



Coachella Valley Conservation Commission

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Coachella Valley Multiple Species Habitat Conservation Plan &
Natural Community Conservation Plan

Orocopia Sage & Mecca Aster Biological Monitoring Report



Prepared by the University of California
Riverside's Center for Conservation Biology

& CVCC Biologist Working Group

COACHELLA VALLEY CONSERVATION COMMISSION

FEBRUARY 2014
BIOLOGICAL MONITORING PROTOCOL

for

Salvia greatae

(Orocopia Sage)

and

Xylorhiza cognata

(Mecca Aster)

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Preface

The Coachella Valley Multiple Species Habitat Conservation Plan and Natural Communities Conservation Plan (CVMSHCP/NCCP, or Plan) was established in 2008 to ensure regional conservation of plant and animal species, natural communities and landscape scale ecological processes across the Coachella Valley. Areas where conservation must occur throughout the life of the Plan are designated by a Conservation Area Reserve system which is designed to include representative native plants, animals and natural communities across their modeled natural ranges of variation in the valley. The types and extent of Conservation requirements for covered species, natural communities and landscapes within these reserves are defined by specific goals and objectives that are intended to support the following guiding ecologically-based principles:

- 1) maintaining or restoring self-sustaining populations or metapopulations of covered species;
- 2) sustaining ecological and evolutionary processes necessary to maintain the functionality of the natural communities and Habitats for the species included in the Plan;
- 3) maximizing connectivity among populations and avoiding habitat fragmentation to conserve biological diversity, ecological balance, and connected populations;
- 4) minimizing adverse impacts from off road vehicle use, illegal dumping, edge effects, exotic species and other disturbances;
- 5) ensuring management is responsive to short-term and long-term environmental changes, and new science.

The Plan uses ongoing biological monitoring and land management programs to assure these general conservation principles, as well as species-specific Conservation Goals and Objectives, are met and maintained throughout the life of the Plan. The Biological Monitoring program is novel in that it uses a unique, science-based approach that not only assesses species distributions and population fluctuations but also employs the peer-reviewed scientific research process to develop hypotheses and address information gaps relating to the ecology of covered species. These information gaps are species-dependent and could include (but are not limited to) certain aspects of life-cycle requirements, gene flow barriers, population threats and stressors, resiliency and resistance to threats and stressors, population drivers and responses to drivers, etc... The research element of the monitoring program is therefore value-added, as it provides the additional capacity to revise and refine the Plan's habitat models, survey locations, and develop additional research questions and projects at the same time as population numbers are collected. Data from the Biological Monitoring program also feed into the Land Management program and assist Conservation Reserve managers with developing best management practices that are intended to ensure the Conservation Goals and Objectives for each species are met and maintained. This linkage between the monitoring and management programs enables the capacity to support an adaptive, self-updating process. As management prescriptions are employed and the biological monitoring program continues evaluating Covered Species, the effects from installed management prescriptions can be measured, evaluated, and fed back into the management program so that managers can review and revise conservation practices, as needed.

Introduction

Orocopia Sage (*Salvia greatae*, SAGR) and Mecca Aster (*Xylohiza cognata*, XYCO) are two of 26 species covered under the CVMSHCP/NCCP. Orocopia sage (*Salvia greatae*, SAGR) is a perennial evergreen shrub endemic to California, found in the mountainous desert areas of southeastern Riverside and northern Imperial Counties. It is found primarily within alluvial fans and washes in the Orocopia and Chocolate Mountains at elevations below sea level to 825m (Jepson 2013, CNPS 2013). SAGR is categorized as California Rare Plant Rank 1B.3 (Threatened or Endangered in California and elsewhere, with < 20% of occurrences threatened / low degree and immediacy of threat or no current threats known) (CNPS 2013). Mecca aster (*Xylorhiza cognata*, XYCO) is a perennial herb commonly found in Sonoran desert scrub on steep canyon slopes and faces. Within the canyons of the Mecca Hills and Indio Hills, they are commonly found at the base of slopes and in washes, at elevations between 20-300m in sandstone or rocky alkali/gypsum clays (Jepson 2013, CalFlora 2013). XYCO is categorized as California Rare Plant Rank 1B.2 (Threatened or Endangered in California and elsewhere, with 20-80% of occurrences threatened / moderate degree and immediacy of threat) (CNPS 2013).

Both SAGR and XYCO are classified as Alluvial Fan and Wash species under the Plan and section 8.4.2.3.3 defines key monitoring objectives for this Natural Community to include:

- 1) estimating distributions or population sizes;
- 2) developing and evaluating ecological models that propose relationships between biotic and abiotic variables and Covered Species;
- 3) learning more about the ecology of the Covered Species,
- 4) identifying and evaluating potential threats to Covered Species, and
- 5) developing effective and efficient non-lethal sampling protocols (CVMSHCP 8-61 to 8-62).

Species specific monitoring should determine whether Specific species Conservation Goals and Objectives for XYCO and SAGR attained. Both species share the same Conservation Goals and Objectives, which include:

- 1) protecting Core Habitat areas to allow for evolutionary processes and natural population fluctuations, minimizing fragmentation, human-caused disturbance and edge effects;
- 2) protecting Other Conserved Habitat to provide sufficient area and variety of Habitat types to accommodate population fluctuations, allow for genetic diversity and to conserve the full range of environmental conditions within which this species is known to occur;
- 3) ensuring conservation by maintaining the long-term persistence of self-sustaining populations and conserving Habitat quality through biological monitoring and Adaptive Management actions in the Plan area.

Since SAGR is found more often in open washes and alluvial fans, the Plan also outlines the additional Conservation Goal for SAGR as maintaining Biological Corridors and Linkages among all conserved populations to provide for seed dispersal and shifts in species distribution over time. Since population fluctuations could result from natural processes or unnatural pressures, it is

important for the monitoring program to identify and measure external threats, stressors and limiting factors, and be able tease out as possible when observed population declines result from natural processes as opposed to anthropogenic influences. The Conservation Planning process for SAGR and XYCO began with an inventory, threats analysis, and habitat model, 6 years before the Plan was permitted.

In 2002, an inventory for SAGR, XYCO and three other covered plant species was performed. Historic locational data were assembled in a master database of occurrence records, and field assessments were performed to identify any changes in occupancy and distribution patterns. Data were mined querying various herbaria and museums and required considerable effort to remove duplicate points and identify points that were precise enough for geo-referencing (CVAG report 2005). The resulting records for SAGR were concentrated on the alluvial fans within and around the Orocopia and Chocolate mountains, with a few records extending into the Mecca Hills area. Both locations are currently protected by the BLM as Wilderness Areas. The research team noted that Orocopia sage was present and fairly numerous over large areas within its range, and recommendations supported that additional populations may exist at upper elevation sites in the Orocopia Mountains as well. The majority of records for XYCO were collected in the Mecca Hills area, as at that time the Indio Hills contained only one point on public land.

Following the development of the database, field monitoring of XYCO and SAGR occurred from 2002 to 2005 and consisted of visiting the historic occurrence locations and documenting the existing populations through 500m² vegetation relevés (CVAG report 2005). For XYCO, 58 historic records were collected, 15 of which were on private land and 30 of which were deemed to be duplicate records, leaving 13 unique public records. From 2002-2005 researchers were able to visit all 13 unique public locations. Of these 13 records, individuals of XYCO were observed at 12 locations (92% occupancy rate). In addition, researchers located two new locations where this plant species was occurring. Population sizes at all occupied locations averaged approximately 80 plants per location. With SAGR, 51 records were originally found, and of those 24 were on public land and 11 were found to be duplicates, leaving 16 unique records on public land. Six of those locations were found to be too vague to geo-reference, or too remote to access. Of the ten locations visited, individuals were observed at seven locations (70% occupancy rate). Populations varied, but averaged over 200 individuals per hectare at each location (CVAG report 2005).

A Natural Community Model and individual habitat suitability models for SAGR, XYCO and other Alluvial Fan species were developed using results from the inventory and other investigations of Alluvial Fan and Wash natural community elements. The Plan identifies that specific major threats, stressors and limiting factors to XYCO could include cumulative habitat loss and degradation of existing habitat resulting from OHV activity, illegal dumping sand and gravel mining, and edge effects (9-10). Notably, the 1994 Desert Protection Act designated the Mecca Hills as wilderness and has led to the subsequent exclusion/reduction in OHV activity in core and other conserved habitat, therefore it could be hypothesized that XYCO and other species sensitive to OHV activity may now be recovering in these areas. Invasive species were also identified as a concern for XYCO. The CVMSHCP specifically calls for monitoring to determine whether impacts from invasive species

are occurring, and to develop and test models for the distribution, abundance, and ecological requirements of the species (CVMSHCP/NCCP 9-11). In contrast, very few threats to SAGR were identified and most of its habitat within the Plan area occurs in designated Wilderness areas, therefore OHV impacts may be reduced. The Plan recommends monitoring to determine whether and to what extent OHV activity and invasive species may be impacting both SAGR and SAGR Habitat. Monitoring results that quantify impacts to XYCO and SAGR, and XYCO and SAGR Habitat, over time, will be used to ascertain whether it will be necessary to identify and implement management actions that reduce impacts from specific threats, stressors and limiting factors to the individual species, as feasible (CVMSHP/NCCP 9-42).

Statement of Purpose

Since developing the Alluvial Fan and Wash natural community habitat model, species suitability models and receiving the Plan's permits in 2008, no additional work has been performed for XYCO and SAGR. Therefore, for this 2014 survey effort, our primary objective is to reassess the presence and distribution of Orocopia sage and Mecca aster within the Plan's Conservation Areas, to ascertain whether and to what extent populations have changed since the 2002-2005 surveys. A second objective is to collect information about potential habitat attributes and threats that may affect SAGR and XYCO distributions. This information will help CVCC to begin establishing real baselines and refine the species habitat suitability models, improving correlation information that will help CVCC better determine habitat suitability for each species. Results obtained from this effort will also be used to construct additional hypotheses regarding the impacts of stressors on the persistence of these species.

Objectives

Currently, there are no data detailing the demographics for either *Salvia greatae* (SAGR) or *Xylorhiza cognata* (XYCO). An important outcome of repeated surveys of known populations will be to provide those data and enable analyses regarding the relative impacts of potential stressors on the distribution and persistence of populations of these two species. Recent research suggests potential stressors include fire, invasive species, off-road vehicles (SAGR and XYCO), trampling (XYCO), altered ecosystem processes due to flood control measures (SAGR), and the effects of climate change on species distribution (SAGR and XYCO). Both XYCO and SAGR occur in habitats prone to periodic flooding (canyons and alluvial fans, respectively). Portions of the Salt Creek alluvial fan have been altered to control flood events and protect the old railroad and the Coachella Canal. To assess the impacts of flooding, sites will be surveyed both within areas of active flooding and adjacent areas that are more protected (e.g. where flooding is controlled). Since this is the first assessment/baseline monitoring for this species since 2005, information about the presence of the target species and drivers and stressors will be collected and integrated into predictive species models, and hypotheses will be developed relating distribution to habitat attributes and climatic variables. Predictive species models will require at least 40 independent observations and, once collected, will help to facilitate the eventual

expansion of survey efforts to increase our understanding of the demography and phenology of these perennial species.

Research Questions

In the longer-term, ongoing data collection will help to provide more insight and help answer the following research questions:

- 1) What are the impacts of flooding on these species? Does flooding foster germination or result in overall mortality?
- 2) Has flood control benefited or degraded the potential habitat for SAGR?
- 3) Has/will climate change alter the frequency of flooding in this region?

Methods

Habitat Suitability Models

Occurrence points were collected for XYCO and SAGR from the Consortium of California Herbaria and California Natural Diversity Database (CNDDDB) databases in 2013. Additional points were provided by the Bureau of Land Management. After investigating the source and description of each point, points that were found to be duplicates or considered invalid due to lack of precision were deleted. The remaining XYCO (n=73) and SAGR (n=55) points were then integrated into habitat suitability models (see Table 2 for variables used to construct each species' habitat model). Habitat suitability models are place-based, using a species' location data to construct a spatial model that synthesizes environmental features (such as land cover, soil types, climate, and topography) selected by that species in that area (see Table 1 for variables used to construct each species' habitat model). For the modeling process, a GIS (ArcGIS 9.3) map of the study area was divided into 180 m × 180 m cells and each cell was scored for underlying environmental variables. Cells containing a species observation were used to create a calibration data set from which each species' niche model was constructed using the Mahalanobis distance statistic (D^2) (Browning et al. 2005, Clark et al. 1993, Rotenberry et al. 2002, 2006).

The Mahalanobis statistic yields, for any location, an index of its habitat similarity (HSI) to the multivariate mean of the habitat characteristics at the target species' locations (the calibration data set). We selected habitat variables based on our expectation of their likely influence on the distribution of the selected species (XYCO and SAGR) based on available literature. To prevent model over-fitting we maintained a ratio of one variable per 10 observations (Osborne and Costello 2004). Environmental variables were derived from GIS layers readily available from internet sources in 2008: soils (Natural Resources Conservation Service 2008), ruggedness (Sappington et al. 2007, United States Geological Survey 2009), and climate (PRISM Climate Group 2004). The Mahalanobis statistic may be refined by partitioning it into separate components (Dunn and Duncan 2000, Rotenberry et al. 2002, 2006). This partitioning is based on a principal components analysis of the selected model variables in the calibration data set.

Each of the partitions are additive, orthogonal variable combinations that explain increasingly more variance until the final partition, the full model, captures the full range of variance exhibited in the calibration data. We calculated Mahalanobis distances and their partitions with SAS code provided in Rotenberry et al. (2006). Once a model was created, it was used to calculate Habitat Suitability Indices (HSIs) for the selected Mahalanobis distance partition for every other cell of the map data set. We then examined the mapped representations of the selected model partition to determine which HSI threshold best encompassed the observation points without including additional area known to be unsuitable habitat. From these steps we selected and produced our best performing habitat suitability model.

Site Selection

The CVMSHCP/NCCP identifies that at minimum, monitoring for Mecca Aster (p 9-9) and Orocopia Sage (p9-41) should be implemented within Core Habitat, and could also occur in designated Other Conserved Habitat, as these areas provide for essential ecologically linked features. Core Habitat and Other Conserved Habitat areas provided below in Table 1.

Table 1: Summary of Mecca Aster and Orocopia Sage Core Habitat and Other Conserved Habitat

Species	Conservation Areas with Core Habitat or Other Conserved Habitat							
	Thousand Palms	Indio Hills Palms	East Indio Hills	Edom Hill	Indio Hills/Joshua Tree National Park Linkage	Desert Tortoise and Linkage	Mecca Hills/Orocopia Mountains	Dos Palmas
Mecca Aster (XYCO)	C	C	C	O	O	C	C	-
Orocopia Sage (SAGR)	-	-	-	-	-	C	C	O

C = Core Habitat

O = Other Habitat

For each species, 20 sites were chosen by identifying groups of occurrence points within the conservation areas, and by identifying potential suitable habitat through the models and therefore monitoring sites, where populations of each species may occur (Figs. 1 & 2). Sites were then selected to be distributed across the range of the known occurrences for each species. For SAGR, sites 1-17 are in the Mecca Hills / Orocopia Mountains Conservation Area and the Dos Palmas Conservation Area near where the Bradshaw Trail crosses the Coachella Canal, north and east of the Chocolate Mountains Aerial Gunnery Range (Figure 3 and 4). Sites 18 and 19 are north of the Coachella Canal near the Hidden Springs Oasis in Mecca Wilderness, and site 20 in the Desert Tortoise and Linkage Conservation Area. SAGR sites are on alluvial fans, and relevés

will be spaced parallel to one another 250m apart. Five of the SAGR sites (Sites 14-17, and 20) were placed in areas within the habitat suitability map that do not currently have occurrence points but are modeled as potential habitat (Figure 4).

For XYCO, sites 1-14 are within the Mecca Hills / Orocopia Mountains Conservation Area (Figure 5), sites 10 and 15 are in the Desert Tortoise and Linkage Conservation Area, site 16 is in the East Indio Hills Conservation Area, sites 17 and 18 are in the Indio Hills Palms Conservation Area, and site 18 is placed at the westernmost known occurrences for the species, and sites 19 and 20 are in the Thousand Palms Conservation Area (Figure 6). To maximize the sites which will confirm an abundance of points throughout their range and document environmental variables, only 4 sites were chosen as reconnaissance for XYCO where no current occurrence points exist (sites 15, 18-20). Because XYCO are abundant within narrow canyons, relevés for this species will follow the topography of the canyon and the toe of the slope. Therefore many relevés will be spaced in-line with one another 250m beyond the previous relevé, with some branching off into adjacent slot canyons within a site. Whenever possible, relevés will sample areas adjacent to one another that have flood control features or active flood areas, and will vary in topography and elevation to help researchers understand the habitat suitability limits of these species.

Sites with known occurrence locations should continue to be revisited with every future survey effort, and variables documented should be reanalyzed for change. Sites outside current known occurrences but within habitat modeled for SAGR (Sites 14-17 and 20) and XYCO (Sites 18-20) will be visited for this survey effort and species alliance and associations documented to refine vegetation maps and habitat suitability models. If target species are found to be absent at any of the above listed reconnaissance, sites still must be visited at least one more time in a subsequent survey year before documenting absence (CDFG 2009).

Data Collection

Between the months of March and June, surveyors will visit 20 sites and complete four 1000m² (10m x 100m) vegetation relevés at least 250m apart at each site, resulting in 80 spatially independent points per species. The CNPS-CDFW Combined Vegetation Rapid Assessment and Relevé protocol (Buck-Diaz and Evens 2011) will be employed when visiting each relevé to document habitat attributes such as slope and substrate, and measure the presence and extent of invasive plant species, annual herbaceous cover and disturbance. Variables that will be recorded include species density, soil characteristics, slope and aspect, adjacent land uses (suburban, agriculture, natural open space), degrees of anthropogenic alteration, and as outlined in the protocol, which will assist with determining whether detectable patterns exist that can be tested with future work (Buck-Diaz and Evens 2011). Number of individuals of XYCO and SAGR within the site will be counted, and the percentage of those individuals in different life stages (seedling vs. reproductive individuals) as well as their density will be documented as outlined in the Special Status or Natural Community Observations section of Protocols for Surveying and Evaluating Impacts to Special Status Native Plant Populations and Natural Communities (CDFG

2009). To quantify soil particle size distribution and type in each releve, surveyors will collect one quart bags of soil at random, and analyze them with the standard shaker table and sieves (Blott and Pye 2001). At each relevé, digital pictures and voucher specimens will also be collected and stored for record at the UC Riverside Herbarium. Once verified, voucher data will be added to the California Consortia of Herbarium and the California Natural Diversity Database.

Data Analyses

Vegetation data collected from this preliminary study will have the relationship between the presence of plant species and environmental variables analyzed through logistic regression / ANOVA in R or SAS. Environmental variables identified as significant will then be integrated into the principal component analysis for XYCO and SAGR and used to refine species habitat suitability models. GRADISTAT will be used to quantify soil particle analysis.

Table 2. Environmental variables selected to construct habitat suitability models for *Salvia greatae* and *Xylorhiza cognata* based on known occurrences.

Variable descriptions	<i>Salvia greatae</i>	<i>Xylorhiza cognata</i>
Available water content		X
Percent sand contents of soil	X	
Percent silt contents of soil	X	
Average total precipitation from December-March during years 1971-2000	X	
Sappington ruggedness analysis of a 18 x 18 10m neighborhood	X	X
Mean value from a Sappington ruggedness analysis		X
Median slope value	X	
Average maximum temperature occurring July-August during years 1971 – 2000	X	X
Landcover: Bedrock cliff, outcrop, and badland (within a 510m x 510m neighborhood)		X
Landcover: Bedrock cliff, outcrop, and badland (within a 180m x 180m neighborhood)		X
Edaphic: Badlands		X
Edaphic: Carsitas cobbly sand		X
# records (known occurrences)	55	73
# partitions (equal to variables used)	6	8
Partition selected	1	1
P-Value	0.785	0.716
HSI value	0.7	0.7

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Figure 1: SAGR occurrence points and habitat suitability model.

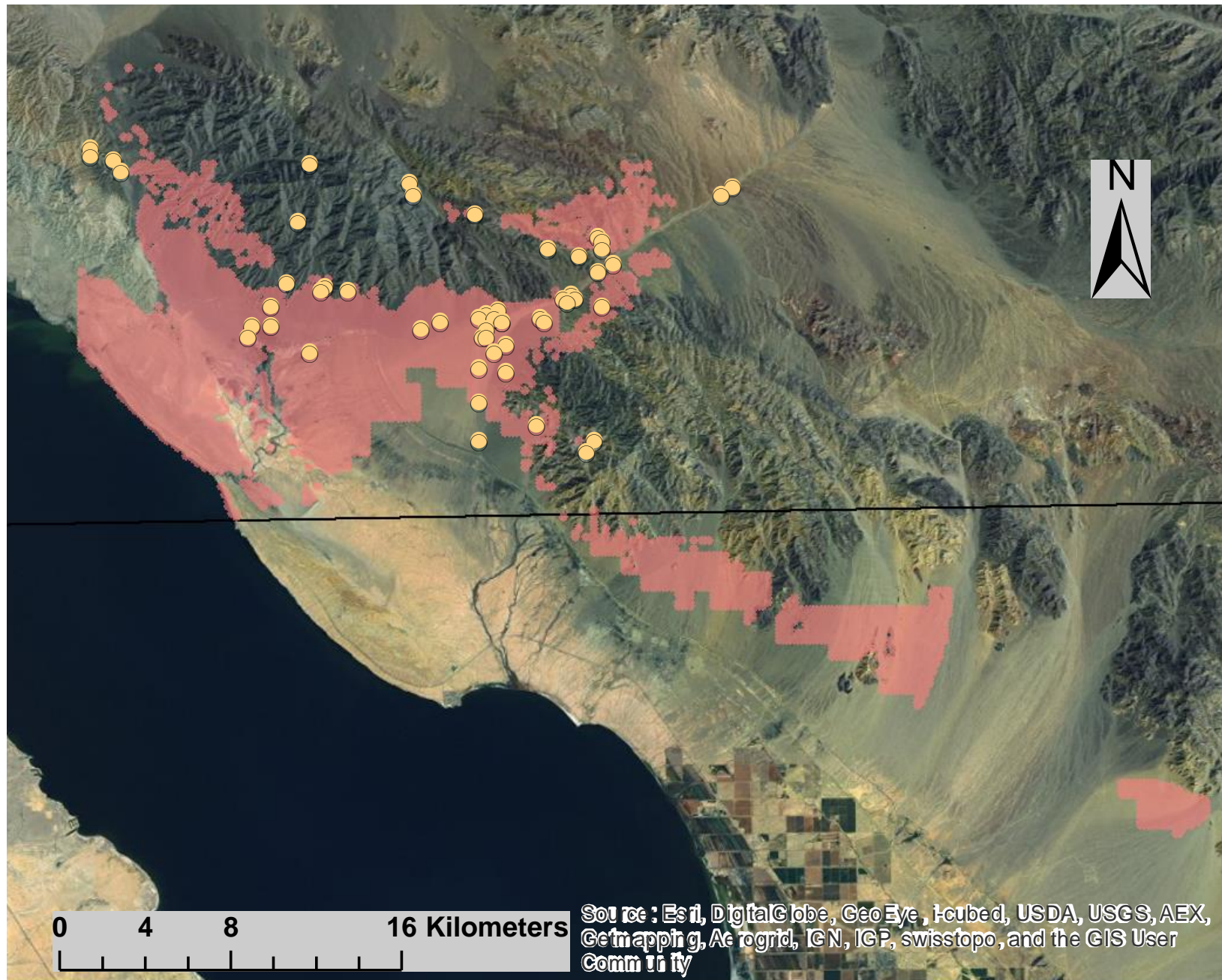


Figure 2: XYCO occurrence points and habitat suitability model

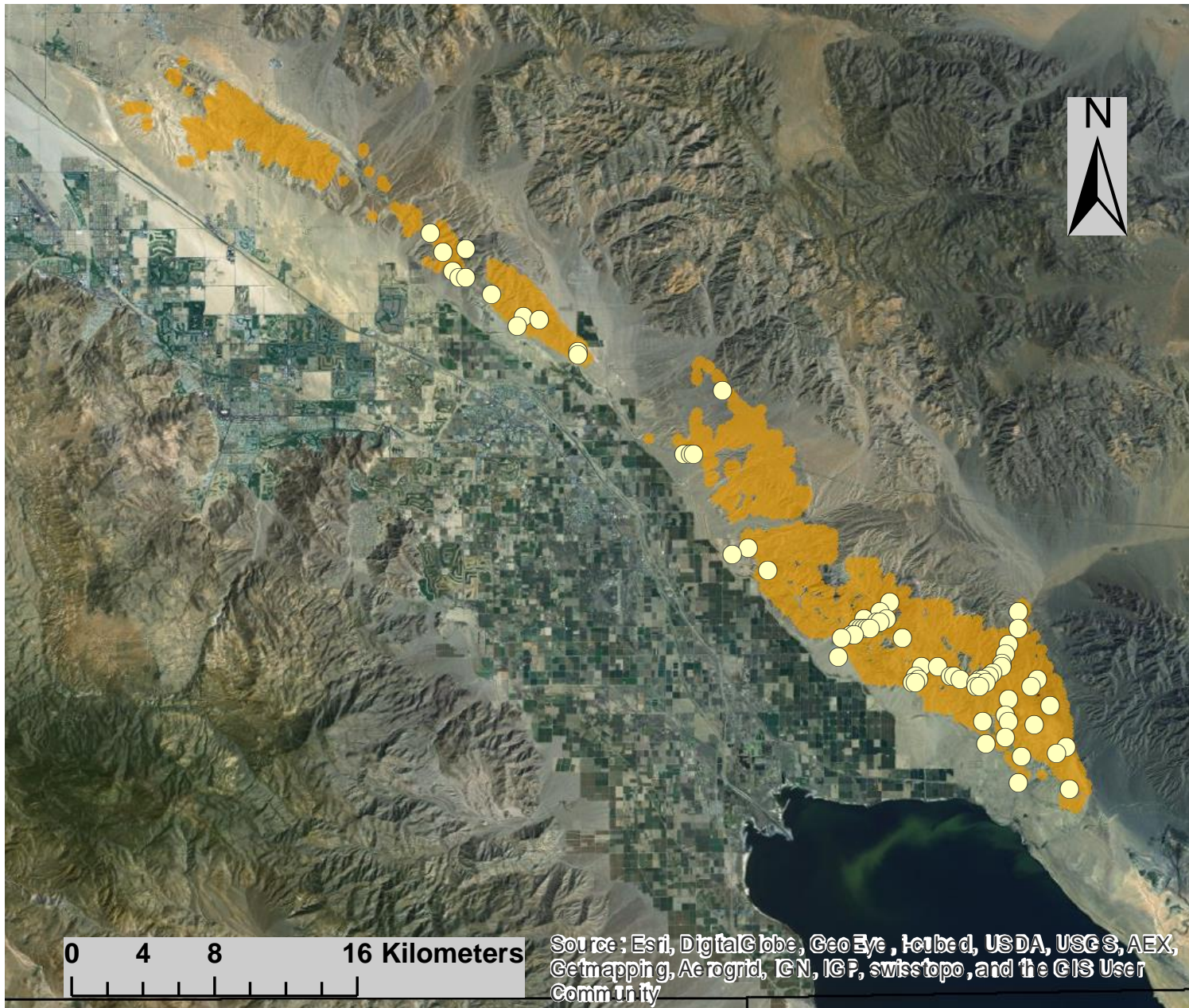


Figure 3: SAGR habitat suitability model and historic occurrences; white circles represent site placing for eastern SAGR sites 1-12

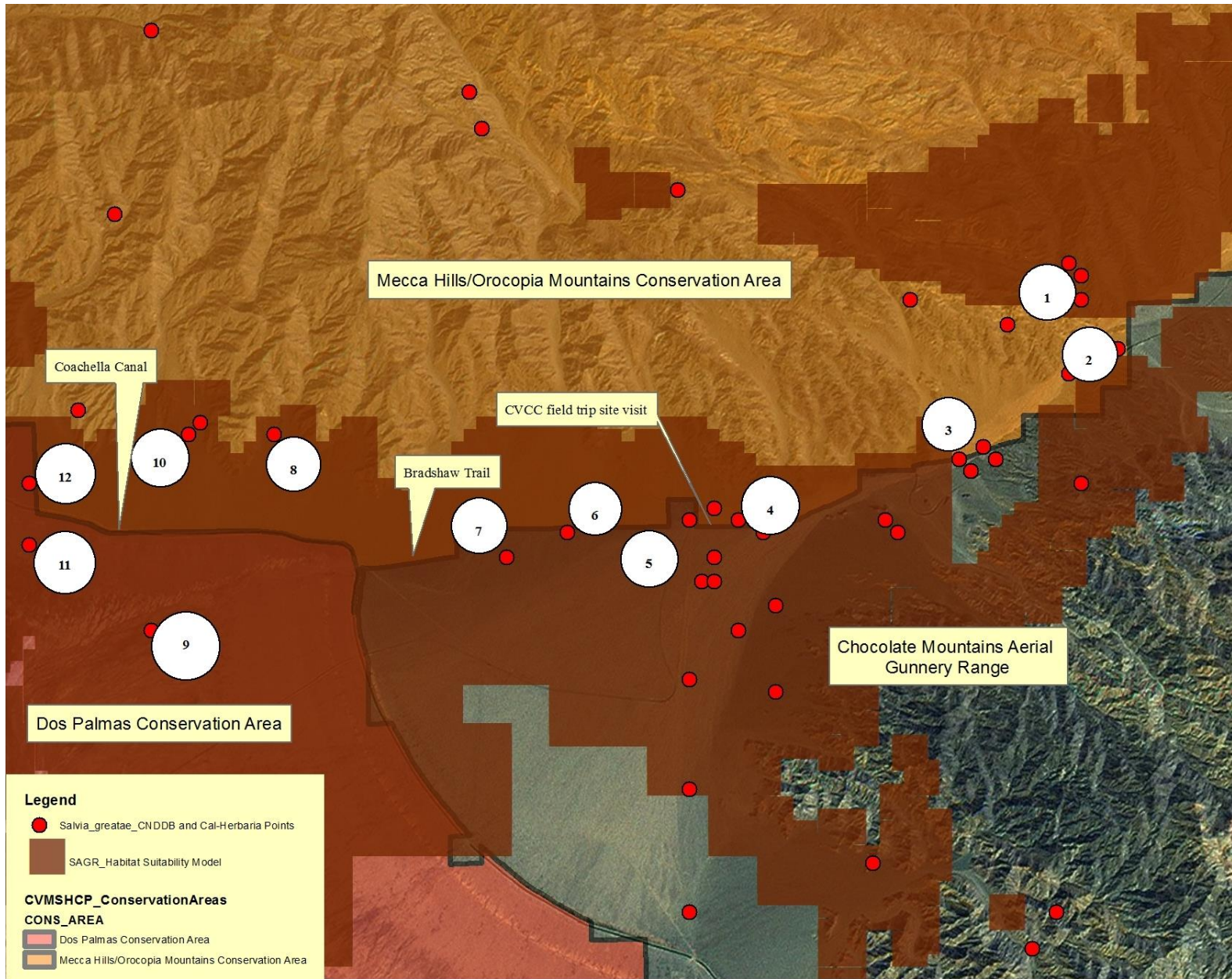


Figure 4: SAGR habitat suitability model and historic occurrence points; white circles represent site placing for western SAGR sites 13-20.

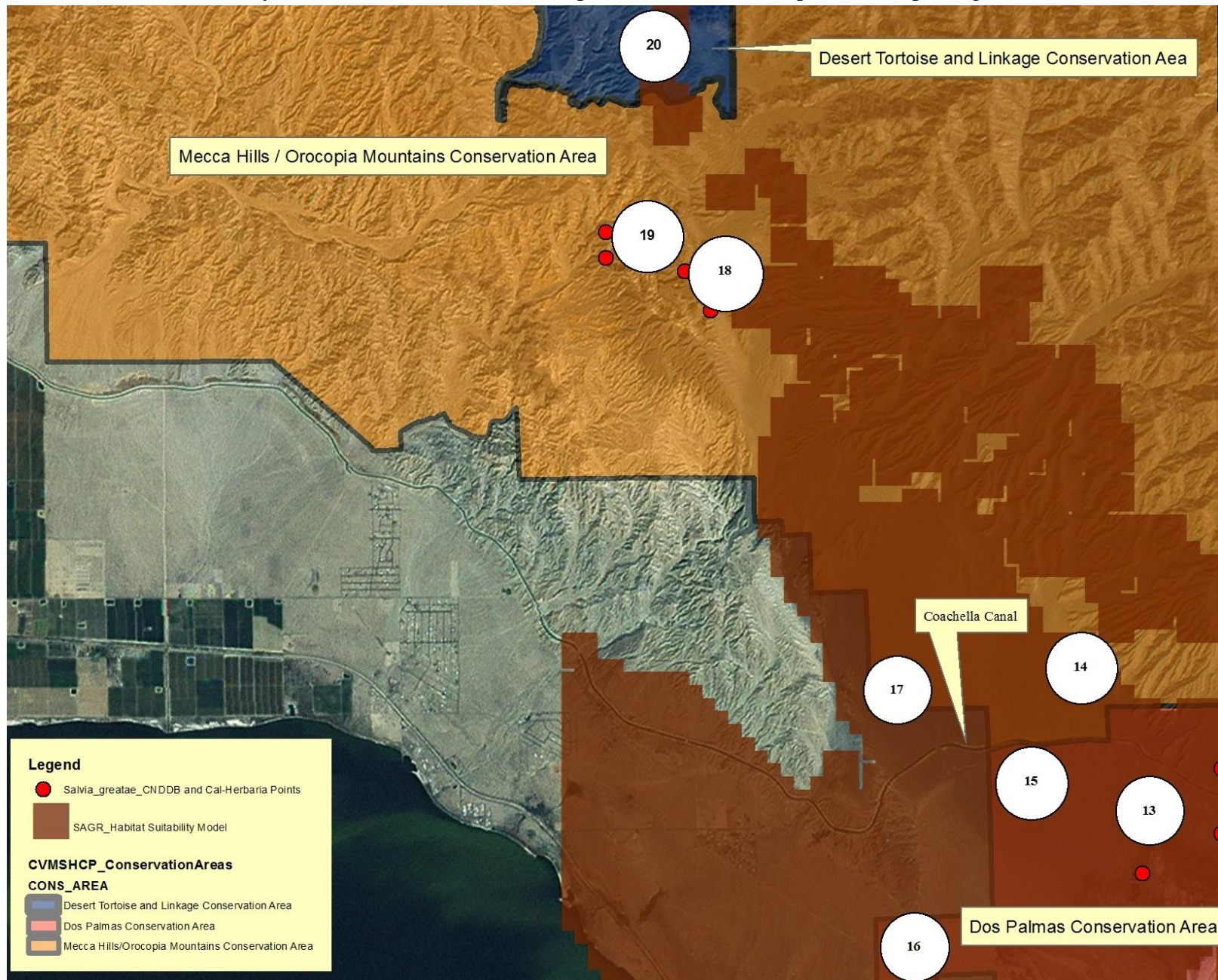


Figure 5: XYCO habitat suitability model and historic occurrence; tan squares represent site placing for southern XYCO sites 1-15.

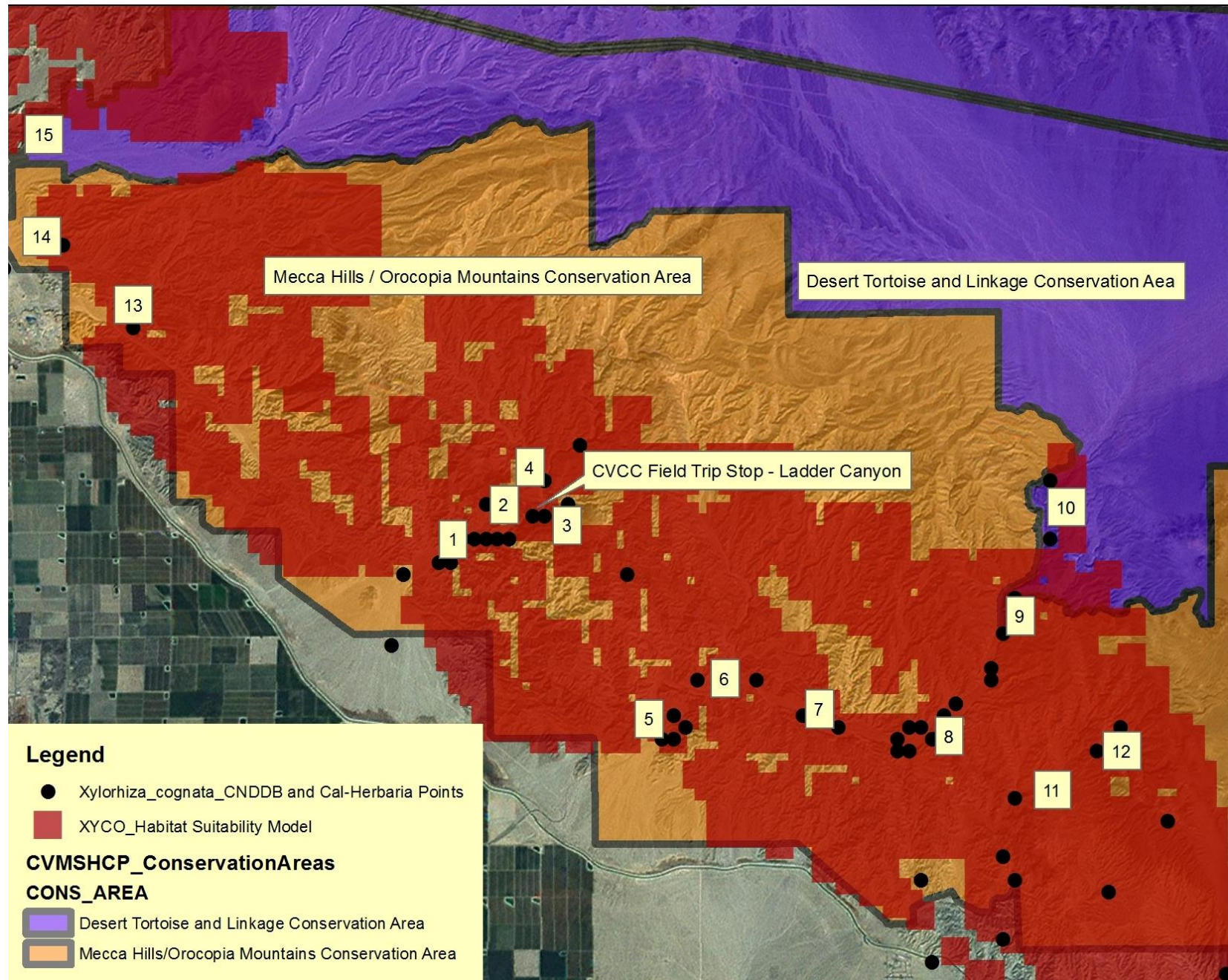


Figure 6: XYCO habitat suitability model and historic occurrence points; tan squares represent site placing for northern XYCO sites 16-20.

