: Euclidean distance to nearest edge of non-native grassland cover.
DV15: Euclidean distance to nearest edge of vernal pool or playa land cover.
DV16: Euclidean distance to nearest edge of oak woodland cover.
DV17: Euclidean distance to nearest edge of juniper woodland/scrub land cover.
DV18: Euclidean distance to nearest edge of broadleaf and oak forest land cover.
DV19: Euclidean distance to nearest edge of coniferous forest land cover.

Appendix Table 2

UNIVERSITY OF CALIFORNIA RIVERSIDE'S CENTER FOR CONSERVATION BIOLOGY: 2006 PROTOCOL FOR COLLECTING COASTAL SAGE SCRUB BIRD POINT COUNT DATA

The University of California Riverside's Center for Conservation Biology began developing methods and collecting data to describe coastal sage scrub and riparian communities in the Western Riverside County Multiple Species Habitat Conservation Plan (WRCMSHCP) preserve system as part of the Community Monitoring Program (Barrows et al. in press). This data will help to determine the status of many of the 146 sensitive species protected by the WRCMSHCP plan and will provide information on ecological relationships and processes important in managing these communities. As part of initial development of this monitoring program, we gathered data on avian communities in coastal sage scrub and non-native grassland habitats, including data on sensitive species occurrence and abundance. This protocol was used in 2004, the first year of developing monitoring methods, and remains untested against other methods. This protocol was developed following standard bird survey methods outlined in Ralph et al. (1993) and distance sampling techniques presented in Rosenstock et al. 2002.

Data Collection Procedures:

When an observer arrives at point he/she will determine the point center, and stand 10 meters away from point center. All point related data (e.g. location, point #, etc.) and environmental data will be collected prior to initiating point so that any birds potentially startled can resume normal activity (see below for details regarding point and environmental data). If the coordinates of the point are not marked prior to conducting the point count, they should be marked and stored in the observer's GPS unit at the conclusion of the point, as the observer will need to walk to the point center to mark them. A compass will be used to orient the observer and birds in the point count location.

Each bird will be mapped onto a point count sheet. The sheet contains two concentric circles denoting 25m and 50m distances from the point count center. When a bird is initially detected the following data will be recorded: (1) species, (2) distance, (3) time, (4) behavior and (5) substrate. Species will be determined by sight and/or sound, and will be recorded using the four-letter alpha code (Pyle 1997). Distance from the point center to the bird will be determined using a rangefinder or estimated by the observer. The distance will be written in parentheses below the species code. After the point the observer may pace off distances to increase accuracy of distance estimates in locations where walking will not disturb nesting birds, vegetation or other animal species (this may be necessary for distances <13 m as rangefinders can only measure distances greater than or equal to13 m). The 8-minute point count will be divided into three time intervals: (1) 0:00 – 3:00 min, (2) 3:01 – 5:00 min, and (3) 5:01 – 8:00 min. The time interval in which the bird was first detected will be denoted as a subscript (1-3) following the species code.

The behavior of the bird when it is first sighted will be recorded as a superscript following the species code. A list of common behaviors and their abbreviations are provided below (Table 1). Specific notes regarding the details of observed breeding activity will be described at the conclusion of the point count at the bottom of the data sheet in the "Comments" section. The behavior of birds that are identified by vocalizations will be recorded as singing (S) or calling (C). The substrate where a bird is observed will be recorded if time permits. If the observer is unable to indicate substrate use during the point, the observer may record any information regarding substrate that he/she recalls at the conclusion of the point. A list of common CSS substrates is listed below (Table 2). Additional data, such as age or sex, should also be recorded if known. The movement of an individual bird will be denoted using arrows drawn from first to second location and so on. When there is too much activity on a point for the observer to record all above data, the data should be recorded in the following order:

1. Record the abundance, distance, behavior, and movement of covered species.
2. Record the abundance, distance, and behavior of other species.
3. Record substrate use of covered species (may be recorded after point count).
4. Record substrate use of other species (may be recorded after point count)

Example:

1 $SAGS^{S}_{2}$
(12m)

1SAGS

POINT DATA

Location = four letter code referring to site name
Point = point count number at a particular location
Date = DD/MM/YY
Visit # = refers to first or second visit to any particular point within a season
Observer = initials of observer conducting point count (A.C., J.D., K.P.)
Time start = time point count was started
Time end = time point count was terminated
UTM N and UTM E = UTM coordinates in NAD27 CONUS

ENVIRONMENTAL DATA

Habitat 1 = most abundant habitat type (e.g., CSS, NNG, Oak, Rip, Dev, Dist) with an estimate for the percent cover of this habitat type within 50 m radius of the point. Each habitat should have a listing of the most common plant species observed within it, using the 6 code plant species names (first 3 letters of genus and first 3 letters of species name).
Habitat 2 = second most abundant habitat type within 50 m radius of the point with the same information as for Habitat 1.
Temperature = °C measured using digital thermometer
Wind = measured using a Kestral 1000 windmeter. The observer first determines the predominant wind direction and holds windmeter in that direction. The windmeter is held above head at arm's length, turned on, and switched to "ave" mode. The "ave" and "max" wind speed is taken after 15 seconds.
Sky = percent cloud cover is recorded visually; indicate exact cloud cover estimate; can later group into cloud cover classes

Precipitation = record general type of precipitation
0 = No Precipitation
1 = Sprinkle: few scattered, small drops of precipitation
2 = Drizzle: constant, but very light precipitation
3 = Light rain: constant, small drops of precipitation
4 = Rain: constant, moderate drops
5 = Hard rain: pouring

Water = indicate presence of water within 50 m of the point count center.
1 = No water
2 = Standing water (still)
3 = Slow flowing
4 = Fast flowing

TABLE 1. Common bird behaviors

S	singing
C	calling
P	perched
SM	self-maintenance (preening, bathing)
M	movement (flight, hop, walk, run, flutter; movement may be related to search behavior; any movement clearly related to searching should be included as food searching (FS))
G	glean (food item retrieved from surface of leaves, branches, trunk, ground, water)
SA	sally (food item retrieved via "flycatcher-like" movement, regardless of where food is retrieved – surface or air)
PR	probe (food item retrieved from beneath surface of trunk, litter, ground)
FH	food handling (bird observed manipulating food; e.g. wiping food on branch, chewing)
FS	food searching (bird observed searching for food, movement is classified as search behavior if bird is seen retrieving or attempting to retreive a food item within 10 seconds after movement first observed)
A	aggressive behavior (mobbing, chasing, territorial defense; excludes nest defense which is part of nesting behavior)
N	nesting behavior (carrying nesting material, nest construction, incubating, nest defense)
CB	courtship behavior or pair bonding (mating display, courtship feeding, copulation)
CF	carry food (carrying food to nestlings, fledglings or other adult; note in comments section who delivered and received food)
O	other (any behavior not included in the above categories)
U	unknown (when behavior is unknown or not recorded during point count period)

TABLE 2. Common CSS substrates

ADEFAS	*Adenostoma fasciculatum*
ADESPA	*Adenostoma sparsifolium*
ARTCAL	*Artemesia californica*
CEACRA	*Ceanothus crassifolius*
CEATOM	*Ceanothus tomentosus*
ERIFAS	*Eriogonum fasciculatum fasiculatum*
ERIFASPOL	*Eriognum fasiculatum poliofolium*

ENCCAL	*Encelia californica*
ENCFAR	*Encelia farinosa*
KECANT	*Keckiella antirrhinoides*
MALLAU	*Malosma laurina*
RHACRO	*Rhamnus crocea*
RHUOVA	*Rhus ovatum*
SALAPI	*Salvia apiana*
SALMEL	*Salvia melifera*
SAMMEX	*Sambucus mexicana*
Grass Sp	Identify to species if you can
Rock	Rock
TELE	telephone line
POLE	pole (including telephone pole) or post
FENC	fence
GRD	Ground

References:

Barrows, C.W., M.B. Swartz, W.L. Hodges, M.F. Allen, J.T. Rotenberry, B.L. Li, T.A. Scott, and X. Chen. *In Press*. A framework for monitoring multiple species conservation plans. *Journal of Wildlife Management*

Ralph, C.J., G.R. Geupel, P. Pyle, T.E. Martin, and D.F. DeSante. 1993. *Handbook of field methods for monitoring landbirds*. Gen.Tech. Rep. PSW-GTR-144. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture; 41 p.

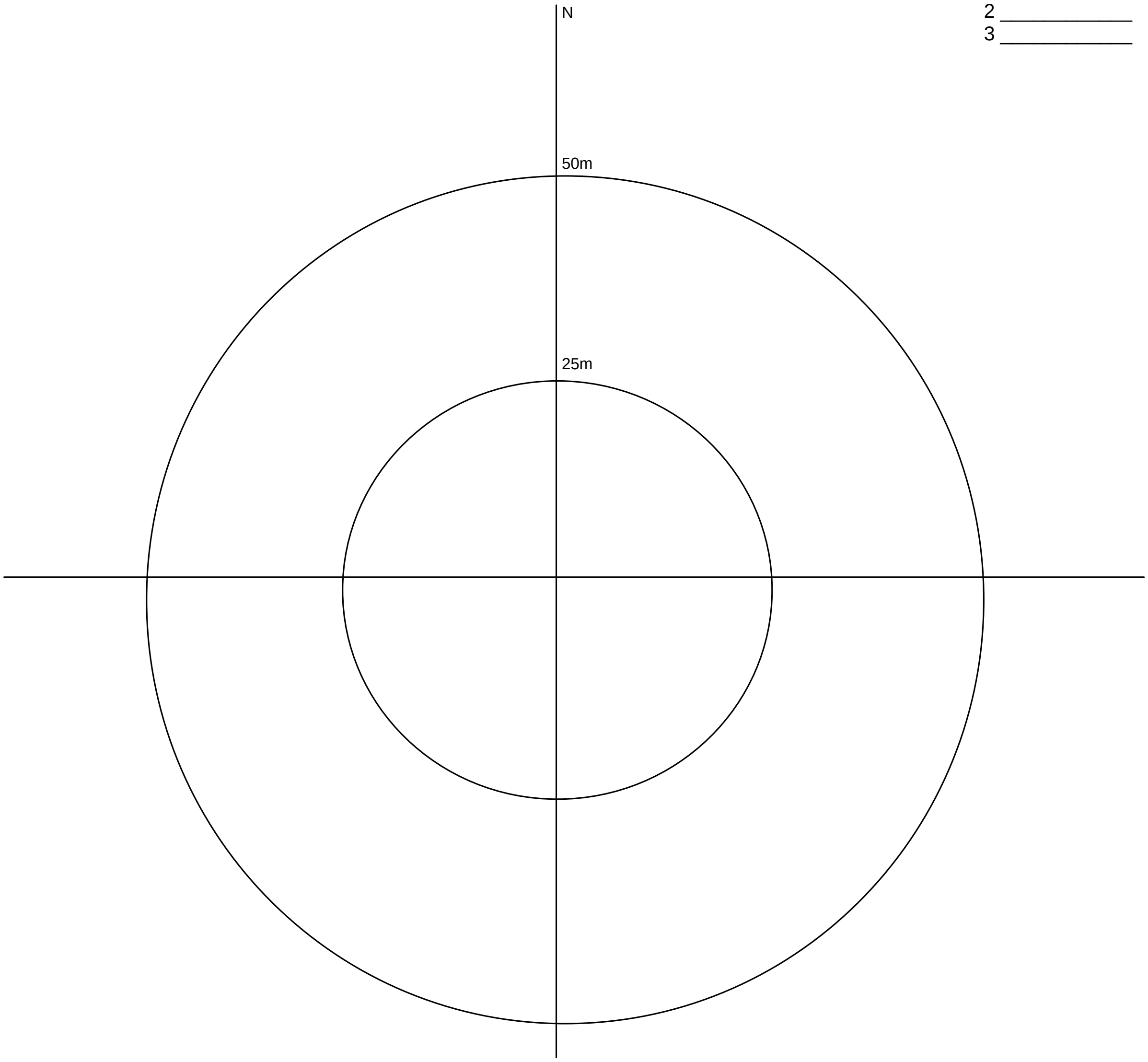
Rosenstock, S.S., D.R. Anderson, K.M. Geisen, T. Leukering, and M.F. Carter. 2002. Landbird counting techniques current practices and an alternative. Auk 119:46-53.

Appendix Figure 1

Center for Conservation Biology: 2006 CSS Bird Survey Datasheet

Location ___________ Point ______ Date _____________ Visit # ______ Observer ______ Time Start ______ Time End ______
UTM (NAD27 CONUS) N _______________ E _______________ Temp (C) _______ Wind (km/hr) (ave) _______ (max)_______
Sky (% cover) ______ Precip. _______Habitat 1: ____________________________ Habitat 2:____________________________

1 ____________
2 ____________
3 ____________



Fly-overs: ____

Comments: ____
____

S = singing	**M** = Movement	**FH** = food handling	**CB** = courting behavior
C = calling	**G** = glean	**FS** = food searching	**CF** = carry food
P = perching	**SA** = sally	**A** = aggressive behavior	**O** = other
SM = self maintenance	**PR** = probe	**N** = nesting behavior	**U** = unknown

Time interval
1 – 0:00-3:00
2 – 3:01-5:00
3 – 5:01-8:00

Appendix Table 3

UNIVERSITY OF CALIFORNIA, RIVERSIDE

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CENTER FOR CONSERVATION BIOLOGY
RIVERSIDE, CALIFORNIA 92521-0122
TEL: 951-827-5494; FAX: 951-827-2620

COLLEGE OF NATURAL AND AGRICULTURAL SCIENCES
CITRUS RESEARCH CENTER AND AGRICULTURAL EXPERIMENT STATION

Niche modeling of several reptile species in Western Riverside County
Field Survey Protocol

04-11-06
By Yolanda M. Verhulst

To test for the presence of the species we will do field surveys in possible suitable habitat of coastal sage scrub and chaparral. The survey points will be 250m apart at each selected location (figure 1). Each survey will be distance-constrained in the sense that the survey will be a transect walk around the point within a circle with a radius of 50m. Within this circle the exact walking path is quite random, we just try to cover as much of the area as possible. A more random walk instead of for instance several circles around the point is used because the shrubs can be very dense with major rocks, so parts of the area can be not accessible. A pre-set path is therefore in most of the areas not possible.
The transect walk is also time-constrained. We want to cover as much area as possible but we also want to spend the same amount of time around each point; say 30 minutes.
First we will find a point with the GPS unit. On the point itself several measurements will be done. These will be recorded on a standard form, when necessary in code names.
We will measure (see also table 1): % coastal sage scrub
% chaparral
% non-native grassland
% disturbance and the kind of disturbance
% rock outcrops
% bare ground
the dominant plant species
temperature
wind speed (min, max, average)
% cloudiness/ sunshine

Then the transect walk itself will be started, the start time will be recorded and during 30 minutes all the lizards and snakes will be recorded on the form by species, time, GPS coordinates, their age class (adult, juvenile or hatchling), their behavior (running, climbing, basking, hiding etc.) and the substrate they are spotted on (on rocks, on grass, on/under shrubs, on bare ground etc.). See also table 2. During the transect walk the GPS unit will be used to mark points along the route that is walked (at least all the corners that are made) so it can be made sure that the area is covered well.
During the walk also relevant objects as Harvester ant mounts and Termite casings and their location will be recorded on the form, because certain lizard species feed on these animals and this can be an additional indication to suitable habitat. Furthermore, snake skins and snake tracks will be recorded. When an animal is spotted, but runs off before the species can be determined, we will stop and stand still for a few minutes to see if it comes out again and can be recorded after all.
After the 30 minutes the end time, the trip odometer and walking time recorded by the GPS unit will be recorded on the form and we will go to the next point where the same procedure will take place. When animals are spotted in the time between the transect walks, these sightings are recorded on a separate form as incidental sightings, with species, observer, time, GPS coordinates, behavior, substrate and habitat location. Incidental sightings of other endangered species will also be recorded.

Appendix Table 2 Continued…

UNIVERSITY OF CALIFORNIA, RIVERSIDE

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COLLEGE OF NATURAL AND AGRICULTURAL SCIENCES
CITRUS RESEARCH CENTER AND AGRICULTURAL EXPERIMENT STATION

Niche modeling of several reptile species in Western Riverside County
Field Survey Protocol – figures

04-11-06
By Yolanda Verhulst

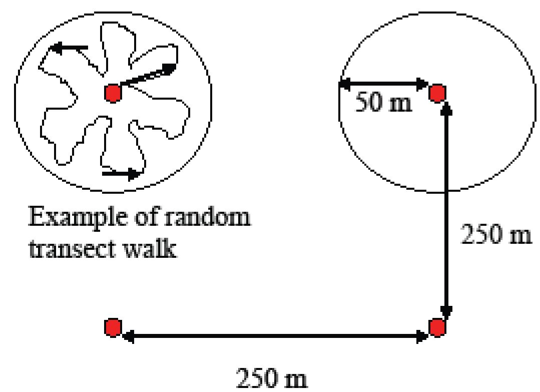


Figure 1. The visualization of some survey points (red) with an example of a random transect walk within an imaginary circle with a 50 m radius

Table 1. Measurement that will be done on the survey point

Measurements
% coastal sage scrub
% chaparral
% non-native grassland
% disturbance and the kind of disturbance
% rock outcrops
% bare ground
The dominant plant species
Temperature
Wind speed (min, max, average)
% cloudiness / sunshine

Table 2. Measurements that will be done during the transect walk

Measurements
The species of the spotted reptiles
Time of sighting
GPS coordinates of sighting
Their age class (adult, juvenile, hatchling) if possible
Their behavior (running climbing, basking, hiding etc.)
The substrate they are spotted on (on rocks, on grass, on/under shrubs, on bare ground etc.)
Location of harvester ant mounts and termite casings
Location of snake skins and snake tracks

Appendix Table 4

Herp surveys April-July 2006

Observer: Site: Point: Date:

UTM27N: UTM27E: Dom Habitat: 1 %, 2 %

Dominant plant Species:

Disturbance: %, sort: Rock cover: Bare ground cover:

Cloud cover: Temperature: Odometer: Time walked:

Wind speed, max: Wind speed, avg: Wind speed, min:

Start time: End time: First GPS number: Last GPS number:

Species	Time	UTM27N	UTM27E	Age class	Behavior	Substrate	Remarks

Object	Time	UTM27N	UTM27E	Remarks

Appendix Table 5

UNIVERSITY OF CALIFORNIA'S CENTER FOR CONSERVATION BIOLOGY
INCIDENTAL SIGHTINGS OF TARGET SPECIES

SPECIES	OBSERVER	DATE	SITE NAME	UTMN NAD 27	UTME NAD 27	DIST FROM COORD (M)	DIRECTION FROM COORD	TIME	HERPS TEMP (ºC)	BEHAVIOR	SUBSTRATE

Appendix Table 6

University of California Riverside's Center for Conservation Biology Protocol for rare plant field visits:

1. Locate the area corresponding to the coordinates of the map points being surveyed
    a. Search within 120 m of the point in a wandering transect all areas that appear to have the potential to support rare plant species.
2. Record the area that you searched for the species
3. Record on the data sheet whether the species is present or not.
4. If a rare plant species is detected, records the approximate center of the population,
5. If the population is small enough (<100 individuals or so), count the number of individuals. If the population is large, estimate the number of individuals. Record whether this number is exact or estimated.
6. Conduct a releve survey of the population, centered at the GPS coordinates.
    a. Place pin flags, in the cardinal directions, 16m from the GPS coordinates. This creates a plot approximately 510m² in area.
    b. List all species observed, and estimate their cover classes and average height.
    c. Record the number of target individuals found in the plot by counting them, if possible. If numbers are too high, this may also be estimated. Be sure to record whether this is an exact or estimated number.
    d. Note any obvious site history characteristics… (e.g. fire scars, construction, disturbance, etc.)

Appendix Table 7

Rare Plant Survey
Field Visit Data Sheet

Date: ____________________ **Observers: _________________**

Point Name: _________________

UTM NAD27 North: _______________ **UTMNAD27 East:________________**

Rare Plan Species Observed? Y N

Species Detected: ____

Time spent (in minutes) searching for species:__________________________

Estimated area searched for species:___________________________

Population Info

This is an (circle one): exact estimated number.

Number of individuals in plot:_______________________________

Notes:____

____

____

____

____

Appendix Table 8

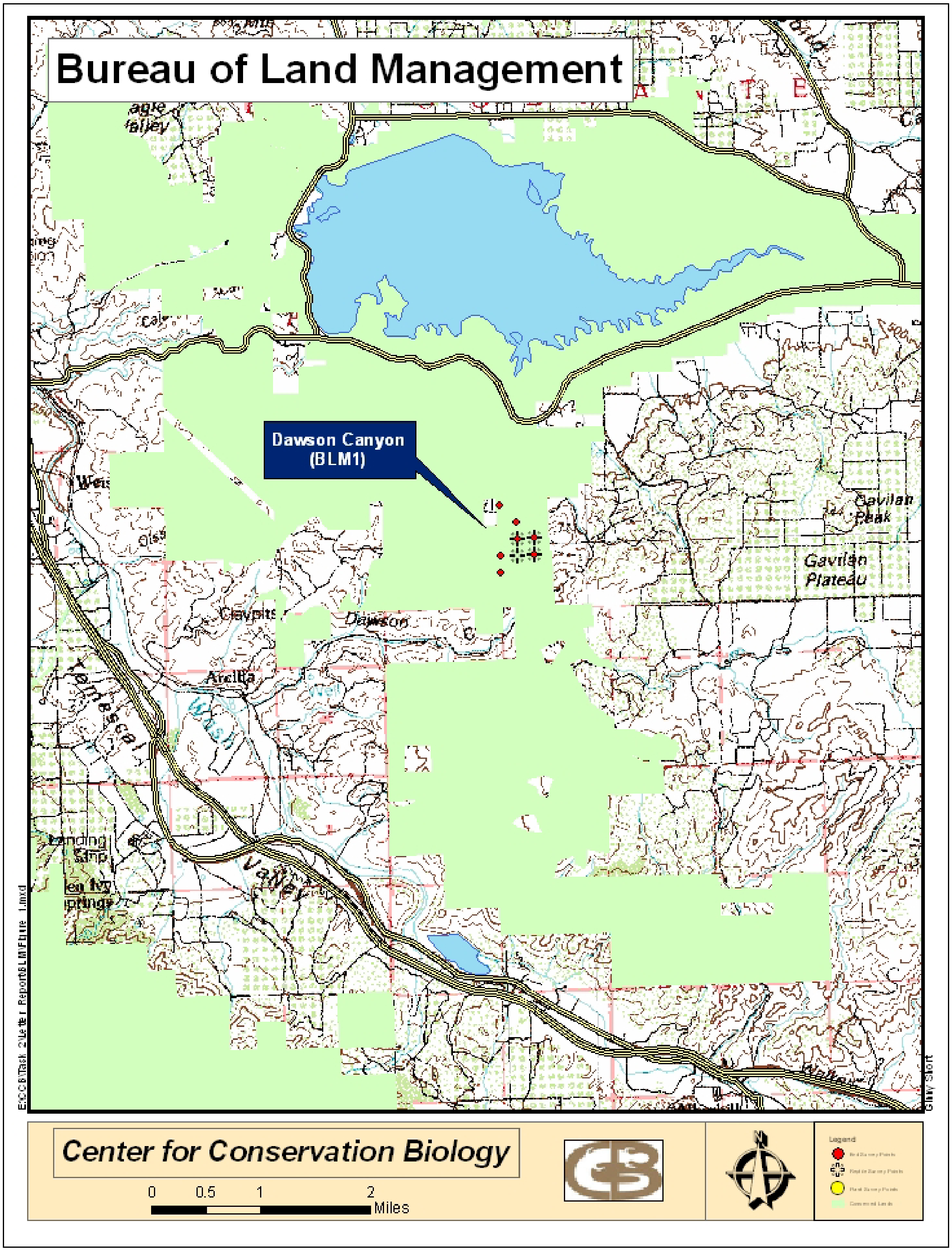
RARE PLANT RELEVE DATA SHEET

Releve Info (plots = 32 m X 32 m)

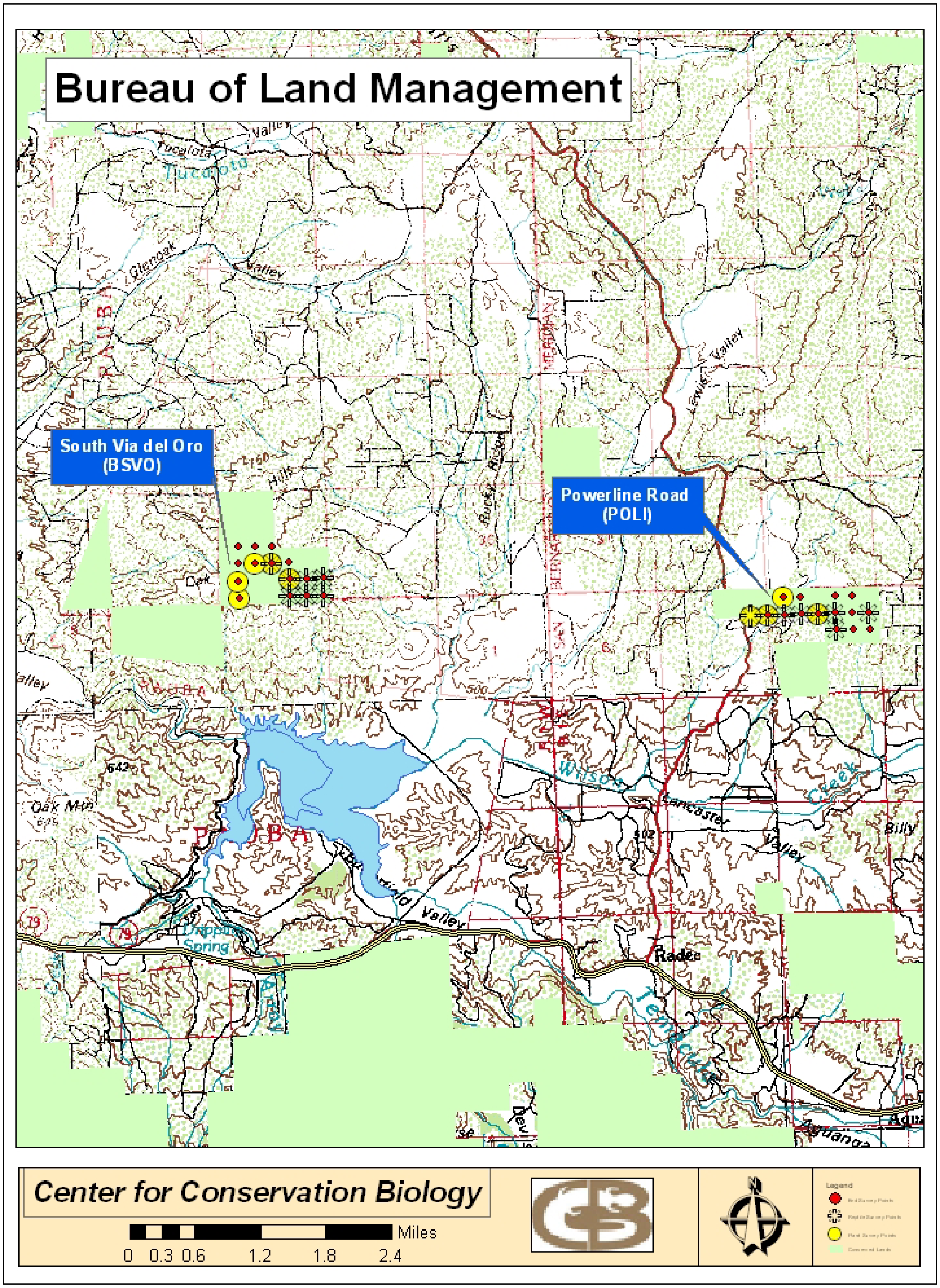
List all species observed and estimate cover class:

Cover Class intervals: 1=<1% 2=1-5% 3=5-15% 4=15-25% 5=25-50% 6=50-75% 7=>75%

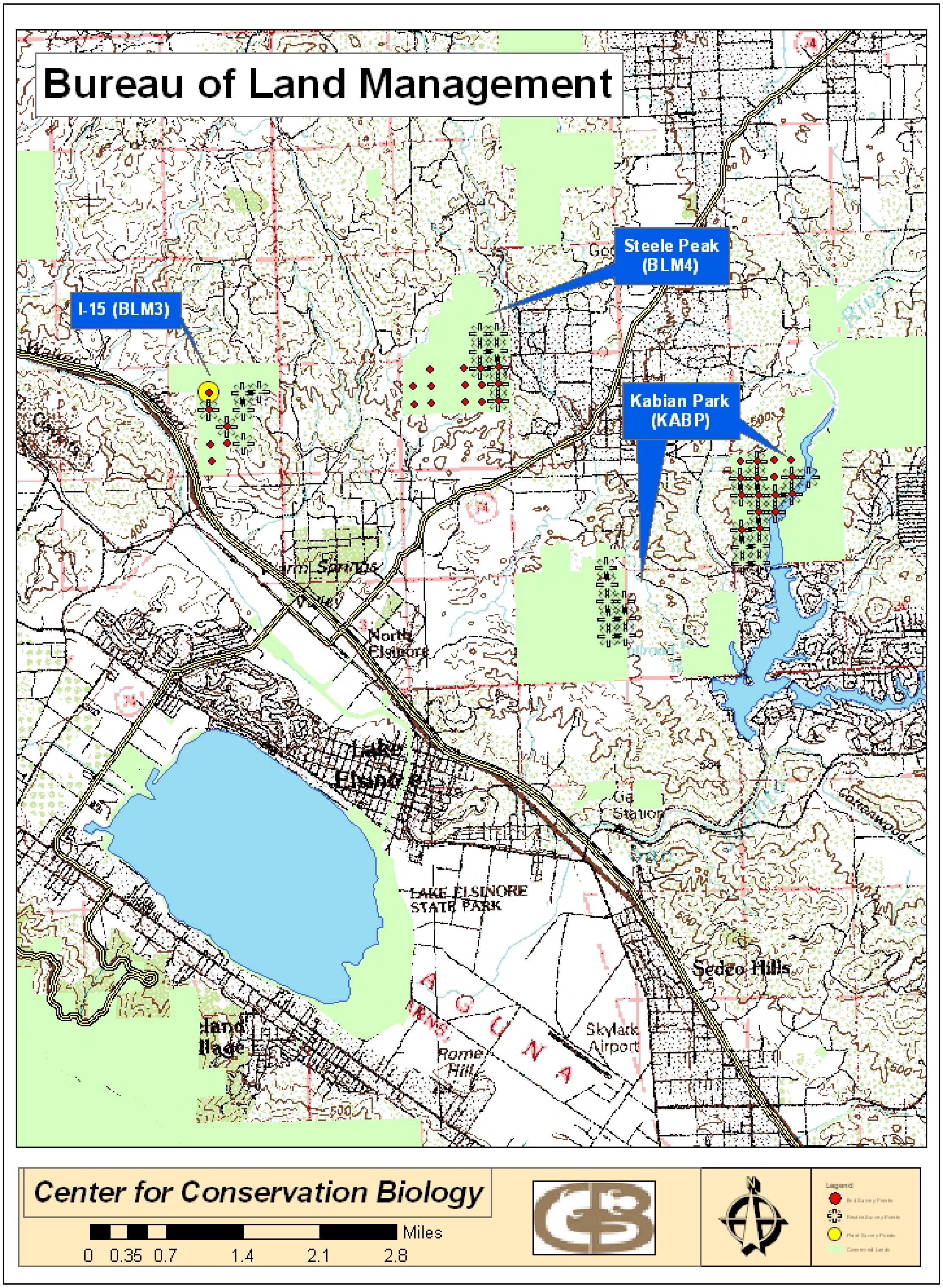
Species	Cover Class	Ave. Height
Herbaceous Layer		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
Shrub Layer		
1		
2		
3		
4		
5		
6		
Tree Layer		
1		
2		
3		
4		
5		



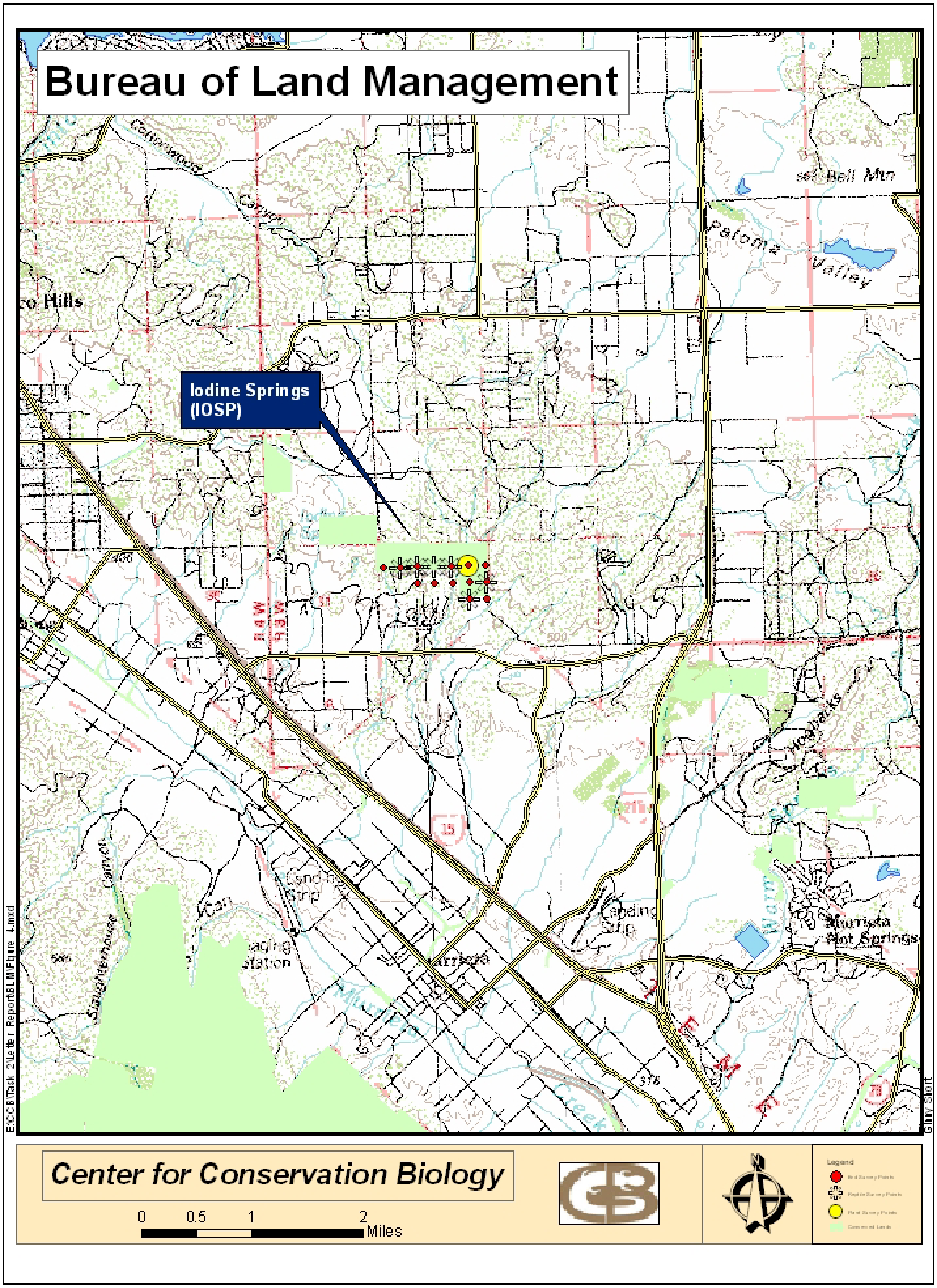
Appendix Figure 2. Locations of 2006 surveys conducted by the Center for Conservation Biology on Bureau of Land Management lands in Dawson Canyon, western Riverside County. Red circles indicate survey locations for birds, yellow circles for rare plants, and black crosses for reptiles.



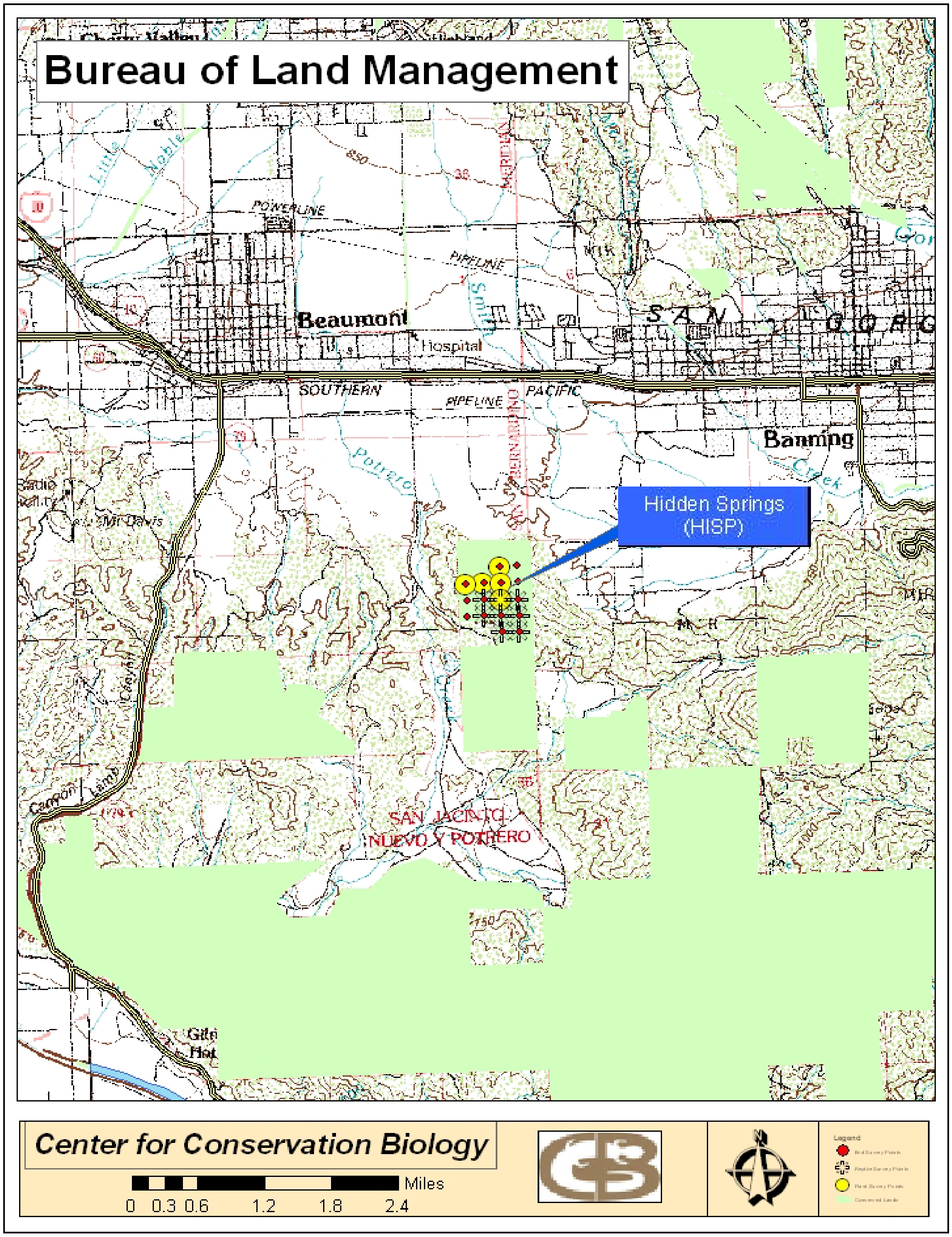
Appendix Figure 3. Locations of 2006 surveys conducted by the Center for Conservation Biology on Bureau of Land Management lands near South Via del Oro and Powerline Road, western Riverside County. Red circles indicate survey locations for birds, yellow circles for rare plants, and black crosses for reptiles.



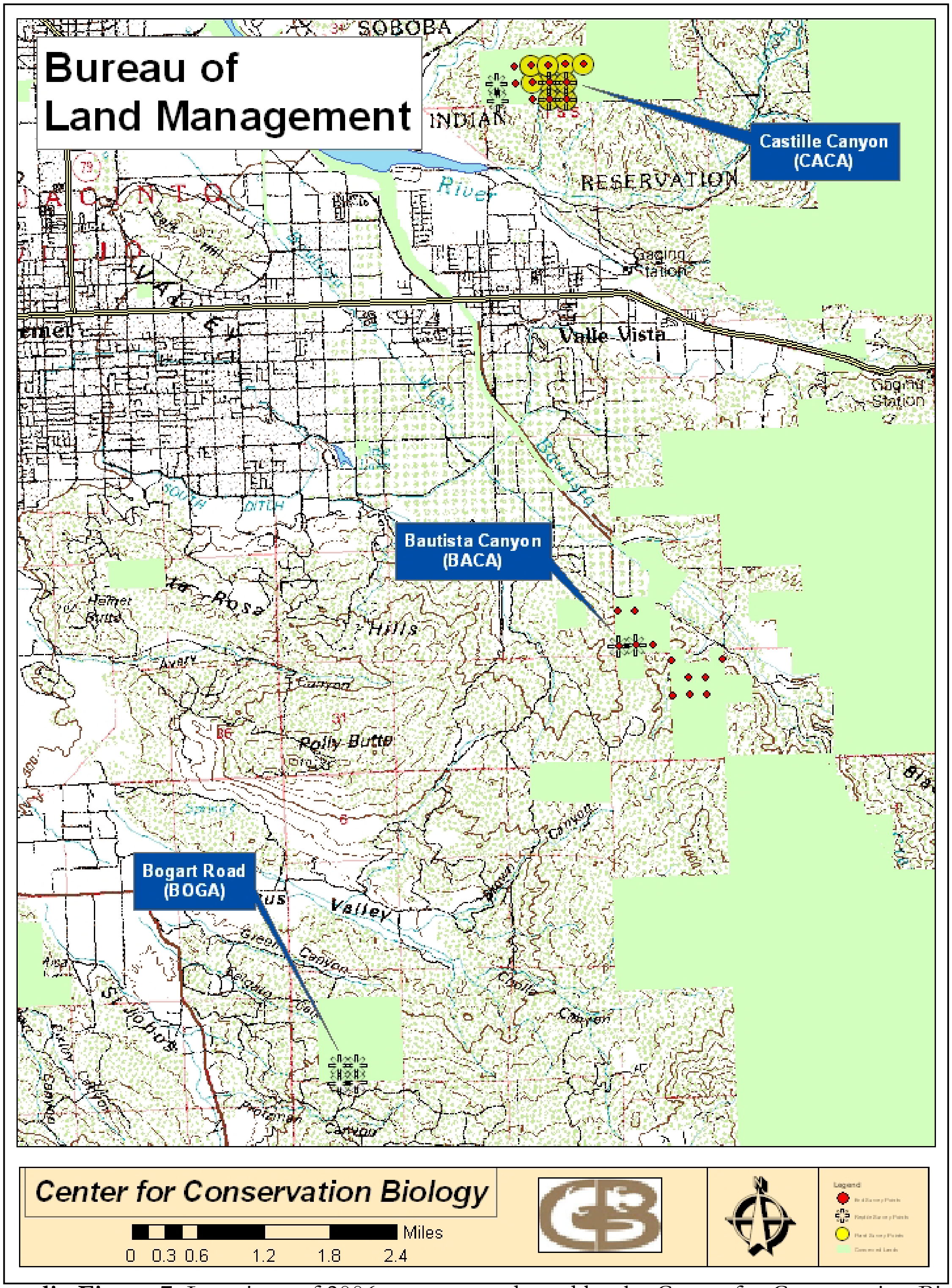
Appendix Figure 4. Locations of 2006 surveys conducted by the Center for Conservation Biology on Bureau of Land Management lands near I-15, Steele Peak and Kabian Park in western Riverside County. Red circles indicate survey locations for birds, yellow circles for rare plants, and black crosses for reptiles.



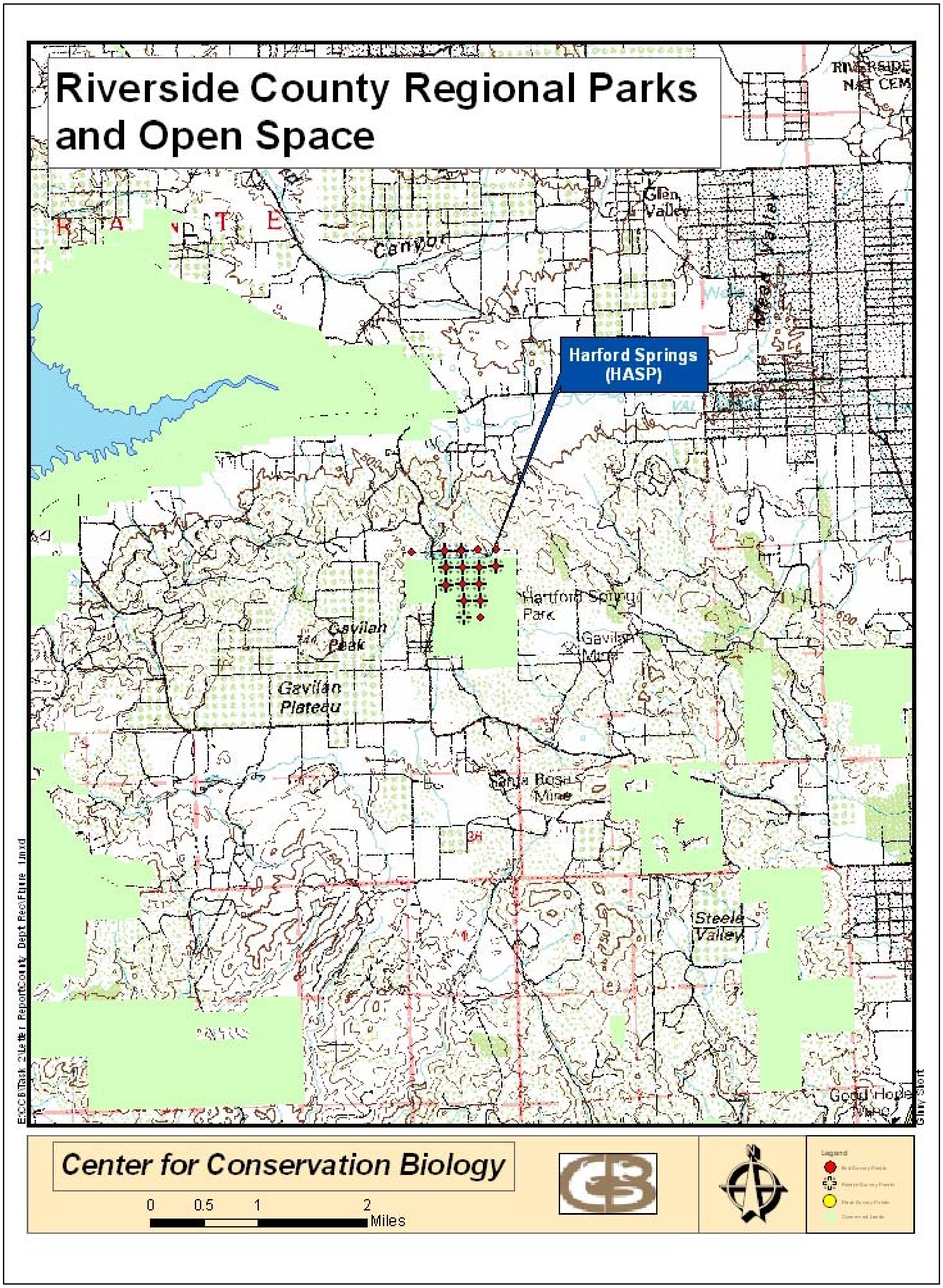
Appendix Figure 5. Locations of 2006 surveys conducted by the Center for Conservation Biology on Bureau of Land Management lands near Iodide Springs, western Riverside County. Red circles indicate survey locations for birds, yellow circles for rare plants, and black crosses for reptiles.



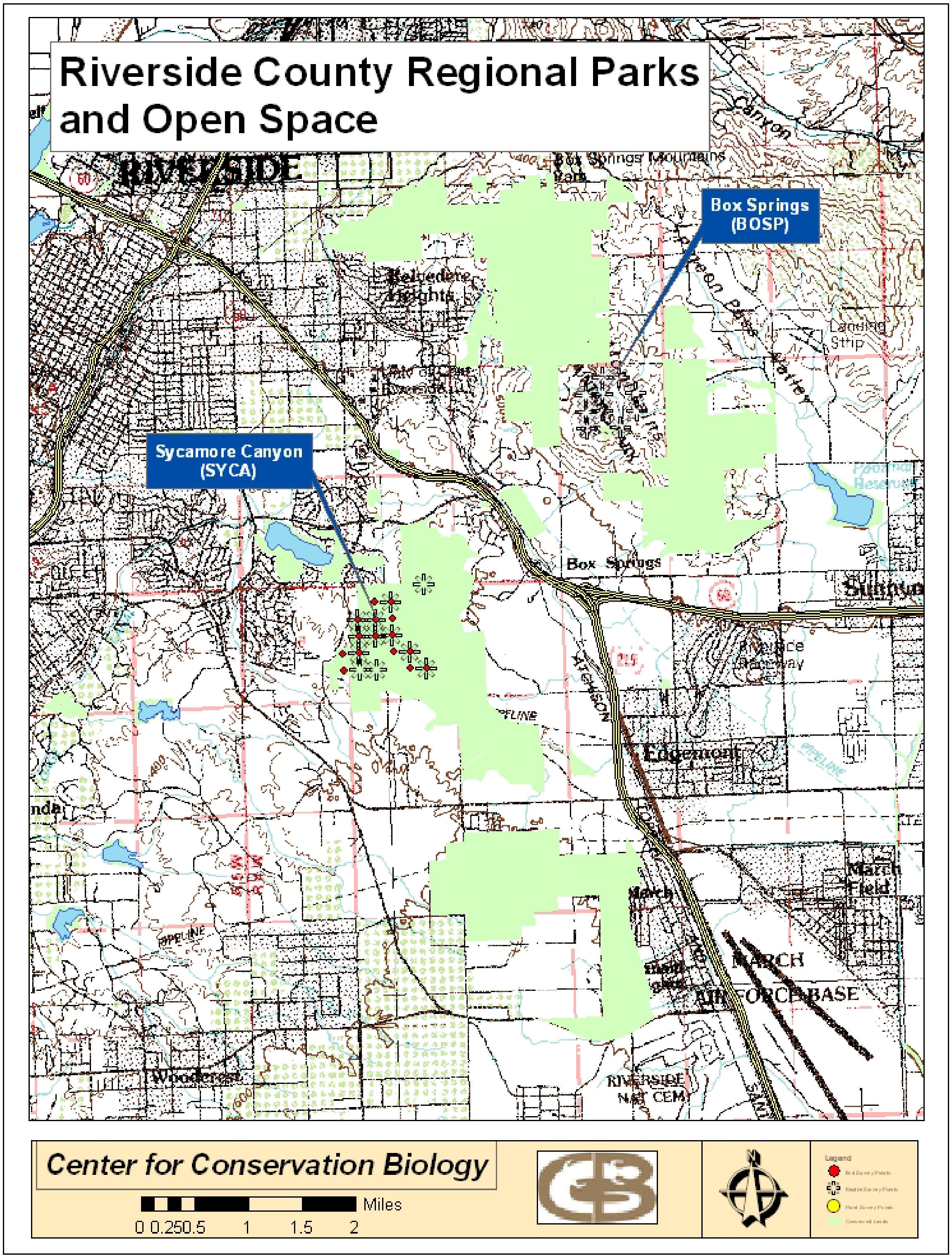
Appendix Figure 6. Locations of 2006 surveys conducted by the Center for Conservation Biology on Bureau of Land Management lands near Hidden Springs, western Riverside County. Red circles indicate survey locations for birds, yellow circles for rare plants, and black crosses for reptiles.



Appendix Figure 7. Locations of 2006 surveys conducted by the Center for Conservation Biology on Bureau of Land Management lands in Castille Canyon, Bautista Canyon, and near Bogart Road in western Riverside County. Red circles indicate survey locations for birds, yellow circles for rare plants, and black crosses for reptiles.

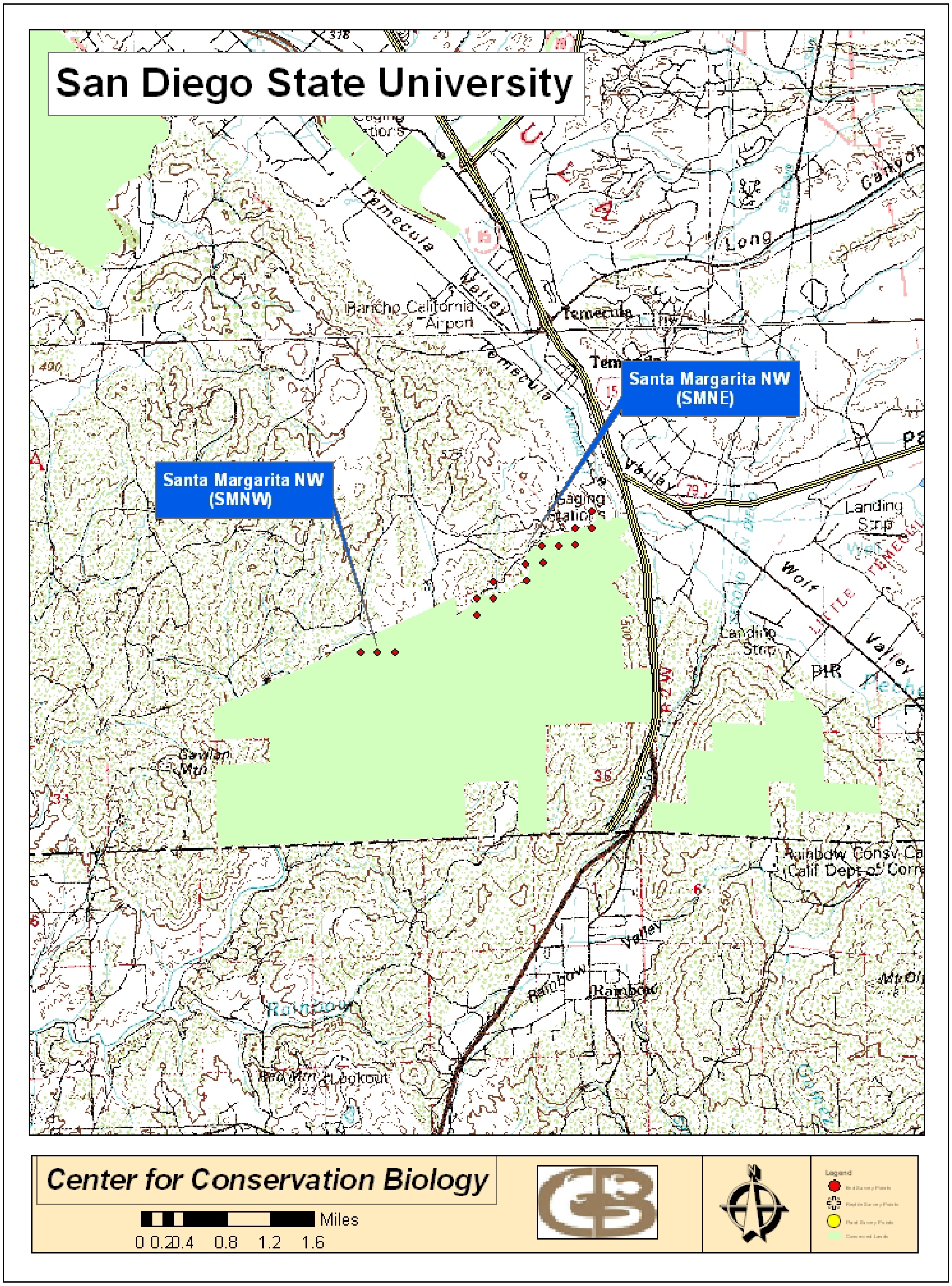


Appendix Figure 8. Locations of surveys conducted by the Center for Conservation Biology on County Parks and Open Space District lands at Harford Springs, western Riverside County. Red circles indicate survey locations for birds, yellow circles for rare plants, and black crosses for reptiles.

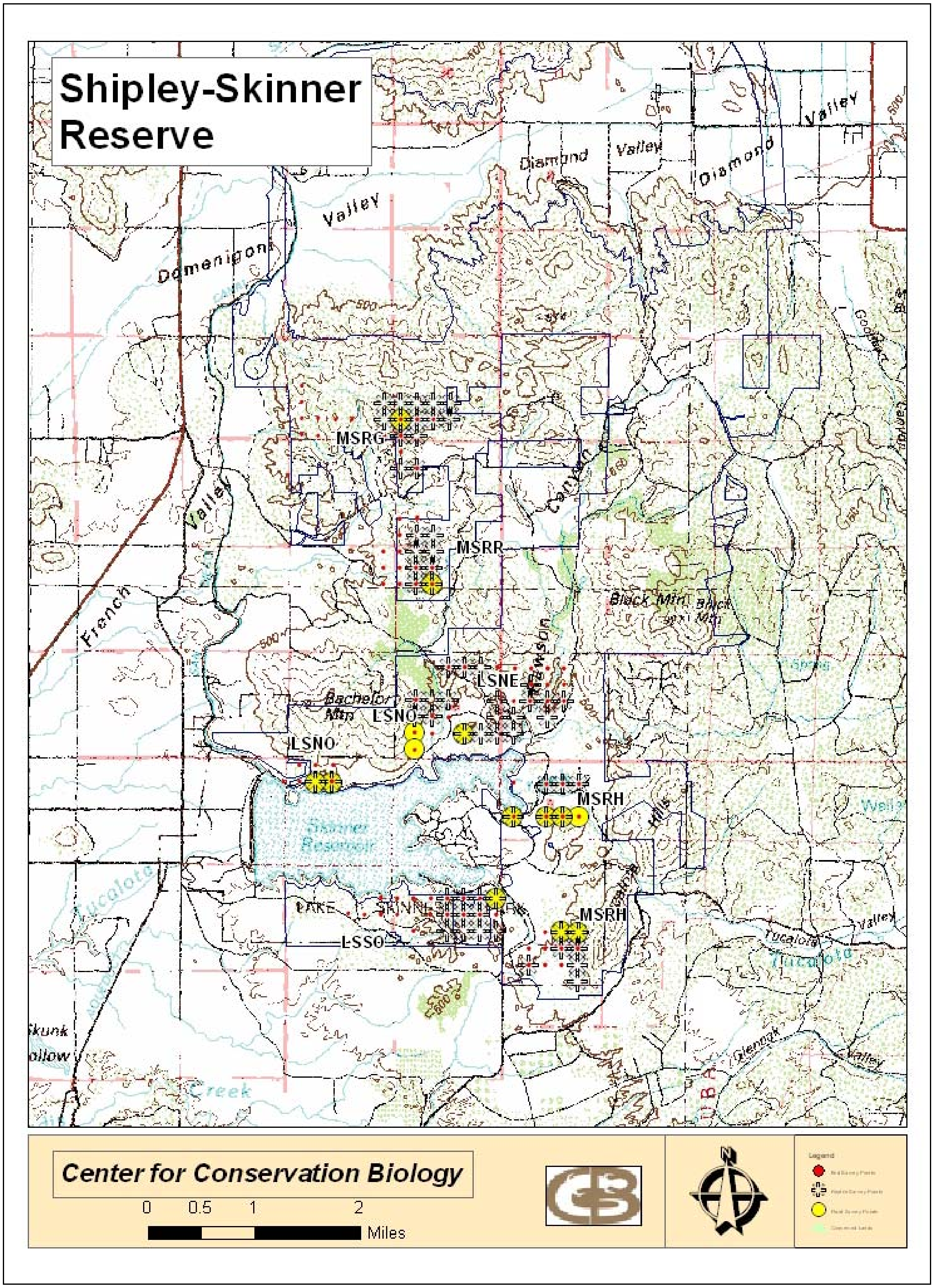


Appendix Figure 9. Locations of surveys conducted by the Center for Conservation Biology on County Parks and Open Space District lands at Box Springs and Sycamore Canyon in western Riverside County. Red circles indicate survey locations for birds, yellow circles for rare plants, and black crosses for reptiles.

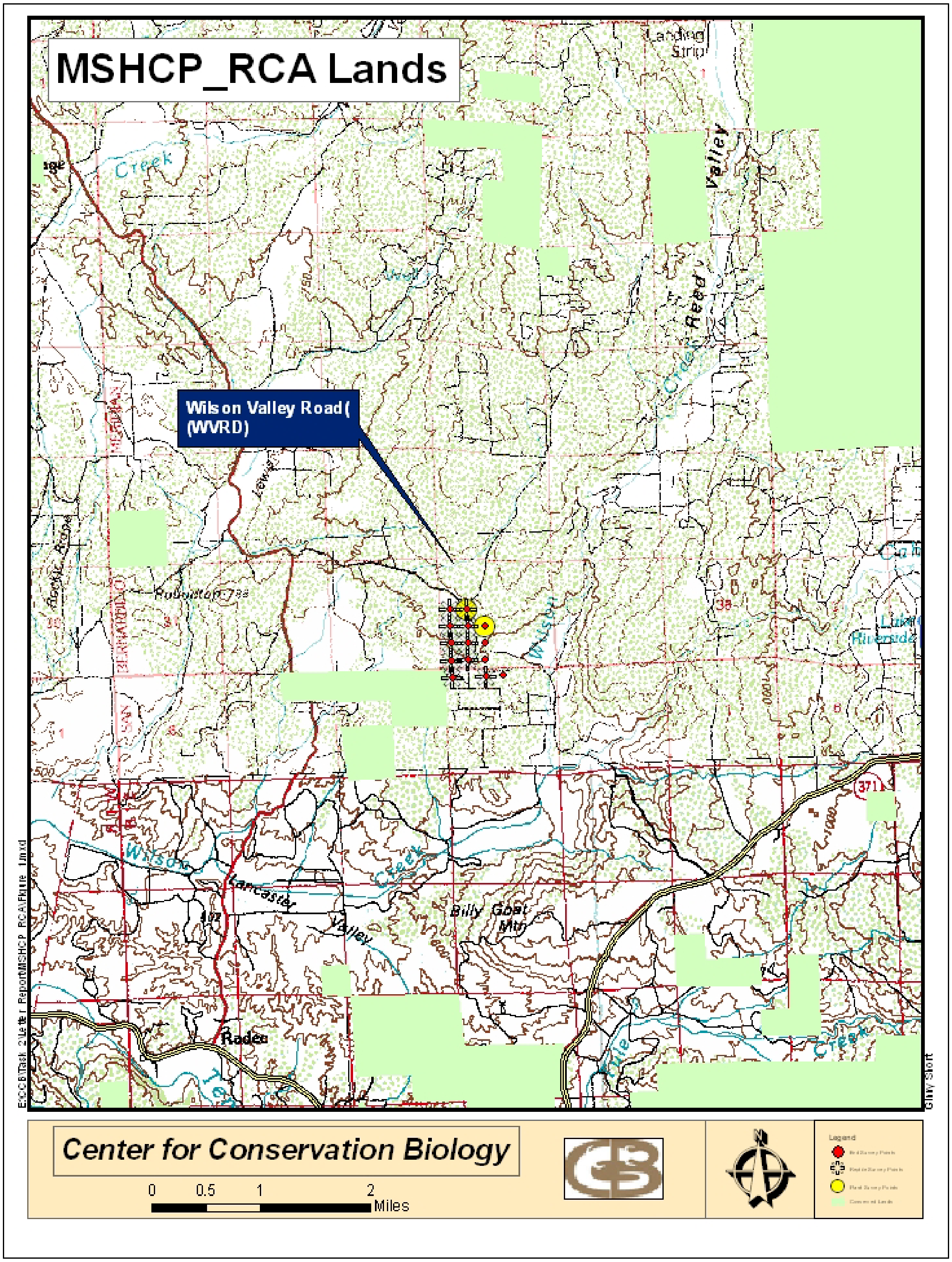
Appendix Figure 10. Locations of surveys conducted by the Center for Conservation Biology on County Parks and Open Space District lands at Kabian Park, western Riverside County. Red circles indicate survey locations for birds, yellow circles for rare plants, and black crosses for reptiles.



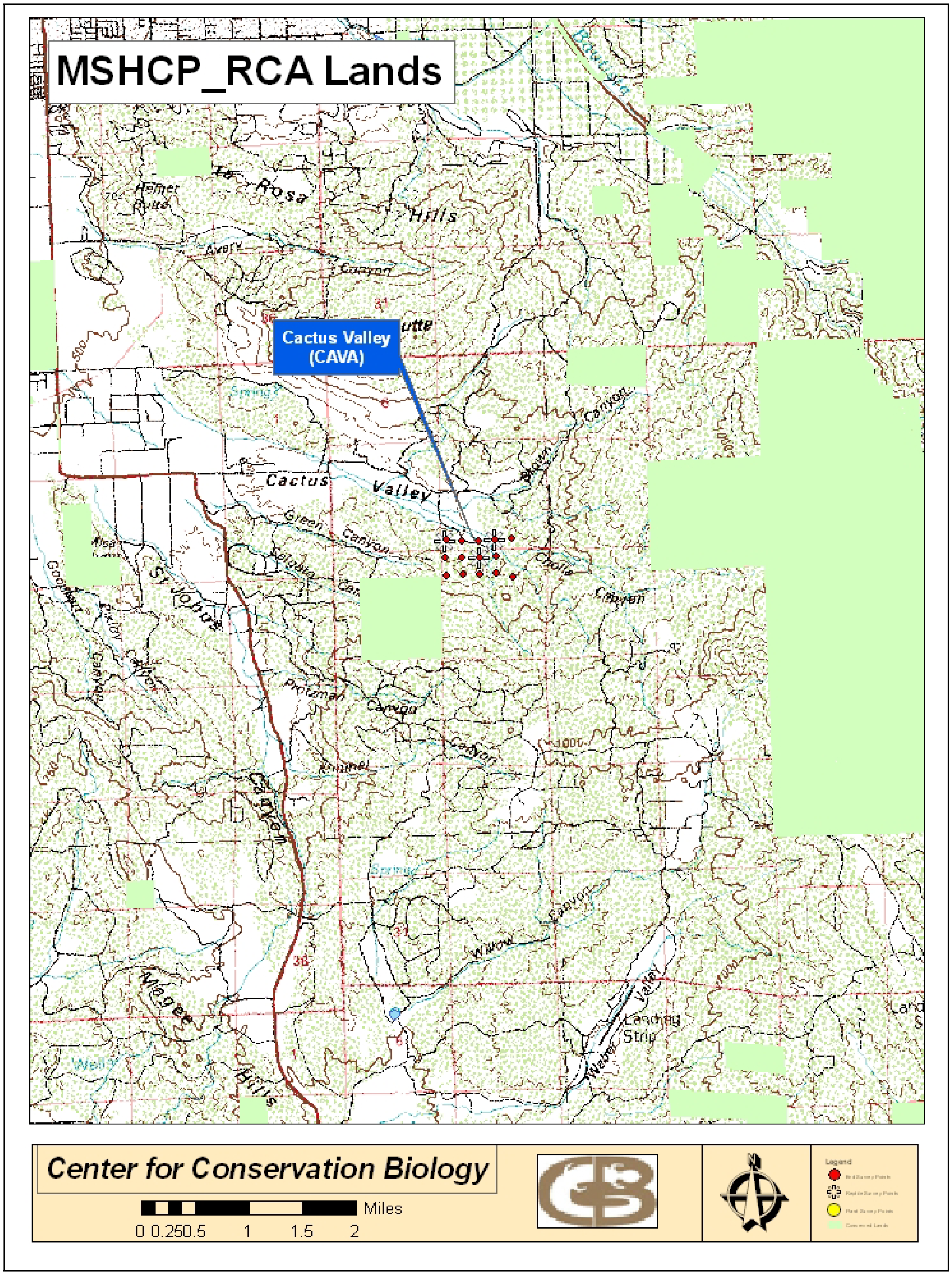
Appendix Figure 11. Locations of avian point count surveys conducted in 2006 by the Center for Conservation Biology on Santa Margarita Ecological Reserve lands in western Riverside County.



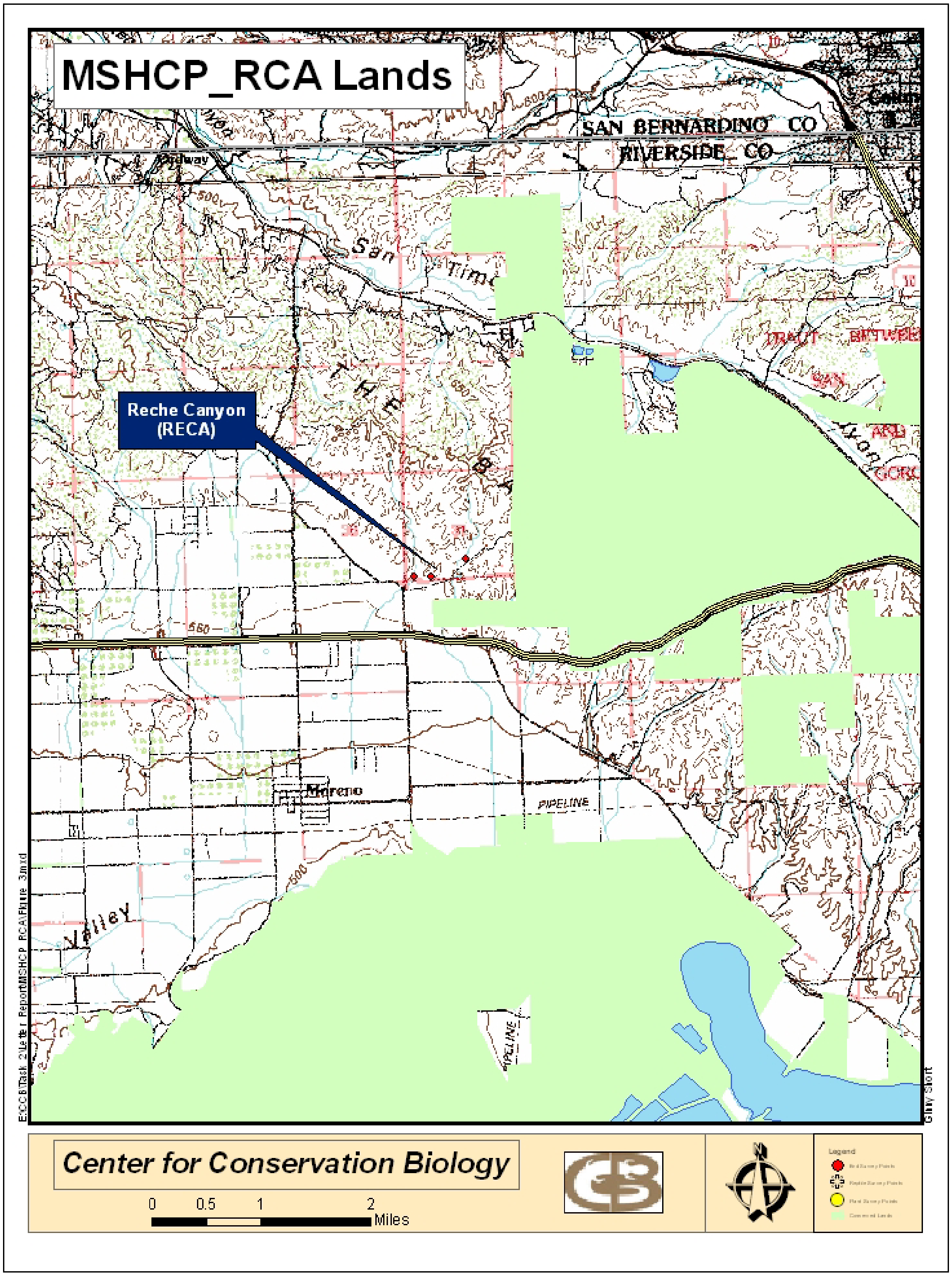
Appendix Figure 12. University of California Riverside's Center for Conservation Biology 2006 survey points at Shipley-Skinner Multi-Species Reserve by survey type. Red circles indicate survey locations for birds, yellow circles for rare plants, and black crosses for reptiles.



Appendix Figure 13. Locations of surveys conducted by the Center for Conservation Biology on Regional Conservation Authority Multiple Species Habitat Conservation lands near Wilson Valley Road, western Riverside County. Red circles indicate survey locations for birds, yellow circles for rare plants, and black crosses for reptiles.



Appendix Figure 14. Locations of surveys conducted by the Center for Conservation Biology on Regional Conservation Authority Multiple Species Habitat Conservation lands in Cactus Valley, western Riverside County. Red circles indicate survey locations for birds, yellow circles for rare plants, and black crosses for reptiles.



Appendix Figure 15. Locations of surveys conducted by the Center for Conservation Biology on Regional Conservation Authority Multiple Species Habitat Conservation lands in Reche Canyon, western Riverside County. Red circles indicate survey locations for birds, yellow circles for rare plants, and black crosses for reptiles.

Appendix Table 9. Species detected on different Bureau of Land Management lands in western Riverside County during 2006 spring and summer surveys conducted by the Center for Conservation Biology. Species highlighted in gray are "Covered Species" under the Western Riverside County's Multiple Species Habitat Conservation Plan.

Common Name	Scientific Name	Bautista Canyon	BLM 1	BLM 3	BLM 4	Bogart Road	South Via de Oro	Castille Canyon	High-land Springs	Iodide Springs	Kabian Park	Power Line Road
Plants												
Coulter's matilija poppy	*Romneya coulteri*		X									
Long-spined spineflower	*Chorizanthe polygonoides longispina*				X				X	X		
Parry's spine flower	*Chorizanthe parryi parryi*						X	X	X			X
Plummer's mariposa lily	*Calochortus plummerae*						X	X				
Reptiles												
Belding's orange-throated whiptail	*Cnemidophorus hyperythrus beldingi*			X						X		X
Coastal western whiptail	*Cnemidophorus tigris multiscutatus*	X	X		X				X	X		
Coast horned lizard	*Phrynosoma coronatum blainvillei*					X			X	X		
Western fence lizard	*Sceloporus occidentalis*	X	X		X	X		X	X			
Granite spiny lizard	*Sceloporus orcutti*	X	X			X		X				X
Side-blotched lizard	*Uta stansburiana*	X	X	X	X		X	X		X	X	X
Birds												
Acorn Woodpecker	*Melanerpes formicivorus*							X		X		
American Crow	*Corvus brachyrhynchos*	X						X		X	X	
American Goldfinch	*Carduelis tristis*									X	X	
American Kestrel	*Falco sparverius*	X			X			X				
Anna's Hummingbird	*Calypte anna*	X	X	X	X		X	X	X	X	X	X
Ash-throated flycatcher	*Myiarchus cinerascens*	X			X			X	X	X		
Audubon's Warbler	*Dendroica coronata*	X					X			X		
Barn Swallow	*Hirundo rustica*										X	
Bell's Sage Sparrow	*Amphispiza belli belli*	X	X	X	X		X	X	X	X	X	X
Common Name	**Scientific Name**	**Bautista**	**BLM**	**BLM**	**BLM**	**Bogart**	**South**	**Castille**	**High-**	**Iodide**	**Kabian**	**Power**

Common Name	**Scientific Name**	**Bautista Canyon**	**BLM 1**	**BLM 3**	**BLM 4**	**Bogart Road**	**South Via de Oro**	**Castille Canyon**	**High-land Springs**	**Iodide Springs**	**Kabian Park**	**Power Line Road**
		Canyon	**1**	**3**	**4**	**Road**	**Via de Oro**	**Canyon**	**land Springs**	**Springs**	**Park**	**Line Road**
Bewick's Wren	*Thryomanes bewickii*	X	X	X	X		X	X	X	X	X	X
Black-chinned Sparrow	*Spizella atrogularis*	X					X	X	X	X		X
Black-crowned Night Heron	*Nycticorax nycticorax*										X	X
Black-headed Grosbeak	*Pheucticus melanocephalus*							X	X	X	X	
Black phoebe	*Sayornis nigricans*							X				
Black-throated Gray Warbler	*Dendroica nigrescens*						X					
Blue-gray Gnatcatcher	*Polioptila caerulea*	X	X	X	X		X	X	X	X	X	X
Brewer's sparrow	*Spizella breweri*											X
Brown-crested Flycatcher	*Myiarchus tyrannulus*	X										
Brown-headed Cowbird	*Molothrus ater*									X		
Bullock's Oriole	*Icterus bullockii*							X	X	X	X	
Bushtit	*Psaltriparus minimus*	X	X		X		X	X	X	X	X	X
Cactus Wren	*Campylorhynchus brunneicapillus*											X
California Gnatcatcher	*Polioptila californica californica*				X		X				X	
California Horned Lark	*Eremophila alpestris actia*		X				X					
California Quail	*Callipepla californica*	X	X	X	X		X	X	X	X	X	X
California Thrasher	*Toxostoma redivivum*	X	X	X	X		X	X	X	X		X
California Towhee	*Pipilo crissalis*	X	X	X			X	X	X	X	X	X
Cassin's Kingbird	*Tyrannus vociferans*				X							X
Cliff Swallow	*Petrochelidon pyrrhonota*						X	X		X		X
Common Raven	*Corvus corax*	X	X	X	X		X	X	X	X	X	X
Common Yellowthroat	*Geothlypis trichas*										X	

Common Name	**Scientific Name**	**Bautista Canyon**	**BLM 1**	**BLM 3**	**BLM 4**	**Bogart Road**	**South Via de Oro**	**Castille Canyon**	**High-land Springs**	**Iodide Springs**	**Kabian Park**	**Power Line Road**
Cooper's Hawk	*Accipiter cooperii*	X								X	X	
Costa's Hummingbird	*Colypte costae*	X			X		X	X	X	X	X	X
European Starling	*Sturnus vulgaris*						X			X		
Fox Sparrow	*Passerella iliaca*									X		
Great Blue Heron	*Ardea herodias*										X	
Great Horned Owl	*Bubo virginianus*		X									
Great Egret	*Ardea alba*										X	
Greater Roadrunner	*Geococcxs californianus*	X							X			
Hermit Thrush	*Catharus guttatus*						X	X				
House finch	*Carpodacus mexicanus*	X	X	X	X			X	X	X	X	X
House Wren	*Troglodytes aedon*	X		X	X		X	X		X		
Killdeer	*Charadrius vociferus*							X				
Lark Sparrow	*Chondestes grammacus*						X		X		X	X
Lawrence"s Goldfinch	*Carduelis lawrencei*							X				
Lazuli Bunting	*Passerina amoena*	X			X			X	X	X	X	X
Lesser Goldfinch	*Carduelis psaltria*	X	X	X	X		X	X	X	X	X	X
Mallard	*Anas platyrhynchos*										X	
Mountain Quail	*Oreortyx pictus*	X										
Mourning Dove	*Zenaida macroura*	X	X	X	X		X	X	X	X	X	X
Northern Flicker	*Colaptes auratus*	X						X		X	X	
Northern Harrier	*Circus cyaneus - breeding*		X		X			X	X		X	
Northern Mockingbird	*Mimus polyglottos*		X		X			X	X	X	X	X
Nuttall"s Woodpecker	*Picoides nuttallii*							X		X		
Oak Titmouse	*Baeolophus inornats*							X		X		
Orange-crowned Warbler	*Vermivora celata*									X		
Phainopepla	*Phainopepla nitens*	X							X			
Red-shouldered Hawk	*Buteo lineatus*										X	
Red-tailed Hawk	*Buteo jamaicensis*				X			X	X			X
Red-winged Blackbird	*Agelaius phoeniceus*										X	

Common Name	**Scientific Name**	**Bautista Canyon**	**BLM 1**	**BLM 3**	**BLM 4**	**Bogart Road**	**South Via de Oro**	**Castille Canyon**	**High-land Springs**	**Iodide Springs**	**Kabian Park**	**Power Line Road**
Rock Wren	*Salpinctes obsoletus*	X		X	X				X			X
Ruby-crowned Kinglet	*Regulus calendula*				X					X	X	
Rufous Hummingbird	*Selasphorus rufous*	X							X			
Savannah Sparrow	*Passerculus sandwichensis*	X			X							X
Say's Phoebe	*Sayornis saya*	X			X		X		X			X
Snowy Egret	*Egretta thula*										X	
Song Sparrow	*Melospiza melodia*	X		X	X				X	X	X	
Southern California rufous-crowned Sparrow	*Aimophila ruficeps canescens*	X	X	X	X		X	X	X	X	X	X
Spotted towhee	*Pipilo maculates*	X	X	X			X	X	X	X	X	X
Townsend's warbler	*Dendroica townsendii*						X		X			
Turkey Vulture	*Cathartes aura*							X			X	
Westerm Kingbird	*Tyrannus verticalis*							X				
Western Meadowlark	*Sturnella neglecta*	X	X		X		X	X	X		X	X
Western Scrub-Jay	*Aphelocoma californica*	X			X		X	X	X	X		X
Western Tanager	*Piranga ludoviciana*							X				
White-crowned Sparrow	*Zonotrichia leucophrys*	X	X	X	X		X	X	X	X	X	X
White-tailed Kite	*Elanus leucurus*	X								X	X	
Wilson's Warbler	*Wilsonia pusilla*				X			X		X		
Yellow Warbler	*Dendroica petechia brewsteri*								X			

Appendix Table 10. Species detected on Regional Park and Open Space District lands during 2006 surveys conducted by the Center for Conservation Biology. Species highlighted in gray are "Covered Species" under the Western Riverside County's Multiple Species Habitat Conservation Plan.

Common Name	Scientific Name	Box Springs	Harford Springs	Sycamore Canyon	Kabian Park
Reptiles					
Belding's orange-throated whiptail	*Cnemidophorus hyperythrus beldingi*	X	X		
Coastal western whiptail	*Cnemidophorus tigris multiscutatus*		X		
Granite spiny lizard	*Sceloporus orcutti*	X	X	X	
Northern red diamond rattlesnake	*Crotalus ruber ruber*	X			
Side-blotched lizard	*Uta stansburiana*	X	X	X	X
Western fence lizard	*Sceloporus occidentalis*	X	X	X	
Birds					
American Crow	*Corvus brachyrhynchos*		X	X	M
American Goldfinch	*Carduelis tristis*		X		X
Anna's Hummingbird	*Calypte anna*		X	X	X
Ash-throated Flycatcher	*Myiarchus cinerascens*		X		
Audubon's Warbler	*dendroica coronata*		X	X	
Barn Swallow	*Hirundo rustica*			X	X
Bell's Sage Sparrow	*Amphispiza belli belli*		X	X	X
Bewick's Wren	*Thryomanes bewickii*		X	X	X
Black-chinned Sparrow	*Spizella atrogularis*			X	
Black-crowned Night Heron	*Nycticorax nycticorax*				X
Black-headed Grosbeak	*Pheucticus melanocephalus*				X
Black Phoebe	*Sayornis nigricans*		X		
Blue-gray Gnatcatcher	*Polioptila caerulea*		X	X	X
Blue Grosbeak	*Passerina caerulea*			X	X
Brown-headed Cowbird	*Molothrus ater*		X		
Bullock's Oriole	*Icterus bullockii*			X	X
Bushtit	*Psaltriparus minimus*		X	X	X
California Gnatcatcher	*Polioptila californica californica*		X	X	X
California Quail	*Callipepla californica*		X	X	X
California Thrasher	*Toxostoma redivivum*		X	X	

Common Name	**Scientific Name**	**Box Springs**	**Harford Springs**	**Sycamore Canyon**	**Kabian Park**
California Towhee	*Pipilo crissalis*		X	X	X
Canyon Wren	*Catherpes mexicanus*		X	X	
Cassin's Kingbird	*Tyrannus vociferans*			X	
Cliff Swallow	*Petrochelidon pyrrhonota*		X	X	
Common Raven	*Corvus corax*		X	X	X
Common Yellowthroat	*Geothlypis trichas*			X	X
Cooper's Hawk	*Accipiter cooperii*		X	X	X
Costa's Hummingbird	*Colypte costae*		X	X	X
European Starling	*Sturnus vulgaris*		X		
Grasshopper Sparrow	*Ammodramus savannarum*			X	
Great Blue Heron	*Ardea herodias*				X
Great Egret	*Ardea alba*				X
Greater Roadrunner	*Geococcxs californianus*			X	
House Finch	*Carpodacus mexicanus*		X	X	X
House Wren	*Troglodytes aedon*			X	
Killdeer	*Charadrius vociferus*			X	
Lark Sparrow	*Chondestes grammacus*				X
Lazuli Bunting	*Passerina amoena*				X
Lesser Goldfinch	*Carduelis psaltria*		X	X	X
Mallard	*Anas platyrhynchos*			X	X
Mourning Dove	*Zenaida macroura*		X	X	X
Northern Flicker	*Colaptes auratus*		X	X	X
Northern Harrier	*Circus cyaneus*		X		X
Northern Mockingbird	*Mimus polyglottos*		X	X	X
Nuttall's Woodpecker	*Picoides nuttallii*		X	X	
Phainopepla	*Phainopepla nitens*		X		
Red-shouldered Hawk	*Buteo lineatus*		X	X	X
Red-tailed Hawk	*Buteo jamaicensis*		X	X	X
Red-winged Blackbird	*Agelaius phoeniceus*				X
Rock Wren	*Salpinctes obsoletus*		X		
Ruby-crowned Kinglet	*Regulus calendula*			X	X
Rufous Hummingbird	*Selasphorus rufous*			X	
Savannah Sparrow	*Passerculus sandwichensis*		X	X	X

Common Name	**Scientific Name**	**Box Springs**	**Harford Springs**	**Sycamore Canyon**	**Kabian Park**
Say's Phoebe	*Sayornis saya*		X	X	
Snowy Egret	*Egretta thula*				X
Song Sparrow	*Melospiza melodia*		X	X	X
Southern California rufous-crowned Sparrow	*Aimophila ruficeps canescens*		X	X	X
Spotted Towhee	*Pipilo maculates*		X	X	X
Turkey Vulture	*Cathartes aura*		X		X
Western Meadowlark	*Sturnella neglecta*			X	X
Western Scrub-Jay	*Aphelocoma californica*		X	X	
White-crowned Sparrow	*Zonotrichia leucophrys*		X	X	X
White-tailed Kite	*Elanus leucurus*		X		X

Appendix Table 11. Bird species detected on the Santa Margarita Ecological Reserve during 2006 point count surveys conducted by the Center for Conservation Biology. Species highlighted in gray are "Covered Species" under the Western Riverside County's Multiple Species Habitat Conservation Plan.

Common Name	Scientific Name	Santa Margarita Northeast	Santa Margarita Northwest
Acorn Woodpecker	*Melanerpes formicivorus*	X	
American Crow	*Corvus brachyrhynchos*	X	X
Anna's Hummingbird	*Calypte anna*	X	X
Ash-throated Flycatcher	*Myiarchus cinerascens*	X	X
Audubon's Warbler	*Dendroica coronata*	X	
Bewick's Wren	*Thryomanes bewickii*	X	X
Black-chinned Sparrow	*Spizella atrogularis*	X	
Black-headed Grosbeak	*Pheucticus melanocephalus*	X	X
Blue-gray Gnatcatcher	*Polioptila caerulea*	X	X
Blue Grosbeak	*Passerina caerulea*	X	
Bullock's Oriole	*Icterus bullockii*	X	
Bushtit	*Psaltriparus minimus*	X	X
California Quail	*Callipepla californica*	X	
California Thrasher	*Toxostoma redivivum*	X	X
California Towhee	*Pipilo crissalis*	X	X
Canyon Wren	*Catherpes mexicanus*	X	
Common Raven	*Corvus corax*	X	X
Costa's Hummingbird	*Colypte costae*	X	
Great Blue Heron	*Ardea herodias*	X	
Hermit Warbler	*Denroica occidentalis*	X	
House Finch	*Carpodacus mexicanus*	X	
House Wren	*Troglodytes aedon*	X	
Lazuli Bunting	*Passerina amoena*	X	
Lesser Goldfinch	*Carduelis psaltria*	X	
Mallard	*Anas platyrhynchos*	X	
Mountain Quail	*Oreortyx pictus*	X	
Mourning Dove	*Zenaida macroura*	X	X
Northern Flicker	*Colaptes auratus*	X	X
Northern Mockingbird	*Mimus polyglottos*	X	
Nuttall’s Woodpecker	*Picoides nuttallii*	X	X
Oak Titmouse	*Baeolophus inornats*	X	
Orange-crowned Warbler	*Vermivora celata*	X	
Red-shouldered Hawk	*Buteo lineatus*	X	
Red-tailed Hawk	*Buteo jamaicensis*	X	
Rock Wren	*Salpinctes obsoletus*	X	
Ruby-crowned Kinglet	*Regulus calendula*	X	
Savannah Sparrow	*Passerculus sandwichensis*	X	
Song Sparrow	*Melospiza melodia*	X	
Southern California rufous-crowned Sparrow	*Aimophila ruficeps canescens*	X	
Spotted Towhee	*Pipilo maculates*	X	X
Turkey Vulture	*Cathartes aura*	X	

Common Name	Scientific Name	Santa Margarita Northeast	Santa Margarita Northwest
Violet Green Swallow	*Tachycineta thalassina*	X	
Western Scrub-Jay	*Aphelocoma californica*	X	X
White-crowned Sparrow	*Zonotrichia leucophrys*	X	
White-throated Swift	*Aeronautes saxatalis*	X	
Wilson's Warbler	*Wilsonia pusilla*	X	
Yellow Warbler	*Dendroica petechia brewsteri*	X	
Yellow-breasted Chat	*Icteria virens*	X	

Appendix Table 12. Species detected at Shipley-Skinner Multi-Species Reserve during 2006 surveys conducted by the Center for Conservation Biology. Species highlighted in gray are "Covered Species" under Western Riverside County's Multiple species Habitat Conservation Plan.

Common_Name	**Scientific_Name**	**NE Lake Skinner**	**No. Lake Skinner**	**So. Lake Skinner**	**Goldrich Trail**	**East Head-quarters**	**So. Rawson Road**
Rare Plants							
Long-spined spineflower	*Chorizanthe polygonoides longispina*		X			X	
Parry's spine flower	*Chorizanthe parryi parryi*		X			X	
Plummer's mariposa lily	*Calochortus plummerae*				X		
Smooth tarplant	*Centromadia pungens laevis*						X
Reptiles							
Belding's orange-throated whiptail	*Cnemidophorus hyperythrus beldingi*	X	X			X	X
Coast horned lizard	*Phrynosoma coronatum blainvillei*					X	
Coastal western whiptail	*Cnemidophorus tigris multiscutatus*	X		X			
Granite spiny lizard	*Sceloporus orcutti*			X	X		
Red coachwhip	*Masticophis flagellum fulginosus*		X		X		
Side-blotched lizard	*Uta stansburiana*	X			X		
Southwestern rattlesnake	*Crotalus viridis helleri*	X					
Western fence lizard	*Sceloporus occidentalis*	X		X	X	X	X
Birds							
American Coot	*Fulica americana*			X			
American Crow	*Corvus brachyrhynchos*			X			
American Goldfinch	*Carduelis tristis*	X				X	X
American Kestrel	*Falco sparverius*	X					X
Anna's Hummingbird	*Calypte anna*	X	X	X	X	X	X
Ash-throated Flycatcher	*Myiarchus cinarascens*	X	X	X	X		
Audubon's Warbler	*dendroica coronata*					X	
Bewick's Wren	*Thryomanes bewickii*	X	X	X	X	X	X
Bell's Sage Sparrow	*Amphispiza belli belli*	X	X		X	X	X
Black-chinned Sparrow	*Spizella atrogularis*	X	X			X	X
Black-headed Grosbeak	*Pheucticus melanocephalus*			X		X	
Black Phoebe	*Sayornis nigricans*		X				

Common_Name	**Scientific_Name**	**NE Lake Skinner**	**No. Lake Skinner**	**So. Lake Skinner**	**Goldrich Trail**	**East Head-quarters**	**So. Rawson Road**
Blue-gray Gnatcatcher	*Polioptila caerulea*	X	X	X	X	X	X
Blue Grosbeak	*Passerina caerulea*			X			
Brewer's Sparrow	*Spizella breweri*	X				X	
Bullock's Oriole	*Icterus bullockii*	X		X		X	X
Bushtit	*Psaltriparus minimus*	X	X	X	X	X	X
California Gnatcatcher	*Polioptila californica californica*	X	X	X	X	X	X
California Quail	*Callipepla californica*	X	X	X	X	X	X
California Thrasher	*Toxostoma redivivum*	X	X	X	X	X	X
California Towhee	*Pipilo crissalis*	X	X	X	X	X	X
Canyon Wren	*Catherpes mexicanus*	X	X				X
Cassin's Kingbird	*Tyrannus vociferans*	X	X	X			
Cliff Swallow	*Petrochelidon pyrrhonota*			X			
Common Moorhen	*Gallinula chloropus*			X			
Common Raven	*Corvus corax*	X	X	X	X	X	X
Common Yellowthroat	*Geothlypis trichas*		X	X	X		
Cooper's Hawk	*Accipiter cooperii*	X	X	X	X	X	
Costa's Hummingbird	*Colypte costae*	X	X	X	X	X	X
Downy Woodpecker	*Picoides pubescens*			X			
European Starling	*Sturnus vulgaris*		X				
Grasshopper Sparrow	*Ammodramus savannarum*	X	X	X		X	X
Great Horned Owl	*Bubo virginianus*			X			
Greater Roadrunner	*Geococcxs californianus*	X			X	X	X
House Finch	*Carpodacus mexicanus*	X		X		X	X
House Wren	*Troglodytes aedon*	X	X	X	X	X	X
Killdeer	*Charadrius vociferus*			X			
Lazuli Bunting	*Passerina amoena*						X
Lesser Goldfinch	*Carduelis psaltria*	X	X	X	X	X	X
Mallard	*Anas platyrhynchos*			X		X	
Mourning Dove	*Zenaida macroura*	X	X	X	X	X	X
Northern Flicker	*Colaptes auratus*	X	X	X		X	X
Northern Harrier	*Circus cyaneus - breeding*	X	X	X	X	X	X
Northern Mockingbird	*Mimus polyglottos*				X		

Common_Name	**Scientific_Name**	**NE Lake Skinner**	**No. Lake Skinner**	**So. Lake Skinner**	**Goldrich Trail**	**East Head-quarters**	**So. Rawson Road**
Nuttall's Woodpecker	*Picoides nuttallii*	X	X	X		X	X
Oak Titmouse	*Baeolophus inornats*	X					
Orange-crowned Warbler	*Vermivora celata*				X		
Pacific Slope Flycatcher	*Empidonax difficilis*		X				
Red-shouldered Hawk	*Buteo lineatus*			X		X	
Red-tailed Hawk	*Buteo jamaicensis*	X			X	X	X
Red-winged Blackbird	*Agelaius phoeniceus*			X		X	
Rock Wren	*Salpinctes obsoletus*	X	X		X		X
Ruby-crowned Kinglet	*Regulus calendula*		X				
Rufous Hummingbird	*Selasphorus rufous*						X
Savannah Sparrow	*Passerculus sandwichensis*	X	X	X		X	X
Say's Phoebe	*Sayornis saya*		X	X			
Song Sparrow	*Melospiza melodia*	X	X	X	X	X	X
Southern California rufous-crowned Sparrow	*Aimophila ruficeps canescens*	X	X	X	X	X	X
Spotted Towhee	*Pipilo maculates*	X	X	X	X	X	X
Turkey Vulture	*Cathartes aura*		X			X	
Warbling Vireo	*Vireo gilvus*		X				
Western Grebe	*Aechmophorus occidentalis*		X	X		X	
Western Kingbird	*Tyrannus verticalis*	X		X			X
Western Meadowlark	*Sturnella neglecta*	X	X	X	X	X	X
Western Scrub-Jay	*Aphelocoma californica*	X	X			X	
White-crowned Sparrow	*Zonotrichia leucophrys*	X	X	X	X	X	X
White-tailed Kite	*Elanus leucurus*	X	X	X		X	
White-throated Swift	*Aeronautes saxatalis*				X		
Yellow Warbler	*Dendroica petechia brewsteri*		X			X	X

Appendix Table 13. Species detected on Multiple Species Habitat Conservation Plan lands during 2006 surveys conducted by the Center for Conservation Biology. Species highlighted in gray are "Covered Species" under the Western Riverside County's Multiple Species Habitat Conservation Plan.

Common Name	Scientific Name	Reche Canyon	Wilson Valley Road	Cactus Valley
Plants				
Parry's spine flower	*Chorizanthe parryi parryi*		X	
Reptiles				
Belding's orange-throated whiptail	*Cnemidophorus hyperythrus beldingi*		X	
Coastal western whiptail	*Cnemidophorus tigris multiscutatus*	X	X	X
Granite spiny lizard	*Sceloporus orcutti*	X	X	X
Northern red diamond rattlesnake	*Crotalus ruber ruber*		X	
Side-blotched lizard	*Uta stansburiana*		X	
Western fence lizard	*Sceloporus occidentalis*	X	X	X
Birds				
American Crow	*Corvus brachyrhynchos*	X		X
American Kestrel	*Falco sparverius*			X
Anna's Hummingbird	*Calypte anna*	X	X	X
Ash-throated Flycatcher	*Myiarchus cinerascens*		X	X
Audubon's Warbler	*Dendroica coronata*	X		
Bell's Sage Sparrow	*Amphispiza belli belli*		X	X
Bewick's Wren	*Thryomanes bewickii*	X	X	X
Black-chinned Sparrow	*Spizella atrogularis*			X
Black-headed Grosbeak	*Pheucticus melanocephalus*			X
Black Phoebe	*Sayornis nigricans*			X
Blue-gray Gnatcatcher	*Polioptila caerulea*		X	
Bullock's Oriole	*Icterus bullockii*			X
Brewer's Sparrow	*Spizella breweri*		X	
Brown-crested Flycatcher	*Myiarchus tyrannulus*		X	
Brown-headed Cowbird	*Molothrus ater*	X		
Bushtit	*Psaltriparus minimus*	X	X	X
Cactus Wren	*Campylorhynchus brunneicapillus*		X	
California Horned Lark	*Eremophila alpestris actia*		X	
California Quail	*Callipepla californica*	X	X	X
California Thrasher	*Toxostoma redivivum*		X	X
California Towhee	*Pipilo crissalis*	X	X	X
Common Raven	*Corvus corax*		X	X
Costa's Hummingbird	*Colypte costae*		X	X
European Starling	*Sturnus vulgaris*			X
House Finch	*Carpodacus mexicanus*	X	X	X

Common Name	**Scientific Name**	**Reche Canyon**	**Wilson Valley Road**	**Cactus Valley**
House Sparrow	*Passer domesticus*		X	
House Wren	*Troglodytes aedon*		X	X
Killdeer	*Charadrius vociferus*			X
Lark Sparrow	*Chondestes grammacus*	X	X	
Lawrence's Goldfinch	*Carduelis lawrencei*			X
Lazuli Bunting	*Passerina amoena*		X	X
Lesser Goldfinch	*Carduelis psaltria*	X	X	X
Loggerhead Shrike	*Lanius ludovicianus*		X	
Mourning Dove	*Zenaida macroura*	X	X	X
Northern Flicker	*Colaptes auratus*			X
Northern Mockingbird	*Mimus polyglottos*		X	X
Nuttall's Woodpecker	*Picoides nuttallii*			X
Oak Titmouse	*Baelophus inornatus*			X
Phainopepla	*Phainopepla nitens*		X	
Red-tailed Hawk	*Buteo jamaicensis*	X	X	X
Rock Wren	*Salpinctes obsoletus*		X	
Say's Phoebe	*Sayornis saya*	X	X	
Song Sparrow	*Melospiza melodia*			X
Southern California rufous-crowned Sparrow	*Aimophila ruficeps canescens*	X	X	X
Spotted Towhee	*Pipilo maculates*	X	X	X
Turkey Vulture	*Cathartes aura*			X
Warbling Vireo	*Vireo gilvus*		X	
Western Bluebird	*Sialia mexicana*		X	
Westerm Kingbird	*Tyrannus verticalis*	X		X
Western Meadowlark	*Sturnella neglecta*	X	X	X
Western Scrub-Jay	*Aphelocoma californica*		X	X
Western Tanager	*Piranga ludoviciana*			X
White-crowned Sparrow	*Zonotrichia leucophrys*	X	X	
Wrentit	*Chamaea fasciata*			X

Appendix Table 14. Environmental variables included in niche models constructed for WRC MSHCP rare plant species. Selected models and their important environmental variables are in bold.

Species:	Beautiful Hulsea			Coulter's Goldfields			
Model Run:	**HULVES R1**	HULVES R2	HULVES R3	LASGLA R1B	LASGLA R2B	LASGLA R3B	LASGLA R4B
Model Scale:	**500 m**	500 m	500 m	500 m	500 m	500 m	500 m
Variables:							
CLAY (%)							
SILT (%)				X	X	X	X
WHC						X	
PH					X		
MINT (Minimum Ave. Jan Temp °F)	**X**	X	X	X	X	X	X
MAXT (Maximum Ave July Temp °F)	**X**	X					
ELEV (Elevation)	**X**	X	X	X	X	X	X
PRECIP (Precipitation)	**X**	X	X		X	X	X
SLOPE (%)		X	X				
NORTH (Northness aspect)			X				
EAST (Eastness aspect)							
V15_16: Vernal Pool/Alkali Playa (Local)				X	X	X	X
V6_4: Developed (Local)							
V5_16: Riparian (Local)							
V8_16: Chaparral (Local)							
V6_16: Coastal Sage Scrub (Local)							
V9_16: Grassland (Local)							
ROCKSUM8X8: Rock Outcrops (Local)							
PERV4: Developed (Landscape)							
Sample Size Calibration/Validation:	**39/0**	39/0	39/0	47/20	47/20	47/20	47/20
Number of Variables:	**4**	5	5	4	6	6	5
Type of Datasets:	**Calib**	Calib	Calib	Calib/Valid	Calib/Valid	Calib/Valid	Calib/Valid
Full Model: Median HSI by Dataset	**0.537**	0.525	0.527	0.867/0.941	0.673/0.567	0.651/0.568	0.896/0.448
Reduced Model: Median HSI by Dataset	**0.442**	0.485	0.537	0.566/0.564	0.566/0.667	0.543/0.656	0.532/0.661
Selected Model: Median HSI by Dataset	**PV1**	PV1	PV5	PV1	PV6	PV6	PV5
	0.537	0.525	0.537	0.867/0.941	0.566/0.667	0.651/0.656	0.532/0.661

Species:	**Coulter's Goldfields**					**Coulter's Matilija Poppy**	
Model Run:	LASGLA R5B	LASGLA R6B	**LASGLA R7B**	LASGLA R8B	LASGLA R9B	ROMCOU R1	ROMCOU R2
Model Scale:	500 m	500 m	**500 m**	500 m	500 m	500 m	500 m
<u>Variables:</u>							
CLAY (%)					X		
SILT (%)	X				X		
WHC							
PH			**X**				
MINT (Minimum Ave. Jan Temp °F)	X	X	**X**	X	X		
MAXT (Maximum Ave July Temp °F)	X	X	**X**	X	X		
ELEV (Elevation)	X	X	**X**	X	X	X	X
PRECIP (Precipitation)	X	X	**X**	X	X	X	X
SLOPE (%)				X		X	X
NORTH (Northness aspect)						X	X
EAST (Eastness aspect)						X	
V15_16: Vernal Pool/Alkali Playa (Local)							
V6_4: Developed (Local)							
V5_16: Riparian (Local)							
V8_16: Chaparral (Local)							X
V6_16: Coastal Sage Scrub (Local)							
V9_16: Grassland (Local)							
ROCKSUM8X8: Rock Outcrops (Local)							
PERV4: Developed (Landscape)							
Sample Size Calibration/Validation:	47/20	47/20	**47/20**	47/20	47/20	41/0	41/0
Number of Variables:	5	4	**5**	5	6	5	5
Type of Datasets:	Calib/Valid	Calib/Valid	**Calib/Valid**	Calib/Valid	Calib/Valid	Calib	Calib
Full Model: Median HSI by Dataset	0.883/0.742	0.795/0.671	**0.621/0.768**	0.869/0.784	0.758/0.778	0.658	0.603
Reduced Model: Median HSI by Dataset	0.666/0.489	0.599/0.345	**0.573/0.380**	0.711/0.566	0.646/0.557	0.565	0.548
Selected Model: Median HSI by Dataset	PV1	PV1	**PV3**	PV1	PV1	PV4	PV4
	0.883/0.742	0.795/0.671	**0.571/0.778**	0.869/0.784	0.758/0.778	0.697	0.607

Species:	**Coulter's Matilija Poppy**							
Model Run:	ROMCOU R3	ROMCOU R4	ROMCOU R5	ROMCOU R6	ROMCOU R7	ROMCOU R8	ROMCOU R9	ROMCOU R10
Model Scale:	500 m	500 m	500 m	500 m	500 m	500 m	500 m	500 m
Variables:								
CLAY (%)								
SILT (%)							X	
WHC								
PH								
MINT (Minimum Ave. Jan Temp °F)							X	X
MAXT (Maximum Ave July Temp °F)		X						X
ELEV (Elevation)	X	X	X	X	X	X	X	X
PRECIP (Precipitation)	X	X	X	X	X	X	X	X
SLOPE (%)	X			X				
NORTH (Northness aspect)			X	X	X	X		
EAST (Eastness aspect)			X					
V15_16: Vernal Pool/Alkali Playa (Local)								
V6_4: Developed (Local)				X				
V5_16: Riparian (Local)								
V8_16: Chaparral (Local)	X	X	X			X	X	
V6_16: Coastal Sage Scrub (Local)								
V9_16: Grassland (Local)								
ROCKSUM8X8: Rock Outcrops (Local)								
PERV4: Developed (Landscape)					X	X		
Sample Size Calibration/Validation:	41/0	41/0	41/0	41/0	41/0	41/0	41/0	41/0
Number of Variables:	4	4	5	5	4	5	5	4
Type of Datasets:	Calib	Calib	Calib	Calib	Calib	Calib	Calib	Calib
Full Model: Median HSI by Dataset	0.645	0.582	0.595	0.594	0.597	0.613	0.712	0.626
Reduced Model: Median HSI by Dataset	0.673	0.600	0.594	0.564	0.530	0.545	0.500	0.531
Selected Model: Median HSI by Dataset	PV4 0.673	PV4 0.600	PV1 0.595	PV1 0.594	PV3 0.658	PV1 0.613	PV2 0.729	PV1 0.626

Species:	**Engelmann Oak**			**Graceful Tarplant**			**Little Mousetail**	
Model Run:	**QUEENG R1**	QUEENG R2	QUEENG R3	HOLVIR R1	**HOLVIR R2**	HOLVIR R3	MYOMIN R1	MYOMIN R2
Model Scale:	**500 m**	500 m	500 m	500 m	**500 m**	500 m	500 m	500 m
<u>Variables:</u>								
CLAY (%)							X	X
SILT (%)								
WHC								
PH								
MINT (Minimum Ave. Jan Temp °F)	**X**	X			**X**			
MAXT (Maximum Ave July Temp °F)	**X**		X			X		
ELEV (Elevation)	**X**	X	X	X	**X**	X		X
PRECIP (Precipitation)	**X**	X	X	X	**X**	X	X	
SLOPE (%)			X	X	**X**	X	X	
NORTH (Northness aspect)		X						
EAST (Eastness aspect)								
V15_16: Vernal Pool/Alkali Playa (Local)								X
V6_4: Developed (Local)								
V5_16: Riparian (Local)								
V8_16: Chaparral (Local)								
V6_16: Coastal Sage Scrub (Local)								
V9_16: Grassland (Local)								
ROCKSUM8X8: Rock Outcrops (Local)								
PERV4: Developed (Landscape)								
Sample Size Calibration/Validation:	**32/0**	32/0	32/0	23/0	**23/0**	23/0	25/0	25/0
Number of Variables:	**4**	4	4	3	**4**	4	3	3
Type of Datasets:	**Calib**	Calib	Calib	Calib	**Calib**	Calib	Calib	Calib
Full Model: Median HSI by Dataset	**0.588**	0.453	0.530	0.699	**0.716**	0.683	0.632	0.575
Reduced Model: Median HSI by Dataset	**0.594**	0.435	0.534	0.642	**0.577**	0.584	0.626	0.604
Selected Model: Median HSI by Dataset	**PV2 0.647**	PV3 0.561	PV2 0.577	PV1 0.699	**PV1 0.716**	PV1 0.683	PV1 0.632	PV2 0.651

Species:	**Little Mousetail**			**Long-spined Spineflower**			
Model Run:	MYOMIN R3	MYOMIN R4	**MYOMIN R5**	CHOPOL R1	CHOPOL R2	**CHOPOL R3**	CHOPOL R4
Model Scale:	500 m	500 m	**500 m**	500 m	500 m	**500 m**	500 m
<u>Variables:</u>							
CLAY (%)		X		X			X
SILT (%)							
WHC							
PH							
MINT (Minimum Ave. Jan Temp °F)	X	X	**X**	X	X		
MAXT (Maximum Ave July Temp °F)					X		X
ELEV (Elevation)	X			X	X	**X**	
PRECIP (Precipitation)	X	X	**X**	X	X	**X**	X
SLOPE (%)	X	X	**X**			**X**	
NORTH (Northness aspect)						**X**	
EAST (Eastness aspect)							
V15_16: Vernal Pool-Alkali Playa (Local)							
V6_4: Developed (Local)							
V5_16: Riparian (Local)							
V8_16: Chaparral (Local)							
V6_16: Coastal Sage Scrub (Local)							
V9_16: Grassland (Local)							
ROCKSUM8X8: Rock Outcrops (Local)							
PERV4: Developed (Landscape)							
Sample Size Calibration/Validation:	25/0	25/0	**25/0**	40/0	40/0	**40/0**	40/0
Number of Variables:	4	4	**3**	4	4	**4**	3
Type of Datasets:	Calib	Calib	**Calib**	Calib	Calib	**Calib**	Calib
Full Model: Median HSI by Dataset	0.567	0.702	**0.670**	0.539	0.522	**0.580**	0.570
Reduced Model: Median HSI by Dataset	0.491	0.518	**0.550**	0.564	0.554	**0.446**	0.600
Selected Model: Median HSI by Dataset	PV2 0.758	PV2 0.752	**PV2 0.806**	PV4 0.564	PV4 0.554	**PV1 0.580**	PV2 0.606

Species:	**Mojave Tarplant**			**Munz's Onion**			
Model Run:	DEIMOH R1	DEIMOH R2	**DEIMOH R3**	ALLMEN R1	**ALLMEN R2**	ALLMEN R3	ALLMEN R4
Model Scale:	500 m	500 m	**500 m**	500 m	**500 m**	500 m	500 m
Variables:							
CLAY (%)		X		X		X	
SILT (%)	X						
WHC							
PH							
MINT (Minimum Ave. Jan Temp °F)	X	X	**X**		X		
MAXT (Maximum Ave July Temp °F)							X
ELEV (Elevation)	X	X	**X**	X	**X**	X	X
PRECIP (Precipitation)			**X**	X	**X**		X
SLOPE (%)						X	
NORTH (Northness aspect)							
EAST (Eastness aspect)							
V15_16: Vernal Pool/Alkali Playa (Local)							
V6_4: Developed (Local)							
V5_16: Riparian (Local)							
V8_16: Chaparral (Local)							
V6_16: Coastal Sage Scrub (Local)							
V9_16: Grassland (Local)							
ROCKSUM8X8: Rock Outcrops (Local)							
PERV4: Developed (Landscape)							
Sample Size Calibration/Validation:	20/0	20/0	**20/0**	24/0	**24/0**	24/0	24/0
Number of Variables:	3	3	**3**	3	**3**	3	3
Type of Datasets:	Calib	Calib	**Calib**	Calib	**Calib**	Calib	Calib
Full Model: Median HSI by Dataset	0.556	0.448	**0.661**	0.418	**0.532**	0.443	0.585
Reduced Model: Median HSI by Dataset	0.526	0.424	**0.627**	0.487	**0.637**	0.431	0.579
Selected Model: Median HSI by Dataset	PV2 0.571	PV2 0.488	**PV1 0.661**	PV3 0.487	**PV3 0.742**	PV3 0.538	PV2 0.593

Species:	**Nevin's Barberry**			**Palmer's Grapplinghook**		
Model Run:	**BERNEV R1**	BERNEV R2	BERNEV R3	**HARPAL R1**	HARPAL R2	HARPAL R3
Model Scale:	**500 m**	500 m	500 m	**500 m**	500 m	500 m
<u>Variables:</u>						
CLAY (%)				X		
SILT (%)						
WHC						
PH						
MINT (Minimum Ave. Jan Temp °F)		X	X		X	
MAXT (Maximum Ave July Temp °F)		X				X
ELEV (Elevation)	**X**	X	X	**X**	X	X
PRECIP (Precipitation)	**X**	X	X	**X**	X	X
SLOPE (%)						
NORTH (Northness aspect)						
EAST (Eastness aspect)						
V15_16: Vernal Pool/Alkali Playa (Local)						
V6_4: Developed (Local)						
V5_16: Riparian (Local)						
V8_16: Chaparral (Local)	**X**					
V6_16: Coastal Sage Scrub (Local)						
V9_16: Grassland (Local)						
ROCKSUM8X8: Rock Outcrops (Local)	**X**		X			
PERV4: Developed (Landscape)						
Sample Size Calibration/Validation:	**34/0**	34/0	34/0	**27/0**	27/0	27/0
Number of Variables:	**4**	4	4	**3**	3	3
Type of Datasets:	**Calib**	Calib	Calib	**Calib**	Calib	Calib
Full Model: Median HSI by Dataset	**0.793**	0.700	0.820	**0.532**	0.527	0.485
Reduced Model: Median HSI by Dataset	**0.649**	0.490	0.484	**0.617**	0.439	0.425
Selected Model: Median HSI by Dataset	**PV2 0.859**	PV1 0.700	PV1 0.820	**PV3 0.617**	PV1 0.527	PV1 0.485

Species:	**Parry's Spineflower**				
Model Run:	CHOPAR R1	CHOPAR R2	CHOPAR R3	CHOPAR R4	**CHOPAR R5**
Model Scale:	500 m	500 m	500 m	500 m	**500 m**
<u>Variables:</u>					
CLAY (%)					**X**
SILT (%)	X				**X**
WHC					
PH					
MINT (Minimum Ave. Jan Temp °F)	X	X	X		
MAXT (Maximum Ave July Temp °F)		X			
ELEV (Elevation)	X	X	X	X	X
PRECIP (Precipitation)	X	X	X	X	X
SLOPE (%)			X	X	X
NORTH (Northness aspect)					
EAST (Eastness aspect)					
V15_16: Vernal Pool/Alkali Playa (Local)					
V6_4: Developed (Local)					
V5_16: Riparian (Local)					
V8_16: Chaparral (Local)				X	
V6_16: Coastal Sage Scrub (Local)					
V9_16: Grassland (Local)					
ROCKSUM8X8: Rock Outcrops (Local)					
PERV4: Developed (Landscape)					
Sample Size Calibration/Validation:	30/22	30/22	30/22	30/22	**30/22**
Number of Variables:	4	4	4	4	**5**
Type of Datasets:	Calib/Valid	Calib/Valid	Calib/Valid	Calib/Valid	**Calib/Valid**
Full Model: Median HSI by Dataset	0.495/0.464	0.582/0.392	0.628/0.343	0.629/0.350	**0.530/0.607**
Reduced Model: Median HSI by Dataset	0.374/0.423	0.492/0.472	0.499/0.317	0.564/0.318	**0.574/0.750**
Selected Model: Median HSI by Dataset	PV2 0.566/0.662	PV3 0.477/0.494	PV2 0.529/0.346	PV3 0.527/0.466	**PV5 0.574/0.750**

Species:	**Plummer's Mariposa Lily**				**Rainbow Manzanita**				
Model Run:	CALPLU R1	CALPLU R2	CALPLU R3	CALPLU R4	ARCRAI R1	ARCRAI R2	ARCRAI R3	ARCRAI R4	**ARCRAI R5**
Model Scale:	500 m	500 m	500 m	500 m	500 m	500 m	500 m	500 m	**500 m**
<u>Variables:</u>									
CLAY (%)									
SILT (%)				X					
WHC									
PH									
MINT (Minimum Ave. Jan Temp °F)	X				X	X			
MAXT (Maximum Ave July Temp °F)							X		**X**
ELEV (Elevation)	X	X	X	X	X	X	X	X	**X**
PRECIP (Precipitation)	X	X	X	X		X	X	X	
SLOPE (%)		X				X	X	X	
NORTH (Northness aspect)					X				X
EAST (Eastness aspect)			X		X				X
V15_16: Vernal Pool/Alkali Playa (Local)									
V6_4: Developed (Local)									
V5_16: Riparian (Local)									
V8_16: Chaparral (Local)									
V6_16: Coastal Sage Scrub (Local)									
V9_16: Grassland (Local)									
ROCKSUM8X8: Rock Outcrops (Local)									
PERV4: Developed (Landscape)									
Sample Size Calibration/Validation:	26/0	26/0	26/0	26/0	31/0	31/0	31/0	31/0	**31/0**
Number of Variables:	3	3	3	3	4	4	4	3	**4**
Type of Datasets:	Calib	Calib	Calib	Calib	Calib	Calib	Calib	Calib	**Calib**
Full Model: Median HSI by Dataset	0.759	0.560	0.627	0.847	0.408	0.428	0.476	0.477	**0.467**
Reduced Model: Median HSI by Dataset	0.659	0.698	0.604	0.860	0.512	0.362	0.378	0.372	**0.524**
Selected Model: Median HSI by Dataset	PV1 0.759	PV2 0.698	PV1 0.627	PV3 0.860	PV2 0.575	PV2 0.504	PV1 0.476	PV1 0.477	**PV4 0.524**

Species:	**San Jacinto Valley Crownscale**						
Model Run:	ATRCOR R1B	ATRCOR R2B	ATRCOR R3B	ATRCOR R4B	ATRCOR R5B	ATRCOR R6B	**ATRCOR R7B**
Model Scale:	500 m	500 m	500 m	500 m	500 m	500 m	**500 m**
<u>Variables:</u>							
CLAY (%)							**X**
SILT (%)	X	X	X			X	**X**
WHC							
PH							
MINT (Minimum Ave. Jan Temp °F)	X	X	X	X	X	X	**X**
MAXT (Maximum Ave July Temp °F)		X	X	X	X	X	**X**
ELEV (Elevation)	X	X	X	X	X	X	**X**
PRECIP (Precipitation)		X	X	X	X	X	**X**
SLOPE (%)					X	X	
NORTH (Northness aspect)							
EAST (Eastness aspect)							
V15_16: Vernal Pool/Alkali Playa (Local)	X	X					
V6_4: Developed (Local)							
V5_16: Riparian (Local)							
V8_16: Chaparral (Local)							
V6_16: Coastal Sage Scrub (Local)							
V9_16: Grassland (Local)							
ROCKSUM8X8: Rock Outcrops (Local)							
PERV4: Developed (Landscape)							
Sample Size Calibration/Validation:	52/15	52/15	52/15	52/15	52/15	52/15	**52/15**
Number of Variables:	4	6	5	4	5	6	**6**
Type of Datasets:	Calib/Valid	Calib/Valid	Calib/Valid	Calib/Valid	Calib/Valid	Calib/Valid	**Calib/Valid**
Full Model: Median HSI by Dataset	0.807/0.442	0.895/0.442	0.847/0.630	0.759/0.496	0.850/0.592	0.900/0.722	**0.758/0.563**
Reduced Model: Median HSI by Dataset	0.501/0.356	0.675/0.310	0.677/0.556	0.616/0.535	0.590/0.448	0.669/0.393	**0.655/0.519**
Selected Model: Median HSI by Dataset	PV1	PV5	PV4	PV3	PV4	PV1	**PV5**
	0.807/0.718	0.816/0.521	0.840/0.693	0.829/0.715	0.796/0.748	0.900/0.722	**0.783/0.583**

Species:	**Small-flowered Microseris**			**Smooth Tarplant**			
	MICDOU	MICDOU	**MICDOU**	CENPEN	CENPEN	CENPEN	CENPEN
Model Run:	R1	R2	**R3**	R1B	R2B	R3B	R4B
Model Scale:	500 m	500 m	**500 m**	500 m	500 m	500 m	500 m
<u>Variables:</u>							
CLAY (%)	X	X					
SILT (%)							X
WHC							
PH							
MINT (Minimum Ave. Jan Temp °F)		X	**X**	X	X	X	X
MAXT (Maximum Ave July Temp °F)					X	X	
ELEV (Elevation)	X		**X**	X	X	X	X
PRECIP (Precipitation)			X	X	X	X	X
SLOPE (%)	X	X			X		
NORTH (Northness aspect)							
EAST (Eastness aspect)							
V15_16: Vernal Pool/Alkali Playa (Local)				X	X	X	X
V6_4: Developed (Local)							
V5_16: Riparian (Local)				X	X	X	X
V8_16: Chaparral (Local)							
V6_16: Coastal Sage Scrub (Local)							
V9_16: Grassland (Local)					X	X	X
ROCKSUM8X8: Rock Outcrops (Local)							
PERV4: Developed (Landscape)							
Sample Size Calibration/Validation:	20/0	20/0	**20/0**	70/39	70/39	70/39	70/39
Number of Variables:	3	3	**3**	5	8	7	7
Type of Datasets:	Calib	Calib	**Calib**	Calib/Valid	Calib/Valid	Calib/Valid	Calib/Valid
Full Model: Median HSI by Dataset	0.341	0.364	**0.570**	0.751/0.641	0.889/0.620	0.848/0.514	0.878/0.521
Reduced Model: Median HSI by Dataset	0.421	0.398	**0.606**	0.566/0.340	0.565/0.362	0.591/0.282	0.515/0.367
Selected Model: Median HSI by Dataset	PV2	PV2	**PV3**	PV2	PV2	PV2	PV2
	0.564	0.570	**0.606**	0.748/0.732	0.880/0.737	0.823/0.684	0.864/0.738

Species:	**Smooth Tarplant**			**Thread-leaved Brodiaea**			
	CENPEN	**CENPEN**	CENPEN	BROFIL	BROFIL	BROFIL	BROFIL
Model Run:	R5B	**R6B**	R7B	R1	R2	R3	R4
Model Scale:	500 m	**500 m**	500 m	500 m	500 m	500 m	500 m
Variables:							
CLAY (%)			X	X	X		
SILT (%)		**X**	X	X		X	
WHC							
PH							
MINT (Minimum Ave. Jan Temp °F)	X	**X**	X				X
MAXT (Maximum Ave July Temp °F)	X	**X**	X				
ELEV (Elevation)	X	**X**	X	X	X	X	X
PRECIP (Precipitation)	X	**X**	X	X	X	X	
SLOPE (%)							X
NORTH (Northness aspect)							
EAST (Eastness aspect)							
V15_16: Vernal Pool/Alkali Playa (Local)			X				X
V6_4: Developed (Local)							
V5_16: Riparian (Local)			X				
V8_16: Chaparral (Local)							
V6_16: Coastal Sage Scrub (Local)							
V9_16: Grassland (Local)			X				
ROCKSUM8X8: Rock Outcrops (Local)							
PERV4: Developed (Landscape)							
Sample Size Calibration/Validation:	70/39	**70/39**	70/39	33/0	33/0	33/0	33/0
Number of Variables:	4	**5**	9	4	3	3	4
Type of Datasets:	Calib/Valid	**Calib/Valid**	Calib/Valid	Calib	Calib	Calib	Calib
Full Model: Median HSI by Dataset	0.585/0.613	**0.682/0.628**	0.727/0.263	0.714	0.819	0.801	0.708
Reduced Model: Median HSI by Dataset	0.547/0.318	**0.557/0.318**	0.634/0.303	0.640	0.572	0.589	0.420
Selected Model: Median HSI by Dataset	PV1	**PV1**	PV4	PV1	PV1	PV1	PV1
	0.585/0.613	**0.682/0.628**	0.642/0.504	0.714	0.819	0.801	0.708

Appendix Table 15. Environmental variables and calibration/validation results for Quino checkerspot models. Selected model and important environmental variables are in bold.

Model Run:	EUPEDI R1B Combined #1	EUPEDI R2 Local #1	EUPEDI R3B Abiotic #1	**EUPEDI R4B Landscape #1**
Model Scale:	250 m	250 m	250 m	**250 m**
MINT: Minimum average January temperature (°C)	X	X	X	**X**
MAXT: Maximum average July temperature (°C)	X	X	X	X
PRECIP: Average annual precipitation (mm)	X	X	X	X
ELEV: Elevation (m)	X	X	X	**X**
NORTH: Northness aspect	X	X	X	X
EAST: Eastness aspect	X	X	X	X
SLOPE (%)	X	X	X	X
TMIDCAP: Minimum average temperature Dec-Apr (°C)				
TMXDCAP: Maximum average temperature Dec-Apr (°C)				
TMXJLSP: Maximum average temperature Jul-Sep (°C)				
TSEASON (Standard deviation of mean monthly temperature as percentage of annual mean temperature in degrees Kelvin)				
RDECJAN: Mean monthly radiation Dec-March (watts/m^2)				
RFEBMAR: Mean monthly radiation February-Mar (watts/m2)				
RJULSEP: Mean monthly radiation Jul-Sep(watts/m2)				
RSEASON (Standard deviation of mean monthly radiation as percentage of annual mean radiation in watts/m2)				
PDECMAR: Mean monthly precitation Dec-Mar (mm)				
PNOVMAY: Mean monthly precitation Nov-May (mm)				
PSEASON (Standard deviation of mean monthly precipitation as percentage of annual mean precipitation)				
VEG1: Agriculture (Local)		X		
VEG4: Development (Local)		X		
VEG6: Coastal Sage Scrub (Local)	X	X		
VEG8: Chaparral (Local)	X	X		
VEG9: Grassland (Local)		X		
SHRUBLAND: Coastal Sage Scrub + Chaparral (Local)				
PERV1: Agriculture (Landscape)	X			X
PERV4: Development (Landscape)	X			X
PERV6: Coastal Sage Scrub (Landscape)	X			**X**
PERV8: Chaparral (Landscape)	X			**X**
PERV9: Grassland (Landscape)	X			X
PERSHRUB: Coastal Sage Scrub + Chaparral (Landscape)				
EDGE: Meters of development adjacent to natural lands	X			X
CSSLOWEXOT: Coastal Sage Scrub with <25% exotic cover (Local)				
CSSLOWDEN: Coastal Sage Scrub <25% shrub density (Local)				
Sample Size: Calibration/Validation/CDFG Valid/Validation Precision of 1	120/41/30/65	120/41/30/65	120/41/30/65	**120/41/30/65**
Number of Variables	15	12	7	**13**
Full Model: Median HSI by Dataset	0.667/0.303/0.705/0.292	0.692/0.493/0.595/0.668	0.574/0.490/0.649/0.585	**0.679/0.368/0.808/0.446**
Reduced Model: Median HSI by Dataset	0.583/0.531/0.540/0.466	0.498/0.410/0.460/0.519	0.521/0.479/0.555/0.594	**0.569/0.601/0.631/0.609**
Selected Model: Median HSI by Dataset	PV13: 0.696/0.602/0.776/0.511	PV1: 0.692/0.493/0.595/0.668	PV4: 0.545/0.562/0.815/0.741	**PV12: 0.688/0.625/0.669/0.276**

Model Run:	EUPEDI R5B Combined #2	EUPEDI R6B Local #2	EUPEDI R7B Abiotic #2	EUPEDI R8B Landscape #2
Model Scale:	250 m	250 m	250 m	250 m
MINT: Minimum average January temperature (°C)				
MAXT: Maximum average July temperature (°C)				
PRECIP: Average annual precipitation (mm)				
ELEV: Elevation (m)	X	X	X	X
NORTH: Northness aspect	X	X	X	X
EAST: Eastness aspect	X	X	X	X
SLOPE (%)	X	X	X	X
TMIDCAP: Minimum average temperature Dec-Apr (°C)	X	X	X	X
TMXDCAP: Maximum average temperature Dec-Apr (°C)				
TMXJLSP: Maximum average temperature Jul-Sep (°C)	X	X	X	X
TSEASON (Standard deviation of mean monthly temperature as percentage of annual mean temperature in degrees Kelvin)	X	X	X	X
RDECJAN: Mean monthly radiation Dec-March (watts/m²)				
RFEBMAR: Mean monthly radiation February-Mar (watts/m2)				
RJULSEP: Mean monthly radiation Jul-Sep(watts/m2)	X	X	X	X
RSEASON (Standard deviation of mean monthly radiation as percentage of annual mean radiation in watts/m2)	X	X	X	X
PDECMAR: Mean monthly precitation Dec-Mar (mm)	X	X	X	X
PNOVMAY: Mean monthly precitation Nov-May (mm)				
PSEASON (Standard deviation of mean monthly precipitation as percentage of annual mean precipitation)	X	X	X	X
VEG1: Agriculture (Local)				
VEG4: Development (Local)		X		
VEG6: Coastal Sage Scrub (Local)				
VEG8: Chaparral (Local)				
VEG9: Grassland (Local)				
SHRUBLAND: Coastal Sage Scrub + Chaparral (Local)	X	X		
PERV1: Agriculture (Landscape)				
PERV4: Development (Landscape)	X			X
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (Landscape)				
PERSHRUB: Coastal Sage Scrub + Chaparral (Landscape)	X			X
EDGE: Meters of development adjacent to natural lands				
CSSLOWEXOT: Coastal Sage Scrub with <25% exotic cover (Local)				
CSSLOWDEN: Coastal Sage Scrub <25% shrub density (Local)				
Sample Size: Calibration/Validation/CDFG Valid/Validation Precision of 1	120/41/30/65	120/41/30/65	120/41/30/65	120/41/30/65
Number of Variables	15	13	11	13
Full Model: Median HSI by Dataset	0.618/0.330/0.743/0.298	0.596/0.311/0.744/0.456	0.591/0.423/0.692/0.546	0.575/0.326/0.756/0.333
Reduced Model: Median HSI by Dataset	0.607/0.339/0.259/0.420	0.545/0.308/0.583/0.478	0.537/0.346/0.611/0.478	0.529/0.358/0.606/0.449
Selected Model: Median HSI by Dataset	PV15: 0.601/0.534/0.259/0.420	PV10: 0.568/0.427/0.535/0.429	PV7: 0.593/0.451/0.685/0.439	PV8: .576/0.466/0.700/0.254

Model Run:	EUPEDI R9B Combined #3	EUPEDI R10B Landscape #3	EUPEDI R11B Combined #4	EUPEDI R12B Local #3
Model Scale:	250 m	250 m	250 m	250 m
MINT: Minimum average January temperature (°C)	X	X	X	X
MAXT: Maximum average July temperature (°C)	X	X	X	X
PRECIP: Average annual precipitation (mm)	X	X	X	X
ELEV: Elevation (m)	X	X	X	X
NORTH: Northness aspect	X	X	X	X
EAST: Eastness aspect	X	X	X	X
SLOPE (%)	X	X	X	X
TMIDCAP: Minimum average temperature Dec-Apr (°C)				
TMXDCAP: Maximum average temperature Dec-Apr (°C)				
TMXJLSP: Maximum average temperature Jul-Sep (°C)				
TSEASON (Standard deviation of mean monthly temperature as percentage of annual mean temperature in degrees Kelvin)				
RDECJAN: Mean monthly radiation Dec-March (watts/m²)		X	X	X
RFEBMAR: Mean monthly radiation February-Mar (watts/m2)		X	X	X
RJULSEP: Mean monthly radiation Jul-Sep(watts/m2)				
RSEASON (Standard deviation of mean monthly radiation as percentage of annual mean radiation in watts/m2)				
PDECMAR: Mean monthly precitation Dec-Mar (mm)				
PNOVMAY: Mean monthly precitation Nov-May (mm)				
PSEASON (Standard deviation of mean monthly precipitation as percentage of annual mean precipitation)		X	X	X
VEG1: Agriculture (Local)				X
VEG4: Development (Local)				X
VEG6: Coastal Sage Scrub (Local)				X
VEG8: Chaparral (Local)				X
VEG9: Grassland (Local)				X
SHRUBLAND: Coastal Sage Scrub + Chaparral (Local)	X		X	
PERV1: Agriculture (Landscape)		X	X	
PERV4: Development (Landscape)	X	X	X	
PERV6: Coastal Sage Scrub (Landscape)		X		
PERV8: Chaparral (Landscape)		X		
PERV9: Grassland (Landscape)	X	X	X	
PERSHRUB: Coastal Sage Scrub + Chaparral (Landscape)			X	
EDGE: Meters of development adjacent to natural lands	X	X	X	
CSSLOWEXOT: Coastal Sage Scrub with <25% exotic cover (Local)				
CSSLOWDEN: Coastal Sage Scrub <25% shrub density (Local)				
Sample Size: Calibration/Validation/CDFG Valid/Validation Precision of 1	120/41/30/65	120/41/30/65	120/41/30/65	120/41/30/65
Number of Variables	11	16	16	15
Full Model: Median HSI by Dataset	0.627/0.404/0.699/0.506	0.701/0.381/0.750/0.264	0.613/0.316/0.756/0.286	0.723/0.373/0.564/0.585
Reduced Model: Median HSI by Dataset	0.535/0.532/0.466/0.669	0.601/0.420/0.432/0.472	0.580/0.452/0.511/0.491	0.539/0.378/0.454/0.461
Selected Model: Median HSI by Dataset	PV10: 0.566/0.547/0.745/0.692	PV5: 0.691/0.511/0.693/0.201	PV13: 0.747/0.491/0.786/0.598	PV12: 0.738/0.537/0.243/0.768

Model Run:	EUPEDI R13B Abiotic #3	EUPEDI R14B Abiotic #4	EUPEDI R15B Local #4	EUPEDI R17B Combined #5
Model Scale:	250 m	250 m	250 m	250 m
MINT: Minimum average January temperature (°C)	X		X	X
MAXT: Maximum average July temperature (°C)	X	X	X	
PRECIP: Average annual precipitation (mm)	X	X	X	
ELEV: Elevation (m)	X	X	X	X
NORTH: Northness aspect	X	X	X	
EAST: Eastness aspect	X	X	X	
SLOPE (%)	X	X	X	
TMIDCAP: Minimum average temperature Dec-Apr (°C)		X		
TMXDCAP: Maximum average temperature Dec-Apr (°C)		X		
TMXJLSP: Maximum average temperature Jul-Sep (°C)				
TSEASON (Standard deviation of mean monthly temperature as percentage of annual mean temperature in degrees Kelvin)				
RDECJAN: Mean monthly radiation Dec-March (watts/m²)	X	X	X	X
RFEBMAR: Mean monthly radiation February-Mar (watts/m2)	X	X	X	X
RJULSEP: Mean monthly radiation Jul-Sep(watts/m2)				
RSEASON (Standard deviation of mean monthly radiation as percentage of annual mean radiation in watts/m2)				
PDECMAR: Mean monthly precitation Dec-Mar (mm)				
PNOVMAY: Mean monthly precitation Nov-May (mm)				
PSEASON (Standard deviation of mean monthly precipitation as percentage of annual mean precipitation)	X	X	X	
VEG1: Agriculture (Local)			X	
VEG4: Development (Local)			X	X
VEG6: Coastal Sage Scrub (Local)				X
VEG8: Chaparral (Local)				
VEG9: Grassland (Local)			X	
SHRUBLAND: Coastal Sage Scrub + Chaparral (Local)				
PERV1: Agriculture (Landscape)				
PERV4: Development (Landscape)				X
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (Landscape)				
PERSHRUB: Coastal Sage Scrub + Chaparral (Landscape)				
EDGE: Meters of development adjacent to natural lands				X
CSSLOWEXOT: Coastal Sage Scrub with <25% exotic cover (Local)			X	
CSSLOWDEN: Coastal Sage Scrub <25% shrub density (Local)			X	
Sample Size: Calibration/Validation/CDFG Valid/Validation Precision of 1	120/41/30/65	120/41/30/65	120/41/30/65	120/41/30/65
Number of Variables	10	11	15	8
Full Model: Median HSI by Dataset	0.686/0.458/0.628/0.595	0.717/0.530/0.656/0.576	0.674/0.291/0.427/0.294	0.729/0.445/0.581/0.614
Reduced Model: Median HSI by Dataset	0.539/0.327/0.452/0.560	0.728/0.599/0.507/0.715	0.526/0.324/0.326/0.377	0.566/0.436/0.521/0.324
Selected Model: Median HSI by Dataset	PV8: 0.778/0.476/0.716/0.853	PV11: 0.728/0.599/0.501/0.715	PV13: 0.707/0.586/0.600/0.63	PV1: 0.639/0.476/0.474/0.594

Model Run:	EUPEDI R18B Combined #6	EUPEDI R19B Local #5	EUPEDI R20B Combined #6	EUPEDI R21B Combined #7
Model Scale:	250 m	250 m	250 m	250 m
MINT: Minimum average January temperature (°C)	X	X		X
MAXT: Maximum average July temperature (°C)				X
PRECIP: Average annual precipitation (mm)	X			X
ELEV: Elevation (m)	X	X		
NORTH: Northness aspect	X		X	
EAST: Eastness aspect	X		X	
SLOPE (%)	X			X
TMIDCAP: Minimum average temperature Dec-Apr (°C)	X			
TMXDCAP: Maximum average temperature Dec-Apr (°C)	X			
TMXJLSP: Maximum average temperature Jul-Sep (°C)				
TSEASON (Standard deviation of mean monthly temperature as percentage of annual mean temperature in degrees Kelvin)				
RDECJAN: Mean monthly radiation Dec-March (watts/m²)		X	X	
RFEBMAR: Mean monthly radiation February-Mar (watts/m2)		X	X	
RJULSEP: Mean monthly radiation Jul-Sep(watts/m2)				
RSEASON (Standard deviation of mean monthly radiation as percentage of annual mean radiation in watts/m2)				
PDECMAR: Mean monthly precitation Dec-Mar (mm)				
PNOVMAY: Mean monthly precitation Nov-May (mm)	X			
PSEASON (Standard deviation of mean monthly precipitation as percentage of annual mean precipitation)				X
VEG1: Agriculture (Local)	X	X		
VEG4: Development (Local)	X	X		
VEG6: Coastal Sage Scrub (Local)	X	X		
VEG8: Chaparral (Local)	X	X		
VEG9: Grassland (Local)	X	X		
SHRUBLAND: Coastal Sage Scrub + Chaparral (Local)			X	X
PERV1: Agriculture (Landscape)	X			
PERV4: Development (Landscape)	X		X	
PERV6: Coastal Sage Scrub (Landscape)	X		X	
PERV8: Chaparral (Landscape)				
PERV9: Grassland (Landscape)				
PERSHRUB: Coastal Sage Scrub + Chaparral (Landscape)				X
EDGE: Meters of development adjacent to natural lands				
CSSLOWEXOT: Coastal Sage Scrub with <25% exotic cover (Local)			X	
CSSLOWDEN: Coastal Sage Scrub <25% shrub density (Local)			X	
Sample Size: Calibration/Validation/CDFG Valid/Validation Precision of 1	120/41/30/65	120/41/30/65	120/41/30/65	120/41/30/65
Number of Variables	17	9	9	7
Full Model: Median HSI by Dataset	0.724/0.262/0.673/0.353	0.788/0.611/0.447/0.692	0.630/0.417/0.446/0.237	0.574/0.439/0.541/0.555
Reduced Model: Median HSI by Dataset	0.573/0.445/0.281/0.421	0.560/0.492/0.464/0.424	0.642/0.338/0.594/0.191	0.549/0.537/0.549/0.587
Selected Model: Median HSI by Dataset	PV13: 0.713/0.486/0.317/0.284	PV1: 0.788/0.611/0.447/0.692	PV1: 0.630/0.417/0.446/0.237	PV7: 0.549/0.537/0.549/0.587

Model Run:	EUPEDI R22B Combined #8
Model Scale:	250 m
MINT: Minimum average January temperature (°C)	
MAXT: Maximum average July temperature (°C)	
PRECIP: Average annual precipitation (mm)	
ELEV: Elevation (m)	
NORTH: Northness aspect	X
EAST: Eastness aspect	X
SLOPE (%)	
TMIDCAP: Minimum average temperature Dec-Apr (°C)	
TMXDCAP: Maximum average temperature Dec-Apr (°C)	
TMXJLSP: Maximum average temperature Jul-Sep (°C)	
TSEASON (Standard deviation of mean monthly temperature as percentage of annual mean temperature in degrees Kelvin)	
RDECJAN: Mean monthly radiation Dec-March (watts/m²)	X
RFEBMAR: Mean monthly radiation February-Mar (watts/m2)	X
RJULSEP: Mean monthly radiation Jul-Sep(watts/m2)	
RSEASON (Standard deviation of mean monthly radiation as percentage of annual mean radiation in watts/m2)	
PDECMAR: Mean monthly precitation Dec-Mar (mm)	
PNOVMAY: Mean monthly precitation Nov-May (mm)	
PSEASON (Standard deviation of mean monthly precipitation as percentage of annual mean precipitation)	
VEG1: Agriculture (Local)	
VEG4: Development (Local)	
VEG6: Coastal Sage Scrub (Local)	
VEG8: Chaparral (Local)	
VEG9: Grassland (Local)	
SHRUBLAND: Coastal Sage Scrub + Chaparral (Local)	X
PERV1: Agriculture (Landscape)	
PERV4: Development (Landscape)	X
PERV6: Coastal Sage Scrub (Landscape)	X
PERV8: Chaparral (Landscape)	
PERV9: Grassland (Landscape)	
PERSHRUB: Coastal Sage Scrub + Chaparral (Landscape)	
EDGE: Meters of development adjacent to natural lands	
CSSLOWEXOT: Coastal Sage Scrub with <25% exotic cover (Local)	
CSSLOWDEN: Coastal Sage Scrub <25% shrub density (Local)	
Sample Size: Calibration/Validation/CDFG Valid/Validation Precision of 1	120/41/30/65
Number of Variables	7
Full Model: Median HSI by Dataset	0.574/0.439/0.541/0.555
Reduced Model: Median HSI by Dataset	0.549/0.537/0.549/0.587
Selected Model: Median HSI by Dataset	PV7: 0.549/0.537/0.549/0.587

Appendix Table 16. Environmental variables and calibration/validation results for arroyo toad models. Selected model and important environmental variables are in bold.

Model Run:	BUFCAL R1 Local #1	BUFCAL R2 Local #2	**BUFCAL R3 Combined #1**	BUFCAL R4 Abiotic #1	BUFCAL R5 Landscape #1
Model Scale:	250 m	250 m	**250 m**	250 m	250 m
MAXT: Maximum average July temperature (°C)	X		X	X	X
MINT: Average minimum January temperature (°C)				X	
PRECIP: Average annual precipitation (mm)	X	X	**X**	X	X
ELEV: Elevation (m)	X	X	**X**	X	X
SLOPE (%)	X			X	
VEG5: Riparian (Local)	X		X		
VEG28: Willow Riparian (Local)		X			
VEG29: Cottonwood Riparian (Local)		X			
VEG30: Sycamore Riparian (Local)		X			
PERV4: Developed (Landscape)			**X**		X
PERV5: Riparian (Landscape)					X
Sample Size: Calibration/Validation	Calib/Valid	Calib/Valid	**Calib/Valid**	Calib/Valid	Calib/Valid
Number of Variables	5	5	**5**	5	5
Full Model: Calibration/Validation Median HSI	0.608/0.608	0.605/0.552	**0.706/0.817**	0.713/0.718	0.847/0.892
Least Restrictive Model: Calibration/Validation Median HSI	0.458/0.543	0.674/0.630	**0.571/0.663**	0.485/0.485	0.551/0.551
Selected Model: Calibration/Validation Median HSI	PV1: 0.608/0.608	PV3: 0.628/0.724	**PV3: 0.742/0.872**	PV1: 0.713/0.718	PV1: 0.847/0.892

Appendix Table 17. Environmental variables and calibration/validation results for WRC MSHCP reptile models. Selected models and important environmental variables are in bold.

Species Modeled:	**Coast Horned Lizard**			
Model Run:	PHRCOR R1 Combined #1	PHRCOR R2 Local #1	PHRCOR R3 Landscape #1	PHRCOR R4 Abiotic #1
Model Scale:	500 M	500 M	500 M	500 M
ELEV: Elevation (m)	X	X	X	X
MAXT: Maximum average July temperature (°C)	X	X	X	X
MINT: Average minimum January temperature (°C)	X	X	X	X
PRECIP: Average annual precipitation (mm)	X	X	X	X
NORTH: Northness aspect				X
EAST: Eastness aspect				X
SLOPE (%)	X	X	X	X
V1_16: Agriculture (Local)				
V4_16: Developed (Local)				
V5_16: Riparian (Local)				
V6_16: Coastal Sage Scrub (Local)	X	X		
V7_16: Other Shrubland (Local)	X	X		
V8_16: Chaparral (Local)	X	X		
V9_16: Grassland (Local)	X	X		
V10_16: Woodland (Local)				
V16_16: Oak Woodland (Local)				
SHRUBLAND: Coastal Sage Scrub + Chaparral (Local)				
ROCKSUM8X8: Rock Outcrop (Local)				
PERV1: Agriculture (Landscape)			X	
PERV4: Developed (Landscape)	X		X	
PERV6: Coastal Sage Scrub (Landscape)	X		X	
PERV8: Chaparral (Landscape)				
PERV9: Grassland (Landscape)				
PERSHRUB: Coastal Sage Scrub + Chaparral (Landscape)				
EDGE: Meters of developed land adjacent to natural lands				
CSSLOWEXOT: Coastal Sage Scrub with <25% Exotic Cover (Local)				
CSSHIEXOT: Coastal Sage Scrub with >25% Exotic Cover (Local)				
CSSLOWDEN: Coastal Sage Scrub <25% Shrub Density (Local)				
CSSMEDDEN: Coastal Sage Scrub 25-60% Shrub Density (Local)				
CSSDENS1: Coastal Sage Scrub >60% Shrub Density (Local)				
Type of Datasets:	Calib/Valid	Calib/Valid	Calib/Valid	Calib/Valid
Sample Size: Calibration/Validation	115/59	115/59	115/59	115/59
Number of Variables	11	9	8	7
Full Model: Median HSI by Dataset	0.711/0.560	0.714/0.638	0.740/0.566	0.635/0.529
Reduced Model: Median HSI by Dataset	0.578/0.519	0.529/0.484	0.563/0.580	0.477/0.437
Selected Model: Median HSI by Dataset	PV1: 0.711/0.560	PV1: 0.714/0.638	PV8: 0.563/0.580	PV3: 0.565/0.586

Species Modeled:	**Coast Horned Lizard**		
Model Run:	PHRCOR R5 Combined #2	PHRCOR R6 Combined #3	**PHRCOR R7 Combined #4**
Model Scale:	500 M	500 M	**500 M**
ELEV: Elevation (m)	X	X	**X**
MAXT: Maximum average July temperature (°C)	X	X	**X**
MINT: Average minimum January temperature (°C)	X	X	**X**
PRECIP: Average annual precipitation (mm)	X	X	**X**
NORTH: Northness aspect			
EAST: Eastness aspect			
SLOPE (%)	X	X	**X**
V1_16: Agriculture (Local)			
V4_16: Developed (Local)			
V5_16: Riparian (Local)			
V6_16: Coastal Sage Scrub (Local)		X	
V7_16: Other Shrubland (Local)			
V8_16: Chaparral (Local)		X	
V9_16: Grassland (Local)			
V10_16: Woodland (Local)			
V16_16: Oak Woodland (Local)			
SHRUBLAND: Coastal Sage Scrub + Chaparral (Local)	X		**X**
ROCKSUM8X8: Rock Outcrop (Local)			
PERV1: Agriculture (Landscape)	X	X	**X**
PERV4: Developed (Landscape)	X	X	**X**
PERV6: Coastal Sage Scrub (Landscape)		X	
PERV8: Chaparral (Landscape)		X	
PERV9: Grassland (Landscape)			
PERSHRUB: Coastal Sage Scrub + Chaparral (Landscape)	X		**X**
EDGE: Meters of developed land adjacent to natural lands	X	X	**X**
CSSLOWEXOT: Coastal Sage Scrub with <25% Exotic Cover (Local)			**X**
CSSHIEXOT: Coastal Sage Scrub with >25% Exotic Cover (Local)			
CSSLOWDEN: Coastal Sage Scrub <25% Shrub Density (Local)			
CSSMEDDEN: Coastal Sage Scrub 25-60% Shrub Density (Local)			
CSSDENS1: Coastal Sage Scrub >60% Shrub Density (Local)			
Type of Datasets:	Calib/Valid	Calib/Valid	**Calib/Valid**
Sample Size: Calibration/Validation	115/59	115/59	**115/59**
Number of Variables	10	12	**11**
Full Model: Median HSI by Dataset	0.751/0.680	0.722/0.531	**0.741/0.710**
Reduced Model: Median HSI by Dataset	0.494/0.433	0.533/0.444	**0.493/0.439**
Selected Model: Median HSI by Dataset	PV1: 0.751/0.680	PV1: 0.722/0.531	**PV1: 0.741/0.710**

Species Modeled:	**Coastal Western Whiptail**			
Model Run:	**CNETIG R1 Combined #1**	CNETIG R2 Combined #2	CNETIG R3 Abiotic #1	CNETIG R4 Combined #3
Model Scale:	**500 M**	500 M	500 M	500 M
ELEV: Elevation (m)	**X**	X	X	X
MAXT: Maximum average July temperature (°C)	**X**	X	X	X
MINT: Average minimum January temperature (°C)	**X**	X	X	X
PRECIP: Average annual precipitation (mm)	**X**	X	X	X
NORTH: Northness aspect			X	X
EAST: Eastness aspect			X	X
SLOPE (%)	**X**	X	X	X
V1_16: Agriculture (Local)				
V4_16: Developed (Local)				
V5_16: Riparian (Local)				
V6_16: Coastal Sage Scrub (Local)	**X**	X		
V7_16: Other Shrubland (Local)	**X**	X		
V8_16: Chaparral (Local)	**X**	X		
V9_16: Grassland (Local)	**X**	X		
V10_16: Woodland (Local)				
V16_16: Oak Woodland (Local)	X	X		
SHRUBLAND: Coastal Sage Scrub + Chaparral (Local)				X
ROCKSUM8X8: Rock Outcrop (Local)				
PERV1: Agriculture (Landscape)	**X**	X		
PERV4: Developed (Landscape)	**X**	X		X
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (Landscape)				
PERSHRUB: Coastal Sage Scrub + Chaparral (Landscape)				X
EDGE: Meters of developed land adjacent to natural lands				
CSSLOWEXOT: Coastal Sage Scrub with <25% Exotic Cover (Local)				
CSSHIEXOT: Coastal Sage Scrub with >25% Exotic Cover (Local)		X		
CSSLOWDEN: Coastal Sage Scrub <25% Shrub Density (Local)		X		
CSSMEDDEN: Coastal Sage Scrub 25-60% Shrub Density (Local)				
CSSDENS1: Coastal Sage Scrub >60% Shrub Density (Local)				
Type of Datasets:	**Calib/Valid**	Calib/Valid	Calib/Valid	Calib/Valid
Sample Size: Calibration/Validation	**178/96**	178/96	178/96	178/96
Number of Variables	**12**	15	7	10
Full Model: Median HSI by Dataset	**0.754/0.763**	0.756/0.636	0.603/0.652	0.631/0.687
Reduced Model: Median HSI by Dataset	**0.505/0.537**	0.479/0.447	0.460/0.504	0.484/0.430
Selected Model: Median HSI by Dataset	**PV3: 0.729/0.849**	PV3: 0.736/0.744	PV1: 0.603/0.652	PV1: 0.631/0.687

Species Modeled:	**Coastal Western Whiptail**			
Model Run:	CNETIG R5 Combined #4	CNETIG R6 Local #1	CNETIG R7 Combined #5	CNETIG R8 Combined #6
Model Scale:	500 M	500 M	500 M	500 M
ELEV: Elevation (m)	X	X	X	X
MAXT: Maximum average July temperature (°C)	X	X	X	X
MINT: Average minimum January temperature (°C)	X	X	X	X
PRECIP: Average annual precipitation (mm)		X	X	X
NORTH: Northness aspect				
EAST: Eastness aspect				
SLOPE (%)	X	X		X
V1_16: Agriculture (Local)				
V4_16: Developed (Local)		X	X	
V5_16: Riparian (Local)				
V6_16: Coastal Sage Scrub (Local)		X	X	X
V7_16: Other Shrubland (Local)				X
V8_16: Chaparral (Local)		X	X	X
V9_16: Grassland (Local)		X	X	X
V10_16: Woodland (Local)				
V16_16: Oak Woodland (Local)		X		X
SHRUBLAND: Coastal Sage Scrub + Chaparral (Local)	X			
ROCKSUM8X8: Rock Outcrop (Local)				
PERV1: Agriculture (Landscape)			X	X
PERV4: Developed (Landscape)	X		X	X
PERV6: Coastal Sage Scrub (Landscape)			X	X
PERV8: Chaparral (Landscape)			X	
PERV9: Grassland (Landscape)			X	
PERSHRUB: Coastal Sage Scrub + Chaparral (Landscape)	X			
EDGE: Meters of developed land adjacent to natural lands			X	X
CSSLOWEXOT: Coastal Sage Scrub with <25% Exotic Cover (Local)				X
CSSHIEXOT: Coastal Sage Scrub with >25% Exotic Cover (Local)				
CSSLOWDEN: Coastal Sage Scrub <25% Shrub Density (Local)				
CSSMEDDEN: Coastal Sage Scrub 25-60% Shrub Density (Local)				
CSSDENS1: Coastal Sage Scrub >60% Shrub Density (Local)				
Type of Datasets:	Calib/Valid	Calib/Valid	Calib/Valid	Calib/Valid
Sample Size: Calibration/Validation	178/96	178/96	178/96	178/96
Number of Variables	7	10	14	15
Full Model: Median HSI by Dataset	0.613/0.656	0.633/0.687	0.646/0.604	0.736/0.687
Reduced Model: Median HSI by Dataset	0.485/0.408	0.502/0.529	0.670/0.480	0.546/0.464
Selected Model: Median HSI by Dataset	PV1: 0.613/0.656	PV7: 0.669/0.769	PV3: 0.678/0.750	PV4: 0.704/0.758

Species Modeled:	**Granite Spiny Lizard**			
Model Run:	SCEORC R1 Combined #1	SCEORC R2 Combined #2	SCEORC R3 Combined #3	SCEORC R4 Local #1
Model Scale:	500 M	500 M	500 M	500 M
ELEV: Elevation (m)	X	X	X	X
MAXT: Maximum average July temperature (°C)	X	X	X	X
MINT: Average minimum January temperature (°C)	X	X	X	X
PRECIP: Average annual precipitation (mm)	X	X	X	X
NORTH: Northness aspect			X	
EAST: Eastness aspect			X	
SLOPE (%)			X	X
V1_16: Agriculture (Local)	X	X		X
V4_16: Developed (Local)				X
V5_16: Riparian (Local)				
V6_16: Coastal Sage Scrub (Local)	X	X		X
V7_16: Other Shrubland (Local)				
V8_16: Chaparral (Local)	X	X		X
V9_16: Grassland (Local)	X	X		X
V10_16: Woodland (Local)				
V16_16: Oak Woodland (Local)	X	X		
SHRUBLAND: Coastal Sage Scrub + Chaparral (Local)			X	
ROCKSUM8X8: Rock Outcrop (Local)	X	X	X	X
PERV1: Agriculture (Landscape)		X	X	
PERV4: Developed (Landscape)	X		X	
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (Landscape)			X	
PERSHRUB: Coastal Sage Scrub + Chaparral (Landscape)		X	X	
EDGE: Meters of developed land adjacent to natural lands			X	
CSSLOWEXOT: Coastal Sage Scrub with <25% Exotic Cover (Local)		X		
CSSHIEXOT: Coastal Sage Scrub with >25% Exotic Cover (Local)		X		
CSSLOWDEN: Coastal Sage Scrub <25% Shrub Density (Local)				
CSSMEDDEN: Coastal Sage Scrub 25-60% Shrub Density (Local)				
CSSDENS1: Coastal Sage Scrub >60% Shrub Density (Local)				
Type of Datasets:	Calib/Valid	Calib/Valid	Calib/Valid	Calib/Valid
Sample Size: Calibration/Validation	219/185	219/185	219/185	219/185
Number of Variables	11	14	14	11
Full Model: Median HSI by Dataset	0.787/0.346	0.751/0.321	0.601/0.373	0.746/0.334
Reduced Model: Median HSI by Dataset	0.464/0.494	0.536/0.337	0.528/0.235	0.687/0.533
Selected Model: Median HSI by Dataset	PV9: 0.569/0.507	PV10: 0.552/0.453	PV11: 0.657/0.409	PV9: 0.711/0.595

Species Modeled:	**Granite Spiny Lizard**			
Model Run:	SCEORC R5 Local #2	SCEORC R6 Abiotic #1	SCEORC R7 Landscape #1	**SCEORC R8 Local #3**
Model Scale:	500 M	500 M	500 M	**500 M**
ELEV: Elevation (m)	X	X	X	**X**
MAXT: Maximum average July temperature (°C)	X	X	X	**X**
MINT: Average minimum January temperature (°C)	X	X	X	**X**
PRECIP: Average annual precipitation (mm)	X	X	X	**X**
NORTH: Northness aspect		X		
EAST: Eastness aspect		X		
SLOPE (%)	X	X	X	**X**
V1_16: Agriculture (Local)	X			
V4_16: Developed (Local)	X			**X**
V5_16: Riparian (Local)				
V6_16: Coastal Sage Scrub (Local)	X			
V7_16: Other Shrubland (Local)				
V8_16: Chaparral (Local)	X			
V9_16: Grassland (Local)	X			**X**
V10_16: Woodland (Local)				
V16_16: Oak Woodland (Local)				
SHRUBLAND: Coastal Sage Scrub + Chaparral (Local)				**X**
ROCKSUM8X8: Rock Outcrop (Local)			X	**X**
PERV1: Agriculture (Landscape)			X	
PERV4: Developed (Landscape)			X	
PERV6: Coastal Sage Scrub (Landscape)			X	
PERV8: Chaparral (Landscape)			X	
PERV9: Grassland (Landscape)			X	
PERSHRUB: Coastal Sage Scrub + Chaparral (Landscape)				
EDGE: Meters of developed land adjacent to natural lands			X	
CSSLOWEXOT: Coastal Sage Scrub with <25% Exotic Cover (Local)				
CSSHIEXOT: Coastal Sage Scrub with >25% Exotic Cover (Local)				
CSSLOWDEN: Coastal Sage Scrub <25% Shrub Density (Local)				
CSSMEDDEN: Coastal Sage Scrub 25-60% Shrub Density (Local)				
CSSDENS1: Coastal Sage Scrub >60% Shrub Density (Local)				
Type of Datasets:	Calib/Valid	Calib/Valid	Calib/Valid	**Calib/Valid**
Sample Size: Calibration/Validation	219/185	219/185	219/185	**219/185**
Number of Variables	10	7	12	**9**
Full Model: Median HSI by Dataset	0.283/0.276	0.671/0.550	0.742/0.182	**0.625/0.675**
Reduced Model: Median HSI by Dataset	0.494/0.548	0.568/0.368	0.496/0.204	**0.620/0.494**
Selected Model: Median HSI by Dataset	PV8: 0.196/0.605	PV1: 0.671/0.550	PV10: 0.675/0.307	**PV2: 0.584/0.683**

Species Modeled:	**Granite Spiny Lizard**		**Northern Red Diamond Rattlesnake**	
Model Run:	SCEORC R9 Abiotic #2	SCEORC R10 Local #4	**CRORUB R1 Local**	CRORUB R2 Local #2
Model Scale:	500 M	500 M		
ELEV: Elevation (m)	X	X		X
MAXT: Maximum average July temperature (°C)	X	X	**X**	X
MINT: Average minimum January temperature (°C)	X	X	**X**	X
PRECIP: Average annual precipitation (mm)	X	X	**X**	
NORTH: Northness aspect	X	X		
EAST: Eastness aspect	X	X		
SLOPE (%)	X	X		
V1_16: Agriculture (Local)		X		
V4_16: Developed (Local)		X		
V5_16: Riparian (Local)				
V6_16: Coastal Sage Scrub (Local)			**X**	X
V7_16: Other Shrubland (Local)				
V8_16: Chaparral (Local)			**X**	X
V9_16: Grassland (Local)		X	**X**	X
V10_16: Woodland (Local)				
V16_16: Oak Woodland (Local)				
SHRUBLAND: Coastal Sage Scrub + Chaparral (Local)		X		
ROCKSUM8X8: Rock Outcrop (Local)	X	X		
PERV1: Agriculture (Landscape)				
PERV4: Developed (Landscape)				
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (Landscape)				
PERSHRUB: Coastal Sage Scrub + Chaparral (Landscape)				
EDGE: Meters of developed land adjacent to natural lands				
CSSLOWEXOT: Coastal Sage Scrub with <25% Exotic Cover (Local)				
CSSHIEXOT: Coastal Sage Scrub with >25% Exotic Cover (Local)				
CSSLOWDEN: Coastal Sage Scrub <25% Shrub Density (Local)				
CSSMEDDEN: Coastal Sage Scrub 25-60% Shrub Density (Local)				
CSSDENS1: Coastal Sage Scrub >60% Shrub Density (Local)				
Type of Datasets:	Calib/Valid	Calib/Valid	**Calib/Valid**	Calib/Valid
Sample Size: Calibration/Validation	219/185	219/185	**60/24**	60/24
Number of Variables	8	12	**6**	6
Full Model: Median HSI by Dataset	0.613/0.481	0.655/0.658	**0.706/0.643**	0.582/0.560
Reduced Model: Median HSI by Dataset	0.555/0.388	0.599/0.488	**0.671/0.510**	0.515/0.439
Selected Model: Median HSI by Dataset	PV7: 0.637/0.533	PV1: 0.655/0.658	**PV3 0.718/0.699**	PV3 0.580/0.618

Species Modeled:	**Northern Red Diamond Rattlesnake**			
Model Run:	CRORUB R3 Abiotic	CRORUB R4 Landscape	CRORUB R5 Combined Shrubland	CRORUB R6 Local Shrub & Exotic
Model Scale:				
ELEV: Elevation (m)	X		X	
MAXT: Maximum average July temperature (°C)	X	X	X	X
MINT: Average minimum January temperature (°C)	X	X	X	X
PRECIP: Average annual precipitation (mm)	X	X	X	X
NORTH: Northness aspect				
EAST: Eastness aspect				
SLOPE (%)	X			
V1_16: Agriculture (Local)				
V4_16: Developed (Local)				
V5_16: Riparian (Local)				
V6_16: Coastal Sage Scrub (Local)				
V7_16: Other Shrubland (Local)				
V8_16: Chaparral (Local)				
V9_16: Grassland (Local)				X
V10_16: Woodland (Local)				
V16_16: Oak Woodland (Local)				
SHRUBLAND: Coastal Sage Scrub + Chaparral (Local)			X	X
ROCKSUM8X8: Rock Outcrop (Local)				
PERV1: Agriculture (Landscape)				
PERV4: Developed (Landscape)		X		
PERV6: Coastal Sage Scrub (Landscape)		X		
PERV8: Chaparral (Landscape)				
PERV9: Grassland (Landscape)				
PERSHRUB: Coastal Sage Scrub + Chaparral (Landscape)			X	
EDGE: Meters of developed land adjacent to natural lands		X		
CSSLOWEXOT: Coastal Sage Scrub with <25% Exotic Cover (Local)				X
CSSHIEXOT: Coastal Sage Scrub with >25% Exotic Cover (Local)				
CSSLOWDEN: Coastal Sage Scrub <25% Shrub Density (Local)				
CSSMEDDEN: Coastal Sage Scrub 25-60% Shrub Density (Local)				
CSSDENS1: Coastal Sage Scrub >60% Shrub Density (Local)				
Type of Datasets:	Calib/Valid	Calib/Valid	Calib/Valid	Calib/Valid
Sample Size: Calibration/Validation	60/24	60/24	60/24	60/24
Number of Variables	5	6	6	6
Full Model: Median HSI by Dataset	0.578/0.589	0.572/0.404	0.535/0.186	0.576/0.595
Reduced Model: Median HSI by Dataset	0.508/0.488	0.503/0.468	0.522/0.445	0.586/0.472
Selected Model: Median HSI by Dataset	PV4 0.646/0.645	PV4 0.688/0.563	PV6: 0.522/0.445	PV1: 0.576/0.595

Species Modeled:	**Orange-throated Whiptail**			
Model Run:	CNEHYP R1 Combined & Exotics	CNEHYP R2 Local	**CNEHYP R3 Combined #1**	CNEHYP R4 Combined #2
Model Scale:				
ELEV: Elevation (m)			**X**	X
MAXT: Maximum average July temperature (°C)	X	X	**X**	X
MINT: Average minimum January temperature (°C)	X	X	**X**	X
PRECIP: Average annual precipitation (mm)	X	X		X
NORTH: Northness aspect				
EAST: Eastness aspect				
SLOPE (%)		X	**X**	X
V1_16: Agriculture (Local)		X	**X**	X
V4_16: Developed (Local)		X		
V5_16: Riparian (Local)				
V6_16: Coastal Sage Scrub (Local)	X	X	**X**	X
V7_16: Other Shrubland (Local)	X	X	**X**	X
V8_16: Chaparral (Local)	X			X
V9_16: Grassland (Local)		X	**X**	X
V10_16: Woodland (Local)				
V16_16: Oak Woodland (Local)				
SHRUBLAND: Coastal Sage Scrub + Chaparral (Local)				
ROCKSUM8X8: Rock Outcrop (Local)	X			
PERV1: Agriculture (Landscape)				
PERV4: Developed (Landscape)	X		**X**	X
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (Landscape)				
PERSHRUB: Coastal Sage Scrub + Chaparral (Landscape)				
EDGE: Meters of developed land adjacent to natural lands				
CSSLOWEXOT: Coastal Sage Scrub with <25% Exotic Cover (Local)	X			
CSSHIEXOT: Coastal Sage Scrub with >25% Exotic Cover (Local)	X			
CSSLOWDEN: Coastal Sage Scrub <25% Shrub Density (Local)				
CSSMEDDEN: Coastal Sage Scrub 25-60% Shrub Density (Local)				
CSSDENS1: Coastal Sage Scrub >60% Shrub Density (Local)				
Type of Datasets:	Calib/Valid	Calib/Valid	**Calib/Valid**	Calib/Valid
Sample Size: Calibration/Validation	125/68	125/68	**125/68**	125/68
Number of Variables	10	9	**9**	11
Full Model: Median HSI by Dataset	0.722 / 0.622	0.787 / 0.739	**0.742 / 0.783**	0.747/0.636
Reduced Model: Median HSI by Dataset	0.423 / 0.457	0.573 / 0.409	**0.455 / 0.560**	0.4667/0.431
Selected Model: Median HSI by Dataset	PV2: 0.656/0.685	PV2: 0.748/0.738	**PV1: 0.742/0.783**	PV1: 0.747/0.636

Species Modeled:	**Orange-throated Whiptail**			
Model Run:	CNEHYP R5 Local Shrub	CNEHYP R6 Combined Exotic #2	CNEHYP R7 Combined #3	CNEHYP R8 Combined #4
Model Scale:				
ELEV: Elevation (m)	X	X	X	X
MAXT: Maximum average July temperature (°C)	X	X	X	X
MINT: Average minimum January temperature (°C)	X	X	X	X
PRECIP: Average annual precipitation (mm)				X
NORTH: Northness aspect				
EAST: Eastness aspect				
SLOPE (%)	X	X	X	
V1_16: Agriculture (Local)				X
V4_16: Developed (Local)				
V5_16: Riparian (Local)				
V6_16: Coastal Sage Scrub (Local)			X	X
V7_16: Other Shrubland (Local)				X
V8_16: Chaparral (Local)				
V9_16: Grassland (Local)				X
V10_16: Woodland (Local)				
V16_16: Oak Woodland (Local)				
SHRUBLAND: Coastal Sage Scrub + Chaparral (Local)	X			
ROCKSUM8X8: Rock Outcrop (Local)				
PERV1: Agriculture (Landscape)				
PERV4: Developed (Landscape)	X	X	X	
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (Landscape)				
PERSHRUB: Coastal Sage Scrub + Chaparral (Landscape)				
EDGE: Meters of developed land adjacent to natural lands				
CSSLOWEXOT: Coastal Sage Scrub with <25% Exotic Cover (Local)				
CSSHIEXOT: Coastal Sage Scrub with >25% Exotic Cover (Local)				
CSSLOWDEN: Coastal Sage Scrub <25% Shrub Density (Local)		X		
CSSMEDDEN: Coastal Sage Scrub 25-60% Shrub Density (Local)		X		
CSSDENS1: Coastal Sage Scrub >60% Shrub Density (Local)		X		
Type of Datasets:	Calib/Valid	Calib/Valid	Calib/Valid	Calib/Valid
Sample Size: Calibration/Validation	125/68	125/68	125/68	125/68
Number of Variables	6	8	6	9
Full Model: Median HSI by Dataset	0.529/0.630	0.607/0.598	0.548/0.573	0.730/0.771
Reduced Model: Median HSI by Dataset	0.441/0.490	0.452/0.529	0.415/0.530	0.453/0.508
Selected Model: Median HSI by Dataset	PV1: 0.529/0.630	PV1: 0.607/0.598	PV1 0.548/0.573	PV1 0.730/0.771

Species Modeled:	**Orange-throated Whiptail**	**Sagebrush Lizard**

Model Run:	CNEHYP R9 Combined & Exotic #3	SCEGRA R1 Combined #1	**SCEGRA R2 Local #1**	SCEGRA R3 Climate #1
Model Scale:	X			
ELEV: Elevation (m)	X	X	**X**	X
MAXT: Maximum average July temperature (°C)	X			X
MINT: Average minimum January temperature (°C)				X
PRECIP: Average annual precipitation (mm)		X	**X**	X
NORTH: Northness aspect				
EAST: Eastness aspect				
SLOPE (%)	X			X
V1_16: Agriculture (Local)	X			
V4_16: Developed (Local)				
V5_16: Riparian (Local)				
V6_16: Coastal Sage Scrub (Local)	X			
V7_16: Other Shrubland (Local)	X	X		
V8_16: Chaparral (Local)	X	X	**X**	
V9_16: Grassland (Local)	X			
V10_16: Woodland (Local)				
V16_16: Oak Woodland (Local)				
SHRUBLAND: Coastal Sage Scrub + Chaparral (Local)				
ROCKSUM8X8: Rock Outcrop (Local)				
PERV1: Agriculture (Landscape)				
PERV4: Developed (Landscape)	X	X		
PERV6: Coastal Sage Scrub (Landscape)	X			
PERV8: Chaparral (Landscape)				
PERV9: Grassland (Landscape)				
PERSHRUB: Coastal Sage Scrub + Chaparral (Landscape)				
EDGE: Meters of developed land adjacent to natural lands				
CSSLOWEXOT: Coastal Sage Scrub with <25% Exotic Cover (Local)	X			
CSSHIEXOT: Coastal Sage Scrub with >25% Exotic Cover (Local)				
CSSLOWDEN: Coastal Sage Scrub <25% Shrub Density (Local)				
CSSMEDDEN: Coastal Sage Scrub 25-60% Shrub Density (Local)				
CSSDENS1: Coastal Sage Scrub >60% Shrub Density (Local)				
Type of Datasets:	Calib/Valid	Calib	**Calib**	Calib
Sample Size: Calibration/Validation	125/68	37/0	**37/0**	37/0
Number of Variables	12	5	**4**	5
Full Model: Median HSI by Dataset	0.712/0.599	0.695	**0.676**	0.482
Reduced Model: Median HSI by Dataset	0.544/0.402	0.600	**0.552**	0.429
Selected Model: Median HSI by Dataset	PV2: 0.764/0.702	PV3 0.712	**PV2 0.711**	PV2 0.500

Species Modeled:	**Sagebrush Lizard**	
Model Run:	SCEGRA R4 Combined #2	SCEGRA R5 Local #2
Model Scale:		
ELEV: Elevation (m)	X	X
MAXT: Maximum average July temperature (°C)		
MINT: Average minimum January temperature (°C)		
PRECIP: Average annual precipitation (mm)	X	X
NORTH: Northness aspect		
EAST: Eastness aspect		
SLOPE (%)		
V1_16: Agriculture (Local)		
V4_16: Developed (Local)		
V5_16: Riparian (Local)		
V6_16: Coastal Sage Scrub (Local)		
V7_16: Other Shrubland (Local)		
V8_16: Chaparral (Local)	X	X
V9_16: Grassland (Local)		
V10_16: Woodland (Local)	X	X
V16_16: Oak Woodland (Local)		
SHRUBLAND: Coastal Sage Scrub + Chaparral (Local)		
ROCKSUM8X8: Rock Outcrop (Local)		
PERV1: Agriculture (Landscape)		
PERV4: Developed (Landscape)	X	
PERV6: Coastal Sage Scrub (Landscape)		
PERV8: Chaparral (Landscape)		
PERV9: Grassland (Landscape)		
PERSHRUB: Coastal Sage Scrub + Chaparral (Landscape)		
EDGE: Meters of developed land adjacent to natural lands		
CSSLOWEXOT: Coastal Sage Scrub with <25% Exotic Cover (Local)		
CSSHIEXOT: Coastal Sage Scrub with >25% Exotic Cover (Local)		
CSSLOWDEN: Coastal Sage Scrub <25% Shrub Density (Local)		
CSSMEDDEN: Coastal Sage Scrub 25-60% Shrub Density (Local)		
CSSDENS1: Coastal Sage Scrub >60% Shrub Density (Local)		
Type of Datasets:	Calib	Calib
Sample Size: Calibration/Validation	37/0	37/0
Number of Variables	5	4
Full Model: Median HSI by Dataset	0.691	0.555
Reduced Model: Median HSI by Dataset	0.420	0.416
Selected Model: Median HSI by Dataset	PV1 0.691	PV2 0.571

Appendix Table 18. Environmental variables and calibration/validation results for WRC MSHCP bird models. Selected models and important environmental variables are in bold.

Species:	**Bell's Sage Sparrow**			
Variables:	SAGS R1 Abiotic & Combined	SAGS R2 Abiotic & Local	**SAGS R3 Abiotic & Landscape**	SAGS R4 Abiotic
Model Run:				
Model Scale (m²):	X	X	**X**	X
MINT: Average minimum January temperature (°C)	X	X	**X**	X
MAXT: Maximum average July temperature (°C)	X	X	**X**	X
PRECIP: Average annual precipitation (mm)	X	X	**X**	X
ELEV: Elevation (m)	X	X	**X**	X
NORTH: Northness aspect	X	X	**X**	X
EAST: Eastness aspect	X	X	**X**	X
SLOPE (%)				
VEG1 or V1_16: Agriculture (Local)	X	X		
VEG4 or V4_16: Developed (Local)				
VEG5 or V5_16: Riparian (Local)	X	X		
VEG6 or V6_16: Coastal Sage Scrub (CSS) (Local)				
VEG7 or V7_16: Other Shrubland (Local)	X	X		
VEG8 or V8_16: Chaparral (Local)	X	X		
VEG9 or V9_16: Grassland (Local)				
VEG10 or V10_16: Woodland (Local)				
VEG16 or V16_16: Oak Woodland (Local)				
VEG28 (Willow Riparian)				
VEG29 (Cottonwood Riparian)				
VEG30 (Sycamore Riparian)				
VEG39 (Mulefat / Eldenberry Scrub)				
SHRUBLAND (Local CSS + Chaparral)				
ROCKSUM8X8: Rock Outcrop (Local)				
LU4: Rural Residential Land Use(Local)				
LU5: Undeveloped Land Use (Local)				
PERV1: Agriculture (Landscape)	X		**X**	
PERV4: Developed (Landscape)				
PERV5 (Riparian)	X		**X**	
PERV6: Coastal Sage Scrub (Landscape)	X		**X**	
PERV8: Chaparral (Landscape)				
PERV9: Grassland (NNG Landscape)				
PERV16				
PERSHRUB: CSS + Chaparral (Landscape)				
LU4P: Rural Residential Land Use (Landscape)				
LU5P: Undeveloped Land Use (Landscape)	X		**X**	
EDGE: Developed Land Adjacent to Natural (meters)				
CSSLOWDEN: CSS <25% Shrub Density (Local)				
D_ROCK: Distance to Nearest Rock Outcrop				
D_DRAIN: Distance to Nearest Drainage	Cal/Log Reg Val	Cal/Log Reg Val	**Cal/Log Reg Val**	Cal/Log Reg Val
Type of Datasets	144/146	144/146	**144/146**	144/146
Sample Size: Calibration/Validation	15	11	**11**	7
Number of Variables	0.658/0.464	0.713/0.598	**0.586/0.501**	0.656/0.685
Full Model: Median HSI by Dataset	0.605/0.417	0.542/0.482	**0.560/0.543**	0.453/0.597
Reduced Model: Median HSI by Dataset	PV9: 0.586/0.566	PV4: 0.643/0.725	**PV8: 0.585/0.599**	PV1: 0.656/0.685
Selected Partition: Median HSI by Dataset	SAGS R1 Abiotic & Combined	SAGS R2 Abiotic & Local	**SAGS R3 Abiotic & Landscape**	SAGS R4 Abiotic

Species:	**Bell's Sage Sparrow**			**Cactus Wren**
Model Run:	SAGS R5 Abiotic & Local #2	SAGSR6 Abiotic & Combined #2	SAGS R7 Abiotic & Combined #3	CACW R1 Abiotic & Combined
Model Scale (m²):				500
MINT: Average minimum January temperature (°C)	X	X	X	
MAXT: Maximum average July temperature (°C)	X	X	X	X
PRECIP: Average annual precipitation (mm)	X	X	X	X
ELEV: Elevation (m)	X	X	X	X
NORTH: Northness aspect	X		X	
EAST: Eastness aspect	X		X	
SLOPE (%)	X	X	X	
VEG1 or V1_16: Agriculture (Local)	X			
VEG4 or V4_16: Developed (Local)	X			
VEG5 or V5_16: Riparian (Local)				
VEG6 or V6_16: Coastal Sage Scrub (CSS) (Local)	X	X		X
VEG7 or V7_16: Other Shrubland (Local)				X
VEG8 or V8_16: Chaparral (Local)	X			
VEG9 or V9_16: Grassland (Local)	X	X		
VEG10 or V10_16: Woodland (Local)				
VEG16 or V16_16: Oak Woodland (Local)				
VEG28 (Willow Riparian)				
VEG29 (Cottonwood Riparian)				
VEG30 (Sycamore Riparian)				
VEG39 (Mulefat / Eldenberry Scrub)				
SHRUBLAND (Local CSS + Chaparral)			X	
ROCKSUM8X8: Rock Outcrop (Local)				
LU4: Rural Residential Land Use(Local)				
LU5: Undeveloped Land Use (Local)				
PERV1: Agriculture (Landscape)		X	X	
PERV4: Developed (Landscape)		X	X	X
PERV5 (Riparian)				
PERV6: Coastal Sage Scrub (Landscape)		X		
PERV8: Chaparral (Landscape)				
PERV9: Grassland (NNG Landscape)				
PERV16				
PERSHRUB: CSS + Chaparral (Landscape)			X	
LU4P: Rural Residential Land Use (Landscape)				
LU5P: Undeveloped Land Use (Landscape)				
EDGE: Developed Land Adjacent to Natural (meters)		X	X	
CSSLOWDEN: CSS <25% Shrub Density (Local)				
D_ROCK: Distance to Nearest Rock Outcrop				
D_DRAIN: Distance to Nearest Drainage				
Type of Datasets	Cal/Log Reg Val	Cal/Log Reg Val	Cal/Log Reg Val	Cal
Sample Size: Calibration/Validation	144/146	144/146	144/146	50/0
Number of Variables	12	12	12	6
Full Model: Median HSI by Dataset	0.716/0.623	0.553/0.543	0.595/0.684	0.601
Reduced Model: Median HSI by Dataset	0.652/0.610	0.515/0.529	0.610/0.480	0.609
Selected Partition: Median HSI by Dataset	PV4: 0.642/0.679	PV1: 0.553/0.543	PV1: 0.595/0.684	PV5: 0.612

Species:	**Cactus Wren**			
Model Run:	CACW R2 Abiotic & Local	**CACW R3 Abiotic**	CACW R4 Abiotic #2	CACW R5 Abiotic & Local #2
Model Scale (m^2):	500	**500**	500	500
MINT: Average minimum January temperature (°C)		**X**	X	
MAXT: Maximum average July temperature (°C)	X	**X**	X	X
PRECIP: Average annual precipitation (mm)	X	**X**	X	X
ELEV: Elevation (m)	X	**X**	X	X
NORTH: Northness aspect			X	
EAST: Eastness aspect			X	
SLOPE (%)		**X**	X	
VEG1 or V1_16: Agriculture (Local)				
VEG4 or V4_16: Developed (Local)				
VEG5 or V5_16: Riparian (Local)				
VEG6 or V6_16: Coastal Sage Scrub (CSS) (Local)	X			X
VEG7 or V7_16: Other Shrubland (Local)	X			X
VEG8 or V8_16: Chaparral (Local)				X
VEG9 or V9_16: Grassland (Local)				X
VEG10 or V10_16: Woodland (Local)				
VEG16 or V16_16: Oak Woodland (Local)				
VEG28 (Willow Riparian)				
VEG29 (Cottonwood Riparian)				
VEG30 (Sycamore Riparian)				
VEG39 (Mulefat / Eldenberry Scrub)				
SHRUBLAND (Local CSS + Chaparral)				
ROCKSUM8X8: Rock Outcrop (Local)				
LU4: Rural Residential Land Use(Local)				
LU5: Undeveloped Land Use (Local)				
PERV1: Agriculture (Landscape)				
PERV4: Developed (Landscape)				
PERV5 (Riparian)				
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (NNG Landscape)				
PERV16				
PERSHRUB: CSS + Chaparral (Landscape)				
LU4P: Rural Residential Land Use (Landscape)				
LU5P: Undeveloped Land Use (Landscape)				
EDGE: Developed Land Adjacent to Natural (meters)				
CSSLOWDEN: CSS <25% Shrub Density (Local)				
D_ROCK: Distance to Nearest Rock Outcrop				
D_DRAIN: Distance to Nearest Drainage				
Type of Datasets	Cal	**Cal**	Cal	Cal
Sample Size: Calibration/Validation	50/0	**50/0**	50/0	50/0
Number of Variables	5	**5**	7	7
Full Model: Median HSI by Dataset	0.503	**0.68**	0.509	0.538
Reduced Model: Median HSI by Dataset	0.67	**0.591**	0.643	0.652
Selected Partition: Median HSI by Dataset	PV5: 0.670	**PV3: 0.696**	PV7: 0.643	PV6: 0.661

Species:	**Cactus Wren**	**California Gnatcatcher**		
Model Run:	CACW R6 Abiotic & Landscape	CAGN R1 Abiotic & Combined	**CAGN R2 Abiotic & Local**	CAGN R3 Abiotic & Landscape
Model Scale (m^2):	500	250	**250**	250
MINT: Average minimum January temperature (°C)		X	**X**	X
MAXT: Maximum average July temperature (°C)	X	X	**X**	X
PRECIP: Average annual precipitation (mm)	X	X	**X**	X
ELEV: Elevation (m)	X	X	**X**	X
NORTH: Northness aspect		X	**X**	X
EAST: Eastness aspect		X	**X**	X
SLOPE (%)		X	**X**	X
VEG1 or V1_16: Agriculture (Local)		X	**X**	
VEG4 or V4_16: Developed (Local)		X	**X**	
VEG5 or V5_16: Riparian (Local)				
VEG6 or V6_16: Coastal Sage Scrub (CSS) (Local)		X	**X**	
VEG7 or V7_16: Other Shrubland (Local)				
VEG8 or V8_16: Chaparral (Local)		X	**X**	
VEG9 or V9_16: Grassland (Local)		X	**X**	
VEG10 or V10_16: Woodland (Local)				
VEG16 or V16_16: Oak Woodland (Local)				
VEG28 (Willow Riparian)				
VEG29 (Cottonwood Riparian)				
VEG30 (Sycamore Riparian)				
VEG39 (Mulefat / Eldenberry Scrub)				
SHRUBLAND (Local CSS + Chaparral)				
ROCKSUM8X8: Rock Outcrop (Local)				
LU4: Rural Residential Land Use(Local)				
LU5: Undeveloped Land Use (Local)				
PERV1: Agriculture (Landscape)				
PERV4: Developed (Landscape)	X	X		X
PERV5 (Riparian)				
PERV6: Coastal Sage Scrub (Landscape)	X	X		X
PERV8: Chaparral (Landscape)		X		X
PERV9: Grassland (NNG Landscape)		X		X
PERV16				
PERSHRUB: CSS + Chaparral (Landscape)				
LU4P: Rural Residential Land Use (Landscape)				
LU5P: Undeveloped Land Use (Landscape)				
EDGE: Developed Land Adjacent to Natural (meters)	X	X		X
CSSLOWDEN: CSS <25% Shrub Density (Local)				
D_ROCK: Distance to Nearest Rock Outcrop				
D_DRAIN: Distance to Nearest Drainage				
Type of Datasets	Cal	Cal/30% Val/Log Reg Val	**Cal/30% Val/Log Reg Val**	Cal/30% Val/Log Reg Val
Sample Size: Calibration/Validation	50/0	384/164/81	**384/164/81**	384/164/81
Number of Variables	6	17	**12**	12
Full Model: Median HSI by Dataset	0.664	0.646/0.584/0.829	**0.659/0.704/0.915**	0.640/0.606/0.631
Reduced Model: Median HSI by Dataset	0.557	0.643/0.627/0.785	**0.694/0.672/0.819**	0.546/0.562/0.539
Selected Partition: Median HSI by Dataset	PV3: 0.672	PV2: 0.673/0.582/0.892	**PV1: 0.659/0.704/0.915**	PV6: 0.589/0.572/0.706

Species:	**California Gnatcatcher**	**California Horned Lark**		
Model Run:	CAGN R4 Abiotic	HOLA R1B Abiotic & Combined	**HOLA R2B Abiotic & Local**	HOLA R3B Abiotic
Model Scale (m²):	250	500	**500**	500
MINT: Average minimum January temperature (°C)	X			X
MAXT: Maximum average July temperature (°C)	X			X
PRECIP: Average annual precipitation (mm)	X	X	**X**	X
ELEV: Elevation (m)	X	X	**X**	X
NORTH: Northness aspect	X			X
EAST: Eastness aspect	X			X
SLOPE (%)	X	X	**X**	X
VEG1 or V1_16: Agriculture (Local)			**X**	
VEG4 or V4_16: Developed (Local)			**X**	
VEG5 or V5_16: Riparian (Local)				
VEG6 or V6_16: Coastal Sage Scrub (CSS) (Local)				
VEG7 or V7_16: Other Shrubland (Local)				
VEG8 or V8_16: Chaparral (Local)				
VEG9 or V9_16: Grassland (Local)		X	**X**	
VEG10 or V10_16: Woodland (Local)				
VEG16 or V16_16: Oak Woodland (Local)				
VEG28 (Willow Riparian)				
VEG29 (Cottonwood Riparian)				
VEG30 (Sycamore Riparian)				
VEG39 (Mulefat / Eldenberry Scrub)				
SHRUBLAND (Local CSS + Chaparral)				
ROCKSUM8X8: Rock Outcrop (Local)				
LU4: Rural Residential Land Use(Local)				
LU5: Undeveloped Land Use (Local)				
PERV1: Agriculture (Landscape)		X		
PERV4: Developed (Landscape)		X		
PERV5 (Riparian)				
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (NNG Landscape)		X		
PERV16				
PERSHRUB: CSS + Chaparral (Landscape)				
LU4P: Rural Residential Land Use (Landscape)				
LU5P: Undeveloped Land Use (Landscape)				
EDGE: Developed Land Adjacent to Natural (meters)				
CSSLOWDEN: CSS <25% Shrub Density (Local)				
D_ROCK: Distance to Nearest Rock Outcrop				
D_DRAIN: Distance to Nearest Drainage				
Type of Datasets	Cal/30% Val/Log Reg Val	Cal/Val	**Cal/Val**	Cal/Val
Sample Size: Calibration/Validation	384/164/81	60/24	**60/24**	60/24
Number of Variables	7	7	**6**	7
Full Model: Median HSI by Dataset	0.628/0.654/0.718	0.580/0.605	**0.601/0.648**	0.616/0.660
Reduced Model: Median HSI by Dataset	0.502/0.464/0.458	0.542/0.425	**0.558/0.522**	0.504/0.722
Selected Partition: Median HSI by Dataset	PV1: 0.628/0.654/0.718	PV6: 0.551/0.629	**PV1: 0.601/0.648**	PV7: 0.504/0.722

Species:	**California Horned Lark**			
Model Run:	HOLA R4B Abiotic & Local #2	HOLA R1B Abiotic & Combined	**HOLA R2B Abiotic & Local**	HOLA R3B Abiotic
Model Scale (m^2):	500	500	**500**	500
MINT: Average minimum January temperature (°C)	X			X
MAXT: Maximum average July temperature (°C)				X
PRECIP: Average annual precipitation (mm)	X	X	**X**	X
ELEV: Elevation (m)	X	X	**X**	X
NORTH: Northness aspect				X
EAST: Eastness aspect				X
SLOPE (%)	X	X	**X**	X
VEG1 or V1_16: Agriculture (Local)	X		**X**	
VEG4 or V4_16: Developed (Local)	X		**X**	
VEG5 or V5_16: Riparian (Local)				
VEG6 or V6_16: Coastal Sage Scrub (CSS) (Local)				
VEG7 or V7_16: Other Shrubland (Local)				
VEG8 or V8_16: Chaparral (Local)				
VEG9 or V9_16: Grassland (Local)	X	X	**X**	
VEG10 or V10_16: Woodland (Local)				
VEG16 or V16_16: Oak Woodland (Local)				
VEG28 (Willow Riparian)				
VEG29 (Cottonwood Riparian)				
VEG30 (Sycamore Riparian)				
VEG39 (Mulefat / Eldenberry Scrub)				
SHRUBLAND (Local CSS + Chaparral)				
ROCKSUM8X8: Rock Outcrop (Local)				
LU4: Rural Residential Land Use(Local)				
LU5: Undeveloped Land Use (Local)				
PERV1: Agriculture (Landscape)		X		
PERV4: Developed (Landscape)		X		
PERV5 (Riparian)				
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (NNG Landscape)		X		
PERV16				
PERSHRUB: CSS + Chaparral (Landscape)				
LU4P: Rural Residential Land Use (Landscape)				
LU5P: Undeveloped Land Use (Landscape)				
EDGE: Developed Land Adjacent to Natural (meters)				
CSSLOWDEN: CSS <25% Shrub Density (Local)				
D_ROCK: Distance to Nearest Rock Outcrop				
D_DRAIN: Distance to Nearest Drainage				
Type of Datasets	Cal/Val	Cal/Val	**Cal/Val**	Cal/Val
Sample Size: Calibration/Validation	60/24	60/24	**60/24**	60/24
Number of Variables	7	7	**6**	7
Full Model: Median HSI by Dataset	0.572/0.623	0.580/0.605	**0.601/0.648**	0.616/0.660
Reduced Model: Median HSI by Dataset	0.588/0.506	0.542/0.425	**0.558/0.522**	0.504/0.722
Selected Partition: Median HSI by Dataset	PV1: 0.572/0.623	PV6: 0.551/0.629	**PV1: 0.601/0.648**	PV7: 0.504/0.722

Species:	**California Horned Lark**		**Cooper's Hawk**	
Model Run:	HOLA R4B Abiotic & Local #2	HOLA R5B Abiotic & Landscape	COHA R1 Abiotic & Combined	COHA R2 Abiotic & Local
Model Scale (m²):	500	500		
MINT: Average minimum January temperature (°C)	X			
MAXT: Maximum average July temperature (°C)				
PRECIP: Average annual precipitation (mm)	X	X	X	X
ELEV: Elevation (m)	X	X	X	X
NORTH: Northness aspect				
EAST: Eastness aspect				
SLOPE (%)	X	X		
VEG1 or V1_16: Agriculture (Local)	X			
VEG4 or V4_16: Developed (Local)	X		X	X
VEG5 or V5_16: Riparian (Local)			X	X
VEG6 or V6_16: Coastal Sage Scrub (CSS) (Local)				
VEG7 or V7_16: Other Shrubland (Local)				
VEG8 or V8_16: Chaparral (Local)				
VEG9 or V9_16: Grassland (Local)	X			
VEG10 or V10_16: Woodland (Local)				
VEG16 or V16_16: Oak Woodland (Local)			X	X
VEG28 (Willow Riparian)				
VEG29 (Cottonwood Riparian)				
VEG30 (Sycamore Riparian)				
VEG39 (Mulefat / Eldenberry Scrub)				
SHRUBLAND (Local CSS + Chaparral)			X	X
ROCKSUM8X8: Rock Outcrop (Local)				
LU4: Rural Residential Land Use(Local)				
LU5: Undeveloped Land Use (Local)				
PERV1: Agriculture (Landscape)		X		
PERV4: Developed (Landscape)		X	X	
PERV5 (Riparian)			X	
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (NNG Landscape)		X	X	
PERV16			X	
PERSHRUB: CSS + Chaparral (Landscape)			X	
LU4P: Rural Residential Land Use (Landscape)				
LU5P: Undeveloped Land Use (Landscape)				
EDGE: Developed Land Adjacent to Natural (meters)			X	
CSSLOWDEN: CSS <25% Shrub Density (Local)				
D_ROCK: Distance to Nearest Rock Outcrop				
D_DRAIN: Distance to Nearest Drainage				
Type of Datasets	Cal/Val	Cal/Val	Cal/Val	Cal/Val
Sample Size: Calibration/Validation	60/24	60/24	110/50	110/50
Number of Variables	7	6	12	6
Full Model: Median HSI by Dataset	0.572/0.623	0.598/0.591	0.723/0.700	0.657/0.732
Reduced Model: Median HSI by Dataset	0.588/0.506	0.524/0.484	0.543/0.494	0.604/0.512
Selected Partition: Median HSI by Dataset	PV1: 0.572/0.623	PV2: 0.591/0.612	PV7: 0.643/0.718	PV3: 0.672/0.772

Species:	**Cooper's Hawk**			
Model Run:	COHA R3 Abiotic	**COHA R4 Abiotic & Local #2**	COHA R5 Abiotic & Local #3	COHA R6 Abiotic & Landscape
Model Scale (m^2):				
MINT: Average minimum January temperature (°C)	X		X	
MAXT: Maximum average July temperature (°C)	X		X	
PRECIP: Average annual precipitation (mm)	X	**X**	X	X
ELEV: Elevation (m)	X	**X**	X	X
NORTH: Northness aspect	X			
EAST: Eastness aspect	X			
SLOPE (%)	X		X	
VEG1 or V1_16: Agriculture (Local)		**X**	X	
VEG4 or V4_16: Developed (Local)		**X**	X	
VEG5 or V5_16: Riparian (Local)		**X**	X	
VEG6 or V6_16: Coastal Sage Scrub (CSS) (Local)		**X**	X	
VEG7 or V7_16: Other Shrubland (Local)				
VEG8 or V8_16: Chaparral (Local)		**X**	X	
VEG9 or V9_16: Grassland (Local)		**X**	X	
VEG10 or V10_16: Woodland (Local)				
VEG16 or V16_16: Oak Woodland (Local)		**X**	X	
VEG28 (Willow Riparian)				
VEG29 (Cottonwood Riparian)				
VEG30 (Sycamore Riparian)				
VEG39 (Mulefat / Eldenberry Scrub)				
SHRUBLAND (Local CSS + Chaparral)				
ROCKSUM8X8: Rock Outcrop (Local)				
LU4: Rural Residential Land Use(Local)				
LU5: Undeveloped Land Use (Local)				
PERV1: Agriculture (Landscape)				
PERV4: Developed (Landscape)				X
PERV5 (Riparian)				X
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (NNG Landscape)				X
PERV16				X
PERSHRUB: CSS + Chaparral (Landscape)				X
LU4P: Rural Residential Land Use (Landscape)				
LU5P: Undeveloped Land Use (Landscape)				
EDGE: Developed Land Adjacent to Natural (meters)				X
CSSLOWDEN: CSS <25% Shrub Density (Local)				
D_ROCK: Distance to Nearest Rock Outcrop				
D_DRAIN: Distance to Nearest Drainage				
Type of Datasets	Cal/Val	**Cal/Val**	Cal/Val	Cal/Val
Sample Size: Calibration/Validation	110/50	**110/50**	110/50	110/50
Number of Variables	7	**9**	12	8
Full Model: Median HSI by Dataset	0.576/0.534	**0.701/0.762**	0.650/0.553	0.660/0.764
Reduced Model: Median HSI by Dataset	0.413/0.362	**0.730/0.753**	0.469/0.341	0.586/0.446
Selected Partition: Median HSI by Dataset	PV1: 0.576/0.534	**PV3: 0.690/0.798**	PV5: 0.692/0.660	PV2: 0.739/0.799

Species:	**Cooper's Hawk**			
Model Run:	COHA R1B Abiotic & Combined	COHA R2B Abiotic & Local	COHA R3B Abiotic	COHA R4B Abiotic & Local #2
Model Scale (m²):	500	500	500	500
MINT: Average minimum January temperature (°C)			X	
MAXT: Maximum average July temperature (°C)			X	
PRECIP: Average annual precipitation (mm)	X	X	X	X
ELEV: Elevation (m)	X	X	X	X
NORTH: Northness aspect			X	
EAST: Eastness aspect			X	
SLOPE (%)			X	
VEG1 or V1_16: Agriculture (Local)				X
VEG4 or V4_16: Developed (Local)	X	X		X
VEG5 or V5_16: Riparian (Local)	X	X		X
VEG6 or V6_16: Coastal Sage Scrub (CSS) (Local)				X
VEG7 or V7_16: Other Shrubland (Local)				
VEG8 or V8_16: Chaparral (Local)				X
VEG9 or V9_16: Grassland (Local)				X
VEG10 or V10_16: Woodland (Local)				
VEG16 or V16_16: Oak Woodland (Local)	X	X		X
VEG28 (Willow Riparian)				
VEG29 (Cottonwood Riparian)				
VEG30 (Sycamore Riparian)				
VEG39 (Mulefat / Eldenberry Scrub)				
SHRUBLAND (Local CSS + Chaparral)	X	X		
ROCKSUM8X8: Rock Outcrop (Local)				
LU4: Rural Residential Land Use(Local)				
LU5: Undeveloped Land Use (Local)				
PERV1: Agriculture (Landscape)				
PERV4: Developed (Landscape)	X			
PERV5 (Riparian)	X			
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (NNG Landscape)	X			
PERV16	X			
PERSHRUB: CSS + Chaparral (Landscape)	X			
LU4P: Rural Residential Land Use (Landscape)				
LU5P: Undeveloped Land Use (Landscape)				
EDGE: Developed Land Adjacent to Natural (meters)	X			
CSSLOWDEN: CSS <25% Shrub Density (Local)				
D_ROCK: Distance to Nearest Rock Outcrop				
D_DRAIN: Distance to Nearest Drainage				
Type of Datasets	Cal/Val	Cal/Val	Cal/Val	Cal/Val
Sample Size: Calibration/Validation	110/50	110/50	110/50	110/50
Number of Variables	12	6	7	9
Full Model: Median HSI by Dataset	0.674/0.737	0.676/0.709	0.576/0.534	0.665/0.750
Reduced Model: Median HSI by Dataset	0.525/0.596	0.528/0.482	0.413/0.362	0.688/0.719
Selected Partition: Median HSI by Dataset	PV6: 0.682/0.793	PV2: 0.642/0.713	PV1: 0.576/0.534	PV7: 0.732/0.839

Species:	**Cooper's Hawk**		**Downy Woodpecker**	
Model Run:	COHA R5B Abiotic & Local #3	COHA R6B Abiotic & Landscape	DOWO R1 Abiotic & Combined	DOWO R2 Abiotic & Local
Model Scale (m²):	500	500		
MINT: Average minimum January temperature (°C)	X			
MAXT: Maximum average July temperature (°C)	X			
PRECIP: Average annual precipitation (mm)	X	X		
ELEV: Elevation (m)	X	X	X	X
NORTH: Northness aspect				
EAST: Eastness aspect				
SLOPE (%)	X			
VEG1 or V1_16: Agriculture (Local)	X			
VEG4 or V4_16: Developed (Local)	X			X
VEG5 or V5_16: Riparian (Local)	X		X	
VEG6 or V6_16: Coastal Sage Scrub (CSS) (Local)	X			
VEG7 or V7_16: Other Shrubland (Local)				
VEG8 or V8_16: Chaparral (Local)	X			
VEG9 or V9_16: Grassland (Local)	X			
VEG10 or V10_16: Woodland (Local)				
VEG16 or V16_16: Oak Woodland (Local)	X			
VEG28 (Willow Riparian)			X	X
VEG29 (Cottonwood Riparian)			X	X
VEG30 (Sycamore Riparian)				
VEG39 (Mulefat / Eldenberry Scrub)				
SHRUBLAND (Local CSS + Chaparral)				
ROCKSUM8X8: Rock Outcrop (Local)				
LU4: Rural Residential Land Use(Local)				
LU5: Undeveloped Land Use (Local)				
PERV1: Agriculture (Landscape)				
PERV4: Developed (Landscape)		X		
PERV5 (Riparian)		X	X	
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (NNG Landscape)		X		
PERV16		X		
PERSHRUB: CSS + Chaparral (Landscape)		X		
LU4P: Rural Residential Land Use (Landscape)				
LU5P: Undeveloped Land Use (Landscape)				
EDGE: Developed Land Adjacent to Natural (meters)		X		
CSSLOWDEN: CSS <25% Shrub Density (Local)				
D_ROCK: Distance to Nearest Rock Outcrop				
D_DRAIN: Distance to Nearest Drainage				
Type of Datasets	Cal/Val	Cal/Val	Cal/Val Prec =1	Cal/Val Prec =1
Sample Size: Calibration/Validation	110/50	110/50	36/18	36/18
Number of Variables	12	8	4	4
Full Model: Median HSI by Dataset	0.659/0.606	0.660/0.764	0.505/0.476	0.539/0.518
Reduced Model: Median HSI by Dataset	0.564/0.538	0.586/0.446	0.526/0.473	0.425/0.347
Selected Partition: Median HSI by Dataset	PV4: 0.665/0.670	PV2: 0.739/0.799	PV1: 0.505/0.476	PV1: 0.539/0.518

Species:	**Downy Woodpecker**			
Model Run:	**DOWO R3 Abiotic**	DOWO R4 Abiotic & Combined #2	DOWO R5 Abiotic & Local #2	DOWO R6 Abiotic & Combined #3
Model Scale (m²):				
MINT: Average minimum January temperature (°C)	**X**	X	X	
MAXT: Maximum average July temperature (°C)	**X**			
PRECIP: Average annual precipitation (mm)	**X**			X
ELEV: Elevation (m)		X	X	
NORTH: Northness aspect				
EAST: Eastness aspect				
SLOPE (%)	**X**			X
VEG1 or V1_16: Agriculture (Local)				
VEG4 or V4_16: Developed (Local)			X	
VEG5 or V5_16: Riparian (Local)		X	X	X
VEG6 or V6_16: Coastal Sage Scrub (CSS) (Local)				
VEG7 or V7_16: Other Shrubland (Local)				
VEG8 or V8_16: Chaparral (Local)				
VEG9 or V9_16: Grassland (Local)				
VEG10 or V10_16: Woodland (Local)				
VEG16 or V16_16: Oak Woodland (Local)				
VEG28 (Willow Riparian)				
VEG29 (Cottonwood Riparian)				
VEG30 (Sycamore Riparian)				
VEG39 (Mulefat / Eldenberry Scrub)				
SHRUBLAND (Local CSS + Chaparral)				
ROCKSUM8X8: Rock Outcrop (Local)				
LU4: Rural Residential Land Use(Local)				
LU5: Undeveloped Land Use (Local)				
PERV1: Agriculture (Landscape)				
PERV4: Developed (Landscape)		X		X
PERV5 (Riparian)		X		X
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (NNG Landscape)				
PERV16				
PERSHRUB: CSS + Chaparral (Landscape)				
LU4P: Rural Residential Land Use (Landscape)				
LU5P: Undeveloped Land Use (Landscape)				
EDGE: Developed Land Adjacent to Natural (meters)				
CSSLOWDEN: CSS <25% Shrub Density (Local)				
D_ROCK: Distance to Nearest Rock Outcrop				
D_DRAIN: Distance to Nearest Drainage				
Type of Datasets	**Cal/Val Prec =1**	Cal/Val Prec =1	Cal/Val Prec =1	Cal/Val Prec =1
Sample Size: Calibration/Validation	**36/18**	36/18	36/18	36/18
Number of Variables	**5**	5	4	5
Full Model: Median HSI by Dataset	**0.642/0.453**	0.616/0.513	0.580/0.562	0.578/0.254
Reduced Model: Median HSI by Dataset	**0.438/0.35**	0.603/0.646	0.532/0.576	0.549/0.243
Selected Partition: Median HSI by Dataset	**PV1: 0.642/0.453**	PV5: 0.603/0.646	PV4: 0.532/0.576	PV1: 0.578/0.254

Species:	**Downy Woodpecker**	**Ferruginous Hawk**		
Model Run:	DOWO R7 Abiotic & Landscape	FEHA R1 Abiotic & Combined	FEHA R2 Abiotic & Local	**FEHA R3 Abiotic**
Model Scale (m²):		500	500	**500**
MINT: Average minimum January temperature (°C)	X			**X**
MAXT: Maximum average July temperature (°C)				
PRECIP: Average annual precipitation (mm)				**X**
ELEV: Elevation (m)	X		X	**X**
NORTH: Northness aspect				
EAST: Eastness aspect				
SLOPE (%)		X	X	**X**
VEG1 or V1_16: Agriculture (Local)			X	
VEG4 or V4_16: Developed (Local)				
VEG5 or V5_16: Riparian (Local)				
VEG6 or V6_16: Coastal Sage Scrub (CSS) (Local)				
VEG7 or V7_16: Other Shrubland (Local)				
VEG8 or V8_16: Chaparral (Local)				
VEG9 or V9_16: Grassland (Local)		X	X	
VEG10 or V10_16: Woodland (Local)				
VEG16 or V16_16: Oak Woodland (Local)				
VEG28 (Willow Riparian)				
VEG29 (Cottonwood Riparian)				
VEG30 (Sycamore Riparian)				
VEG39 (Mulefat / Eldenberry Scrub)				
SHRUBLAND (Local CSS + Chaparral)				
ROCKSUM8X8: Rock Outcrop (Local)				
LU4: Rural Residential Land Use(Local)				
LU5: Undeveloped Land Use (Local)				
PERV1: Agriculture (Landscape)		X		
PERV4: Developed (Landscape)	X			
PERV5 (Riparian)	X			
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (NNG Landscape)		X		
PERV16				
PERSHRUB: CSS + Chaparral (Landscape)				
LU4P: Rural Residential Land Use (Landscape)				
LU5P: Undeveloped Land Use (Landscape)				
EDGE: Developed Land Adjacent to Natural (meters)				
CSSLOWDEN: CSS <25% Shrub Density (Local)				
D_ROCK: Distance to Nearest Rock Outcrop				
D_DRAIN: Distance to Nearest Drainage				
Type of Datasets	Cal/Val Prec =1	Cal	Cal	**Cal**
Sample Size: Calibration/Validation	36/18	29/0	29/0	**29/0**
Number of Variables	4	4	4	**4**
Full Model: Median HSI by Dataset	0.669/0.502	0.586	0.532	**0.622**
Reduced Model: Median HSI by Dataset	0.600/0.648	0.662	0.448	**0.399**
Selected Partition: Median HSI by Dataset	PV4: 0.600/0.648	PV4: 0.662	PV1: 0.532	**PV1: 0.622**

Species:	**Ferruginous Hawk**	**Golden Eagle**		
Model Run:	FEHA R4 Abiotic & Landscape	GOEA R1 Abiotic & Combined	GOEA R2 Abiotic & Local	GOEA R3 Abiotic
Model Scale (m²):	500	500	500	500
MINT: Average minimum January temperature (°C)				X
MAXT: Maximum average July temperature (°C)				X
PRECIP: Average annual precipitation (mm)				X
ELEV: Elevation (m)		X	X	X
NORTH: Northness aspect				
EAST: Eastness aspect				
SLOPE (%)	X	X	X	X
VEG1 or V1_16: Agriculture (Local)			X	
VEG4 or V4_16: Developed (Local)			X	
VEG5 or V5_16: Riparian (Local)				
VEG6 or V6_16: Coastal Sage Scrub (CSS) (Local)				
VEG7 or V7_16: Other Shrubland (Local)				
VEG8 or V8_16: Chaparral (Local)				
VEG9 or V9_16: Grassland (Local)		X	X	
VEG10 or V10_16: Woodland (Local)				
VEG16 or V16_16: Oak Woodland (Local)				
VEG28 (Willow Riparian)				
VEG29 (Cottonwood Riparian)				
VEG30 (Sycamore Riparian)				
VEG39 (Mulefat / Eldenberry Scrub)				
SHRUBLAND (Local CSS + Chaparral)			X	
ROCKSUM8X8: Rock Outcrop (Local)				
LU4: Rural Residential Land Use(Local)				
LU5: Undeveloped Land Use (Local)				
PERV1: Agriculture (Landscape)	X	X		
PERV4: Developed (Landscape)	X	X		
PERV5 (Riparian)				
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (NNG Landscape)	X	X		
PERV16				
PERSHRUB: CSS + Chaparral (Landscape)				
LU4P: Rural Residential Land Use (Landscape)				
LU5P: Undeveloped Land Use (Landscape)				
EDGE: Developed Land Adjacent to Natural (meters)				
CSSLOWDEN: CSS <25% Shrub Density (Local)				
D_ROCK: Distance to Nearest Rock Outcrop				
D_DRAIN: Distance to Nearest Drainage				
Type of Datasets	Cal	Cal/Val	Cal/Val	Cal/Val
Sample Size: Calibration/Validation	29/0	43/15	43/15	43/15
Number of Variables	4	6	6	5
Full Model: Median HSI by Dataset	0.496	0.562/0.817	0.555/0.601	0.661/0.721
Reduced Model: Median HSI by Dataset	0.611	0.625/0.642	0.437/0.318	0.595/0.499
Selected Partition: Median HSI by Dataset	PV6: 0.611	PV1: 0.562/0.817	PV1: 0.555/0.601	PV1: 0.661/0.721

Species:	**Golden Eagle**	**Grasshopper Sparrow**		
Model Run:	**GOEA R4 Abiotic & Landscape**	**GRSP R1 Abiotic & Combined**	GRSP R2 Abiotic & Local	GRSP R3 Abiotic & Landscape
Model Scale (m²):	**500**			
MINT: Average minimum January temperature (°C)		**X**	X	X
MAXT: Maximum average July temperature (°C)		**X**	X	X
PRECIP: Average annual precipitation (mm)		**X**	X	X
ELEV: Elevation (m)	**X**	**X**	X	X
NORTH: Northness aspect				
EAST: Eastness aspect				
SLOPE (%)	**X**			
VEG1 or V1_16: Agriculture (Local)				
VEG4 or V4_16: Developed (Local)	**X**			
VEG5 or V5_16: Riparian (Local)				
VEG6 or V6_16: Coastal Sage Scrub (CSS) (Local)		**X**	X	
VEG7 or V7_16: Other Shrubland (Local)				
VEG8 or V8_16: Chaparral (Local)				
VEG9 or V9_16: Grassland (Local)	**X**	**X**	X	
VEG10 or V10_16: Woodland (Local)				
VEG16 or V16_16: Oak Woodland (Local)				
VEG28 (Willow Riparian)				
VEG29 (Cottonwood Riparian)				
VEG30 (Sycamore Riparian)				
VEG39 (Mulefat / Eldenberry Scrub)				
SHRUBLAND (Local CSS + Chaparral)				
ROCKSUM8X8: Rock Outcrop (Local)				
LU4: Rural Residential Land Use(Local)				
LU5: Undeveloped Land Use (Local)				
PERV1: Agriculture (Landscape)	**X**			
PERV4: Developed (Landscape)		**X**		X
PERV5 (Riparian)				
PERV6: Coastal Sage Scrub (Landscape)		**X**		X
PERV8: Chaparral (Landscape)				
PERV9: Grassland (NNG Landscape)		**X**		X
PERV16				
PERSHRUB: CSS + Chaparral (Landscape)				
LU4P: Rural Residential Land Use (Landscape)				
LU5P: Undeveloped Land Use (Landscape)				
EDGE: Developed Land Adjacent to Natural (meters)				
CSSLOWDEN: CSS <25% Shrub Density (Local)				
D_ROCK: Distance to Nearest Rock Outcrop				
D_DRAIN: Distance to Nearest Drainage				
Type of Datasets	**Cal/Val**	**Cal/Log Reg Val**	Cal/Log Reg Val	Cal/Log Reg Val
Sample Size: Calibration/Validation	**43/15**	**81/10**	81/10	81/10
Number of Variables	**5**	**9**	6	7
Full Model: Median HSI by Dataset	**0.666/0.839**	**0.72/0.75**	0.73/0.74	0.75/0.87
Reduced Model: Median HSI by Dataset	**0.371/0.531**	**0.54/0.35**	0.51/0.30	0.55//0.30
Selected Partition: Median HSI by Dataset	**PV1: 0.666/0.839**	**PV1: 0.72/0.75**	PV1: 0.73//0.74	PV1: 0.75//0.87

Species:	**Grasshopper Sparrow**	**Least Bell's Vireo**		
Model Run:	GRSP R4 Abiotic	LBVI R1 Abiotic & Combined	LBVI R2 Abiotic & Local	LBVI R3 Abiotic
Model Scale (m²):				
MINT: Average minimum January temperature (°C)	X			X
MAXT: Maximum average July temperature (°C)	X	X	X	X
PRECIP: Average annual precipitation (mm)	X	X	X	X
ELEV: Elevation (m)	X	X	X	X
NORTH: Northness aspect	X			X
EAST: Eastness aspect	X			X
SLOPE (%)	X	X	X	X
VEG1 or V1_16: Agriculture (Local)				
VEG4 or V4_16: Developed (Local)				
VEG5 or V5_16: Riparian (Local)				
VEG6 or V6_16: Coastal Sage Scrub (CSS) (Local)				
VEG7 or V7_16: Other Shrubland (Local)				
VEG8 or V8_16: Chaparral (Local)				
VEG9 or V9_16: Grassland (Local)				
VEG10 or V10_16: Woodland (Local)				
VEG16 or V16_16: Oak Woodland (Local)				
VEG28 (Willow Riparian)		X	X	
VEG29 (Cottonwood Riparian)				
VEG30 (Sycamore Riparian)				
VEG39 (Mulefat / Eldenberry Scrub)		X	X	
SHRUBLAND (Local CSS + Chaparral)			X	
ROCKSUM8X8: Rock Outcrop (Local)				
LU4: Rural Residential Land Use(Local)				
LU5: Undeveloped Land Use (Local)				
PERV1: Agriculture (Landscape)		X		
PERV4: Developed (Landscape)		X		
PERV5 (Riparian)		X		
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (NNG Landscape)				
PERV16				
PERSHRUB: CSS + Chaparral (Landscape)		X		
LU4P: Rural Residential Land Use (Landscape)				
LU5P: Undeveloped Land Use (Landscape)				
EDGE: Developed Land Adjacent to Natural (meters)		X		
CSSLOWDEN: CSS <25% Shrub Density (Local)				
D_ROCK: Distance to Nearest Rock Outcrop				
D_DRAIN: Distance to Nearest Drainage				
Type of Datasets	Cal/Log Reg Val	Cal/Log Reg Val	Cal/Log Reg Val	Cal/Log Reg Val
Sample Size: Calibration/Validation	81/10	117/54	117/54	117/54
Number of Variables	7	11	7	7
Full Model: Median HSI by Dataset	0.68/0.37/0.67	0.568/0.533	0.687/0.722	0.640/0.673
Reduced Model: Median HSI by Dataset	0.52/0.41/0.39	0.504/0.469	0.493/0.411	0.483/0.550
Selected Partition: Median HSI by Dataset	PV1: 0.68/0.37/0.67	PV1: 0.568/0.533	PV1: 0.687/0.722	PV3: 0.686/0.774

Species:	**Least Bell's Vireo**			
Model Run:	LBVI R4 Abiotic & Combined #2	**LBVI R5 Abiotic & Local #2**	LBVI R6 Abiotic & Landscape	LBVI R7 Abiotic & Local #3
Model Scale (m^2):				
MINT: Average minimum January temperature (°C)	X	**X**	X	X
MAXT: Maximum average July temperature (°C)	X	**X**	X	X
PRECIP: Average annual precipitation (mm)	X	**X**	X	X
ELEV: Elevation (m)	X	**X**	X	X
NORTH: Northness aspect	X	**X**	X	X
EAST: Eastness aspect	X	**X**	X	X
SLOPE (%)	X	**X**	X	X
VEG1 or V1_16: Agriculture (Local)				
VEG4 or V4_16: Developed (Local)				
VEG5 or V5_16: Riparian (Local)	X	**X**		
VEG6 or V6_16: Coastal Sage Scrub (CSS) (Local)				
VEG7 or V7_16: Other Shrubland (Local)				
VEG8 or V8_16: Chaparral (Local)				
VEG9 or V9_16: Grassland (Local)				
VEG10 or V10_16: Woodland (Local)				
VEG16 or V16_16: Oak Woodland (Local)				
VEG28 (Willow Riparian)				X
VEG29 (Cottonwood Riparian)				
VEG30 (Sycamore Riparian)				
VEG39 (Mulefat / Eldenberry Scrub)				X
SHRUBLAND (Local CSS + Chaparral)	X	**X**		
ROCKSUM8X8: Rock Outcrop (Local)				
LU4: Rural Residential Land Use(Local)				
LU5: Undeveloped Land Use (Local)				
PERV1: Agriculture (Landscape)				
PERV4: Developed (Landscape)	X		X	
PERV5 (Riparian)			X	
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (NNG Landscape)			X	
PERV16				
PERSHRUB: CSS + Chaparral (Landscape)	X		X	
LU4P: Rural Residential Land Use (Landscape)				
LU5P: Undeveloped Land Use (Landscape)				
EDGE: Developed Land Adjacent to Natural (meters)			X	
CSSLOWDEN: CSS <25% Shrub Density (Local)				
D_ROCK: Distance to Nearest Rock Outcrop				
D_DRAIN: Distance to Nearest Drainage				
Type of Datasets	Cal/Log Reg Val	**Cal/Log Reg Val**	Cal/Log Reg Val	Cal/Log Reg Val
Sample Size: Calibration/Validation	117/54	**117/54**	117/54	117/54
Number of Variables	11	**9**	12	9
Full Model: Median HSI by Dataset	0.517/0.519	**0.555/0.704**	0.546/0.474	0.694/0.763
Reduced Model: Median HSI by Dataset	0.488/0.604	**0.487/0.581**	0.577/0.654	0.483/0.579
Selected Partition: Median HSI by Dataset	PV4: 0.503/0.669	**PV6: 0.529/0.738**	PV1: 1 0.545/0.685	PV3: 0.549/0.820

Species:	**Least Bell's Vireo**	**Loggerhead Shrike**		
Model Run:	LBVI R8 Abiotic & Combined #3	LOSH R1B Abiotic & Combined	LOSH R2B Abiotic & Local	LOSH R3B Abiotic & Landscape
Model Scale (m^2):				
MINT: Average minimum January temperature (°C)	X	X	X	X
MAXT: Maximum average July temperature (°C)	X	X	X	X
PRECIP: Average annual precipitation (mm)	X	X	X	X
ELEV: Elevation (m)	X	X	X	X
NORTH: Northness aspect	X	X	X	X
EAST: Eastness aspect	X	X	X	X
SLOPE (%)	X	X	X	X
VEG1 or V1_16: Agriculture (Local)		X	X	X
VEG4 or V4_16: Developed (Local)				
VEG5 or V5_16: Riparian (Local)				
VEG6 or V6_16: Coastal Sage Scrub (CSS) (Local)		X	X	
VEG7 or V7_16: Other Shrubland (Local)				
VEG8 or V8_16: Chaparral (Local)				
VEG9 or V9_16: Grassland (Local)		X	X	
VEG10 or V10_16: Woodland (Local)				
VEG16 or V16_16: Oak Woodland (Local)				
VEG28 (Willow Riparian)	X			
VEG29 (Cottonwood Riparian)				
VEG30 (Sycamore Riparian)				
VEG39 (Mulefat / Eldenberry Scrub)	X			
SHRUBLAND (Local CSS + Chaparral)				
ROCKSUM8X8: Rock Outcrop (Local)				
LU4: Rural Residential Land Use(Local)				
LU5: Undeveloped Land Use (Local)				
PERV1: Agriculture (Landscape)		X		X
PERV4: Developed (Landscape)		X		X
PERV5 (Riparian)	X			
PERV6: Coastal Sage Scrub (Landscape)		X		X
PERV8: Chaparral (Landscape)				
PERV9: Grassland (NNG Landscape)		X		X
PERV16				
PERSHRUB: CSS + Chaparral (Landscape)				
LU4P: Rural Residential Land Use (Landscape)				
LU5P: Undeveloped Land Use (Landscape)				
EDGE: Developed Land Adjacent to Natural (meters)		X		X
CSSLOWDEN: CSS <25% Shrub Density (Local)				
D_ROCK: Distance to Nearest Rock Outcrop				
D_DRAIN: Distance to Nearest Drainage				
Type of Datasets	Cal/Log Reg Val	Cal/Log Reg Val	Cal/Log Reg Val	Cal/Log Reg Val
Sample Size: Calibration/Validation	117/54	136/51	136/51	136/51
Number of Variables	10	15	10	12
Full Model: Median HSI by Dataset	0.679/0.761	0.657/0.107	0.634/0.235	0.651/0.260
Reduced Model: Median HSI by Dataset	0.473/0.635	0.588/0.618	0.599/0.611	0.607/0.662
Selected Partition: Median HSI by Dataset	PV5: 0.545/0.790	PV1: 5 0.588/0.618	PV1: 0: 0.599/0.611	PV1: 1 0.666/0.700

Species:	**Loggerhead Shrike**		**Mountain Quail**	
Model Run:	LOSH R4B Abiotic	LOSH R5B Abiotic & Combined #2	MOQU R1 Abiotic & Combined	MOQU R2 Abiotic & Local
Model Scale (m^2):			500	500
MINT: Average minimum January temperature (°C)	X	X		
MAXT: Maximum average July temperature (°C)	X	X		
PRECIP: Average annual precipitation (mm)	X	X		X
ELEV: Elevation (m)	X	X	X	X
NORTH: Northness aspect	X			
EAST: Eastness aspect	X			
SLOPE (%)	X	X	X	X
VEG1 or V1_16: Agriculture (Local)	X			
VEG4 or V4_16: Developed (Local)				
VEG5 or V5_16: Riparian (Local)				
VEG6 or V6_16: Coastal Sage Scrub (CSS) (Local)				
VEG7 or V7_16: Other Shrubland (Local)				
VEG8 or V8_16: Chaparral (Local)				X
VEG9 or V9_16: Grassland (Local)				
VEG10 or V10_16: Woodland (Local)				
VEG16 or V16_16: Oak Woodland (Local)			X	X
VEG28 (Willow Riparian)				
VEG29 (Cottonwood Riparian)				
VEG30 (Sycamore Riparian)				
VEG39 (Mulefat / Eldenberry Scrub)				
SHRUBLAND (Local CSS + Chaparral)				
ROCKSUM8X8: Rock Outcrop (Local)				
LU4: Rural Residential Land Use(Local)				
LU5: Undeveloped Land Use (Local)				
PERV1: Agriculture (Landscape)		X		
PERV4: Developed (Landscape)		X	X	
PERV5 (Riparian)				
PERV6: Coastal Sage Scrub (Landscape)		X		
PERV8: Chaparral (Landscape)			X	
PERV9: Grassland (NNG Landscape)				
PERV16				
PERSHRUB: CSS + Chaparral (Landscape)				
LU4P: Rural Residential Land Use (Landscape)				
LU5P: Undeveloped Land Use (Landscape)				
EDGE: Developed Land Adjacent to Natural (meters)				
CSSLOWDEN: CSS <25% Shrub Density (Local)		X		
D_ROCK: Distance to Nearest Rock Outcrop				
D_DRAIN: Distance to Nearest Drainage				
Type of Datasets	Cal/Log Reg Val	Cal/Log Reg Val	Cal	Cal
Sample Size: Calibration/Validation	136/51	136/51	33/0	33/0
Number of Variables	7	9	5	5
Full Model: Median HSI by Dataset	0.680/0.550	0.757/0.605	0.545	0.537
Reduced Model: Median HSI by Dataset	0.583/0.612	0.577/0.556	0.593	0.511
Selected Partition: Median HSI by Dataset	PV7: 0.583/0.612	PV4: 0.700/0.660	PV5: 0.593	PV4: 0.568

Species:		**Mountain Quail**		**Northern Harrier**
Model Run:	MOQU R3 Abiotic	**MOQU R4 Abiotic & Landscape**	MOQU R5 Abiotic & Local #2	NOHA R1 Abiotic & Combined
Model Scale (m²):	500	**500**	500	
MINT: Average minimum January temperature (°C)	X	**X**	X	
MAXT: Maximum average July temperature (°C)	X			
PRECIP: Average annual precipitation (mm)	X	**X**	X	
ELEV: Elevation (m)	X	**X**	X	X
NORTH: Northness aspect				
EAST: Eastness aspect				
SLOPE (%)	X			X
VEG1 or V1_16: Agriculture (Local)				
VEG4 or V4_16: Developed (Local)				
VEG5 or V5_16: Riparian (Local)				
VEG6 or V6_16: Coastal Sage Scrub (CSS) (Local)				
VEG7 or V7_16: Other Shrubland (Local)				
VEG8 or V8_16: Chaparral (Local)			X	
VEG9 or V9_16: Grassland (Local)				X
VEG10 or V10_16: Woodland (Local)				
VEG16 or V16_16: Oak Woodland (Local)			X	
VEG28 (Willow Riparian)				
VEG29 (Cottonwood Riparian)				
VEG30 (Sycamore Riparian)				
VEG39 (Mulefat / Eldenberry Scrub)				
SHRUBLAND (Local CSS + Chaparral)				X
ROCKSUM8X8: Rock Outcrop (Local)				
LU4: Rural Residential Land Use(Local)				
LU5: Undeveloped Land Use (Local)				
PERV1: Agriculture (Landscape)				X
PERV4: Developed (Landscape)		**X**		X
PERV5 (Riparian)				
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)		**X**		
PERV9: Grassland (NNG Landscape)				X
PERV16				
PERSHRUB: CSS + Chaparral (Landscape)				X
LU4P: Rural Residential Land Use (Landscape)				
LU5P: Undeveloped Land Use (Landscape)				
EDGE: Developed Land Adjacent to Natural (meters)				
CSSLOWDEN: CSS <25% Shrub Density (Local)				
D_ROCK: Distance to Nearest Rock Outcrop				
D_DRAIN: Distance to Nearest Drainage				
Type of Datasets	Cal	**Cal**	Cal	Cal/Val
Sample Size: Calibration/Validation	33/0	**33/0**	33/0	68/29
Number of Variables	5	**5**	5	8
Full Model: Median HSI by Dataset	0.619	**0.712**	0.594	0.627/0.498
Reduced Model: Median HSI by Dataset	0.557	**0.423**	0.469	0.595/0.394
Selected Partition: Median HSI by Dataset	PV4: 0.645	**PV1: 0.712**	PV1: 0.594	PV1: 0.627/0.498

Species:	**Northern Harrier**			
Model Run:	NOHA R2 Abiotic & Local	NOHA R3 Abiotic	NOHA R4 Abiotic & Local #2	**NOHA R5 Abiotic & Combined #2**
Model Scale (m²):				
MINT: Average minimum January temperature (°C)		X	X	**X**
MAXT: Maximum average July temperature (°C)		X		
PRECIP: Average annual precipitation (mm)		X	X	**X**
ELEV: Elevation (m)	X	X	X	**X**
NORTH: Northness aspect		X		
EAST: Eastness aspect		X		
SLOPE (%)	X	X		
VEG1 or V1_16: Agriculture (Local)	X		X	**X**
VEG4 or V4_16: Developed (Local)	X		X	
VEG5 or V5_16: Riparian (Local)				
VEG6 or V6_16: Coastal Sage Scrub (CSS) (Local)				
VEG7 or V7_16: Other Shrubland (Local)				
VEG8 or V8_16: Chaparral (Local)				
VEG9 or V9_16: Grassland (Local)	X		X	**X**
VEG10 or V10_16: Woodland (Local)				
VEG16 or V16_16: Oak Woodland (Local)				
VEG28 (Willow Riparian)				
VEG29 (Cottonwood Riparian)				
VEG30 (Sycamore Riparian)				
VEG39 (Mulefat / Eldenberry Scrub)				
SHRUBLAND (Local CSS + Chaparral)	X			
ROCKSUM8X8: Rock Outcrop (Local)				
LU4: Rural Residential Land Use(Local)				
LU5: Undeveloped Land Use (Local)				
PERV1: Agriculture (Landscape)				**X**
PERV4: Developed (Landscape)				
PERV5 (Riparian)				
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (NNG Landscape)				**X**
PERV16				
PERSHRUB: CSS + Chaparral (Landscape)				
LU4P: Rural Residential Land Use (Landscape)				
LU5P: Undeveloped Land Use (Landscape)				
EDGE: Developed Land Adjacent to Natural (meters)				
CSSLOWDEN: CSS <25% Shrub Density (Local)				
D_ROCK: Distance to Nearest Rock Outcrop				
D_DRAIN: Distance to Nearest Drainage				
Type of Datasets	Cal/Val	Cal/Val	Cal/Val	**Cal/Val**
Sample Size: Calibration/Validation	68/29	68/29	68/29	**68/29**
Number of Variables	6	7	6	**7**
Full Model: Median HSI by Dataset	0.545/0.461	0.714/0.353	0.649/0.689	**0.680/0.828**
Reduced Model: Median HSI by Dataset	0.631/0.425	0.486/0.403	0.477/0.463	**0.708/0.683**
Selected Partition: Median HSI by Dataset	PV2: 0.595/0.528	PV3: 0.573/0.492	PV1: 0.649/0.689	**PV1: 0.680/0.828**

Species:	**Northern Harrier**	**Sharp-shinned Hawk**		
Model Run:	NOHA R6 Abiotic & Landscape	SSHA R1 Abiotic & Combined	SSHA R2 Abiotic & Local	**SSHA R3 Abiotic**
Model Scale (m²):		500	500	**500**
MINT: Average minimum January temperature (°C)	X	X	X	**X**
MAXT: Maximum average July temperature (°C)				
PRECIP: Average annual precipitation (mm)	X			**X**
ELEV: Elevation (m)	X	X	X	**X**
NORTH: Northness aspect				
EAST: Eastness aspect				
SLOPE (%)				**X**
VEG1 or V1_16: Agriculture (Local)				
VEG4 or V4_16: Developed (Local)				
VEG5 or V5_16: Riparian (Local)				
VEG6 or V6_16: Coastal Sage Scrub (CSS) (Local)				
VEG7 or V7_16: Other Shrubland (Local)				
VEG8 or V8_16: Chaparral (Local)				
VEG9 or V9_16: Grassland (Local)				
VEG10 or V10_16: Woodland (Local)		X	X	
VEG16 or V16_16: Oak Woodland (Local)				
VEG28 (Willow Riparian)				
VEG29 (Cottonwood Riparian)				
VEG30 (Sycamore Riparian)				
VEG39 (Mulefat / Eldenberry Scrub)				
SHRUBLAND (Local CSS + Chaparral)			X	
ROCKSUM8X8: Rock Outcrop (Local)				
LU4: Rural Residential Land Use(Local)				
LU5: Undeveloped Land Use (Local)				
PERV1: Agriculture (Landscape)	X			
PERV4: Developed (Landscape)	X			
PERV5 (Riparian)				
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (NNG Landscape)	X			
PERV16				
PERSHRUB: CSS + Chaparral (Landscape)	X	X		
LU4P: Rural Residential Land Use (Landscape)				
LU5P: Undeveloped Land Use (Landscape)				
EDGE: Developed Land Adjacent to Natural (meters)				
CSSLOWDEN: CSS <25% Shrub Density (Local)				
D_ROCK: Distance to Nearest Rock Outcrop				
D_DRAIN: Distance to Nearest Drainage				
Type of Datasets	Cal/Val	Cal	Cal	**Cal**
Sample Size: Calibration/Validation	68/29	30/0	30/0	**30/0**
Number of Variables	7	4	4	**4**
Full Model: Median HSI by Dataset	0.663/0.624	0.667	0.644	**0.725**
Reduced Model: Median HSI by Dataset	0.535/0.519	0.434	0.487	**0.486**
Selected Partition: Median HSI by Dataset	PV1: 0.663/0.624	PV1: 0.667	PV1: 0.644	**PV1: 0.725**

Species:	**Sharp-shinned Hawk**	**Southern California Rufous-crowned Sparrow**		
Model Run:	SSHA R4 Abiotic & Landscape	**RCSP R1 Abiotic & Combined**	RCSP R2 Abiotic & Local	RCSP R3 Abiotic & Landscape
Model Scale (m^2):	500			
MINT: Average minimum January temperature (°C)	X	**X**	X	X
MAXT: Maximum average July temperature (°C)		**X**	X	X
PRECIP: Average annual precipitation (mm)	X	**X**	X	X
ELEV: Elevation (m)		**X**	X	X
NORTH: Northness aspect		X	X	X
EAST: Eastness aspect		X	X	X
SLOPE (%)		X	X	X
VEG1 or V1_16: Agriculture (Local)			X	
VEG4 or V4_16: Developed (Local)			X	
VEG5 or V5_16: Riparian (Local)				
VEG6 or V6_16: Coastal Sage Scrub (CSS) (Local)		**X**	X	
VEG7 or V7_16: Other Shrubland (Local)				
VEG8 or V8_16: Chaparral (Local)			X	
VEG9 or V9_16: Grassland (Local)		**X**	X	
VEG10 or V10_16: Woodland (Local)				
VEG16 or V16_16: Oak Woodland (Local)				
VEG28 (Willow Riparian)				
VEG29 (Cottonwood Riparian)				
VEG30 (Sycamore Riparian)				
VEG39 (Mulefat / Eldenberry Scrub)				
SHRUBLAND (Local CSS + Chaparral)				
ROCKSUM8X8: Rock Outcrop (Local)				
LU4: Rural Residential Land Use(Local)				
LU5: Undeveloped Land Use (Local)				
PERV1: Agriculture (Landscape)				X
PERV4: Developed (Landscape)	X	**X**		X
PERV5 (Riparian)				
PERV6: Coastal Sage Scrub (Landscape)		**X**		X
PERV8: Chaparral (Landscape)		**X**		X
PERV9: Grassland (NNG Landscape)		**X**		X
PERV16				
PERSHRUB: CSS + Chaparral (Landscape)	X			
LU4P: Rural Residential Land Use (Landscape)				
LU5P: Undeveloped Land Use (Landscape)				
EDGE: Developed Land Adjacent to Natural (meters)		**X**		X
CSSLOWDEN: CSS <25% Shrub Density (Local)				
D_ROCK: Distance to Nearest Rock Outcrop				
D_DRAIN: Distance to Nearest Drainage				
Type of Datasets	Cal	**Cal/Log Reg Val**	Cal/Log Reg Val	Cal/Log Reg Val
Sample Size: Calibration/Validation	30/0	**233/293**	233/293	233/293
Number of Variables	4	**14**	12	13
Full Model: Median HSI by Dataset	0.609	**0.576/0.631**	0.718/0.750	0.578/0.564
Reduced Model: Median HSI by Dataset	0.559	**0.491/0.527**	0.635/0.611	0.587/0.459
Selected Partition: Median HSI by Dataset	PV1: 0.609	**PV9: 0.543/0.536**	PV1: 0.718/0.750	PV1: 0.578/0.564

Species:	**Southern California Rufous-crowned Sparrow**		**Turkey Vulture**	
Model Run:	RCSP R4 Abiotic	RCSP R5 Abiotic & Combined #2	TUVU R1 Abiotic & Combined	TUVU R2 Abiotic & Local
Model Scale (m²):			500	500
MINT: Average minimum January temperature (°C)	X	X	X	X
MAXT: Maximum average July temperature (°C)	X	X	X	X
PRECIP: Average annual precipitation (mm)	X	X	X	X
ELEV: Elevation (m)	X	X	X	X
NORTH: Northness aspect	X		X	X
EAST: Eastness aspect	X		X	X
SLOPE (%)	X	X	X	X
VEG1 or V1_16: Agriculture (Local)				X
VEG4 or V4_16: Developed (Local)				X
VEG5 or V5_16: Riparian (Local)				
VEG6 or V6_16: Coastal Sage Scrub (CSS) (Local)			X	X
VEG7 or V7_16: Other Shrubland (Local)				
VEG8 or V8_16: Chaparral (Local)			X	X
VEG9 or V9_16: Grassland (Local)			X	X
VEG10 or V10_16: Woodland (Local)				
VEG16 or V16_16: Oak Woodland (Local)				
VEG28 (Willow Riparian)				
VEG29 (Cottonwood Riparian)				
VEG30 (Sycamore Riparian)				
VEG39 (Mulefat / Eldenberry Scrub)				
SHRUBLAND (Local CSS + Chaparral)		X		
ROCKSUM8X8: Rock Outcrop (Local)		X	X	X
LU4: Rural Residential Land Use(Local)				
LU5: Undeveloped Land Use (Local)				
PERV1: Agriculture (Landscape)			X	
PERV4: Developed (Landscape)			X	
PERV5 (Riparian)				
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (NNG Landscape)			X	
PERV16				
PERSHRUB: CSS + Chaparral (Landscape)		X	X	
LU4P: Rural Residential Land Use (Landscape)				
LU5P: Undeveloped Land Use (Landscape)				
EDGE: Developed Land Adjacent to Natural (meters)			X	
CSSLOWDEN: CSS <25% Shrub Density (Local)				
D_ROCK: Distance to Nearest Rock Outcrop				
D_DRAIN: Distance to Nearest Drainage				
Type of Datasets	Cal/Log Reg Val	Cal/Log Reg Val	Cal/Val	Cal/Val
Sample Size: Calibration/Validation	233/293	233/293	160/86	160/86
Number of Variables	7	8	16	13
Full Model: Median HSI by Dataset	0.577/0.622	0.539/0.556	0.599/0.607	0.565/0.583
Reduced Model: Median HSI by Dataset	0.412/0.477	0.428/0.535	0.524/0.543	0.503/0.389
Selected Partition: Median HSI by Dataset	PV3: 0.303/0.616	PV1: 0.539/0.556	PV1: 0.599/0.607	PV7: 0.612/0.603

Species:	**Turkey Vulture**			
Model Run:	TUVU R3 Abiotic	**TUVU R4 Abiotic & Combined #2**	TUVU R5 Abiotic & Local #2	TUVU R6 Abiotic & Landscape
Model Scale (m²):	500	**500**	500	500
MINT: Average minimum January temperature (°C)	X	**X**	X	X
MAXT: Maximum average July temperature (°C)	X	**X**	X	X
PRECIP: Average annual precipitation (mm)	X	**X**	X	X
ELEV: Elevation (m)	X		X	X
NORTH: Northness aspect	X			
EAST: Eastness aspect	X			
SLOPE (%)	X		X	
VEG1 or V1_16: Agriculture (Local)			X	
VEG4 or V4_16: Developed (Local)				
VEG5 or V5_16: Riparian (Local)				
VEG6 or V6_16: Coastal Sage Scrub (CSS) (Local)				
VEG7 or V7_16: Other Shrubland (Local)		**X**	X	
VEG8 or V8_16: Chaparral (Local)				
VEG9 or V9_16: Grassland (Local)		**X**	X	
VEG10 or V10_16: Woodland (Local)				
VEG16 or V16_16: Oak Woodland (Local)				
VEG28 (Willow Riparian)				
VEG29 (Cottonwood Riparian)				
VEG30 (Sycamore Riparian)				
VEG39 (Mulefat / Eldenberry Scrub)				
SHRUBLAND (Local CSS + Chaparral)				
ROCKSUM8X8: Rock Outcrop (Local)				
LU4: Rural Residential Land Use(Local)				
LU5: Undeveloped Land Use (Local)				
PERV1: Agriculture (Landscape)		**X**		X
PERV4: Developed (Landscape)		**X**		X
PERV5 (Riparian)				
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (NNG Landscape)		**X**		X
PERV16				
PERSHRUB: CSS + Chaparral (Landscape)		**X**		X
LU4P: Rural Residential Land Use (Landscape)				
LU5P: Undeveloped Land Use (Landscape)				
EDGE: Developed Land Adjacent to Natural (meters)		**X**		X
CSSLOWDEN: CSS <25% Shrub Density (Local)				
D_ROCK: Distance to Nearest Rock Outcrop				
D_DRAIN: Distance to Nearest Drainage				
Type of Datasets	Cal/Val	**Cal/Val**	Cal/Val	Cal/Val
Sample Size: Calibration/Validation	160/86	**160/86**	160/86	160/86
Number of Variables	7	**11**	8	9
Full Model: Median HSI by Dataset	0.599/0.613	**0.682/0.652**	0.618/0.583	0.659/0.605
Reduced Model: Median HSI by Dataset	0.472/0.463	**0.607/0.529**	0.470/0.405	0.559/0.513
Selected Partition: Median HSI by Dataset	PV1: 0.599/0.613	**PV1: 0.682/0.652**	PV1: 0.618/0.583	PV7: 0.664/0.611

Species:	**Western Burrowing Owl**			
Model Run:	BUOW R1 Abiotic & Local #1	BUOW R2 Abiotic & Landscape	BUOW R3 Abiotic #1	**BUOW R4 Abiotic & Combined #1**
Model Scale (m^2):	250	250	250	**250**
MINT: Average minimum January temperature (°C)	X	X	X	**X**
MAXT: Maximum average July temperature (°C)	X	X	X	**X**
PRECIP: Average annual precipitation (mm)	X	X	X	**X**
ELEV: Elevation (m)	X	X	X	**X**
NORTH: Northness aspect				
EAST: Eastness aspect				
SLOPE (%)	X	X	X	**X**
VEG1 or V1_16: Agriculture (Local)	X			
VEG4 or V4_16: Developed (Local)				
VEG5 or V5_16: Riparian (Local)				
VEG6 or V6_16: Coastal Sage Scrub (CSS) (Local)				
VEG7 or V7_16: Other Shrubland (Local)				
VEG8 or V8_16: Chaparral (Local)				
VEG9 or V9_16: Grassland (Local)	X			
VEG10 or V10_16: Woodland (Local)				
VEG16 or V16_16: Oak Woodland (Local)				
VEG28 (Willow Riparian)				
VEG29 (Cottonwood Riparian)				
VEG30 (Sycamore Riparian)				
VEG39 (Mulefat / Eldenberry Scrub)				
SHRUBLAND (Local CSS + Chaparral)				
ROCKSUM8X8: Rock Outcrop (Local)			X	**X**
LU4: Rural Residential Land Use(Local)	X			**X**
LU5: Undeveloped Land Use (Local)	X			**X**
PERV1: Agriculture (Landscape)		X		**X**
PERV4: Developed (Landscape)		X		
PERV5 (Riparian)				
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (NNG Landscape)				**X**
PERV16				
PERSHRUB: CSS + Chaparral (Landscape)				
LU4P: Rural Residential Land Use (Landscape)		X		
LU5P: Undeveloped Land Use (Landscape)		X		
EDGE: Developed Land Adjacent to Natural (meters)	X	X	X	**X**
CSSLOWDEN: CSS <25% Shrub Density (Local)				
D_ROCK: Distance to Nearest Rock Outcrop	X	X	X	
D_DRAIN: Distance to Nearest Drainage		X	X	**X**
Type of Datasets	Cal/Log Reg Val	Cal/Log Reg Val	Cal/Log Reg Val	**Cal/Log Reg Val**
Sample Size: Calibration/Validation	198/42	198/42	198/42	**198/42**
Number of Variables	13	12	9	**12**
Full Model: Median HSI by Dataset				
Reduced Model: Median HSI by Dataset				
Selected Partition: Median HSI by Dataset				

Species:	**Western Burrowing Owl**			
Model Run:	BUOW R5 Abiotic & Combined #2	BUOW R6 Abiotic & Combined #3	BUOW R7 Abiotic & Combined #4	BUOW R8 Abiotic & Combined #5
Model Scale (m^2):	250	250	250	250
MINT: Average minimum January temperature (°C)	X	X	X	X
MAXT: Maximum average July temperature (°C)	X	X	X	X
PRECIP: Average annual precipitation (mm)	X	X	X	X
ELEV: Elevation (m)	X	X	X	X
NORTH: Northness aspect				
EAST: Eastness aspect				
SLOPE (%)	X	X	X	X
VEG1 or V1_16: Agriculture (Local)	X	X	X	X
VEG4 or V4_16: Developed (Local)				
VEG5 or V5_16: Riparian (Local)				
VEG6 or V6_16: Coastal Sage Scrub (CSS) (Local)				
VEG7 or V7_16: Other Shrubland (Local)				
VEG8 or V8_16: Chaparral (Local)				
VEG9 or V9_16: Grassland (Local)	X	X	X	X
VEG10 or V10_16: Woodland (Local)				
VEG16 or V16_16: Oak Woodland (Local)				
VEG28 (Willow Riparian)				
VEG29 (Cottonwood Riparian)				
VEG30 (Sycamore Riparian)				
VEG39 (Mulefat / Eldenberry Scrub)				
SHRUBLAND (Local CSS + Chaparral)				
ROCKSUM8X8: Rock Outcrop (Local)	X	X	X	X
LU4: Rural Residential Land Use(Local)	X	X	X	X
LU5: Undeveloped Land Use (Local)	X	X	X	X
PERV1: Agriculture (Landscape)				
PERV4: Developed (Landscape)				
PERV5 (Riparian)				
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (NNG Landscape)				
PERV16				
PERSHRUB: CSS + Chaparral (Landscape)				
LU4P: Rural Residential Land Use (Landscape)				
LU5P: Undeveloped Land Use (Landscape)				
EDGE: Developed Land Adjacent to Natural (meters)	X	X	X	X
CSSLOWDEN: CSS <25% Shrub Density (Local)				
D_ROCK: Distance to Nearest Rock Outcrop				
D_DRAIN: Distance to Nearest Drainage	X	X	X	X
Type of Datasets	Cal/Log Reg Val	Cal/Log Reg Val	Cal/Log Reg Val	Cal/Log Reg Val
Sample Size: Calibration/Validation	198/42	198/42	198/42	198/42
Number of Variables	12	12	12	12
Full Model: Median HSI by Dataset				
Reduced Model: Median HSI by Dataset				
Selected Partition: Median HSI by Dataset				

Species:	**Western Burrowing Owl**			**White-tailed Kite**
Model Run:	BUOW R9 Abiotic & Local #2	BUOW R10 Abiotic & Combined #6B	BUOW R11 Abiotic & Landscape #2	WTKI R1 Abiotic & Combined
Model Scale (m²):	250	250	250	500
MINT: Average minimum January temperature (°C)	X	X	X	
MAXT: Maximum average July temperature (°C)	X	X	X	
PRECIP: Average annual precipitation (mm)	X	X	X	
ELEV: Elevation (m)	X	X	X	X
NORTH: Northness aspect				
EAST: Eastness aspect				
SLOPE (%)	X	X	X	X
VEG1 or V1_16: Agriculture (Local)	X	X		X
VEG4 or V4_16: Developed (Local)				
VEG5 or V5_16: Riparian (Local)				X
VEG6 or V6_16: Coastal Sage Scrub (CSS) (Local)				
VEG7 or V7_16: Other Shrubland (Local)				
VEG8 or V8_16: Chaparral (Local)				
VEG9 or V9_16: Grassland (Local)	X	X		X
VEG10 or V10_16: Woodland (Local)				
VEG16 or V16_16: Oak Woodland (Local)				X
VEG28 (Willow Riparian)				
VEG29 (Cottonwood Riparian)				
VEG30 (Sycamore Riparian)				
VEG39 (Mulefat / Eldenberry Scrub)				
SHRUBLAND (Local CSS + Chaparral)				
ROCKSUM8X8: Rock Outcrop (Local)	X	X	X	
LU4: Rural Residential Land Use(Local)				
LU5: Undeveloped Land Use (Local)				
PERV1: Agriculture (Landscape)		X	X	X
PERV4: Developed (Landscape)				X
PERV5 (Riparian)				
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (NNG Landscape)		X	X	X
PERV16				
PERSHRUB: CSS + Chaparral (Landscape)				
LU4P: Rural Residential Land Use (Landscape)				
LU5P: Undeveloped Land Use (Landscape)				
EDGE: Developed Land Adjacent to Natural (meters)	X	X	X	
CSSLOWDEN: CSS <25% Shrub Density (Local)				
D_ROCK: Distance to Nearest Rock Outcrop				
D_DRAIN: Distance to Nearest Drainage		X	X	
Type of Datasets	Cal/Log Reg Val	Cal/Log Reg Val	Cal/Log Reg Val	Cal/Val
Sample Size: Calibration/Validation	198/42	198/42	198/42	83/35
Number of Variables	9	12	10	9
Full Model: Median HSI by Dataset				0.737/0.459
Reduced Model: Median HSI by Dataset				0.493/0.227
Selected Partition: Median HSI by Dataset				PV4: 0.705/0.477

Species:	**White-tailed Kite**			
Model Run:	WTKI R2 Abiotic & Local	**WTKI R3 Abiotic**	WTKI R4 Abiotic & Combined #2	WTKI R5 Abiotic & Local #2
Model Scale (m²):	500	**500**	500	500
MINT: Average minimum January temperature (°C)		**X**	X	X
MAXT: Maximum average July temperature (°C)		**X**	X	X
PRECIP: Average annual precipitation (mm)		**X**		X
ELEV: Elevation (m)	X	**X**	X	X
NORTH: Northness aspect		**X**		
EAST: Eastness aspect		**X**		
SLOPE (%)	X	**X**		X
VEG1 or V1_16: Agriculture (Local)	X			X
VEG4 or V4_16: Developed (Local)	X			
VEG5 or V5_16: Riparian (Local)			X	X
VEG6 or V6_16: Coastal Sage Scrub (CSS) (Local)	X			
VEG7 or V7_16: Other Shrubland (Local)				
VEG8 or V8_16: Chaparral (Local)				
VEG9 or V9_16: Grassland (Local)	X			X
VEG10 or V10_16: Woodland (Local)				
VEG16 or V16_16: Oak Woodland (Local)	X		X	X
VEG28 (Willow Riparian)				
VEG29 (Cottonwood Riparian)				
VEG30 (Sycamore Riparian)				
VEG39 (Mulefat / Eldenberry Scrub)				
SHRUBLAND (Local CSS + Chaparral)				
ROCKSUM8X8: Rock Outcrop (Local)				
LU4: Rural Residential Land Use(Local)				
LU5: Undeveloped Land Use (Local)				
PERV1: Agriculture (Landscape)			X	
PERV4: Developed (Landscape)			X	
PERV5 (Riparian)				
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (NNG Landscape)			X	
PERV16				
PERSHRUB: CSS + Chaparral (Landscape)				
LU4P: Rural Residential Land Use (Landscape)				
LU5P: Undeveloped Land Use (Landscape)				
EDGE: Developed Land Adjacent to Natural (meters)				
CSSLOWDEN: CSS <25% Shrub Density (Local)				
D_ROCK: Distance to Nearest Rock Outcrop				
D_DRAIN: Distance to Nearest Drainage				
Type of Datasets	Cal/Val	**Cal/Val**	Cal/Val	Cal/Val
Sample Size: Calibration/Validation	83/35	**83/35**	83/35	83/35
Number of Variables	8	**7**	8	9
Full Model: Median HSI by Dataset	0.676/0.534	**0.712/0.636**	0.685/0.369	0.656/0.537
Reduced Model: Median HSI by Dataset	0.615/0.468	**0.443/0.385**	0.506/0.371	0.457/0.374
Selected Partition: Median HSI by Dataset	PV5: 0.609/0.660	**PV3: 0.691/0.720**	PV3: 0.635/0.391	PV3: 0.639/0.580

Species:	**White-tailed Kite**	**Willow Flycatcher**		
Model Run:	WTKI R6 Abiotic & Landscape	WIFL R1 Abiotic & Combined	WIFL R2 Abiotic & Local	WIFL R3 Abiotic
Model Scale (m²):	500	500	500	500
MINT: Average minimum January temperature (°C)	X			X
MAXT: Maximum average July temperature (°C)	X	X	X	X
PRECIP: Average annual precipitation (mm)	X	X	X	X
ELEV: Elevation (m)	X			X
NORTH: Northness aspect				
EAST: Eastness aspect				
SLOPE (%)	X			X
VEG1 or V1_16: Agriculture (Local)				
VEG4 or V4_16: Developed (Local)			X	
VEG5 or V5_16: Riparian (Local)		X	X	
VEG6 or V6_16: Coastal Sage Scrub (CSS) (Local)				
VEG7 or V7_16: Other Shrubland (Local)				
VEG8 or V8_16: Chaparral (Local)				
VEG9 or V9_16: Grassland (Local)				
VEG10 or V10_16: Woodland (Local)				
VEG16 or V16_16: Oak Woodland (Local)				
VEG28 (Willow Riparian)				
VEG29 (Cottonwood Riparian)				
VEG30 (Sycamore Riparian)				
VEG39 (Mulefat / Eldenberry Scrub)				
SHRUBLAND (Local CSS + Chaparral)			X	
ROCKSUM8X8: Rock Outcrop (Local)				
LU4: Rural Residential Land Use(Local)				
LU5: Undeveloped Land Use (Local)				
PERV1: Agriculture (Landscape)	X			
PERV4: Developed (Landscape)	X	X		
PERV5 (Riparian)		X		
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (NNG Landscape)	X			
PERV16				
PERSHRUB: CSS + Chaparral (Landscape)	X			
LU4P: Rural Residential Land Use (Landscape)				
LU5P: Undeveloped Land Use (Landscape)				
EDGE: Developed Land Adjacent to Natural (meters)				
CSSLOWDEN: CSS <25% Shrub Density (Local)				
D_ROCK: Distance to Nearest Rock Outcrop				
D_DRAIN: Distance to Nearest Drainage				
Type of Datasets	Cal/Val	Cal	Cal	Cal
Sample Size: Calibration/Validation	83/35	36/0	36/0	36/0
Number of Variables	9	5	5	5
Full Model: Median HSI by Dataset	0.709/0.372	0.482	0.478	0.525
Reduced Model: Median HSI by Dataset	0.617/0.371	0.532	0.55	0.414
Selected Partition: Median HSI by Dataset	PV5: 0.692/0.454	PV5: 0.532	PV2: 0.561	PV1: 0.525

Species:	**Willow Flycatcher**	**Wilson's Warbler**		
Model Run:	WIFL R4 Abiotic & Landscape	WIWA R1 Abiotic & Combined	WIWA R2 Abiotic & Local	WIWA R3 Abiotic
Model Scale (m²):	500	250	250	250
MINT: Average minimum January temperature (°C)		X	X	X
MAXT: Maximum average July temperature (°C)	X			X
PRECIP: Average annual precipitation (mm)	X		X	X
ELEV: Elevation (m)		X	X	X
NORTH: Northness aspect				
EAST: Eastness aspect				
SLOPE (%)				X
VEG1 or V1_16: Agriculture (Local)				
VEG4 or V4_16: Developed (Local)			X	
VEG5 or V5_16: Riparian (Local)		X	X	
VEG6 or V6_16: Coastal Sage Scrub (CSS) (Local)				
VEG7 or V7_16: Other Shrubland (Local)				
VEG8 or V8_16: Chaparral (Local)				
VEG9 or V9_16: Grassland (Local)				
VEG10 or V10_16: Woodland (Local)		X	X	
VEG16 or V16_16: Oak Woodland (Local)				
VEG28 (Willow Riparian)				
VEG29 (Cottonwood Riparian)				
VEG30 (Sycamore Riparian)				
VEG39 (Mulefat / Eldenberry Scrub)				
SHRUBLAND (Local CSS + Chaparral)				
ROCKSUM8X8: Rock Outcrop (Local)				
LU4: Rural Residential Land Use(Local)				
LU5: Undeveloped Land Use (Local)				
PERV1: Agriculture (Landscape)				
PERV4: Developed (Landscape)	X	X		
PERV5 (Riparian)	X			
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (NNG Landscape)				
PERV16				
PERSHRUB: CSS + Chaparral (Landscape)		X		
LU4P: Rural Residential Land Use (Landscape)				
LU5P: Undeveloped Land Use (Landscape)				
EDGE: Developed Land Adjacent to Natural (meters)				
CSSLOWDEN: CSS <25% Shrub Density (Local)				
D_ROCK: Distance to Nearest Rock Outcrop				
D_DRAIN: Distance to Nearest Drainage				
Type of Datasets	Cal	Cal/Log Reg Val	Cal/Log Reg Val	Cal/Log Reg Val
Sample Size: Calibration/Validation	36/0	48/28	48/28	48/28
Number of Variables	4	6	6	5
Full Model: Median HSI by Dataset	0.418	0.767/0.135	0.652/0.382	0.536/0.466
Reduced Model: Median HSI by Dataset	0.492	0.468/0.461	0.479/0.425	0.445/0.251
Selected Partition: Median HSI by Dataset	PV2: 0.543	PV6: 0.468/0.461	PV2: 0.631/0.450	PV1: 0.536/0.466

Species:	**Wilson's Warbler**		**Yellow-breasted Chat**	
Model Run:	WIWA R4 Abiotic & Combined #2	WIWA R5 Abiotic & Landscape	YBCH R1 Abiotic & Combined	YBCH R2 Abiotic & Local
Model Scale (m²):	250	250		
MINT: Average minimum January temperature (°C)	X	X		
MAXT: Maximum average July temperature (°C)			X	X
PRECIP: Average annual precipitation (mm)	X	X		
ELEV: Elevation (m)	X	X	X	X
NORTH: Northness aspect				
EAST: Eastness aspect				
SLOPE (%)			X	X
VEG1 or V1_16: Agriculture (Local)				
VEG4 or V4_16: Developed (Local)				X
VEG5 or V5_16: Riparian (Local)	X		X	X
VEG6 or V6_16: Coastal Sage Scrub (CSS) (Local)				
VEG7 or V7_16: Other Shrubland (Local)				
VEG8 or V8_16: Chaparral (Local)				
VEG9 or V9_16: Grassland (Local)				
VEG10 or V10_16: Woodland (Local)				
VEG16 or V16_16: Oak Woodland (Local)				
VEG28 (Willow Riparian)				
VEG29 (Cottonwood Riparian)				
VEG30 (Sycamore Riparian)				
VEG39 (Mulefat / Eldenberry Scrub)				
SHRUBLAND (Local CSS + Chaparral)	X			X
ROCKSUM8X8: Rock Outcrop (Local)				
LU4: Rural Residential Land Use(Local)				
LU5: Undeveloped Land Use (Local)				
PERV1: Agriculture (Landscape)				
PERV4: Developed (Landscape)	X	X	X	
PERV5 (Riparian)		X	X	
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (NNG Landscape)				
PERV16				
PERSHRUB: CSS + Chaparral (Landscape)		X		
LU4P: Rural Residential Land Use (Landscape)				
LU5P: Undeveloped Land Use (Landscape)				
EDGE: Developed Land Adjacent to Natural (meters)				
CSSLOWDEN: CSS <25% Shrub Density (Local)				
D_ROCK: Distance to Nearest Rock Outcrop				
D_DRAIN: Distance to Nearest Drainage				
Type of Datasets	Cal/Log Reg Val	Cal/Log Reg Val	Cal/Val Prec=1	Cal/Val Prec=1
Sample Size: Calibration/Validation	48/28	48/28	45/11	45/11
Number of Variables	6	6	6	6
Full Model: Median HSI by Dataset	0.647/0.343	0.673/0.070	0.748/0.397	0.840/0.484
Reduced Model: Median HSI by Dataset	0.469/0.400	0.384/0.292	0.536/0.150	0.513/0.409
Selected Partition: Median HSI by Dataset	PV6: 0.469/0.400	PV5: 0.538/0.306	PV3: 0.684/0.572	PV4: 0.662/0.667

Species:	**Yellow-breasted Chat**			
Model Run:	YBCH R3 Abiotic	YBCH R4 Abiotic & Landscape	YBCH R5 Abiotic & Combined #2	YBCH R6 Abiotic & Combined #3
Model Scale (m^2):				
MINT: Average minimum January temperature (°C)	X			
MAXT: Maximum average July temperature (°C)	X	X	X	X
PRECIP: Average annual precipitation (mm)	X		X	X
ELEV: Elevation (m)	X	X	X	X
NORTH: Northness aspect				
EAST: Eastness aspect				
SLOPE (%)	X	X	X	X
VEG1 or V1_16: Agriculture (Local)				
VEG4 or V4_16: Developed (Local)				
VEG5 or V5_16: Riparian (Local)			X	
VEG6 or V6_16: Coastal Sage Scrub (CSS) (Local)				
VEG7 or V7_16: Other Shrubland (Local)				
VEG8 or V8_16: Chaparral (Local)				
VEG9 or V9_16: Grassland (Local)				
VEG10 or V10_16: Woodland (Local)				
VEG16 or V16_16: Oak Woodland (Local)				
VEG28 (Willow Riparian)				X
VEG29 (Cottonwood Riparian)				
VEG30 (Sycamore Riparian)				
VEG39 (Mulefat / Eldenberry Scrub)				
SHRUBLAND (Local CSS + Chaparral)				
ROCKSUM8X8: Rock Outcrop (Local)				
LU4: Rural Residential Land Use(Local)				
LU5: Undeveloped Land Use (Local)				
PERV1: Agriculture (Landscape)				
PERV4: Developed (Landscape)		X		
PERV5 (Riparian)		X	X	X
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (NNG Landscape)				
PERV16				
PERSHRUB: CSS + Chaparral (Landscape)				
LU4P: Rural Residential Land Use (Landscape)				
LU5P: Undeveloped Land Use (Landscape)				
EDGE: Developed Land Adjacent to Natural (meters)		X		
CSSLOWDEN: CSS <25% Shrub Density (Local)				
D_ROCK: Distance to Nearest Rock Outcrop				
D_DRAIN: Distance to Nearest Drainage				
Type of Datasets	Cal/Val Prec=1	Cal/Val Prec=1	Cal/Val Prec=1	Cal/Val Prec=1
Sample Size: Calibration/Validation	45/11	45/11	45/11	45/11
Number of Variables	5	6	6	6
Full Model: Median HSI by Dataset	0.764/0.750	0.806/0.382	0.698/0.389	0.661/0.243
Reduced Model: Median HSI by Dataset	0.536/0.523	0.45/0.2	0.470/0.511	0.448/0.498
Selected Partition: Median HSI by Dataset	PV1: 0.764/0.75	PV1: 0.806/0.382	PV6: 0.47/0.511	PV6: 0.448/0.498

Species:	**Yellow-breasted Chat**		**Yellow Warbler**	
Model Run:	**YBCH R7 Abiotic & Local #2**	YBCH R8 Abiotic & Combined #2	**R1 Abiotic & Combined**	R2 Abiotic & Local
Model Scale (m²):				
MINT: Average minimum January temperature (°C)	**X**			
MAXT: Maximum average July temperature (°C)	**X**		X	X
PRECIP: Average annual precipitation (mm)	**X**		X	X
ELEV: Elevation (m)	**X**	X	**X**	X
NORTH: Northness aspect				
EAST: Eastness aspect				
SLOPE (%)	**X**	X	X	X
VEG1 or V1_16: Agriculture (Local)				
VEG4 or V4_16: Developed (Local)		X		X
VEG5 or V5_16: Riparian (Local)	**X**	X	X	X
VEG6 or V6_16: Coastal Sage Scrub (CSS) (Local)				
VEG7 or V7_16: Other Shrubland (Local)				
VEG8 or V8_16: Chaparral (Local)				
VEG9 or V9_16: Grassland (Local)				
VEG10 or V10_16: Woodland (Local)				
VEG16 or V16_16: Oak Woodland (Local)				
VEG28 (Willow Riparian)				
VEG29 (Cottonwood Riparian)				
VEG30 (Sycamore Riparian)				
VEG39 (Mulefat / Eldenberry Scrub)				
SHRUBLAND (Local CSS + Chaparral)				X
ROCKSUM8X8: Rock Outcrop (Local)				
LU4: Rural Residential Land Use(Local)				
LU5: Undeveloped Land Use (Local)				
PERV1: Agriculture (Landscape)				
PERV4: Developed (Landscape)			**X**	
PERV5 (Riparian)		X	**X**	
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (NNG Landscape)				
PERV16				
PERSHRUB: CSS + Chaparral (Landscape)			**X**	
LU4P: Rural Residential Land Use (Landscape)				
LU5P: Undeveloped Land Use (Landscape)				
EDGE: Developed Land Adjacent to Natural (meters)				
CSSLOWDEN: CSS <25% Shrub Density (Local)				
D_ROCK: Distance to Nearest Rock Outcrop				
D_DRAIN: Distance to Nearest Drainage				
Type of Datasets	**Cal/Val Prec=1**	Cal/Val Prec=1	**Cal/Val**	Cal/Val
Sample Size: Calibration/Validation	**45/11**	45/11	**72/31**	72/31
Number of Variables	**6**	5	**8**	7
Full Model: Median HSI by Dataset	**0.667/0.674**	0.652/0.266	**0.648/0.584**	0.583/0.478
Reduced Model: Median HSI by Dataset	**0.514/0.438**	0.488/0.158	**0.675/0.714**	0.636/0.568
Selected Partition: Median HSI by Dataset	**PV1: 0.667/0.679**	PV1: 0.519/0.307	**PV8: 0.675/0.714**	PV5: : 0.595/0.628

Species:	**Yellow Warbler**			
Variables:	YWAR	YWAR	YWAR	YWAR
Model Run:	R3 Abiotic & Landscape	R4 Abiotic	R5 Abiotic & Combined #2	R6 Abiotic & Combined #3
Model Scale (m²):				
MINT: Average minimum January temperature (°C)		X	X	
MAXT: Maximum average July temperature (°C)	X	X		
PRECIP: Average annual precipitation (mm)	X	X	X	X
ELEV: Elevation (m)	X	X	X	X
NORTH: Northness aspect		X	X	
EAST: Eastness aspect		X		
SLOPE (%)	X		X	X
VEG1 or V1_16: Agriculture (Local)				
VEG4 or V4_16: Developed (Local)				X
VEG5 or V5_16: Riparian (Local)			X	X
VEG6 or V6_16: Coastal Sage Scrub (CSS) (Local)				X
VEG7 or V7_16: Other Shrubland (Local)				
VEG8 or V8_16: Chaparral (Local)				
VEG9 or V9_16: Grassland (Local)				
VEG10 or V10_16: Woodland (Local)				
VEG16 or V16_16: Oak Woodland (Local)			X	
VEG28 (Willow Riparian)				
VEG29 (Cottonwood Riparian)				
VEG30 (Sycamore Riparian)				
VEG39 (Mulefat / Eldenberry Scrub)				
SHRUBLAND (Local CSS + Chaparral)			X	
ROCKSUM8X8: Rock Outcrop (Local)				
LU4: Rural Residential Land Use(Local)				
LU5: Undeveloped Land Use (Local)				
PERV1: Agriculture (Landscape)				
PERV4: Developed (Landscape)	X			
PERV5 (Riparian)	X		X	X
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (NNG Landscape)				
PERV16				
PERSHRUB: CSS + Chaparral (Landscape)	X		X	
LU4P: Rural Residential Land Use (Landscape)				
LU5P: Undeveloped Land Use (Landscape)				
EDGE: Developed Land Adjacent to Natural (meters)				
CSSLOWDEN: CSS <25% Shrub Density (Local)				
D_ROCK: Distance to Nearest Rock Outcrop				
D_DRAIN: Distance to Nearest Drainage				
Type of Datasets	Cal/Val	Cal/Val	Cal/Val	Cal/Val
Sample Size: Calibration/Validation	72/31	72/31	72/31	72/31
Number of Variables	7	7	10	7
Full Model: Median HSI by Dataset	0.668/0.556	0.572/0.485	0.728/0.588	0.579/0.43
Reduced Model: Median HSI by Dataset	0.606/0.592	0.472/0.354	0.545/0.345	0.417/0.551
Selected Partition: Median HSI by Dataset	PV7: 0.606/0.592	PV5: : 0.587/0.536	PV1: 0.728/0.588	PV7: 0.417/0.551

Appendix Table 19. Environmental variables and calibration/validation results for WRC MSHCP mammal models. Selected models and important environmental variables are in bold.

Species	**Brush Rabbit**			
Model Run:	SYLBAC R1B Combined	SYLBAC R2B Local	SYLBAC R3B Abiotic	SYLBAC R4B Landscape
Model Scale:	500	500	500	500
MINT: Average minimum January temperature (°C)	x	x	x	x
MAXT: Maximum average July temperature (°C)			x	
PRECIP: Average annual precipitation (mm)			x	
ELEV: Elevation (m)	x	x	x	x
SLOPE (%)	x	x	x	x
NORTH: Northness aspect				
EAST: Eastness aspect				
V1_16: Agriculture (Local)				
V4_16: Developed (Local)				
V5_16: Riparian (Local)				
V6_16: Coastal Sage Scrub (Local)				
V7_16: Other Shrubland (Local)				
V8_16: Chaparral (Local)	x	x		
V9_16: Grassland (Local)				
V10_16: Woodland (Local)				
V16_16: Oak Woodland (Local)				
V16_Shrub (All Local Shrubland)				
SHRUBLAND: Coastal Sage Scrub + Chaparral (Local)				
CSS LOWDEN				
ROCKSUM8X8: Rock Outcrop (Local)				
PERV1: Agriculture (Landscape)				
PERV4: Developed (Landscape)				x
PERV5: Riparian (Landscape)				
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)	x			x
PERV9: Grassland (Landscape)				
EDGE: Meters of developed land adjacent to natural lands				
PERSHRUB: Coastal Sage Scrub + Chaparral (Landscape)				
Type of Datasets	Cal	Cal	Cal	Cal
Sample Size: Calibration/Validation	45/0	45/0	45/0	45/0
Number of Variables	5	4	5	5
Full Median Pvalue	0.486	0.541	0.464	0.539
Reduced Median Pvalue	0.412	0.417	0.469	0.528
Selected model Median P Value	PV2 0.530	PV1 0.541	PV3 0.508	PV2 0.587

Species	**Brush Rabbit**		**Coyote**	
Model Run:	SYLBAC R5B Landscape #2	**SYLBAC R6B Local #2**	CANLAT R1B Combined	CANLAT R2B Local
Model Scale:	500	**500**	500	500
MINT: Average minimum January temperature (°C)	x	**x**		
MAXT: Maximum average July temperature (°C)				
PRECIP: Average annual precipitation (mm)	x		x	x
ELEV: Elevation (m)	x	**x**	x	x
SLOPE (%)		**x**	x	x
NORTH: Northness aspect				
EAST: Eastness aspect				
V1_16: Agriculture (Local)				
V4_16: Developed (Local)				x
V5_16: Riparian (Local)				
V6_16: Coastal Sage Scrub (Local)				
V7_16: Other Shrubland (Local)				
V8_16: Chaparral (Local)		**x**		
V9_16: Grassland (Local)				x
V10_16: Woodland (Local)				
V16_16: Oak Woodland (Local)				x
V16_Shrub (All Local Shrubland)			x	x
SHRUBLAND: Coastal Sage Scrub + Chaparral (Local)				
CSS LOWDEN				
ROCKSUM8X8: Rock Outcrop (Local)				
PERV1: Agriculture (Landscape)				
PERV4: Developed (Landscape)	x	**x**	x	
PERV5: Riparian (Landscape)				
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)	x			
PERV9: Grassland (Landscape)			x	
EDGE: Meters of developed land adjacent to natural lands				
PERSHRUB: Coastal Sage Scrub + Chaparral (Landscape)		**x**	x	
Type of Datasets	Cal	**Cal**	Cal/ Val	Cal/ Val
Sample Size: Calibration/Validation	45/0	**45/0**	67/29	67/29
Number of Variables	5	**6**	7	7
Full Median Pvalue	0.516	**0.512**	0.561 / 0.425	0.595 / 0.458
Reduced Median Pvalue	0.34	**0.523**	0.524 / 0.377	0.58 / 0.344
Selected model Median P Value	PV2 0.573	**PV2 0.633**	PV1 0.561 / 0.425	PV3 0.64 / 0.568

Species	**Coyote**			
Model Run:	CANLAT R3B Abiotic	CANLAT R4B Landscape	CANLAT R5B Local #2	**CANLAT R6B Local #3**
Model Scale:	500	500	500	**500**
MINT: Average minimum January temperature (°C)	x		x	
MAXT: Maximum average July temperature (°C)	x		x	
PRECIP: Average annual precipitation (mm)	x	x	x	
ELEV: Elevation (m)	x	x		
SLOPE (%)	x	x	x	**x**
NORTH: Northness aspect	x			
EAST: Eastness aspect	x			
V1_16: Agriculture (Local)			x	**x**
V4_16: Developed (Local)			x	**x**
V5_16: Riparian (Local)				
V6_16: Coastal Sage Scrub (Local)				
V7_16: Other Shrubland (Local)				
V8_16: Chaparral (Local)				
V9_16: Grassland (Local)			x	**x**
V10_16: Woodland (Local)				
V16_16: Oak Woodland (Local)				
V16_Shrub (All Local Shrubland)				
SHRUBLAND: Coastal Sage Scrub + Chaparral (Local)			x	**x**
CSS LOWDEN				
ROCKSUM8X8: Rock Outcrop (Local)				
PERV1: Agriculture (Landscape)		x		
PERV4: Developed (Landscape)		x		
PERV5: Riparian (Landscape)				
PERV6: Coastal Sage Scrub (Landscape)		x		
PERV8: Chaparral (Landscape)				
PERV9: Grassland (Landscape)				
EDGE: Meters of developed land adjacent to natural lands		x		
PERSHRUB: Coastal Sage Scrub + Chaparral (Landscape)				
Type of Datasets	Cal/ Val	Cal/ Val	Cal/ Val	**Cal/ Val**
Sample Size: Calibration/Validation	67/29	67/29	67/29	**67/29**
Number of Variables	7	7	7	**6**
Full Median Pvalue	0.653 / 0.479	0.596 / 0.381	0.511 / 0.328	**0.587 / 0.641**
Reduced Median Pvalue	0.439 / 0.256	0.616 / 0.258	0.557 / 0.542	**0.597 / 0.583**
Selected model Median P Value	PV1 0.653 / 0.479	PV6 0.653 / 0.396	PV8 0.557 / 0.542	**PV2 0.619 / 0.786**

Species	**Coyote**	**Northwestern San Diego Pocket Mouse**		
Model Run:	CANLAT R7B Local #4	CHAFAL R1 Combined	CHAFAL R2 Local	CHAFAL R3 Abiotic
Model Scale:	500	500	500	500
MINT: Average minimum January temperature (°C)		x	x	x
MAXT: Maximum average July temperature (°C)				x
PRECIP: Average annual precipitation (mm)	x			x
ELEV: Elevation (m)	x	x	x	x
SLOPE (%)				x
NORTH: Northness aspect				
EAST: Eastness aspect				
V1_16: Agriculture (Local)	x			
V4_16: Developed (Local)			x	
V5_16: Riparian (Local)				
V6_16: Coastal Sage Scrub (Local)				
V7_16: Other Shrubland (Local)				
V8_16: Chaparral (Local)				
V9_16: Grassland (Local)	x			
V10_16: Woodland (Local)				
V16_16: Oak Woodland (Local)				
V16_Shrub (All Local Shrubland)	x	x	x	
SHRUBLAND: Coastal Sage Scrub + Chaparral (Local)				
CSS LOWDEN				
ROCKSUM8X8: Rock Outcrop (Local)				
PERV1: Agriculture (Landscape)				
PERV4: Developed (Landscape)	x	x		
PERV5: Riparian (Landscape)				
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (Landscape)				
EDGE: Meters of developed land adjacent to natural lands				
PERSHRUB: Coastal Sage Scrub + Chaparral (Landscape)		x		
Type of Datasets	Cal/ Val	Cal	Cal	Cal
Sample Size: Calibration/Validation	67/29	44/0	44/0	44/0
Number of Variables	6	5	4	5
Full Median Pvalue	0.507 / 0.691	0.539	0.486	0.622
Reduced Median Pvalue	0.517 / 0.576	0.459	0.56	0.498
Selected model Median P Value	PV3 0.522 / 0.776	PV1 0.539	PV4 0.560	PV2 0.627

Species	**Northwestern San Diego Pocket Mouse**	**San Diego Black-tailed Jackrabbit**		
Model Run:	**CHAFAL R4 Landscape**	LEPCAL R1B Combined	**LEPCAL R2B Local**	LEPCAL R3B Abiotic
Model Scale:	**500**	500	**500**	500
MINT: Average minimum January temperature (°C)	**x**	x	**x**	x
MAXT: Maximum average July temperature (°C)				x
PRECIP: Average annual precipitation (mm)		x	**x**	x
ELEV: Elevation (m)	**x**	x	**x**	x
SLOPE (%)		x	**x**	x
NORTH: Northness aspect				x
EAST: Eastness aspect				x
V1_16: Agriculture (Local)			**x**	
V4_16: Developed (Local)			**x**	
V5_16: Riparian (Local)				
V6_16: Coastal Sage Scrub (Local)				
V7_16: Other Shrubland (Local)				
V8_16: Chaparral (Local)				
V9_16: Grassland (Local)			**x**	
V10_16: Woodland (Local)				
V16_16: Oak Woodland (Local)				
V16_Shrub (All Local Shrubland)		x	**x**	
SHRUBLAND: Coastal Sage Scrub + Chaparral (Local)				
CSS LOWDEN				
ROCKSUM8X8: Rock Outcrop (Local)				
PERV1: Agriculture (Landscape)		x		
PERV4: Developed (Landscape)	**x**	x		
PERV5: Riparian (Landscape)				
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (Landscape)	**x**	x		
EDGE: Meters of developed land adjacent to natural lands				
PERSHRUB: Coastal Sage Scrub + Chaparral (Landscape)	**x**	x		
Type of Datasets	**Cal**	Cal/ Val	**Cal/ Val**	Cal/ Val
Sample Size: Calibration/Validation	**44/0**	87/30	**87/30**	87/30
Number of Variables	**5**	9	**8**	7
Full Median Pvalue	**0.589**	0.645 / 0.723	**0.691 / 0.811**	0.659 / 0.566
Reduced Median Pvalue	**0.499**	0.481 / 0.301	**0.653 / 0.669**	0.477 / 0.362
Selected model Median P Value	**PV1 0.589**	PV2 0.601 / 0.799	**PV4 0.593 / 0.838**	PV1 0.659 / 0.566

Species	**San Diego Black-tailed Jackrabbit**	**San Diego Desert Woodrat**		
Model Run:	LEPCAL R4B Landscape	NEOLEP R1 Combined	NEOLEP R2 Local	NEOLEP R3 Abiotic
Model Scale:	500	500	500	500
MINT: Average minimum January temperature (°C)	x	x	x	x
MAXT: Maximum average July temperature (°C)				x
PRECIP: Average annual precipitation (mm)	x			x
ELEV: Elevation (m)	x	x	x	x
SLOPE (%)	x			x
NORTH: Northness aspect				
EAST: Eastness aspect				
V1_16: Agriculture (Local)				
V4_16: Developed (Local)			x	
V5_16: Riparian (Local)				
V6_16: Coastal Sage Scrub (Local)				
V7_16: Other Shrubland (Local)				
V8_16: Chaparral (Local)				
V9_16: Grassland (Local)				
V10_16: Woodland (Local)				
V16_16: Oak Woodland (Local)				
V16_Shrub (All Local Shrubland)		x	x	
SHRUBLAND: Coastal Sage Scrub + Chaparral (Local)				
CSS LOWDEN				
ROCKSUM8X8: Rock Outcrop (Local)		x	x	
PERV1: Agriculture (Landscape)	x			
PERV4: Developed (Landscape)	x			
PERV5: Riparian (Landscape)				
PERV6: Coastal Sage Scrub (Landscape)				
PERV8: Chaparral (Landscape)				
PERV9: Grassland (Landscape)	x			
EDGE: Meters of developed land adjacent to natural lands				
PERSHRUB: Coastal Sage Scrub + Chaparral (Landscape)	x	x		
Type of Datasets	Cal/ Val	Cal/ Val	Cal/ Val	Cal/ Val
Sample Size: Calibration/Validation	87/30	45/17	45/17	45/17
Number of Variables	8	5	5	5
Full Median Pvalue	0.716 / 0.715	0.669 / 0.717	0.726 / 0.812	0.788 / 0.809
Reduced Median Pvalue	0.448 / 0.404	0.588 / 0.709	0.62 / 0.706	0.649 / 0.575
Selected model Median P Value	PV2 0.654 / 0.755	PV4 0.687 / 0.741	PV1 0.726 / 0.812	PV1 0.788 / 0.809

Species	**San Diego Desert Woodrat**		**Stephens' Kangaroo Rat**	
Model Run:	NEOLEP R4 Landscape	**NEOLEP R5 Local #2**	DIPSTE R1 Combined	DIPSTE R2 Local
Model Scale:	500	**500**	500	500
MINT: Average minimum January temperature (°C)	x	**x**	x	x
MAXT: Maximum average July temperature (°C)			x	x
PRECIP: Average annual precipitation (mm)			x	x
ELEV: Elevation (m)	x	**x**	x	x
SLOPE (%)			x	x
NORTH: Northness aspect				
EAST: Eastness aspect				
V1_16: Agriculture (Local)			x	x
V4_16: Developed (Local)		**x**		x
V5_16: Riparian (Local)				
V6_16: Coastal Sage Scrub (Local)			x	x
V7_16: Other Shrubland (Local)				
V8_16: Chaparral (Local)				
V9_16: Grassland (Local)			x	x
V10_16: Woodland (Local)				
V16_16: Oak Woodland (Local)				
V16_Shrub (All Local Shrubland)		**x**		
SHRUBLAND: Coastal Sage Scrub + Chaparral (Local)				
CSS LOWDEN				
ROCKSUM8X8: Rock Outcrop (Local)				
PERV1: Agriculture (Landscape)			x	
PERV4: Developed (Landscape)	x		x	
PERV5: Riparian (Landscape)				
PERV6: Coastal Sage Scrub (Landscape)			x	
PERV8: Chaparral (Landscape)				
PERV9: Grassland (Landscape)	x		x	
EDGE: Meters of developed land adjacent to natural lands			x	
PERSHRUB: Coastal Sage Scrub + Chaparral (Landscape)	x			
Type of Datasets	Cal/ Val	**Cal/ Val**	Cal/ Val	Cal/ Val
Sample Size: Calibration/Validation	45/17	**45/17**	125/54	125/54
Number of Variables	5	**4**	13	9
Full Median Pvalue	0.629 / 0.881	**0.78 / 0.831**	0.548 / 0.587	0.572 / 0.575
Reduced Median Pvalue	0.628 / 0.689	**0.68 / 0.68**	0.516 / 0.471	0.465 / 0.468
Selected model Median P Value	PV3 0.619 / 0.894	**PV3 0.737 / 0.896**	PV3 0.543 / 0.611	PV6 0.618 / 0.647

Species	**Stephens' Kangaroo Rat**			
Model Run:	DIPSTE R3 Abiotic	DIPSTE R4 Landscape	DIPSTE R5 Local #2	**DIPSTE R6 Local #3**
Model Scale:	500	500	500	**500**
MINT: Average minimum January temperature (°C)	x	x	x	**x**
MAXT: Maximum average July temperature (°C)	x	x	x	
PRECIP: Average annual precipitation (mm)	x	x	x	
ELEV: Elevation (m)	x	x	x	**x**
SLOPE (%)	x	x	x	
NORTH: Northness aspect	x			
EAST: Eastness aspect	x			
V1_16: Agriculture (Local)			x	**x**
V4_16: Developed (Local)				**x**
V5_16: Riparian (Local)				
V6_16: Coastal Sage Scrub (Local)				**x**
V7_16: Other Shrubland (Local)				
V8_16: Chaparral (Local)				
V9_16: Grassland (Local)			x	**x**
V10_16: Woodland (Local)				
V16_16: Oak Woodland (Local)				
V16_Shrub (All Local Shrubland)				
SHRUBLAND: Coastal Sage Scrub + Chaparral (Local)				
CSS LOWDEN			x	
ROCKSUM8X8: Rock Outcrop (Local)				
PERV1: Agriculture (Landscape)		x		
PERV4: Developed (Landscape)		x		
PERV5: Riparian (Landscape)				
PERV6: Coastal Sage Scrub (Landscape)		x		
PERV8: Chaparral (Landscape)				
PERV9: Grassland (Landscape)		x		
EDGE: Meters of developed land adjacent to natural lands		x		
PERSHRUB: Coastal Sage Scrub + Chaparral (Landscape)				
Type of Datasets	Cal/ Val	Cal/ Val	Cal/ Val	**Cal/ Val**
Sample Size: Calibration/Validation	125/54	125/54	125/54	**125/54**
Number of Variables	7	10	8	**6**
Full Median Pvalue	0.553 / 0.423	0.535 / 0.592	0.556 / 0.55	**0.517 / 0.567**
Reduced Median Pvalue	0.442 / 0.483	0.451 / 0.49	0.423 / 0.367	**0.592 / 0.599**
Selected model Median P Value	PV3 0.545 / 0.500	PV1 0.535 / 0.592	PV6 0.508 / 0.570	**PV3 0.603 / 0.732**

Species	**Stephens' Kangaroo Rat**
Model Run:	DIPSTE R7 Combined #2
Model Scale:	500
MINT: Average minimum January temperature (°C)	x
MAXT: Maximum average July temperature (°C)	
PRECIP: Average annual precipitation (mm)	
ELEV: Elevation (m)	x
SLOPE (%)	
NORTH: Northness aspect	
EAST: Eastness aspect	
V1_16: Agriculture (Local)	x
V4_16: Developed (Local)	x
V5_16: Riparian (Local)	
V6_16: Coastal Sage Scrub (Local)	x
V7_16: Other Shrubland (Local)	
V8_16: Chaparral (Local)	
V9_16: Grassland (Local)	x
V10_16: Woodland (Local)	
V16_16: Oak Woodland (Local)	
V16_Shrub (All Local Shrubland)	
SHRUBLAND: Coastal Sage Scrub + Chaparral (Local)	
CSS LOWDEN	
ROCKSUM8X8: Rock Outcrop (Local)	
PERV1: Agriculture (Landscape)	x
PERV4: Developed (Landscape)	x
PERV5: Riparian (Landscape)	
PERV6: Coastal Sage Scrub (Landscape)	
PERV8: Chaparral (Landscape)	
PERV9: Grassland (Landscape)	x
EDGE: Meters of developed land adjacent to natural lands	
PERSHRUB: Coastal Sage Scrub + Chaparral (Landscape)	
Type of Datasets	Cal/ Val
Sample Size: Calibration/Validation	125/54
Number of Variables	9
Full Median Pvalue	0.549 / 0.544
Reduced Median Pvalue	0.539 / 0.654
Selected model Median P Value	PV9 0.539 / 0.654