Current and Future Habitat Suitability for Species of Concern at the Jack and Laura Dangermond Preserve

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Summary and Key Findings

We modeled current habitat suitability for 45 special status species at the Jack and Laura Dangermond Preserve in Southern California using a suite of environmental and climate conditions and projected those models to forecast future habitat suitability at mid-century (2041-2070) under three emissions scenarios. For many species, habitat suitability at the Preserve may increase in the future under a moderate emissions scenario (SSP3-RCP7.0), and while suitability for each individual species is driven by a different combination of environmental conditions, some overall trends did emerge. All groups (plants, birds, mammals, invertebrates, and herps) were highly impacted by precipitation seasonality and slope. For birds, temperature extremes were also important, including the mean daily minimum temperature of the coldest month and the mean daily maximum temperature of the warmest month. While for herps, invertebrates, and mammals, isothermality and mean daily maximum near-surface air temperature of the warmest month were strong predictors of habitat suitability.

Model fits were lower for Golden eagle (*Aquila chrysaetos*), Loggerhead shrike (*Lanius ludovicianus*), Yellow Warbler (*Setophaga petechia*), Pacific pond turtle (*Actinemys marmorata*), Two-striped garter snake (*Thamnophis hammondii*), Pallid bat (*Antrozous pallidus*), Townsend's big-eared bat (*Corynorhinus townsendii*), Mountain lion (*Puma concolor*), and American badger (*Taxidea taxus*). There were insufficient observations to model the Point Conception Jerusalem cricket (*Ammopelmatus muwu*). For these species, we recommend adding observations, where possible, and contributing those observations to the Global Biodiversity Information Facility (GBIF) through platforms such as iNaturalist and eBird so they can be included in future replications.

1. Introduction and Motivation

The warming climate is projected to drive large-scale biodiversity loss worldwide[1,2], necessitating a clearer understanding of how species will respond to global change in order to adapt management plans accordingly, especially in established protected areas[1]. Impacts from climate change are anticipated to be exacerbated in places like California, which is a recognized global biodiversity hotspot[3]. Since the mid-20th century, California's climate has become warmer, drier, and more variable. This trend is projected to continue well into the future, resulting in more extreme weather events[4]. California also supports 5,500 native plant taxa, 40% of which are endemic[5], and more than 700 species of mammals, birds, reptiles and amphibians[6], in which climate and topography govern their distribution.

The Jack and Laura Dangermond Preserve, located at Point Conception in coastal Southern California, is a globally important site for conservation due to its unique geography, biodiversity, and cultural resources. Established in 2017, the Preserve is critically situated within the larger network of protected areas in California and helps to maintain significant regional connectivity for many species. A long-term objective of the Preserve, identified in the Jack and Laura Dangermond Preserve Integrated Resources Management Plan (IRMP)[7], is to model future habitat suitability under different climate scenarios for all special status plant and animal species (e.g., international-, federal- and state-listed threatened or rare species) to inform management and restoration efforts. This project contributes to that objective by modeling the current and future habitat suitability for 45 special status plant and animal species at the Preserve using a species distribution modeling framework. Habitat suitability results are presented for each species individually in 'report cards' (Appendix A) and summarized in this report.

2. Species Distribution Modeling Framework

Species Distribution Models (SDMs) associate georeferenced response variables (typically occurrence points or abundance measurements) with a suite of environmental predictor variables that typically include climate and topographic information[8]. SDMs utilize a variety of statistical and machine learning frameworks to produce spatial predictions of species–environment relationships, and they are widely used in ecology and conservation science to better understand where species might be found geographically[9]. We adopt an approach in this study that uses multiple types of SDMs to develop ensemble habitat suitability models for each of the special status species. Model parameters are then used to project habitat suitability to mid-century using future climate models. We follow the structured ODMAP reporting protocol[10] for species distribution models and have separate sections below describing the Objective, Data, Modeling, Assessment, and Prediction.

2.1. Objective of Species Distribution Modeling

The objective is to create ensemble SDMs of current and future habitat suitability for 45 special status species observed at the Preserve. The focus of the study is the Jack and

Laura Dangermond Preserve at Point Conception (**Figure 1**), which is a 24,460-acre reserve along the California coast where the Southern and Northern Pacific currents collide, creating a unique spot where terrestrial and marine ecoregional boundaries co-occur and conditions are promising for a biodiversity hotspot. Historically, the land was home to the native Chumash extending back at least 9,500 years, and continues to be considered a “cultural keystone place” for Chumash community members today[11].

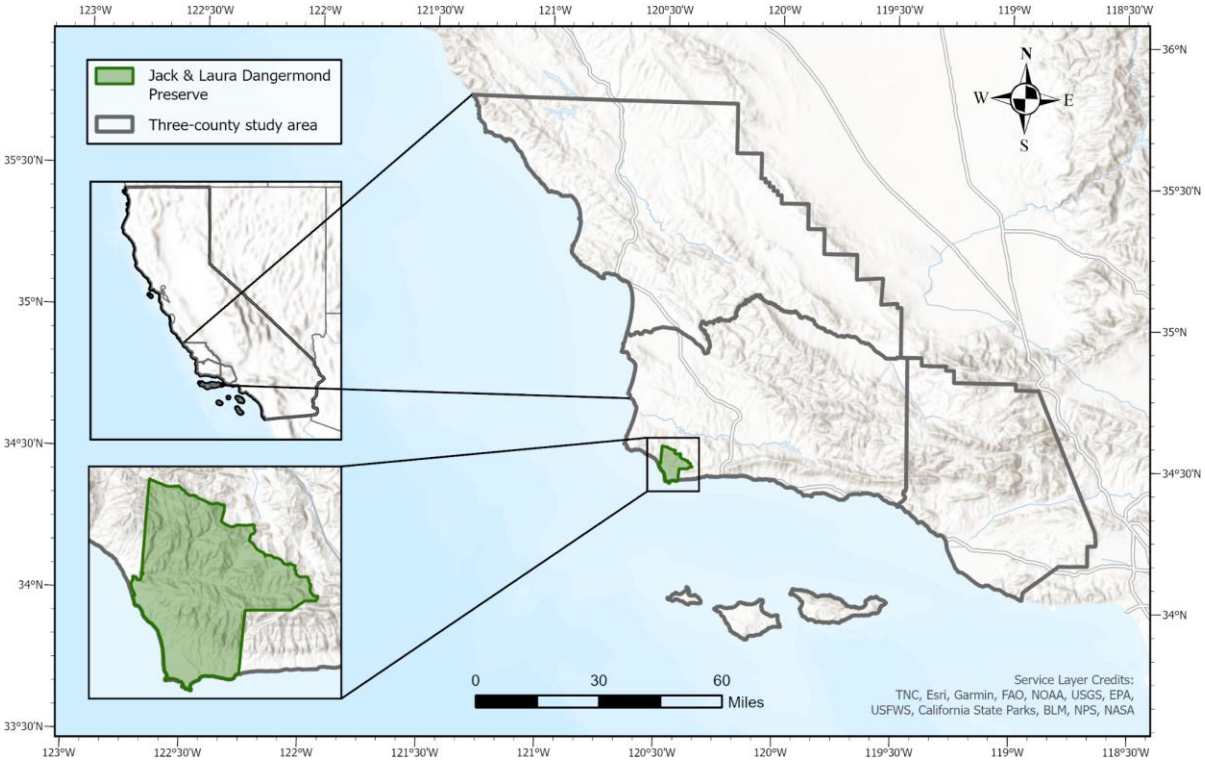

Figure 1. Study area including the Jack and Laura Dangermond Preserve (managed by The Nature Conservancy) and the surrounding San Luis Obispo, Santa Barbara, and Ventura counties.

The land where the Preserve sits was previously used for ranching and was slated to be subdivided for development before it was purchased by The Nature Conservancy through a gift from Jack and Laura Dangermond and protected in 2017. Intense development and population growth in the surrounding Santa Barbara and San Luis Obispo counties has impacted biodiversity habitat and movement corridors for species. Point Conception and its surrounding lands thus represent one of the last and best “wild coast” areas in Southern California, and so understanding how this area can serve as a refuge for species now and in the future is a high priority. The Preserve serves as a natural laboratory for investigating impacts from environmental challenges, including climate change[7].

While the focus is on the Preserve itself, the study area encompasses the larger three-county area surrounding the Preserve that includes Santa Barbara, San Luis Obispo, and Ventura counties (**Figure 1**). This larger area can account for shifting habitat conditions due to climate change and will help Preserve staff understand what species may be moving into or out of the Preserve over time.

2.2. Data Preparation and Preprocessing

Data preparation and preprocessing included acquiring and cleaning species occurrence data for both plants and animals, and downloading and processing environmental covariates including climate layers and physical and topographic variables. These steps are described below.

2.2.1. Species Occurrences

2.2.1.1. Birds, Mammals, Herps and Invertebrates

We created an initial list of special status animal species from the IRMP[7], excluding fish and marine mammals. We acquired occurrence data from the Global Biodiversity Information Facility (GBIF) through *rgbif* and the Dangermond Preserve Biodiversity Data Portal. We removed records with an invalid date, observations before 1980, records with invalid coordinates, records that were located in biodiversity institutions, and records with a 0 individual count. We also removed GBIF records with the coordinate mismatch issue and excluded records with coordinate uncertainty greater than 1000m due to spatial inaccuracies and geoprivacy issues[12].

We were able to acquire at least 10 occurrences for 22 animal species, which is the minimum for standard species distribution modeling (**Table 1**). Those species included 14 birds, 4 mammals, 3 herps, and 1 invertebrate. After identifying additional data from the California Natural Diversity Database (CNDDB), we were able to acquire at least three occurrence points for 3 bird species, which is the minimum for a range bagging approach (discussed below). There were insufficient observations to model the Point Conception Jerusalem cricket (*Ammopelmatus muwu*).

Table 1. Special status animal species identified at the Dangermond Preserve and modeled in this study including the number of observations available for modeling after data cleaning and filtering

Birds	Latin Name	Common Name	No. Observations
	Agelaius tricolor	Tricolored blackbird	422
	Aquila chrysaetos	Golden eagle	1019
	Athene cunicularia	Burrowing owl	296
	Cepphus columba	Pigeon guillemot	209
	Circus hudsonius	Northern Harrier	<10
	Elanus leucurus	White-tailed kite	979
	Empidonax traillii extimus	Southwestern willow flycatcher	<10
	Falco peregrinus anatum	American Peregrine falcon	<10
	Haematopus bachmani	Black oystercatcher	322
	Haliaeetus leucocephalus	Bald eagle	689
	Hydroprogne caspia	Caspian tern	332
	Lanius ludovicianus	Loggerhead shrike	1394
	Pandion haliaetus	Osprey	701
	Phalacrocorax penicillatus	Brandt's cormorant	27
	Setophaga petechia	Yellow warbler	1349
	Sternula antillarum	Least tern	103
	Xanthocephalus xanthocephalus	Yellow-headed blackbird	183

Herp and Invertebrates			
	Actinemys marmorata	Pacific pond turtle	108
	Danaus plexippus	Monarch butterfly	513
	Rana draytonii	California red-legged frog	55
	Thamnophis hammondii	Two-striped garter snake	21
Mammals			
	Antrozous pallidus	Pallid bat	29
	Corynorhinus townsendii	Townsend's big-eared bat	58
	Puma concolor	Mountain lion	125
	Taxidea taxus	American badger	62

2.2.1.2. *Plants*

We expanded the initial list of special status plants from the IRMP to the tri-county area through a Calflora Observation Search[13], with a Native Status of "Rare". We then imported this search into R and generated a list of unique species that occurred in any of the three counties. We combined this list with the IRMP list to create a comprehensive rare plant list of species. We collected occurrence records for all 205 species within the three counties from GBIF and the Botanical Information and Ecology Network (BIEN) using the *rgbif* and *BIEN* R packages[14]. We followed the same cleaning and filtering steps as above. After cleaning, 10 species had fewer than 10 occurrence records. For those species, we downloaded additional occurrences from the Dangermond Preserve Biodiversity Portal and Calflora Observation Search, and acquired California Natural Diversity Database (CNDDB) data from our project partners in order to be able to model habitat suitability for these species. Finally, we removed duplicates and retained only one record per 1-km fishnet grid cell to match the resolution of the climate data (described below). Although we collected species occurrence for the comprehensive plant list within the tri-counties, we only model suitability for the 20 plant species mentioned in the IRMP (**Table 2**). The remaining species are ready to be modeled in the future to meet other management requirements.

Table 2. Special status plant species identified at the Dangermond Preserve and modeled in this study including the number of observations available for modeling after data cleaning and filtering.

Plants	Latin Name	Common Name	No. Observations
	Abronia maritima	Red Sand Verbena	151
	Arctostaphylos purissima	La Purisima Manzanita	74
	Astragalus nuttallii var. nuttallii	Nutall's Milkvetch	39
	Calochortus fimbriatus	Late-flowered Mariposa Lily	30
	Cirsium rhothophilum	Surf Thistle	30
	Deinandra increscens spp. villosa	Gaviota Tarplant	39
	Delphinium umbraculorum	Umbrella Larkspur	17
	Dichondra occidentalis	Western Dichondra	30
	Eriodictyon capitatum	Lompoc Yerba Santa	11
	Erysimum suffrutescens	Large-leaved Wallflower	33
	Horkelia cuneata var. sericea	Kellog's Horkelia	26

	Juglans californica	Southern California Black Walnut	204
	Lilium humboldtii ssp. ocellatum	Ocellated Humboldt Lily	13
	Malacothrix saxatilis var. saxatilis	Cliff Aster	19
	Mucronea californica	California Spineflower	62
	Phacelia hubbyi	Hubby's Phacelia	150
	Ribes amarum var. hoffmannii	Hoffman's Bitter Gooseberry	13
	Scrophularia atrata	Black-flowered Figwort	46
	Senecio blochmaniae	Dune (Blochman's) Ragwort	39
	Suaeda taxifolia	Wooly Seablite	74

2.2.2. Environmental Layers

We selected a suite of physical, terrain and climate variables that capture both current and projected environmental conditions known to shape habitat suitability.

2.2.2.1. Physical and Terrain Variables

We derived five terrain variables (**Table 3**) from a Digital Elevation Model (DEM) from the NASA Shuttle Radar Topography Mission 1 arc-second global (void-filled) dataset[15] via USGS EarthExplorer. Ten GeoTIFF tiles were mosaicked, reprojected from WGS84 (EPSG:4326) to NAD83/California State Plane Zone 5 (EPSG:2229), and cropped and masked to the merged tri-county boundary with a 100m buffer to avoid edge artifacts. From this processed DEM, we derived slope, aspect, and flow accumulation in R using the *terra* package[16]. The resulting rasters retain the same cell size and projection, with slope values ranging from 0° to 40°, and aspect ranging from 0° to 360°.

Table 3. Summary of physical and terrain predictor variables used in this analysis.

Layer	Description	Source	Method/Tool
Elevation (m)	Elevation above mean sea level	USGS EarthExplorer (SRTM 1 Arc-Sec Global)	`terra::mosaic()`, `terra::project()`, `terra::crop()`, `terra::mask()`
Slope (degree)	Rate of elevation change	Derived from DEM	`terra::terrain(v="slope", unit = "degrees")`
Aspect (degree)	Downslope direction	Derived from DEM	`terra::terrain(v="aspect", unit = "degrees")`
Flow accumulation (cell count)	Count of upstream contributing area based on flow direction rasters	Derived from DEM	`terra::terrain(v="flowdir", unit = "degrees")` and `terra::flowAccumulation()`
Solar radiation (kWh/m^2)	Cumulative annual insolation	Derived from DEM	ArcGIS Pro Area Solar Radiation
Distance to Coast (m)	Euclidean distance to nearest coastline	Ecological Coastal Units layer [17]	`terra::distance()`

Annual potential solar radiation was modeled in ArcGIS Pro using the Area Solar Radiation tool, which derives incoming solar insolation for every cell of a DEM. We ran the analysis over a full year, allowing the tool to repeat calculations for each raster cell with default horizontal shadows and sky-size factors to capture both direction and diffuse radiation components. The tool iteratively computes insolation for every raster cell, accounting for topographic shading and sun-angle variation throughout the year. The output is a continuous raster of cumulative solar radiation (kWh/m^2) at 30m resolution.

To quantify coastal proximity, we used Esri's Ecological Coastal Units (ECU) layer[17], which was developed by USGS in partnership with Esri and the Marine Biodiversity Observation Network (MBON). It describes 1km shoreline segments worldwide. We downloaded the polyline feature layer, clipped it to our buffered tri-county extent, and used `terra::distance()` to calculate the Euclidean distance from each 30m DEM cells to its nearest coastline, producing a continuous 'distance to coast' rasters in meters.

2.2.2.2. Baseline Climate Variables

Baseline climate data for the period 1981–2010 were obtained from the CHELSA Bioclimatologies v2.1 dataset[18,19], which offers high spatial resolution (~1 km^2) and accounts for complex topographic and orographic processes. CHELSA was chosen over other datasets such as WorldClim, due to its superior performance in mountainous and coastal regions[18], where local-scale climate variability strongly influences species distributions[20]. The full set of 19 bioclimatic variables were included to start and were reduced to eight based on a multicollinearity analysis (below).

2.2.2.3. Multicollinearity Among Predictor Variables

Multicollinearity among predictor variables is a common issue in ecological niche modeling that can inflate model variance and mislead variable importance[21]. We performed pairwise Pearson correlation analysis for the full set of 23 variables (19 bioclimatic, slope, aspect, flow accumulation, and solar radiation) and retained a parsimonious set of variables with $|r| < 0.7$ (**Figure 2**) and variance inflation factor (VIF) < 5. Elevation was not included as it is used to create the downscaled CHELSA climatologies. This two-step procedure ensured the inclusion of ecologically informative and statistically independent predictors.

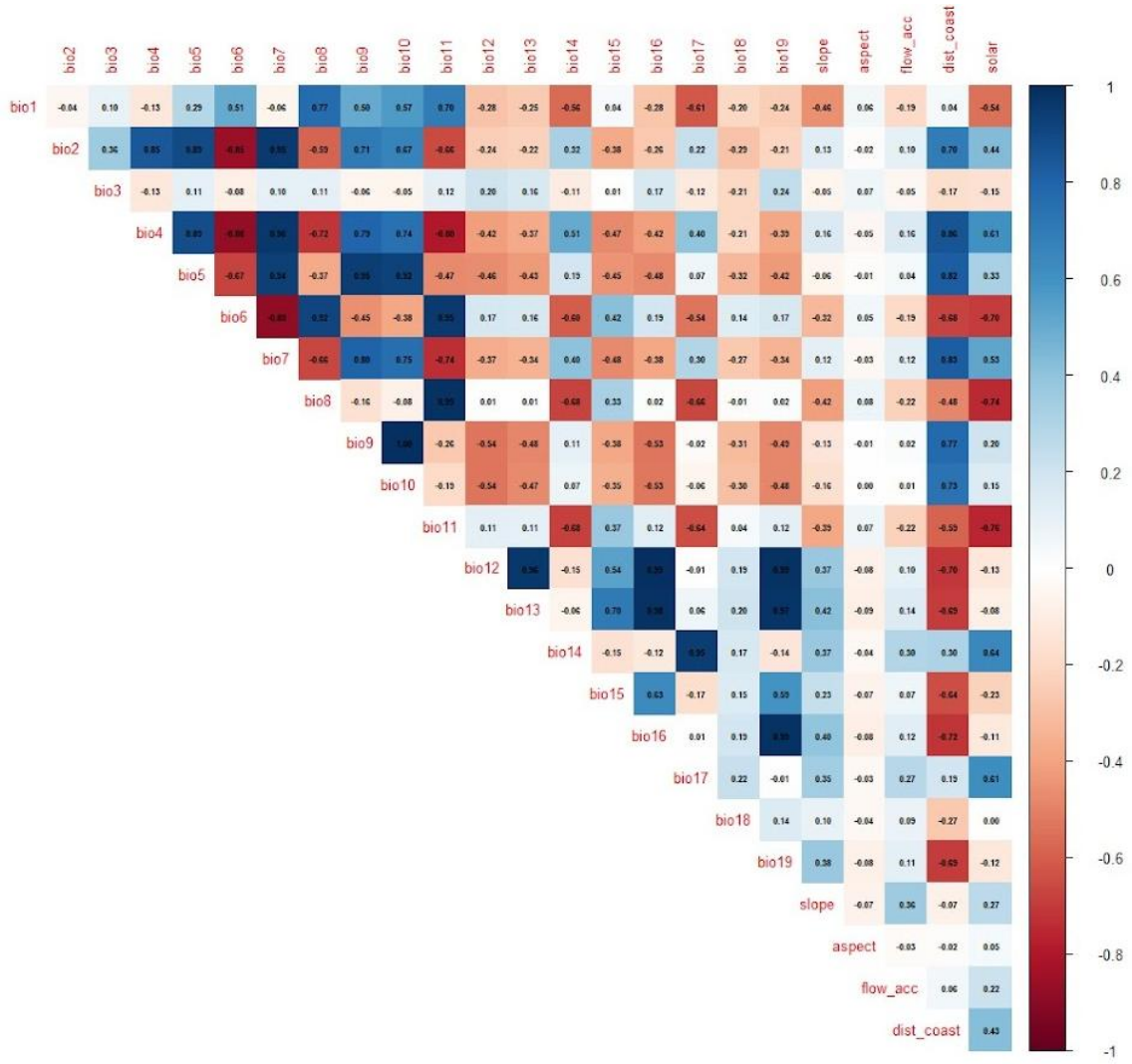

Figure 2. Pearson correlation matrix for bioclimatologies, physical, and terrain variables for a baseline time period (1981-2010) in Ventura, Santa Barbara and San Luis Obispo Counties. Positive values (blue) indicate positive correlation while negative values (red) indicate negative correlation. A set of uncorrelated variables (|r| < 0.7) with VIF<5 were retained for modeling (Table 4)

Slope, aspect, flow accumulation, solar, and eight bioclimatic variables (**Table 4**) that capture temperature extremes, seasonal precipitation dynamics, and climate variability were retained for modeling, which are known to shape species physiological tolerances and habitat suitability[22]. Layers were processed using the *terra* and *tidymodels* packages in R[23].

Table 4. Eight bioclimatic variables from CHELSA used in the analysis.

Name	Long Name	Explanation
Bio1 (°C)	Mean Annual Near-Surface Air Temperature	Mean annual temperature calculated as the average of mean monthly temperatures over the year
Bio3 (%)	Isothermality	Isothermality quantifies how large the day-to-night temperatures oscillate

		relative to the summer-to-winter (annual) oscillations.
Bio5 (°C)	Mean daily maximum near-surface air temperature of the warmest month	The average maximum monthly temperature occurrence
Bio6 (°C)	Mean daily minimum near-surface air temperature of the coldest month	The average minimum monthly temperature
Bio15 (%)	Precipitation Seasonality	The variation in monthly precipitation totals over the course of the year.
Bio17 (mm)	Mean monthly precipitation of the driest quarter	Average monthly precipitation during the driest 3-month period of the year
Bio18 (mm)	Mean monthly precipitation of the warmest quarter	Average monthly precipitation during the warmest 3-month period of the year
Bio19 (mm)	Mean monthly precipitation of the coldest quarter	Average monthly precipitation during the coldest 3-month period of the year

2.2.2.4. Future Climate Projections

For future climate projections (2040–2070), we used downscaled outputs from the CHELSA CMIP6 dataset, specifically selecting the GFDL-ESM4 global climate model based on its performance in North America,[24,25] under three combinations of Shared Socioeconomic Pathways (SSP) and representative concentration pathways (RCP). SSPs are baseline narrative scenarios that identify potential futures considering socio-economic assumptions, geopolitical assumptions, and economic and technological trends. They are often combined with RCP scenarios to impose global warming targets on the baseline SSP scenarios using the radiative forcing levels from the RCP scenarios. The three selected combinations are SSP1-RCP2.6 (SSP126), SSP3-RCP7.0 (SSP370), and SSP5-RCP8.5 (SSP585), representing a ‘low’, ‘middle’, and ‘worst case’ scenario. The range reflects divergent trajectories of global socio-economic development and emissions, from a sustainability-focused path (SSP126), to regional rivalry and moderate emissions (SSP370), to a fossil-fuel intensive future (SSP585). By including a wide range of plausible climate futures, we aim to assess the robustness of species distributions to different levels of climate forcing and uncertainty.

The 12 environmental covariates (bio1, bio3, bio5, bio6, bio15, bio17, bio18, bio19, slope, aspect, flow accumulation, solar radiation) were assembled into multi-band raster stacks at a uniform grid and extent to support species distribution modeling. Each selected layer was cropped and masked to the tri-county boundary, reprojected or confirmed in EPSG:2229, and resampled to the CHELSA grid (EPSG:2229, ~1 km) to ensure exact alignment with both baseline (1980-2010) and future (2040-2070) climate variables. Finally, these processed rasters were concatenated into scenario-specific stacks: one representing current scenario (1980-2010) and three representing future projections (SSP126, SSP370, SSP585).

In order to generate a bias-corrected background sample for all species, we computed a standardized, unweighted kernel-density estimated (KDE) surface at 1 km resolution. We sampled 10,000 background points, weighted according to the KDE surface, and filtered out any points outside the tri-county boundary. We exported the KDE surface and point list with coordinates and weights for modeling.

2.3. Modeling

2.3.1. Approach for Species with at Least 10 Occurrences

We implemented three modeling approaches to predict the species distributions for all species with greater than 10 occurrences (**Tables 1 & 2**): Generalized Additive Models (GAM), Maximum Entropy (MaxEnt), and Random Forests (RF), followed by an ensemble approach.

GAM is a regression technique designed to model nonlinear relationships between environmental predictors and species presence using smooth functions that are trained separately for each explanatory variable, allowing the model to capture complex ecological responses[26]. Restricted Maximum Likelihood (REML) method is employed for estimating smoothing parameters, using a binomial family with a logit link. Sampling weights are applied to balance the influence of presence and background points. MaxEnt is a widely used machine learning approach for modeling species distributions across geographic space[27]. MaxEnt predicts the potential distribution of a species by maximizing the entropy of a probability distribution, and it is known for producing reliable predictions even when using default settings[28]. RF is a machine learning algorithm that builds an ensemble of decision trees, enabling it to effectively capture complex interactions and nonlinear relationships in ecological data. It is considered one of the most accurate and high-performing algorithms for species distribution modeling[26], however it can perform poorly when applied to presence-only data with an overwhelming number of background samples[29]. To address class imbalance, the RF model is trained with a down-sampling approach by setting the number of background samples equal to the number of presence records for each tree.

For each species, we generated ensemble models by averaging the probability predictions from GAM, MaxEnt, and RF to produce a continuous suitability map, and derived a binary presence–absence output using majority voting among the three models. We employed Youden's J statistic[30] to determine the optimal threshold for converting the predicted probabilities of presence from each model into binary presence–absence maps. This ensemble approach leverages the strengths of each individual model and often yields more reliable and stable predictions than any single model alone[26,31]. To assess broader biodiversity patterns, we applied a stacking approach that aggregates the binary ensemble predictions of individual species into composite suitability maps, enabling the identification of species richness hotspots and shared environmental responses. The GAM, MaxEnt, and RF models were implemented using the *mgcv*[32], *dismo*[33], and *randomForest*[34] R packages, respectively.

2.3.2. Rangebagging Approach for Species with Fewer than 10 Occurrences

Following data cleaning and filtering, three bird species, Northern Harrier (*Circus hudsonius*), Peregrine Falcon (*Falco peregrinus anatum*), and Willow Flycatcher (*Empidonax traillii*), had fewer than 10 presence records, which is insufficient for the modeling approaches described above. Therefore, we employed a separate modeling workflow using rangebagging, a presence-only, ensemble-based species distribution modeling technique designed to perform well with limited or spatially clustered occurrence data[35].

Range bagging approximates a species' environmental niche by bootstrapping both occurrence points and environmental variables to generate multiple convex hulls in environmental space. We constructed 100 convex-hull models and for each iteration, randomly selecting 70% of presence points and two environmental variables to build a hull in the corresponding environmental space. For a given location, the values of the same environmental variable pair were tested for inclusion within each hull, and suitability was calculated as the fraction of hulls that contained the pair. Rangebagging was completed with the *bssdm* package in R[36,37]. Consistent with the main workflow, we generated continuous climate suitability maps for each of the three species under all environmental scenarios.

2.4. Assessment

Model performance was assessed using the area under the receiver operating characteristic curve (AUC). AUC is generally accepted for evaluating model performance[38] because it does not require arbitrary threshold selections[27]. AUC ranges [0,1] with values near 1 indicating a better model performance. Generally, AUC values above 0.8 are considered good, and those above 0.9 are excellent.

2.5. Prediction and Model Projection

Model objects from the three approaches (GAM, MaxEnt, RF) were used to project future suitability of each species using the full set of variables, but replacing the baseline climate data with future climate variables at mid-century (2041-2070). Three separate future scenarios were run for the three SSP-RCP scenarios (SSP126, SSP370, and SSP585). We computed variance between the three modeling outputs as a measure of the model uncertainty.

3. Modeling results

Overall, there were generally strong fits and good agreement between the three modeling approaches for each species (**Table 5**). Most species had high AUC values (>0.8) for both the individual and ensemble models, although some animal species had lower model fits including Golden eagle (*Aquila chrysaetos*), Loggerhead shrike (*Lanius ludovicianus*), Yellow Warbler (*Setophaga petechia*), Pacific pond turtle (*Actinemys marmorata*), Two-striped garter snake (*Thamnophis hammondii*), Pallid bat (*Antrozous pallidus*), Townsend's big-eared bat (*Corynorhinus townsendii*), Mountain lion (*Puma concolor*), and American badger (*Taxidea taxus*). For these species, we recommend increasing observations, where possible, and submitting them to platforms such as iNaturalist and eBird so they are findable

via GBIF and can be included in future replications. It is also possible these species have special habitat requirements that were not included in the modeling. Carnivores such as the Mountain lion and American badger may also show decreased model fits because their behavior is less dependent on climate-driven food sources.

Table 5. Area Under the Receiver Operating Curve (AUC) assessment metric for the individual and ensembled species distribution models including the General Additive Model (GAM), Maximum Entropy (MaxEnt), and Random Forest.

SPECIES	GAM	MaxEnt	Random Forest	Ensemble
Birds				
Agelaius tricolor	0.84	0.84	0.84	0.84
Aquila chrysaetos	0.74	0.74	0.75	0.74
Athene cunicularia	0.84	0.85	0.87	0.85
Cepphus columba	0.96	0.96	0.96	0.96
Circus hudsonius*	-	-	-	1.00
Elanus leucurus	0.83	0.83	0.83	0.83
Empidonax traillii*	-	-	-	0.99
Falco peregrinus anatum*	-	-	-	1.00
Haematopus bachmani	0.97	0.97	0.97	0.97
Haliaeetus leucocephalus	0.84	0.85	0.86	0.85
Hydroprogne caspia	0.94	0.94	0.94	0.94
Lanius ludovicianus	0.79	0.79	0.79	0.79
Pandion haliaetus	0.84	0.84	0.86	0.85
Phalacrocorax penicillatus	0.88	0.86	0.87	0.87
Setophaga petechia	0.74	0.75	0.75	0.75
Sternula antillarum	0.96	0.97	0.97	0.97
Xanthocephalus xanthocephalus	0.84	0.84	0.85	0.84
Herps and Invertebrates				
Actinemys marmorata	0.67	0.70	0.71	0.69
Danaus plexippus	0.87	0.88	0.88	0.88
Rana draytonii	0.87	0.84	0.90	0.87
Thamnophis hammondii	0.79	0.72	0.81	0.77
Mammals				
Antrozous pallidus	0.72	0.72	0.66	0.70
Corynorhinus townsendii	0.78	0.82	0.87	0.83
Puma concolor	0.65	0.66	0.68	0.67
Taxidea taxus	0.75	0.77	0.76	0.76
Plants				
Abronia maritima	0.95	0.95	0.97	0.96
Arctostaphylos purissima	0.97	0.96	0.97	0.97
Astragalus nuttallii nuttallii	0.95	0.97	0.99	0.97
Calochortus fimbriatus	0.93	0.91	0.94	0.93
Cirsium rhothophilum	1.00	1.00	1.00	1
Deinandra increscens villosa	0.99	0.99	0.99	0.99
Delphinium umbraculorum	0.88	0.87	0.90	0.88
Dichondra occidentalis	0.95	0.97	0.97	0.96
Eriodictyon capitatum	0.91	0.93	0.95	0.93
Erysimum suffrutescens	0.94	0.94	0.94	0.94
Horkelia cuneata sericea	0.97	0.97	0.99	0.98
Juglans californica	0.86	0.86	0.86	0.86
Lilium humboldtii ocellatum	0.87	0.79	0.88	0.85
Malacothrix saxatilis saxatilis	0.92	0.93	0.92	0.93
Mucronea californica	0.86	0.87	0.88	0.87
Phacelia hubbyi	0.84	0.85	0.88	0.86
Ribes amarum hoffmannii	0.94	0.90	0.93	0.92

Scrophularia atrata	0.97	0.96	0.96	0.96
Senecio blochmaniae	0.97	0.97	0.98	0.97
Suaeda taxifolia	0.95	0.96	0.97	0.96

*Species modeled with the rangebagging approach have only a single AUC value, which is reported in the Ensemble column

3.1. Stacked Current and Future Distribution Maps

The final binary map for each species was generated using majority voting across the three models, and the binary predictions were used to generate the final stacked species distribution maps for plants, birds, and herps, invertebrates, and mammals (**Figure 3**). The stacked current and future distribution maps show different spatial patterns forming over time across the study region and the Preserve. In all three groups, the area comprising the Preserve is projected to have increased suitability by mid-century under the SSP370 scenario, particularly along the coast and canyons/valleys. The changes are most noticeable for animals. However, it should be noted that these maps do not consider other habitat requirements such as food availability or abundance.

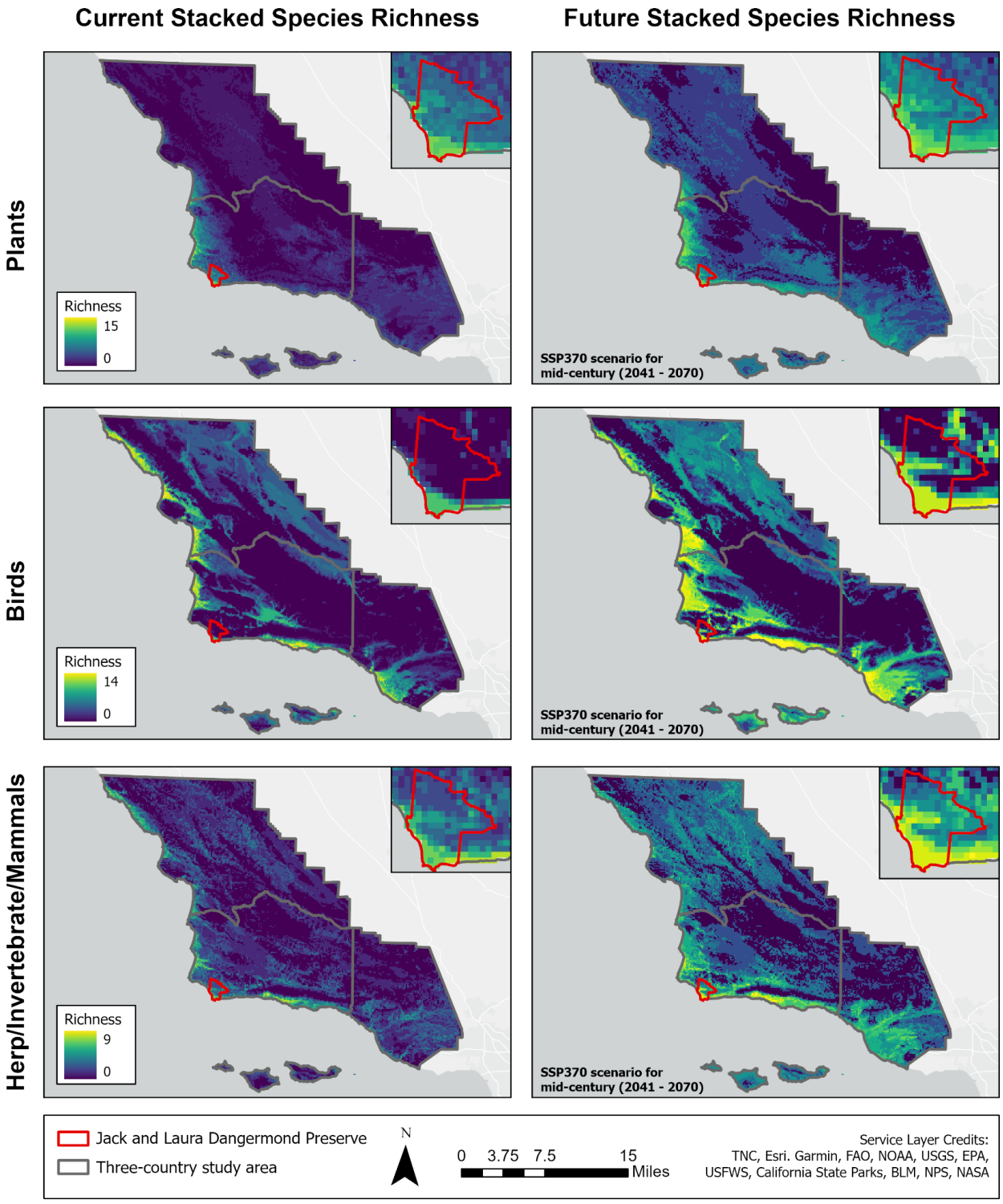

Figure 3. Current and future stacked species richness maps for three groups: plants (top), birds (middle), and herpetofauna, invertebrates, and mammals (bottom).The future maps show the SSP370 scenario for mid century (2041-2070).

3.2. Important Predictors for Current and Future Suitability

While each species' individual distribution is driven by a different combination of environmental conditions, there are some overall trends in the most important drivers (**Figure 4**). For plants, important predictors were Bio15 (precipitation seasonality) and slope. For birds, slope was the most important predictor, followed by Bio15 (precipitation seasonality), Bio1 (mean annual temperature) and Bio19 (mean monthly precipitation of the coldest quarter). For herps, invertebrates, and mammals, slope was again the most important predictor, followed by isothermality, precipitation seasonality, and flow accumulation.

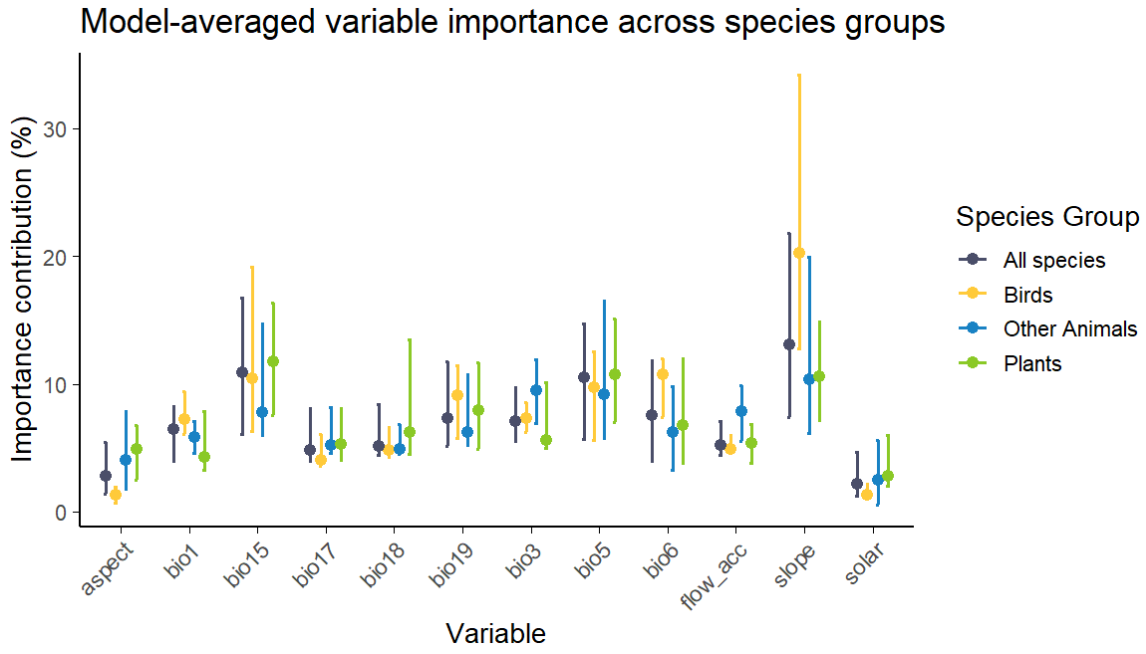

Figure 4. Model-averaged variable importance across species groups (special status bird, plant, and other animal, including herpetofauna, invertebrates, and mammals), summarized as median ± interquartile range (IQR).

3.3. Species Report Cards

Individual species report cards (**Figure 5**) were created to share results and information through a succinct and easily accessible format. Report cards were created for all special status species with sufficient occurrence data for modeling. Each report card presents information in five distinct panels, including species occurrence points, threat status, a species information overview, and current and future habitat suitability, which are detailed below. All 45 report cards are available in Appendix A.

Threat Status: There are a number of ways in which the threat status of a species is determined and documented, and they operate at a range of geographic and administrative scales from the International Union for the Conservation of Nature's (IUCN) Red List of Threatened Species (IUCN), which encompasses thousands of species globally, to the California Native Plant Society Inventory of Rare Plants, which is regionally and topically specific to plant species in the state of California[39,40]. To provide a comprehensive view of

the threat status of each species across scales, we highlight threat status markers across multiple institutional and geographic levels.

Species occurrences map: This map shows the species occurrence data used as input to the SDM process (see section 2 for details). An image of each species is also provided.

Descriptions, habitats, and threats: Short descriptions of each species, their preferred habitats, and threats are included below the threat status. This information provides context beyond the categorical or numerical identifiers. Information on specific habitats and threats.

Current and future habitat suitability maps: Species distribution modeling results for current and future habitat suitability are shown in the bottom two panels. Current habitat suitability maps were created using the ensemble model results. The SSP370, a moderate emissions climate scenario, was used to model future habitat suitability for each species for 2041-2070. The same visualization scale is used in both maps. Maps for alternative climate scenarios are available upon request.

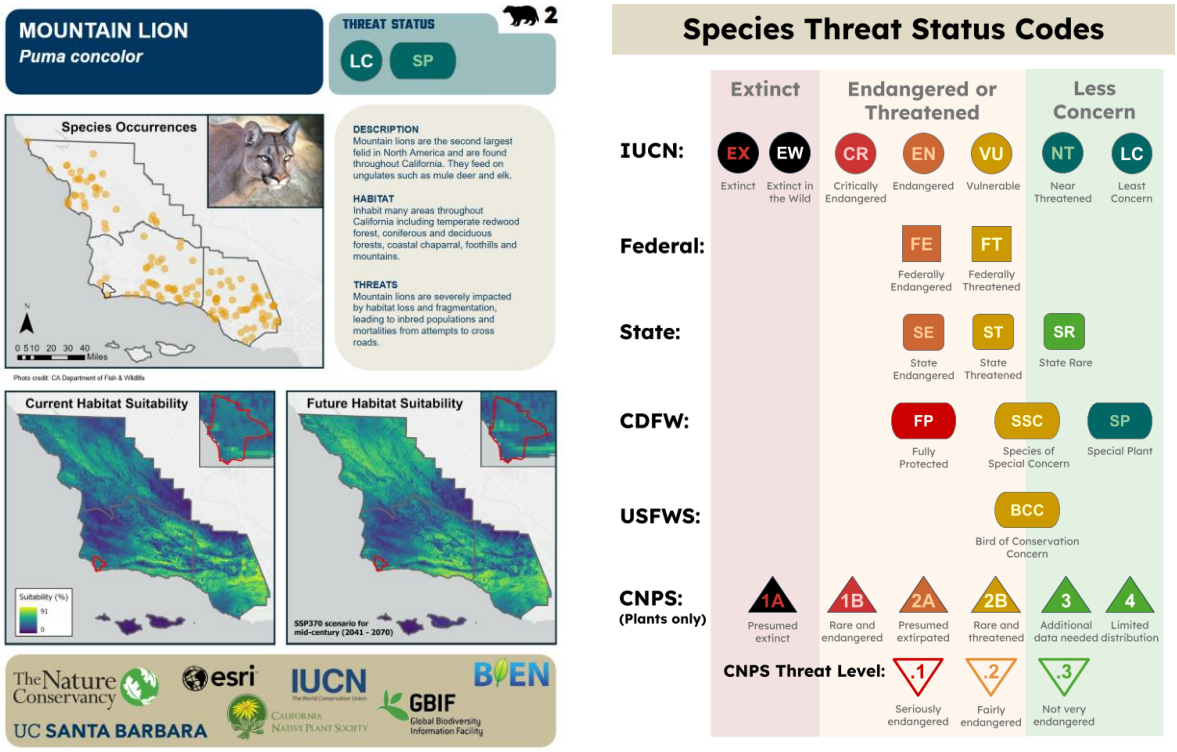

Figure 5. Example species report card (left) and threat status codes (right). IUCN refers to the International Union for the Conservation of Nature's Red List of Threatened Species, Federal refers to species listed as threatened or endangered under the U.S. Endangered Species Act, State refers to species threatened, endangered, or rare under the California Endangered Species Act, CDFW refers to species delineations set by the California Department of Fish and Wildlife, USFWS refers to a specific Bird of Conservation Concern status set by the U.S. Fish and Wildlife Service, and CNPS refers to the plant-specific threat levels set by the California Native Plant Society. The full set of report cards is in Appendix A.

Acknowledgements

We acknowledge generous support from Jack and Laura Dangermond as well as the Center for Spatial Science at the University of California, Santa Barbara.

CRediT Statement: **Conceptualization**: AF, LS, DC; **Data Curation**: XY, YZ, WY, OR, YL, ZL, IL, IP, ET, JV, LS, DC, AF; **Methodology**: XY, YZ, WY, OR, YL, ZL, IL, IP, ET, JV, LS, DC, AF ; **Software**: YZ, XY, WY, OR, YL, LS ; **Validation**: XY, YZ, WY, LS; **Writing (Original Draft)**: XY, YZ, WY, OR, YL ZL, IL, IP, ET, JV, LS, DC, AF ; **Writing (Review & Editing)**: XY, YZ, WY, OR, YL, ZL, IL, IP, ET, JV, LS, DC, AF; **Visualization**: IL, JV, IP, ET, AF; **Supervision**: AF, LS, DC; **Project Administration**: AF; **Funding Acquisition**: AF

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APPENDIX A: SPECIES REPORT CARDS

Background

These species report cards were created by the 2025 UCSB Conservation GIS (GEOG 274) class for the purpose of better understanding special-status species distributions and their future changes in the Jack and Laura Dangermond Preserve (owned by The Nature Conservancy).

Contributors: Zijun Li, Yifei Liu, Izzy Lopez, Isabella Perez, Olivia Ross, Emma Tao, Jacqueline Vogel, Xue Yan, Wenxin Yang, Yanni Zhan

Metadata

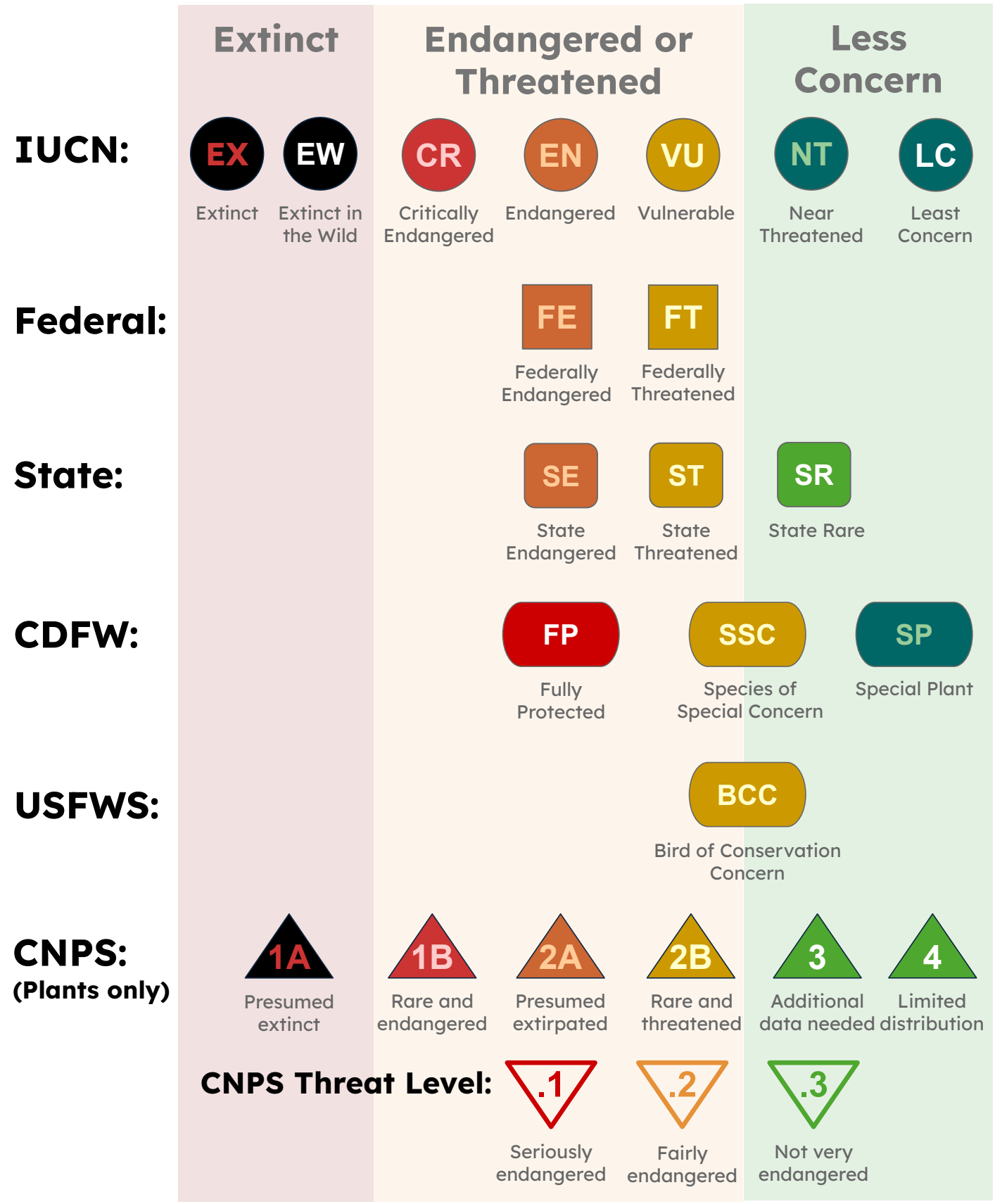
- Species selected from the Jack & Laura Dangermond Preserve Integrated Management Plan “special status species” list
- Species occurrence data includes years 1980 - 2025 and is limited to San Luis Obispo, Santa Barbara, and Ventura counties
- Occurrence data gathered from GBIF, BIEN, Calflora, California Natural Diversity Database (CNDDB), and The Nature Conservancy
- Climate data using Chelsa Climatologies, 1981 - 2010, 2041 - 2070
- Future climate projections mapped using SSP370
- Environmental data gathered from USGS (NASA SRTM), TIGRIS, and processed using terra R package v. 1.8 (Hijmans et al. 2025) and ArcGIS Pro
- Maps made using ArcGIS Pro
- Modeled using SSDM R package v. 0.2.11 (Schmitt et al. 2025)

Advising: Amy Frazier, Lei Song, Diyang Cui

Collaboration from: Point Conception Institute: Kelly Easterday, Mark Reynolds, Elizabeth Hiroyasu

Table of Contents

Species Threat Status Codes



BIRD SPECIES

TRICOLORED BLACKBIRD

Agelaius tricolor

THREAT STATUS

EN ST

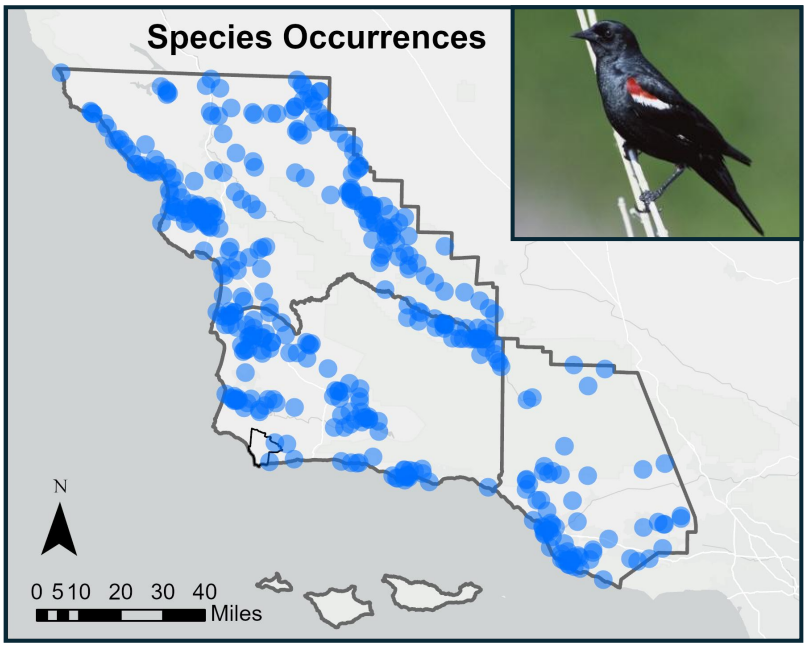


Photo credit: USFWS

DESCRIPTION

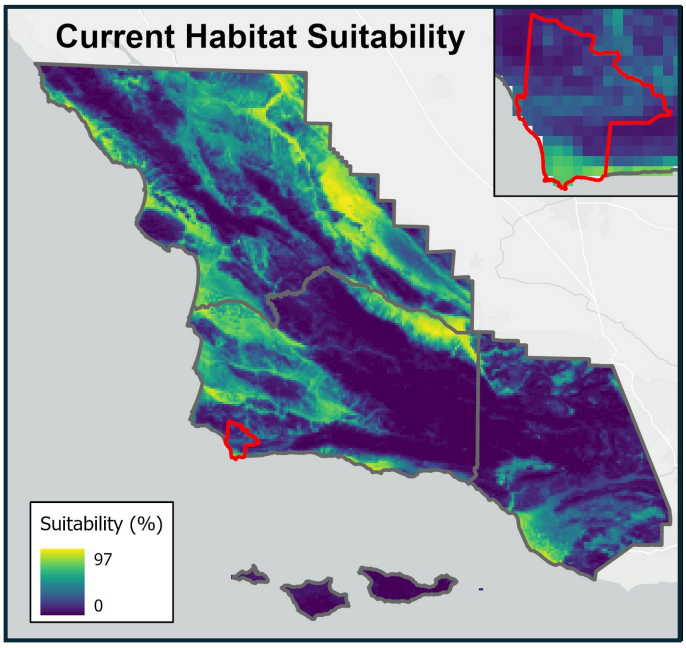
The population has declined by 90% since the 1930s. Its range is limited to coastal areas from northern California to upper Baja California in Mexico.

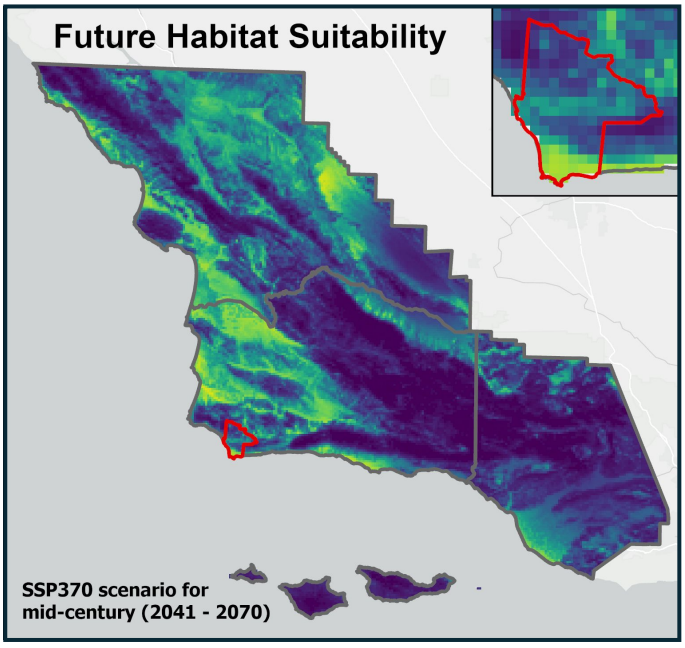
HABITAT

Nest in wetland cattails and bulrushes in the marshes of California, but have adapted to breed and forage in native and non-native vegetation as well as agricultural fields as marshes were lost.

THREATS

Nests in colonies, making them susceptible to environmental change. Anthropogenic change has also reduced marshland habitat.





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GOLDEN EAGLE

Aquila chrysaetos

THREAT STATUS

LC FP

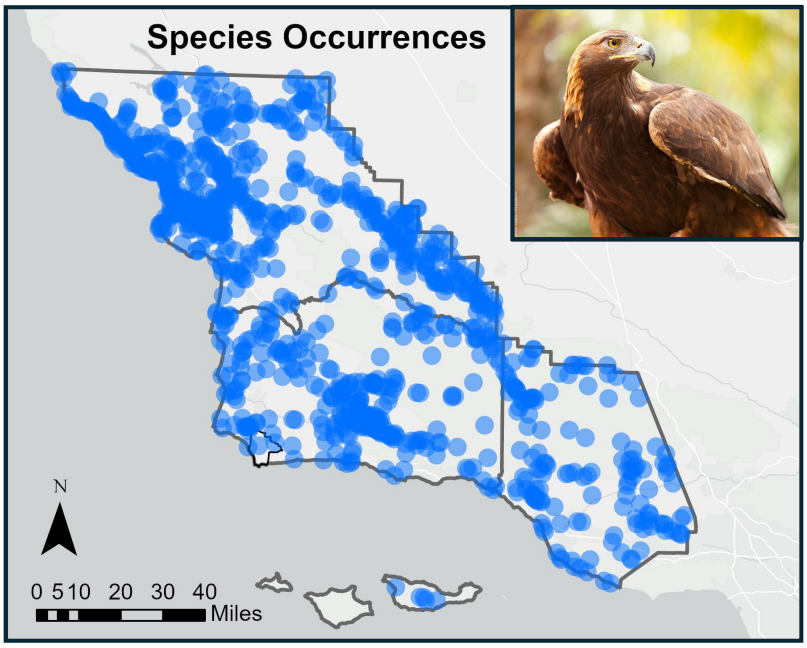


Photo credit: CDFW

DESCRIPTION

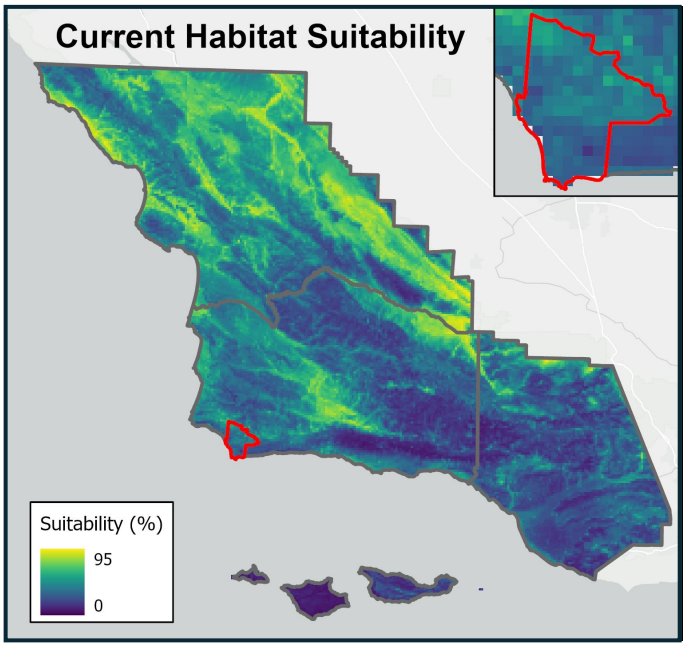
Forage over large areas, feeding primarily on ground squirrels, rabbits, large birds, and carrion. Typically avoid developed areas and heavily forested regions.

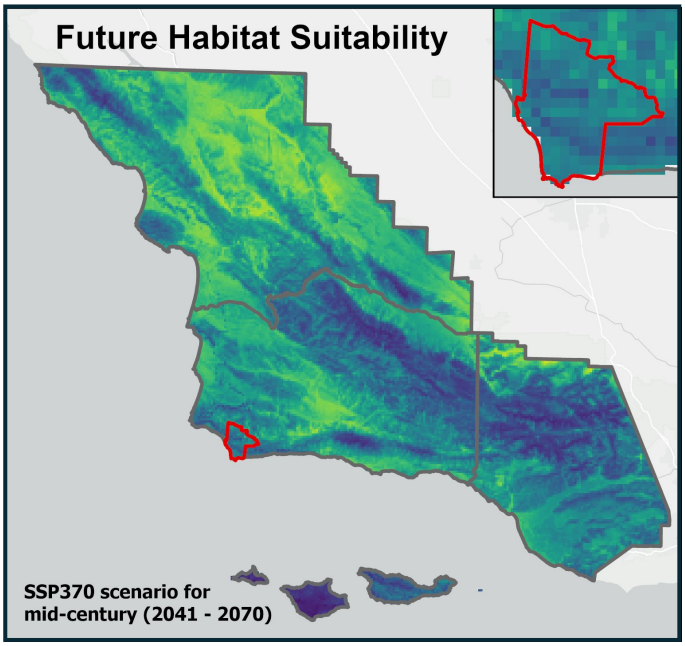
HABITAT

Inhabits shrublands, grasslands, mixed woodlands, and coniferous forests. Typically found in mountainous areas, but may also nest in wetland, riparian, and estuarine habitats.

THREATS

Primary threats include habitat loss due to urbanization and development.





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BURROWING OWL

Athene cunicularia

THREAT STATUS

LC SSC BOCC

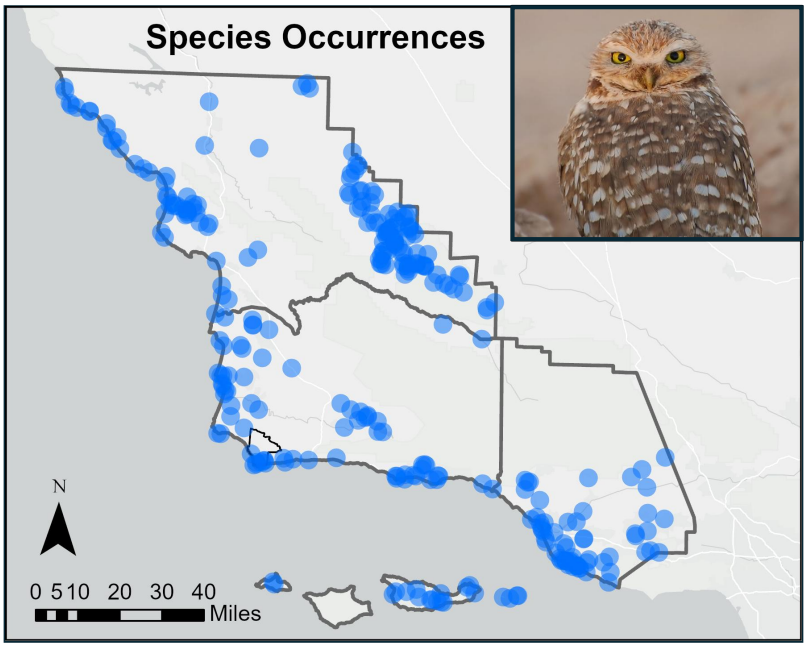


Photo credit: USFWS

DESCRIPTION

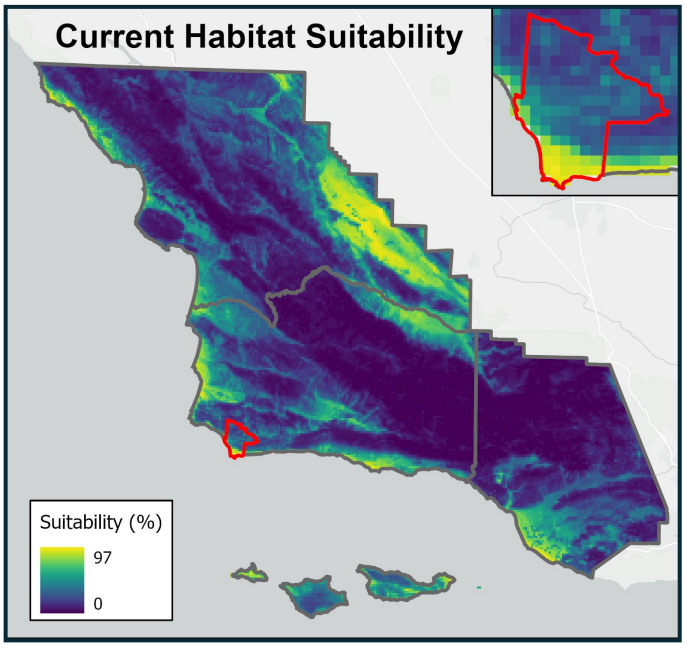
Small, ground-dwelling owl with a round head and no ear tufts. Burrowing owls have a wide range extending to northern South America and into Canada.

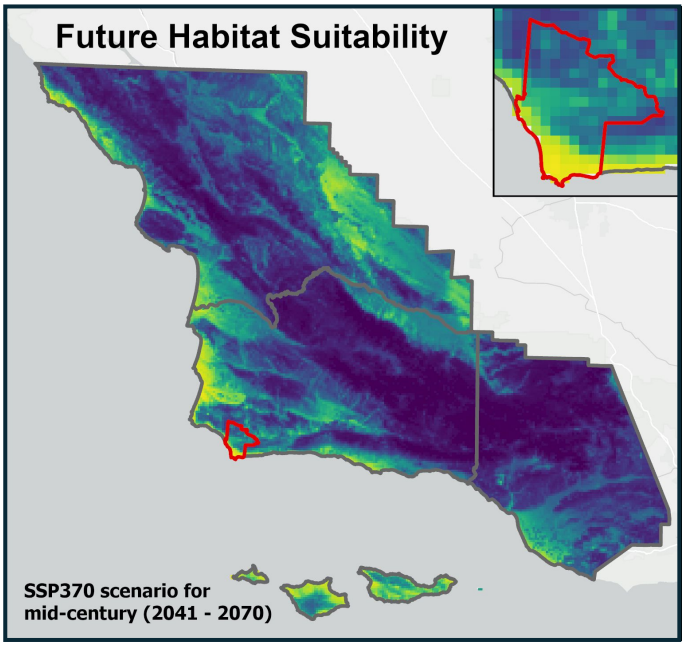
HABITAT

Favor flat, open grasslands or gentle slopes and sparse shrubland ecosystems and sparse or nonexistent tree or shrub canopies.

THREATS

Threats include habitat loss due to development, including agriculture, and loss of burrowing animal populations.





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PIGEON GUILLEMOT

Cepphus columba

THREAT STATUS

LC

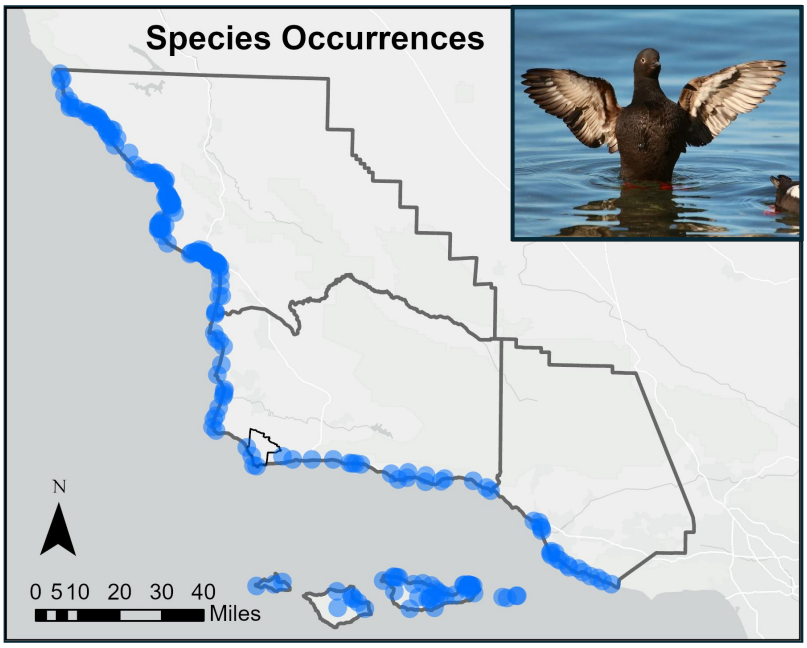


Photo credit: National Audubon Society

DESCRIPTION

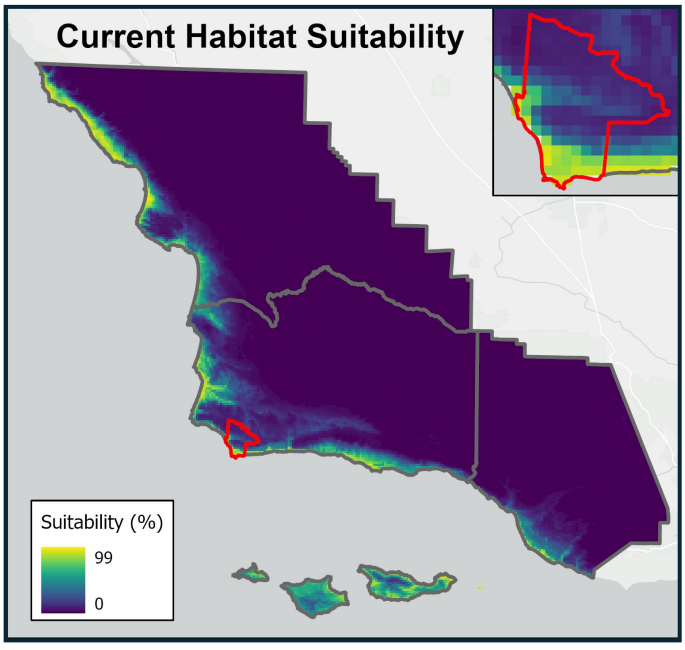
Ranges across the northern Pacific. Breeding plumage is mostly dark brown with a black sheen, with a white wing patch broken by a brown-black wedge.

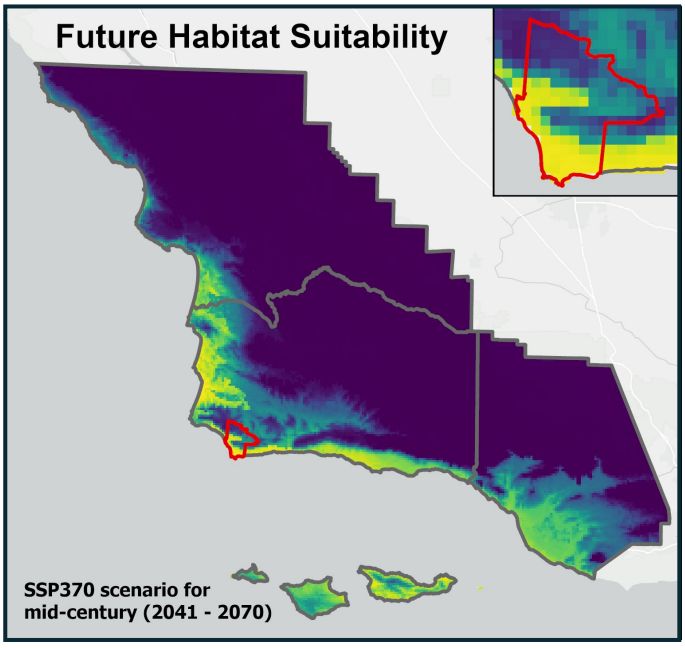
HABITAT

Nests on rocky coastlines of the North Pacific near rocky shores, cliffs, and islands close to shallow water where they feed on small fish and marine invertebrates that they catch by diving.

THREATS

Overabundance of urchins, reduction in habitat, mammalian predators on breeding islands, fishing net entanglement.





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NORTHERN HARRIER

Circus hudsonius

THREAT STATUS

LC SSC

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Photo credit: Steven Sachs via National Audubon Society

DESCRIPTION

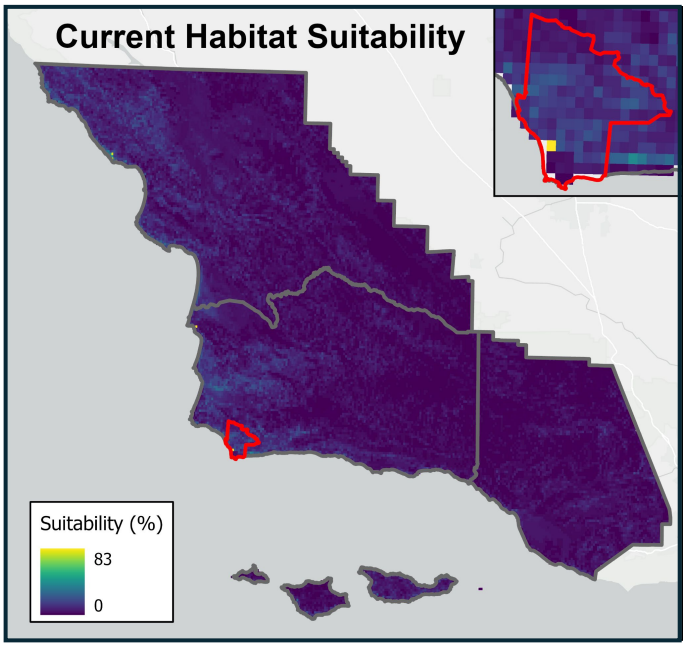
Also known as a 'ring-tail hawk', it is a medium-sized raptor that migrates south but can be found throughout the U.S.

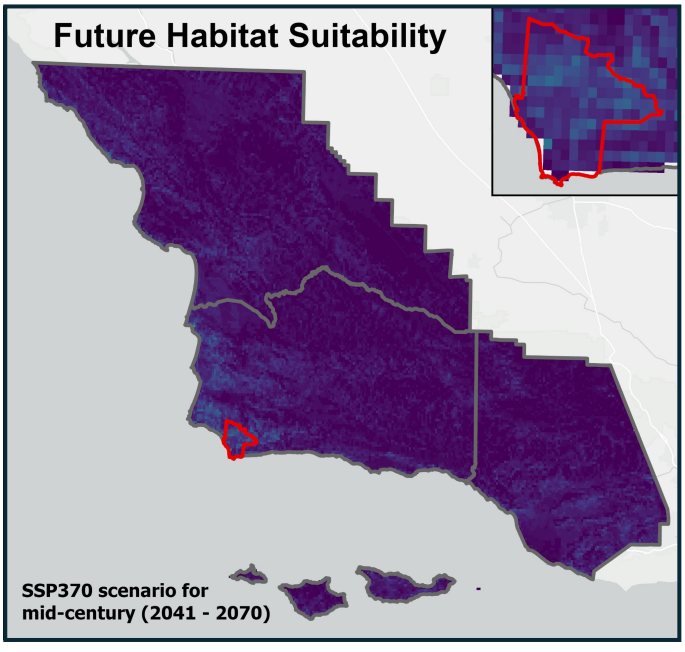
HABITAT

Inhabit and breed in open areas including prairies, marshes, and fields. Nest on the ground, relying on grasses and other vegetation to conceal nests.

THREATS

Threatened by habitat loss from urban development and spread of invasive species, as well as prey population loss.





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WHITE-TAILED KITE

Elanus leucurus

THREAT STATUS

LC

FP

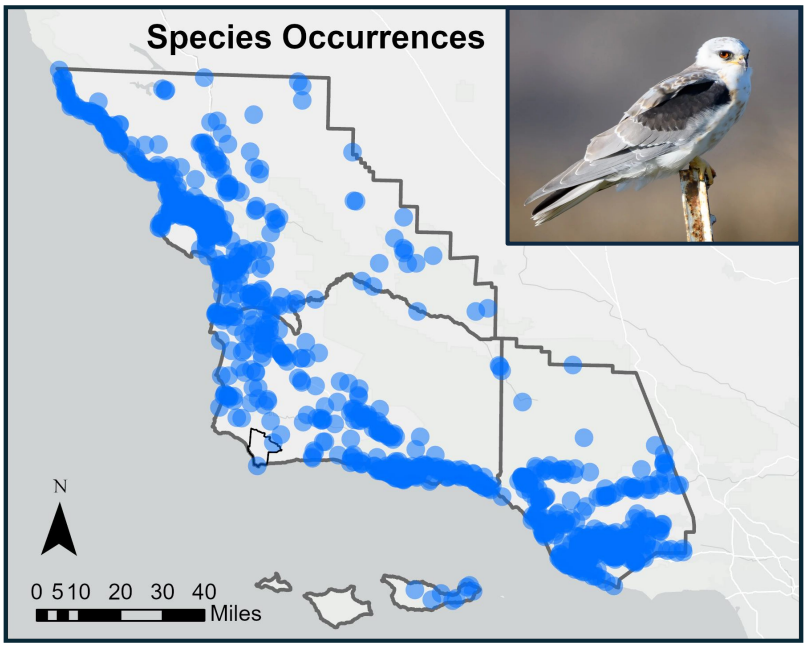


Photo credit: National Audubon Society

DESCRIPTION

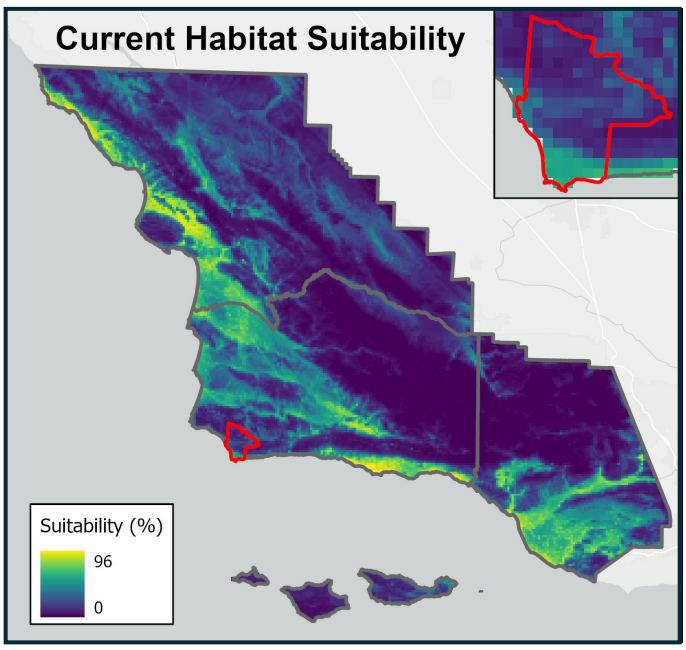
Small raptor that ranges from North America to South America, but has a patchy distribution that includes Goleta.

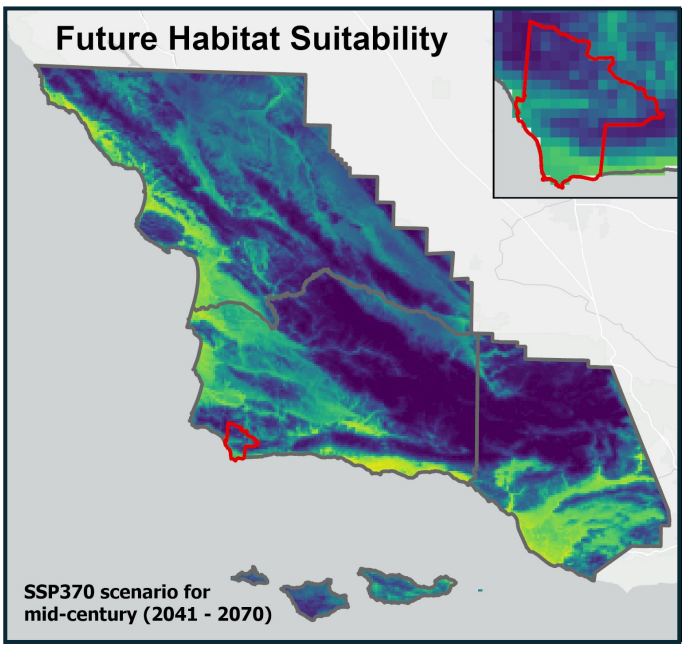
HABITAT

Typically nest at the top of trees, usually around 20-50 feet above ground. Feed primarily on rodents in lowland scrub or grassland areas.

THREATS

Urban and suburban development, reduction in vegetation in cover. Climate change, particularly heat waves, can put young at risk of dehydration.





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SOUTHWESTERN WILLOW FLYCATCHER

Empidonax traillii extimus

THREAT STATUS

LC FE SE

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Photo credit: American Bird Conservancy

DESCRIPTION

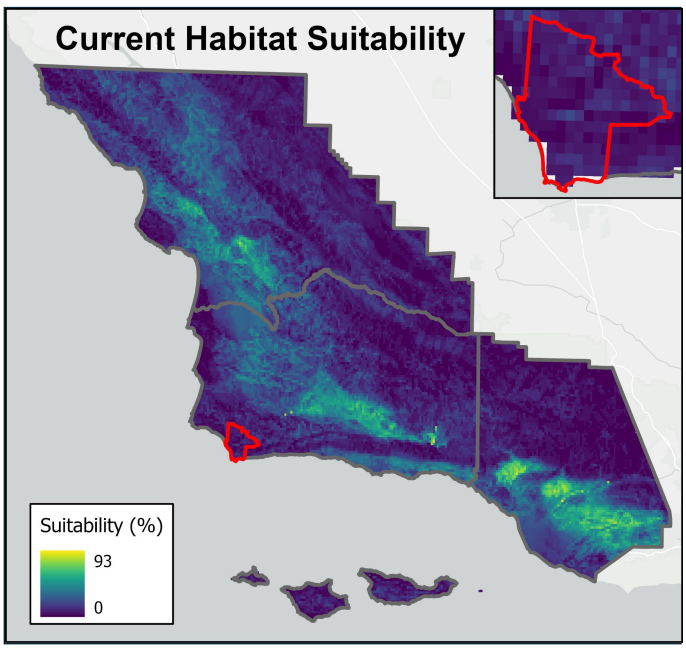
Subspecies of the willow flycatcher found throughout the southwest. Listed as federally endangered since 1995, but populations have since improved.

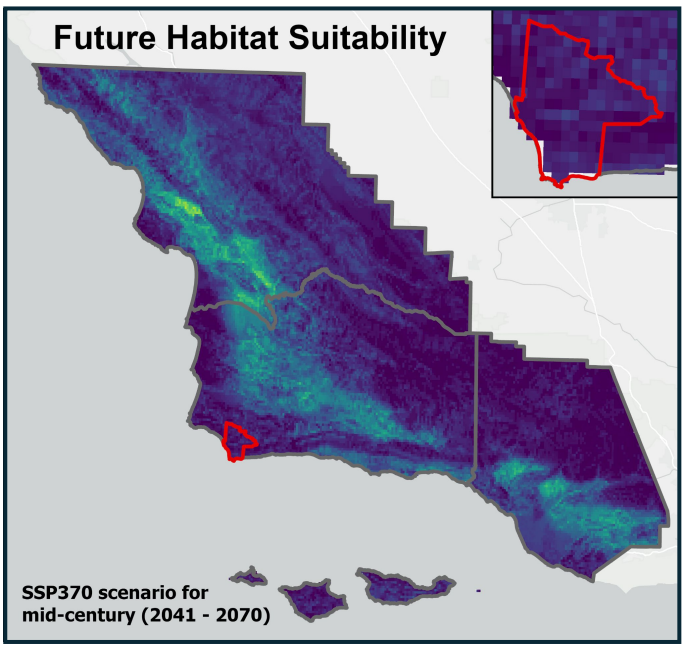
HABITAT

Breed in dense riparian vegetation and rely on wet conditions to breed and build nests in.

THREATS

Habitat degradation due to dam creations as well as agriculture and grazing activities. Habitat loss also often caused by urban development and increased fires.





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AMERICAN PEREGRINE FALCON

Falco peregrinus anatum

THREAT STATUS

LC FP BOCC

Map Intentionally Left Blank

Photo credit: Carpenter Nature Center

DESCRIPTION

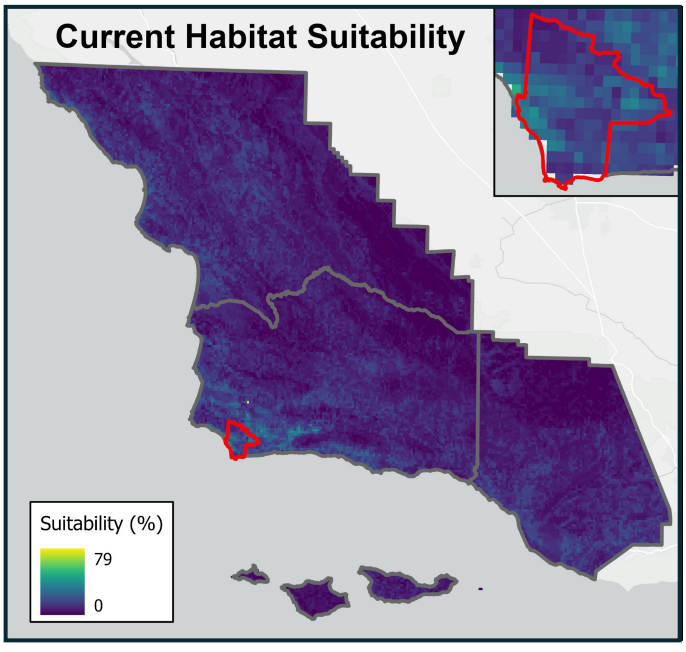
A fast-flying falcon found throughout parts of North America. Populations dramatically declined in the mid-20th century, but have since been in recovery.

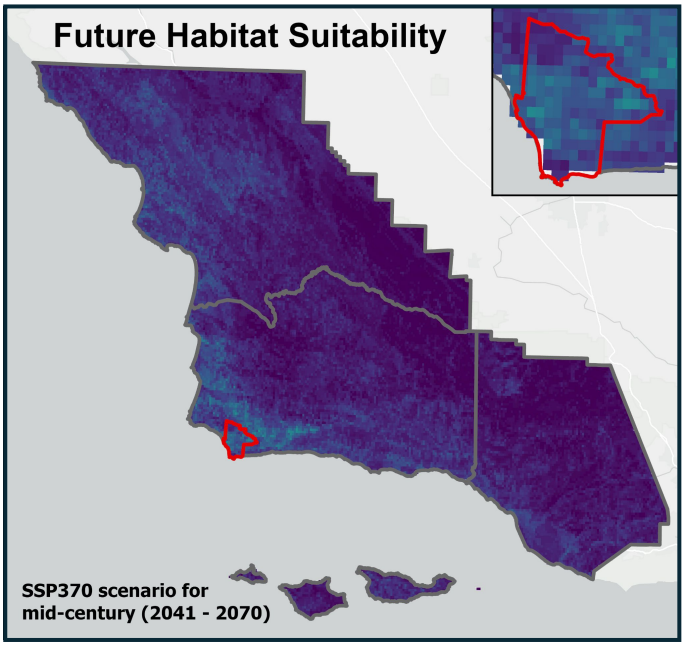
HABITAT

Can be found along rivers, coastlines, mountains, and in cities. Adapted to feed on a wide variety of different prey, including other smaller bird species.

THREATS

Lead poisoning from shot prey, habitat destruction and anthropogenic disturbances, environmental pollution.





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BLACK OYSTERCATCHER

Haematopus bachmani

THREAT STATUS

LC

BOCC

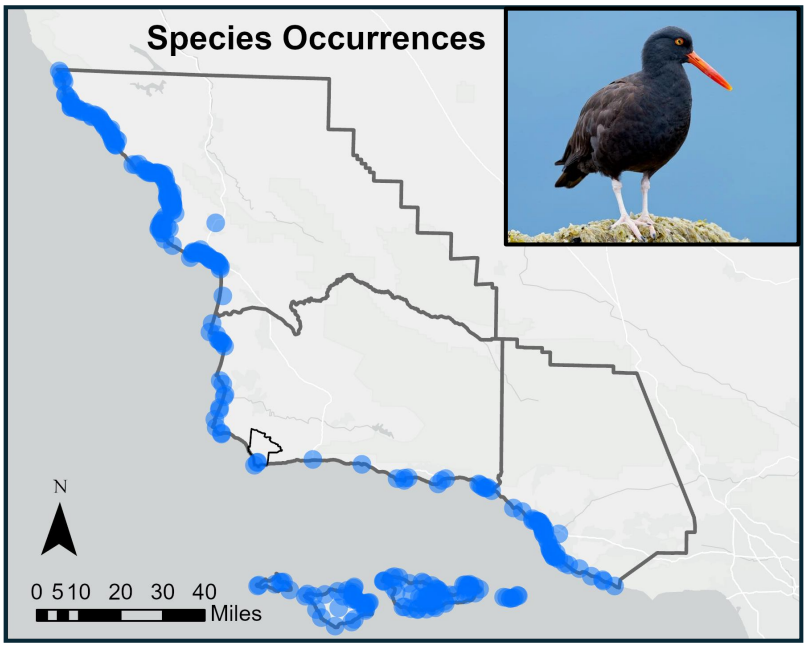


Photo credit: National Audubon Society

DESCRIPTION

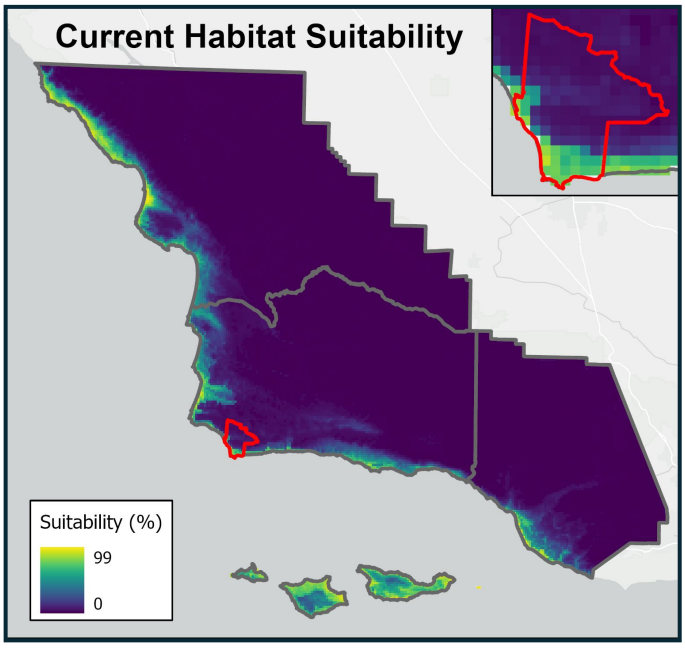
Migratory species that ranges from the Aleutian Islands of Alaska to Baja California along the West Coast.

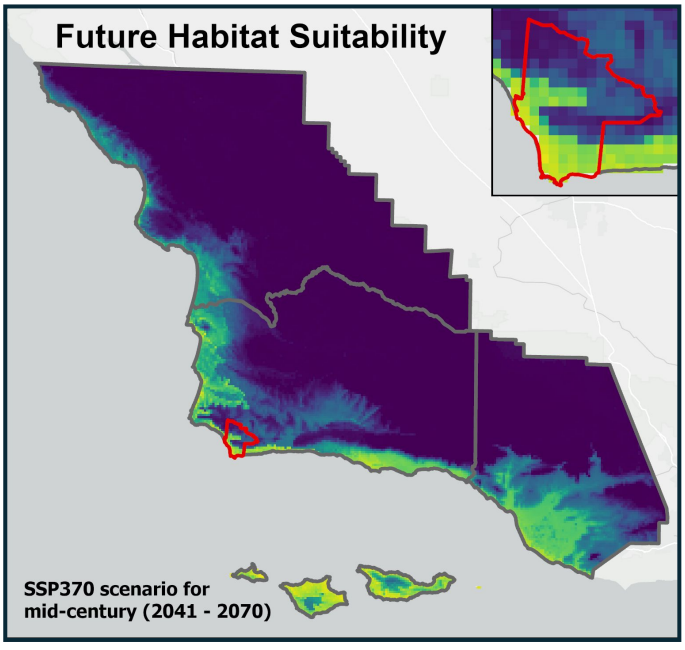
HABITAT

Favors rocky shorelines that include quieter embayments, such as jetties or other protected areas. Forages in the intertidal zone, feeding on marine invertebrates.

THREATS

Primary threats include coastal development and habitat loss as well as beach disturbance and oil spills. Nest flooding due to climate change may also be an issue in the study area.





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BALD EAGLE

Haliaeetus leucocephalus

10

THREAT STATUS

LC | SE | FP | BOCC

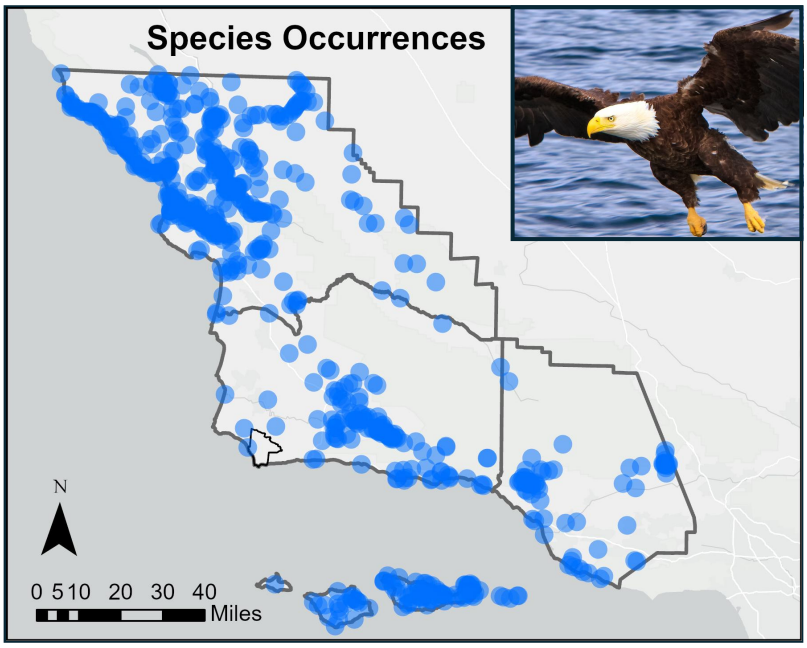


Photo credit: National Geographic

DESCRIPTION

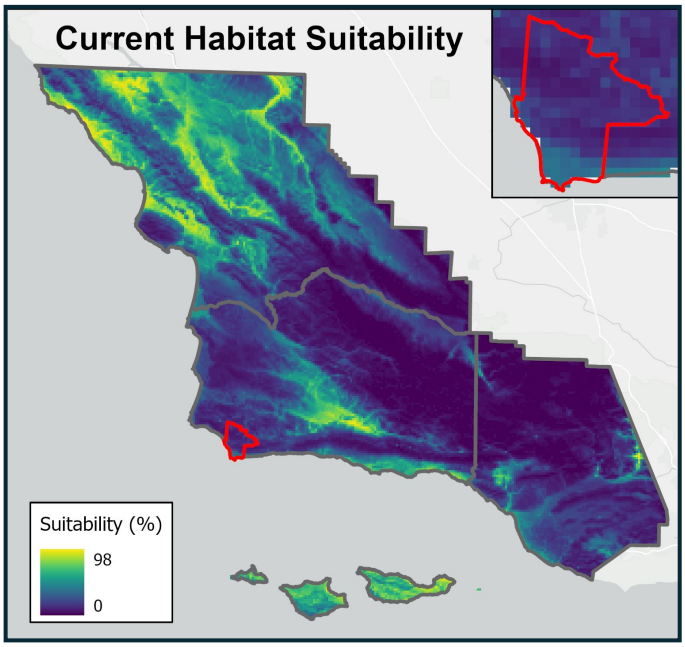
Migratory bird of prey; range includes most of North America. Opportunistic feeder, diet subsists mainly on fish.

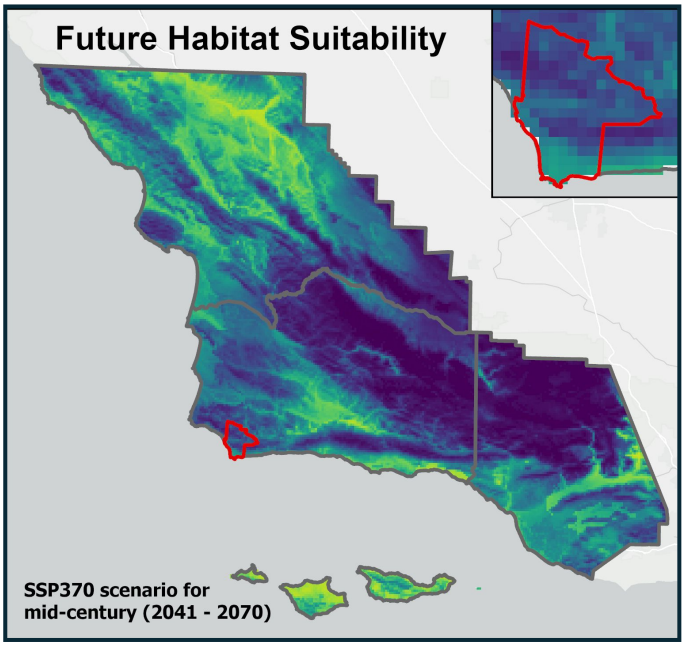
HABITAT

Can be found near bodies of water including coasts, rivers, lakes, and reservoirs during breeding season. Typically nest in large stands of coniferous or hardwood trees.

THREATS

Lead poisoning from shot prey, vehicle and stationary structure collison, shoreline development, habitat destruction, environmental pollution.





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CASPIAN TERN

Hydroprogne caspia

THREAT STATUS

LC

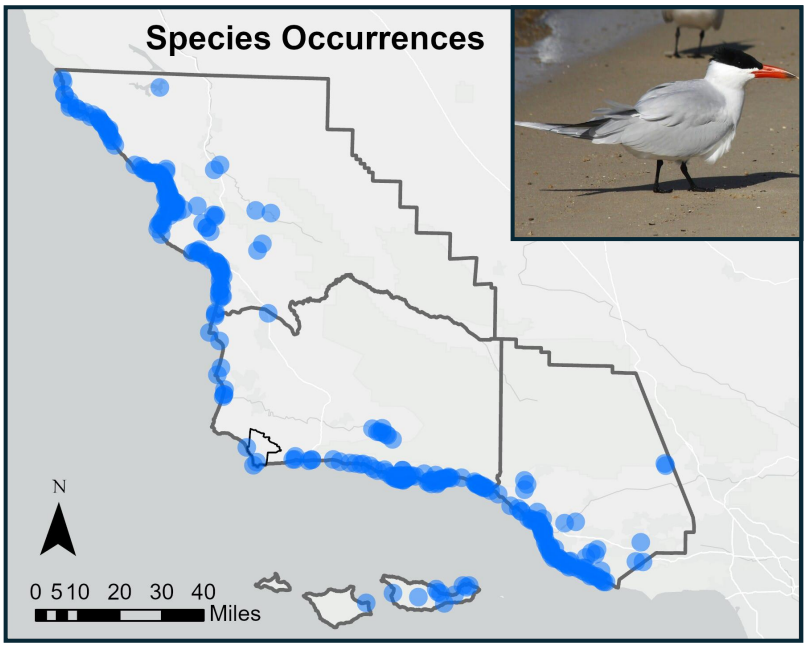


Photo credit: Cornell Lab of Ornithology

DESCRIPTION

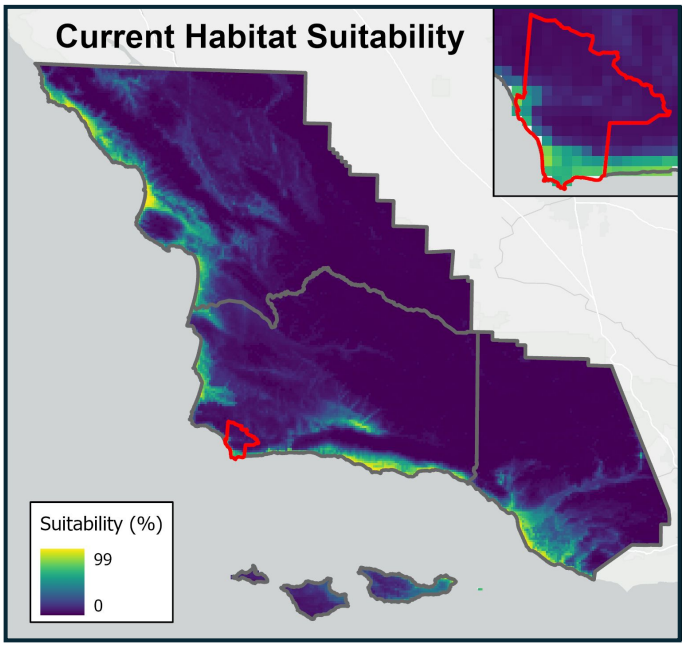
World's largest tern, have a scattered and extensive range. Diet consists primarily of fish

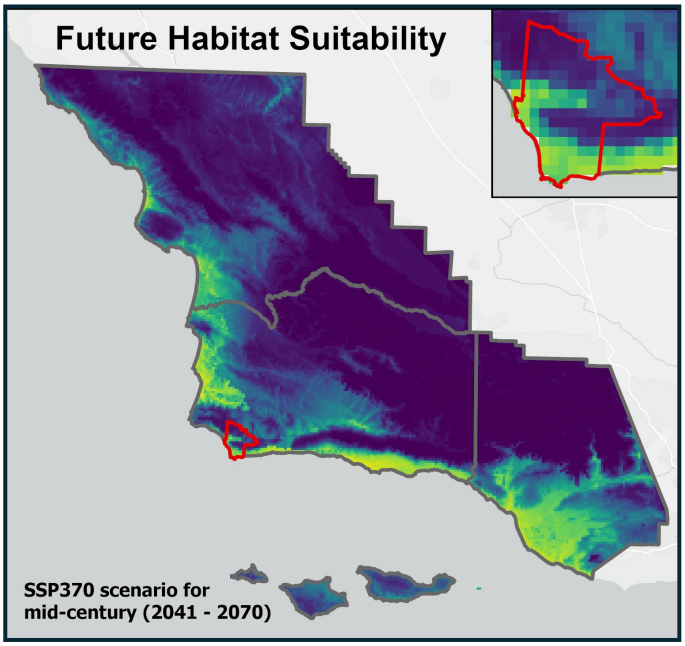
HABITAT

Found along coasts and locally inland near large bodies of water including lakes, ponds, rivers, and saltwater wetlands.

THREATS

Hunting, pesticide, other pollutants, disturbance of colonies, loss of breeding areas to sea level rise.





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LOGGERHEAD SHRIKE

Lanius ludovicianus

THREAT STATUS

NT SSC BOCC

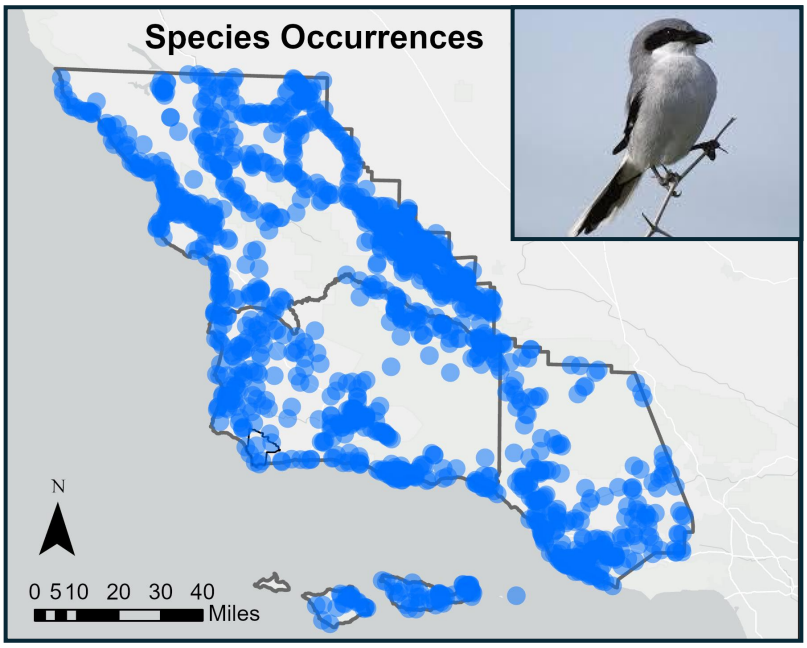


Photo credit: Audubon California

DESCRIPTION

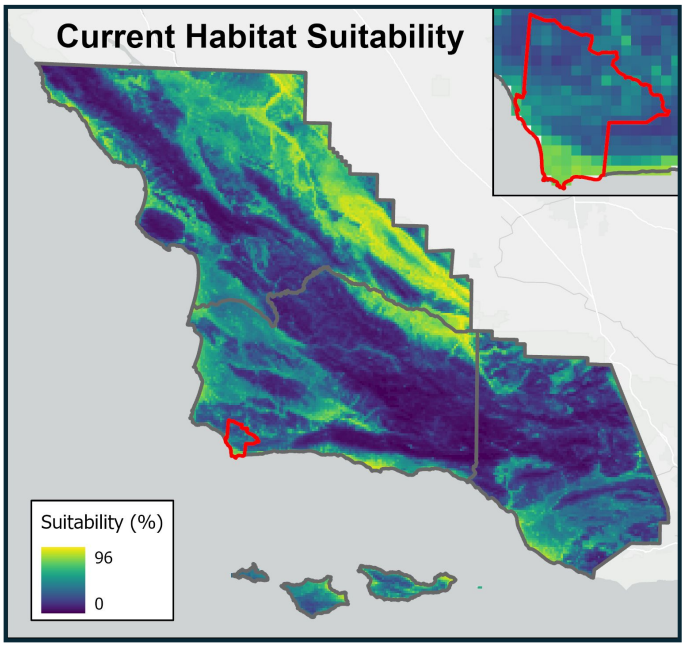
Small predatory bird found throughout North America. Diet consists of insects, amphibians, lizards, small mammals and other small birds.

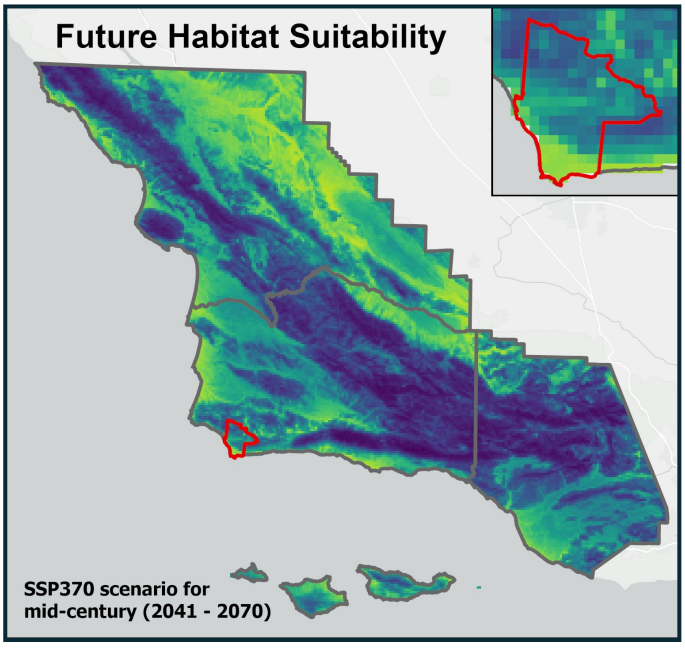
HABITAT

Found in grasslands, shrublands, and open pastures. Nest in shrubs or small trees.

THREATS

Chemical pesticides, vehicle collision, urban development, habitat destruction and conversion, prey population alteration.





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OSPREY

Pandion haliaetus

THREAT STATUS

LC SSC

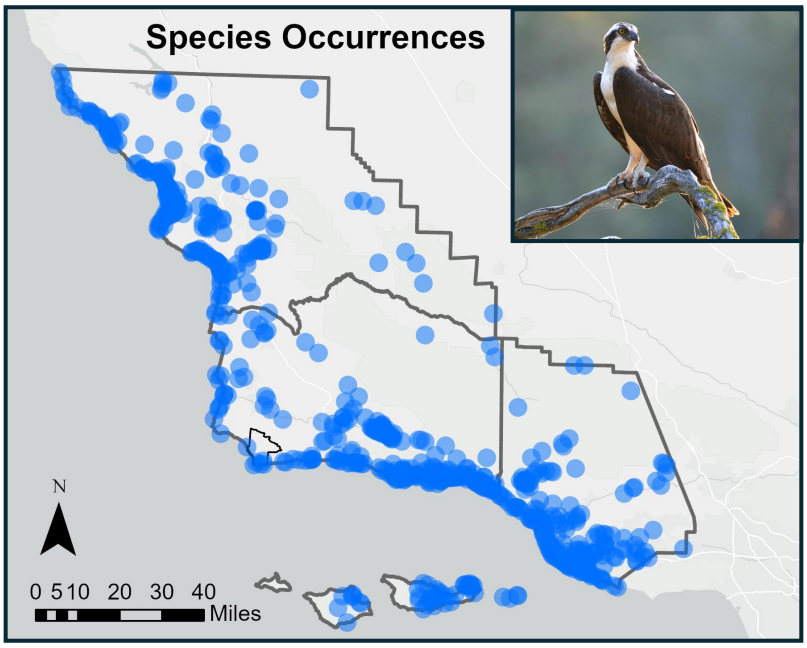


Photo credit: NPS

DESCRIPTION

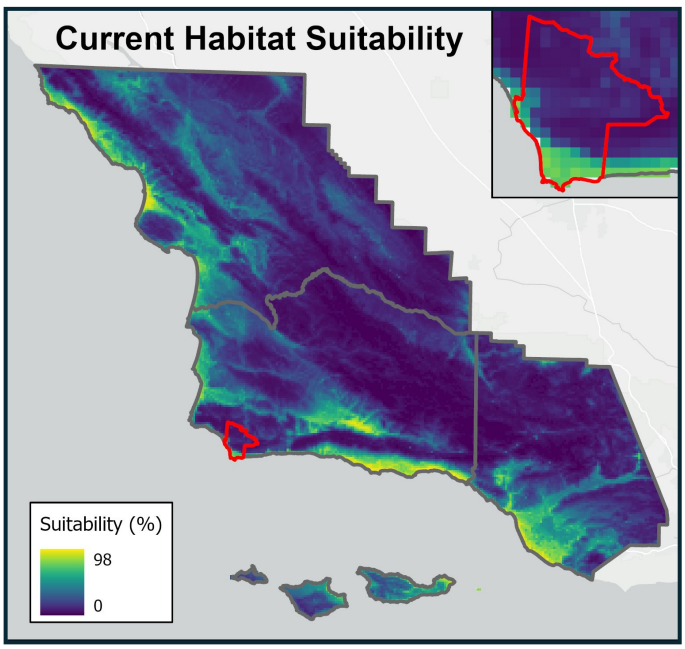
Ospreys are a large migratory species of raptor with a wide global distribution, Diet consists mostly of fish.

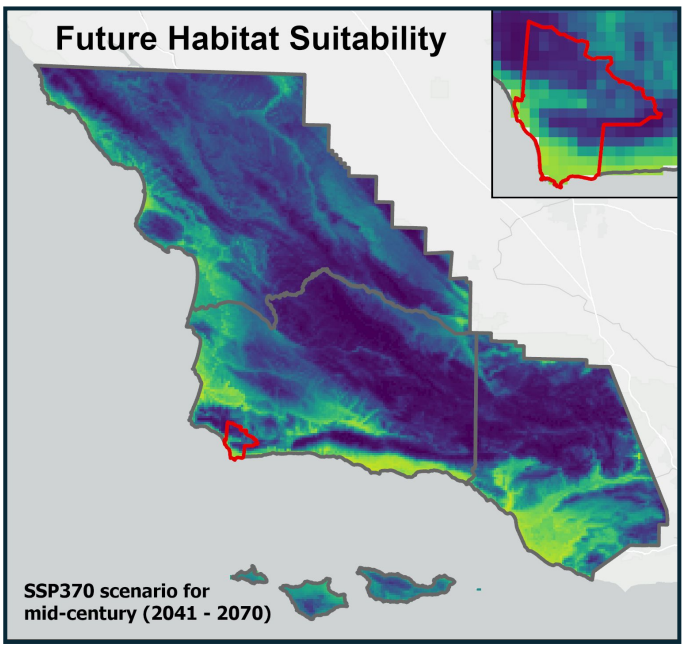
HABITAT

Can be found in a wide variety of habitats; breed near near bodies of water including freshwater lakes and rivers.

THREATS

Ospreys are threatened by pesticide usage, tree removal, shoreline development, entanglement with man made nest material.





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BRANDT'S CORMORANT

Phalacrocorax penicillatus

THREAT STATUS

LC

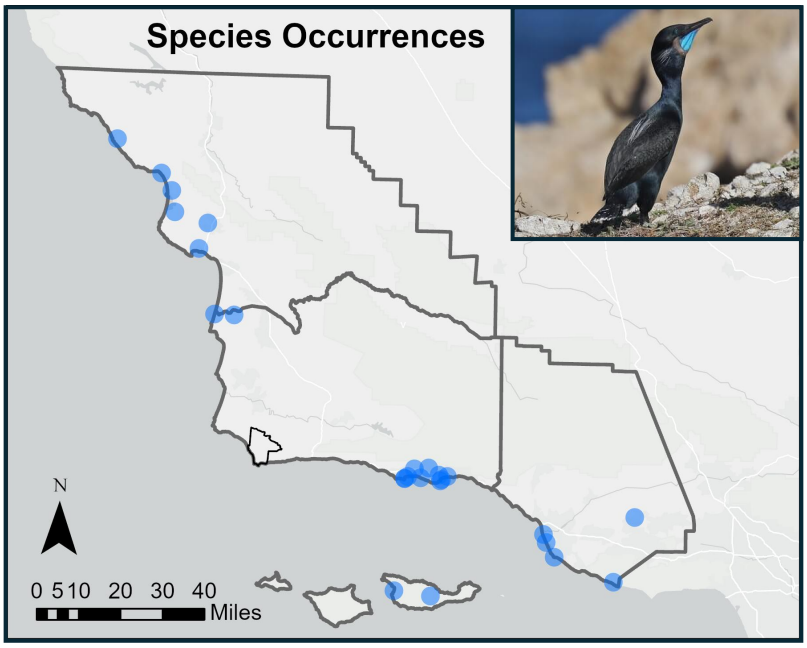


Photo credit: Cornell Lab of Ornithology

DESCRIPTION

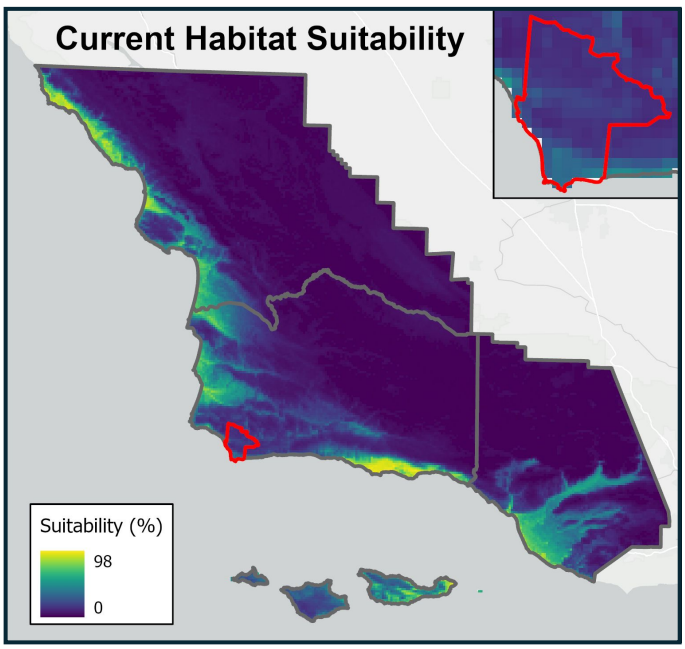
Coastal divers; breed along Pacific coast, primarily between Washington and California. Nest in colonies on cliffs, islands, and offshore rocks.

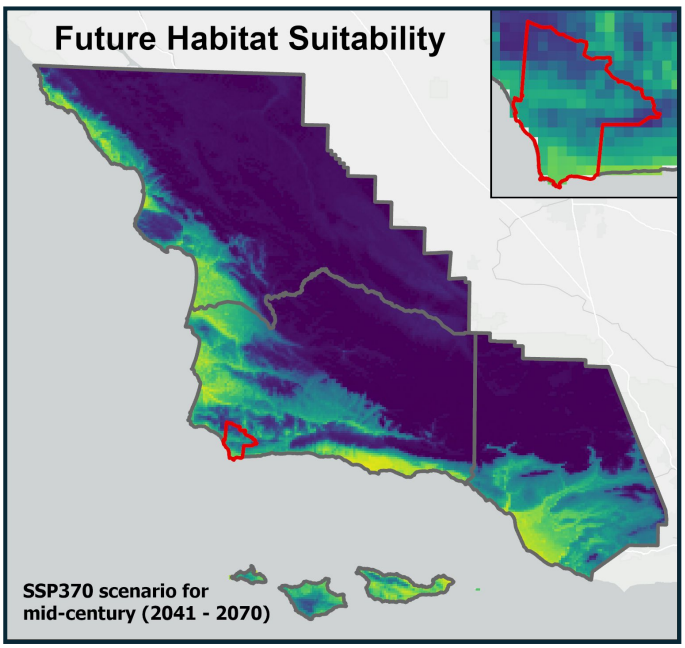
HABITAT

Found throughout the coastline of North America near inlets, bays, sounds, lagoons, and estuaries.

THREATS

Shot by humans; disturbance by humans, dogs, aircrafts, boats; oil spills and chemical pollution.





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YELLOW WARBLER

Setophaga petechia

THREAT STATUS

LC | SSC | BOCC

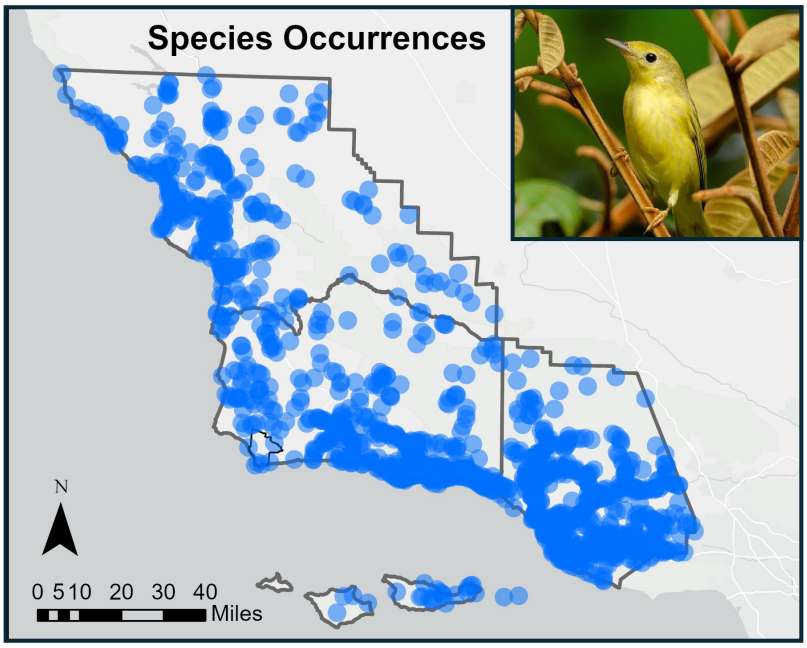


Photo credit: American Bird Conservancy

DESCRIPTION

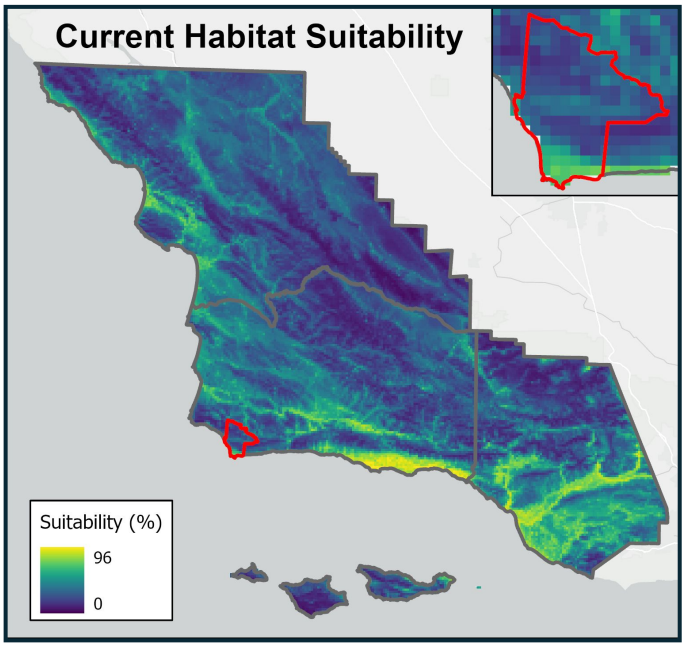
Consume mostly insects supplemented by berries, nest placed in vertical fork of vegetation, migratory form breed in North America.

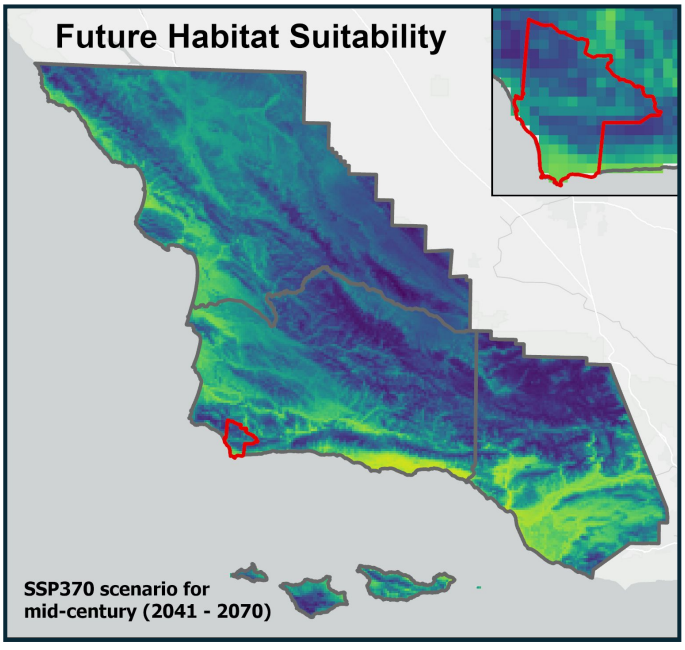
HABITAT

Elevation between 300-9000 ft in CA (higher along riparian growth); breed in wet, deciduous thickets with willows and disturbed or in early successional stage.

THREATS

Brood parasitism from brown-headed cowbirds, habitat destruction, collision with man made structures.





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LEAST TERN

Sternula antillarum

THREAT STATUS

LC

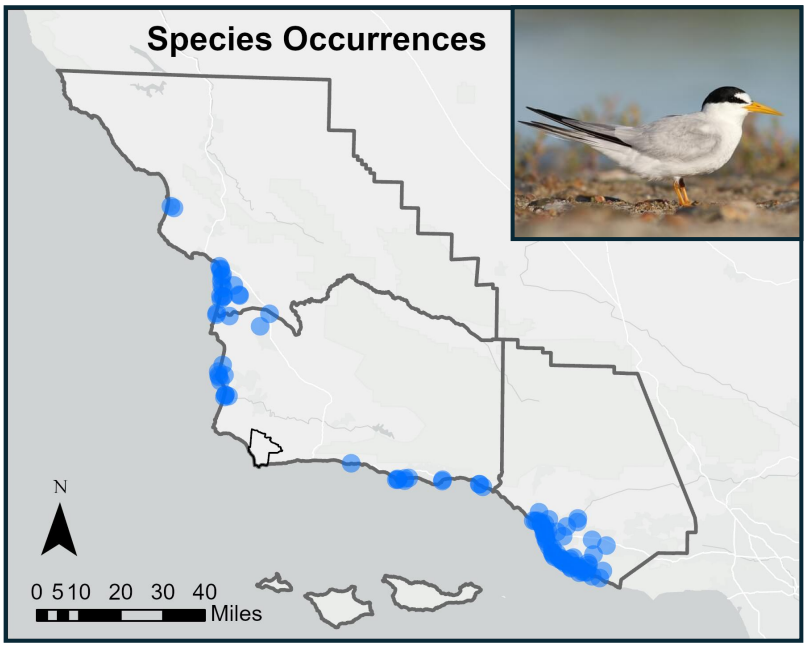


Photo credit: Cornell Lab of Ornithology

DESCRIPTION

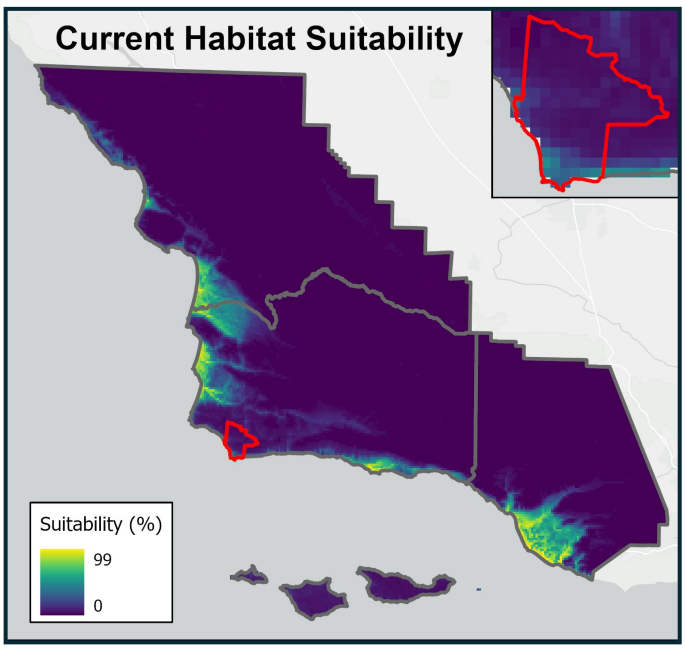
Local in northern South America and breeds in North America, consumes mostly small fish, nest in colonies.

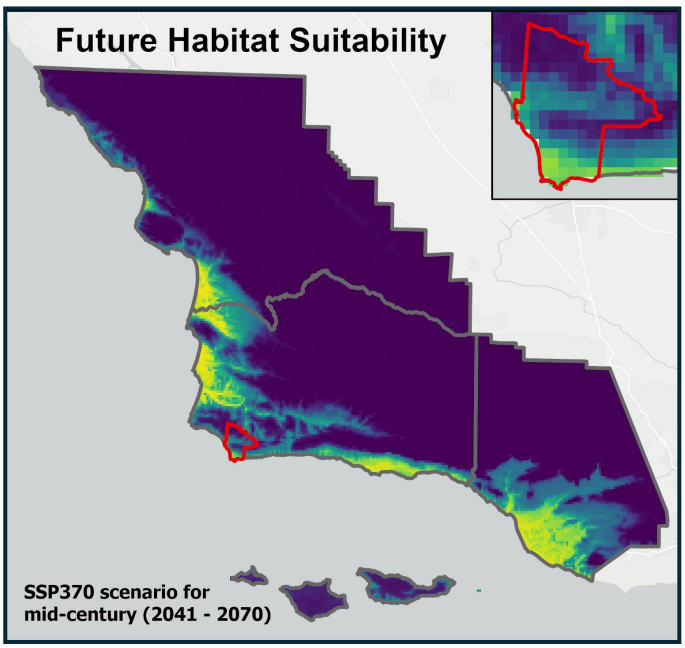
HABITAT

Mostly on sandy beaches or island coastlines and rivers; sometimes in gravel pits, on dredge spoil, dry mudflats, flat rooftops, parking lots, agricultural fields, and airports.

THREATS

Human recreation, development, and alteration of nesting habitat; pollutants affecting water and fish quality; changes in prey availability and distribution; sea level rise.





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YELLOW-HEADED BLACKBIRD

Xanthocephalus xanthocephalus

THREAT STATUS

LC SSC

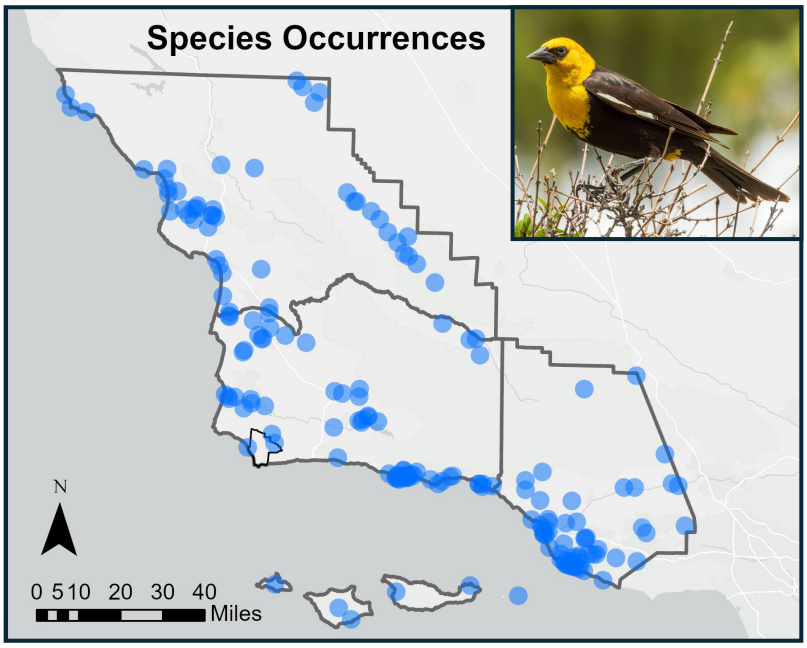


Photo credit: USFWS

DESCRIPTION

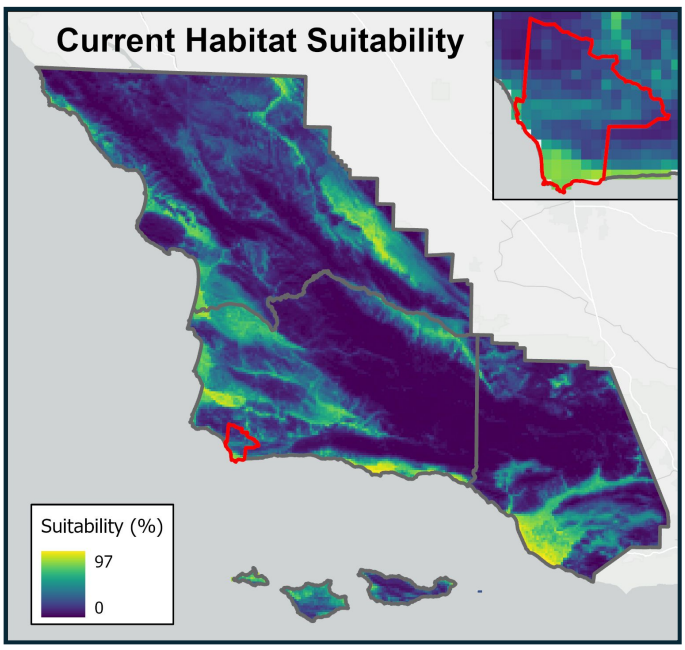
Sexually dimorphous; mostly consume insects in the summer and seeds rest of the year.

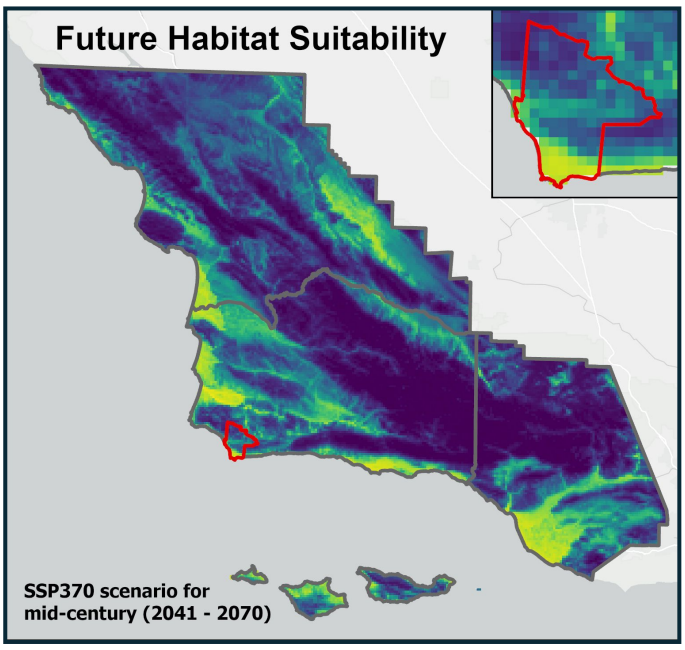
HABITAT

Summer resident of Southern California, nests in marshes with tall emergent vegetation and relatively deep water.

THREATS

Wetland drainage (only breed in wetlands), exposure to herbicides and pesticides.





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HERPETOFAUNA & INVERTEBRATE SPECIES

PACIFIC POND TURTLE

Actinemys marmorata

THREAT STATUS

VU SSC

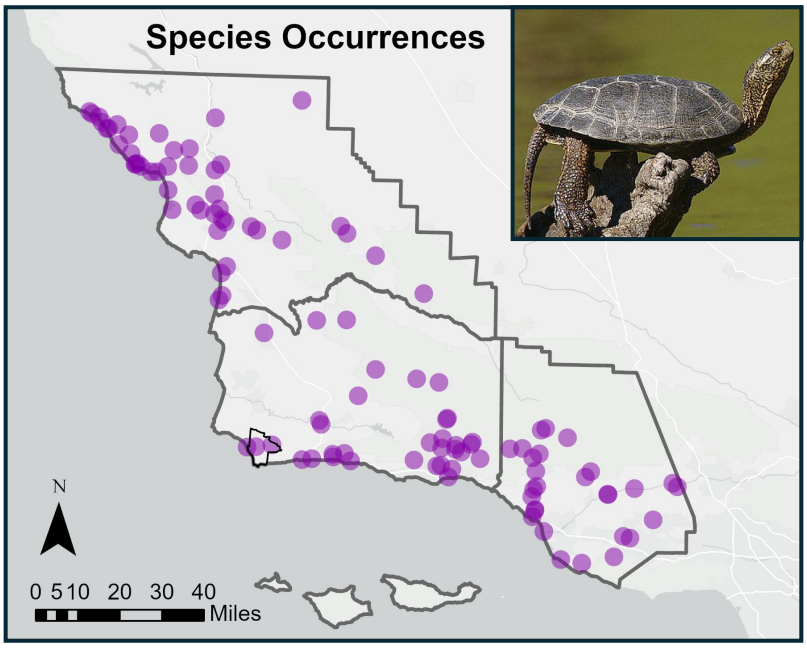


Photo credit: Center for Biological Diversity

DESCRIPTION

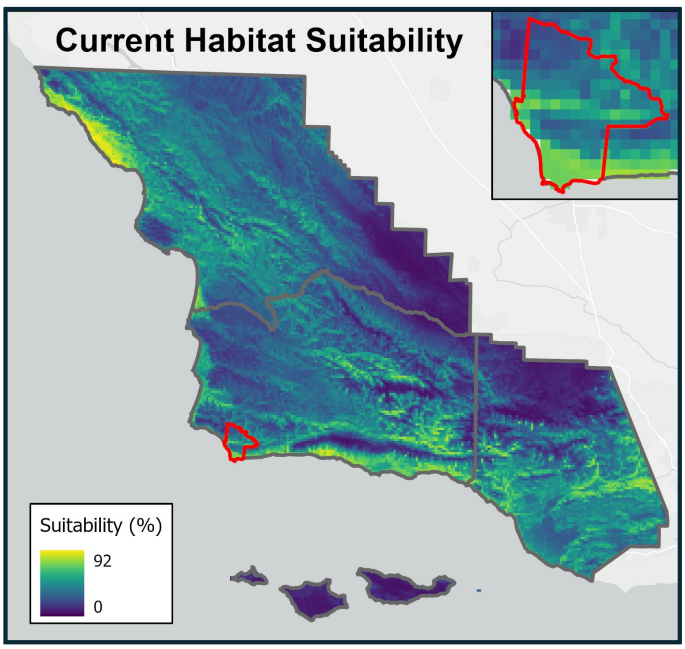
The Pacific pond turtle is the only native pond turtle throughout most of California. They are found from sea level to 5,500 feet in elevation.

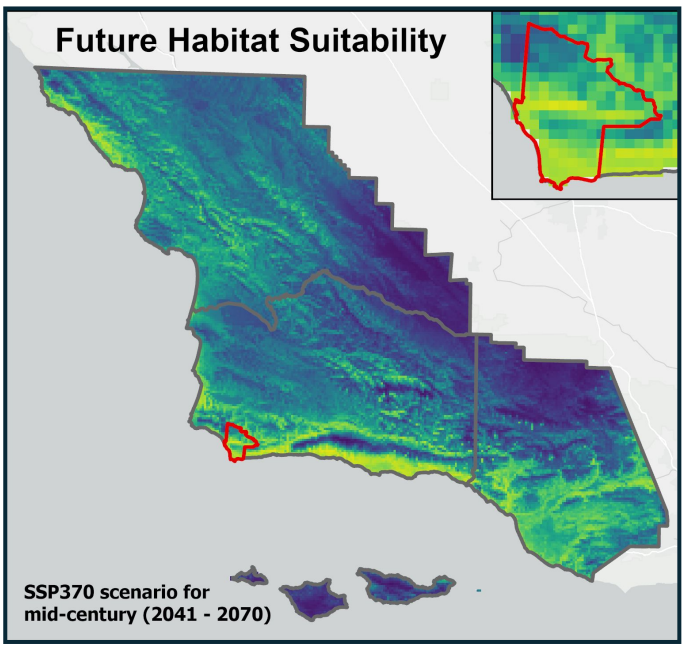
HABITAT

Found in ponds, lakes, rivers, streams, creeks, marshes, and irrigation ditches. Logs, rocks, cattail mats, and exposed banks are required for basking.

THREATS

Pacific Pond Turtles are threatened by habitat loss and fragmentation, disease, and invasive species.





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MONARCH BUTTERFLY

Danaus plexippus

THREAT STATUS

EN SSC

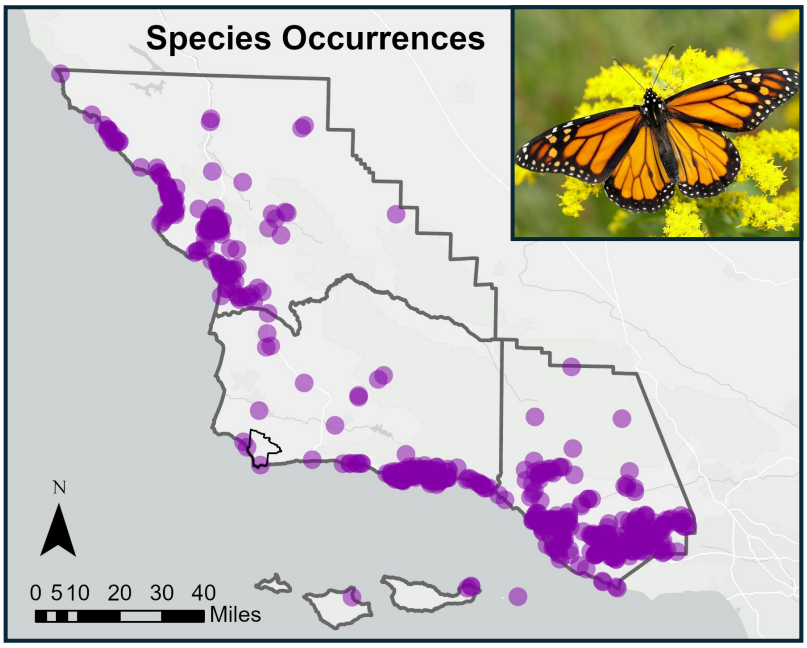


Photo credit: butterfly-conservation.org

DESCRIPTION

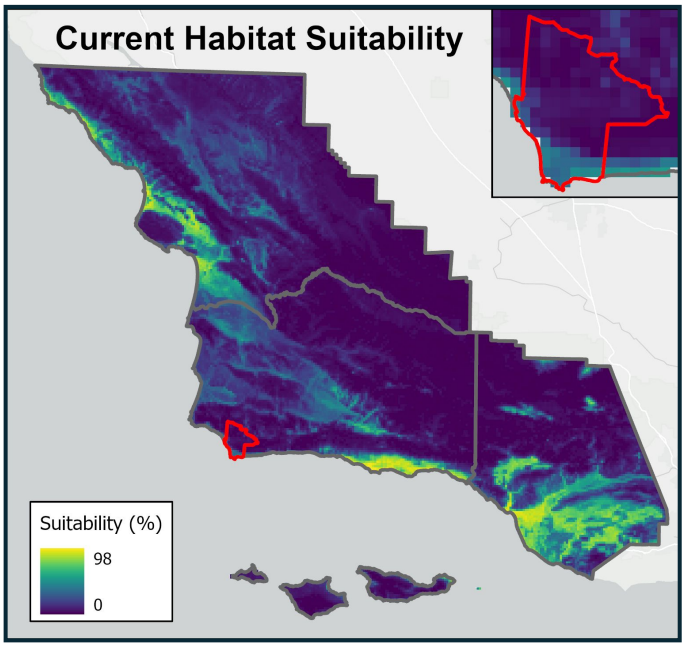
Monarchs are migratory pollinators and rely on milkweed (*Aesclepius* spp.) as a host plant. Western populations overwinter in coastal California.

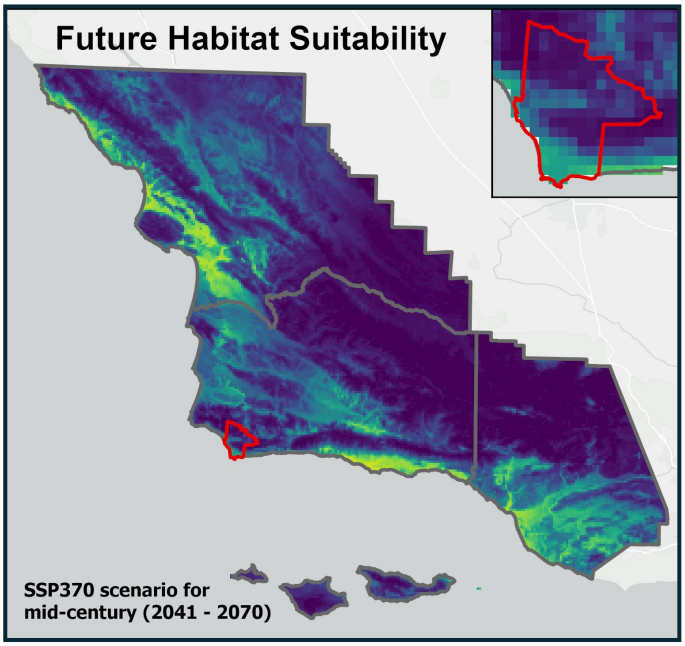
HABITAT

Throughout California, Monarchs overwinter in clusters on blue gum eucalyptus, Monterey pine, and Monterey cypress trees.

THREATS

Listed as endangered due to a variety of threats including loss of host plant populations, habitat degradation, disease, and climate change.





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CALIFORNIA RED-LEGGED FROG

Rana draytonii

THREAT STATUS

VU

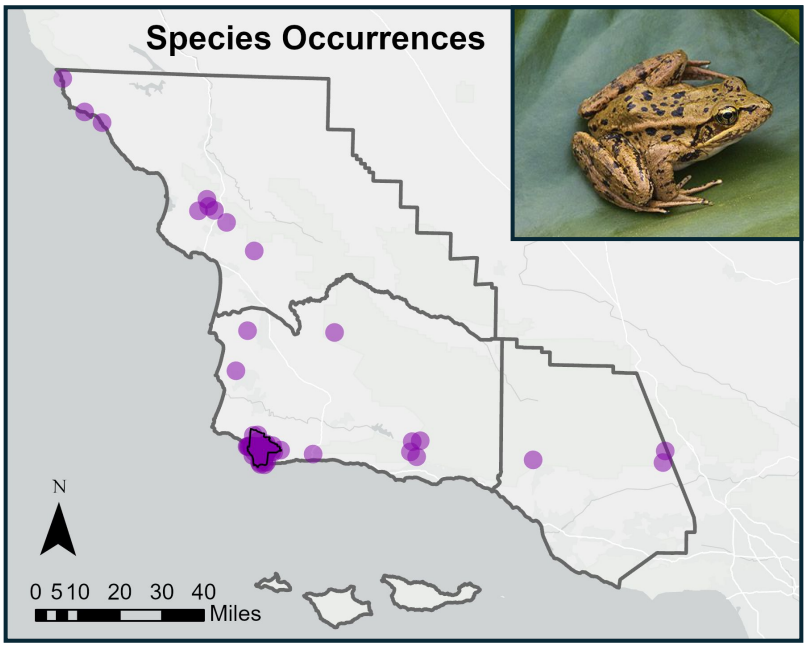


Photo credit: National Wildlife Federation

DESCRIPTION

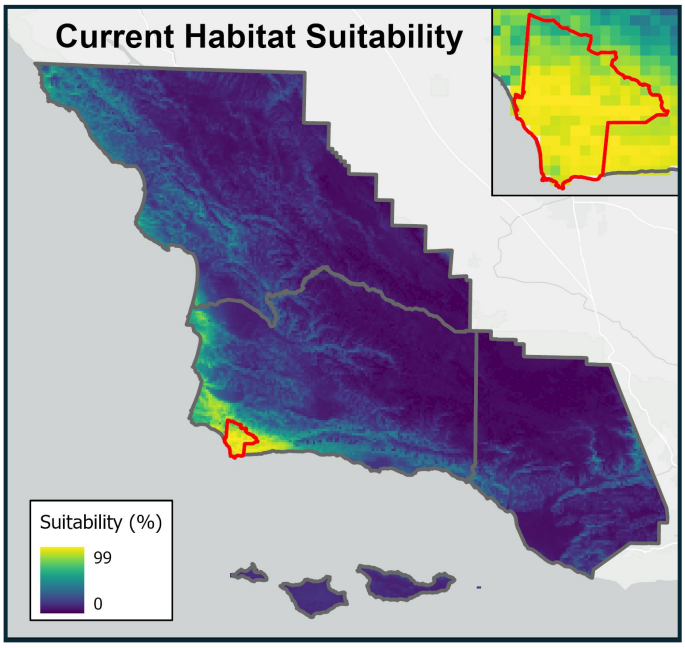
Largest native frog in western US. Adults are largely nocturnal; active year-round near the coast. Diet is invertebrates and small vertebrates.

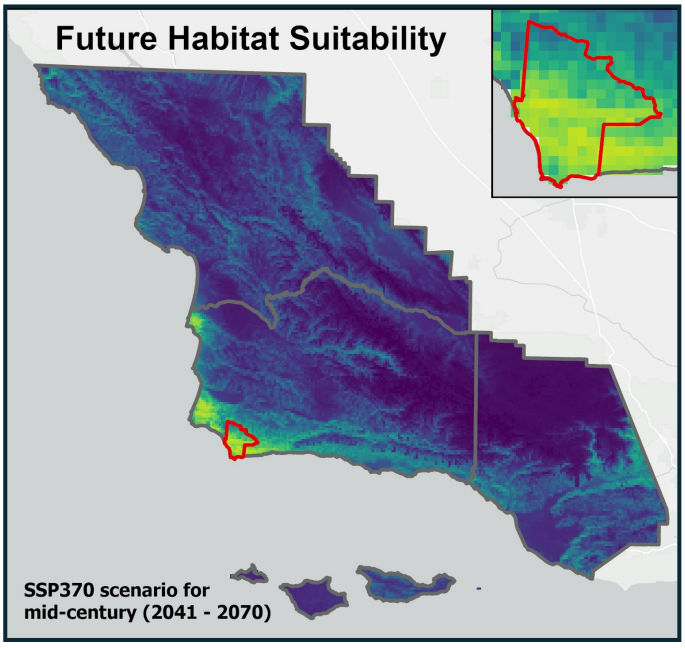
HABITAT

Found in and around water sources such as streams or stock ponds. Benefit from rocks and boulders, leaf litter, and stream channels for hiding.

THREATS

California red-legged frogs are threatened by habitat loss and alteration (agriculture and urban development), non-native species.





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TWO-STRIPED GARTER SNAKE

Thamnophis hammondii

THREAT STATUS

LC SSC

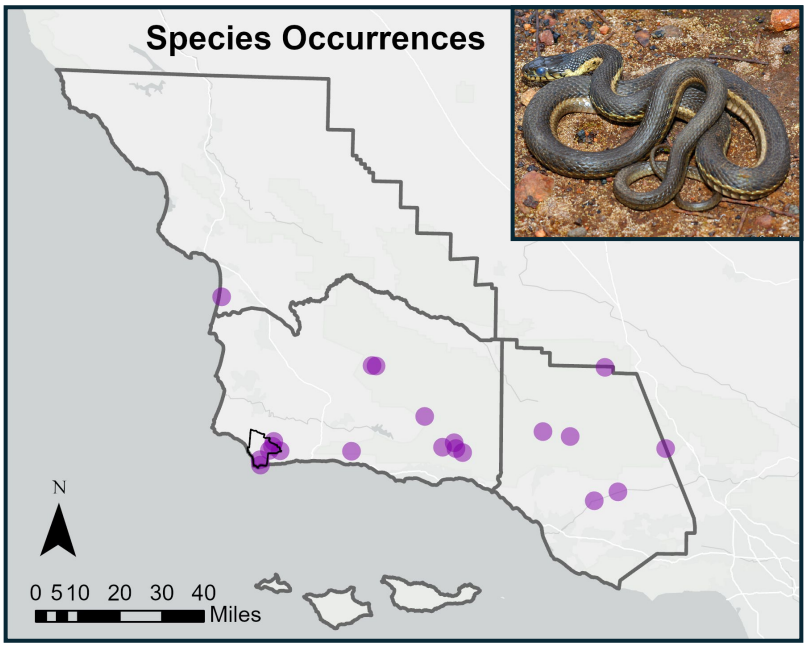
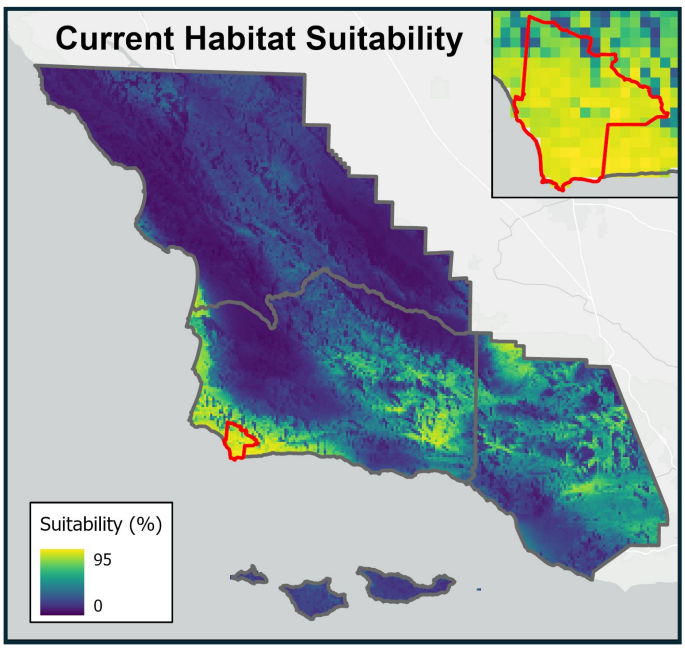


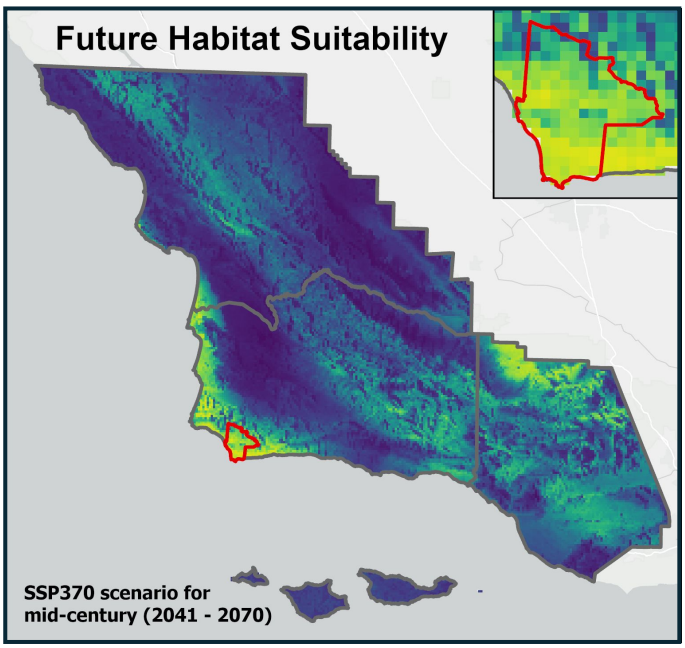
Photo credit: Malibu Creek State Park

DESCRIPTION
Two-striped garter snakes are diurnal and primarily aquatic. Forage for food in and under water, diet is composed of fish, fish eggs, tadpoles, etc.

HABITAT
Found in or near intermittent freshwater rivers and streams, creeks, and pools; on land mostly found amongst low vegetation like herbs and grasses.

THREATS
Urbanization, reservoir construction, flood control, habitat modification, predation from introduced species, loss of native prey, drought.





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MAMMAL SPECIES

PALLID BAT

Antrozous pallidus

THREAT STATUS

LC SSC

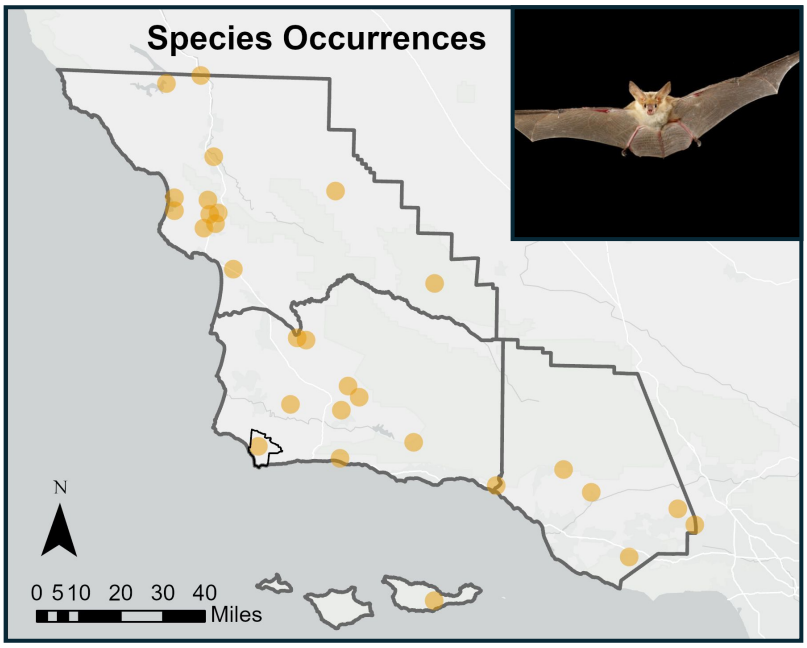


Photo credit: Oregon Conservation Strategy

DESCRIPTION

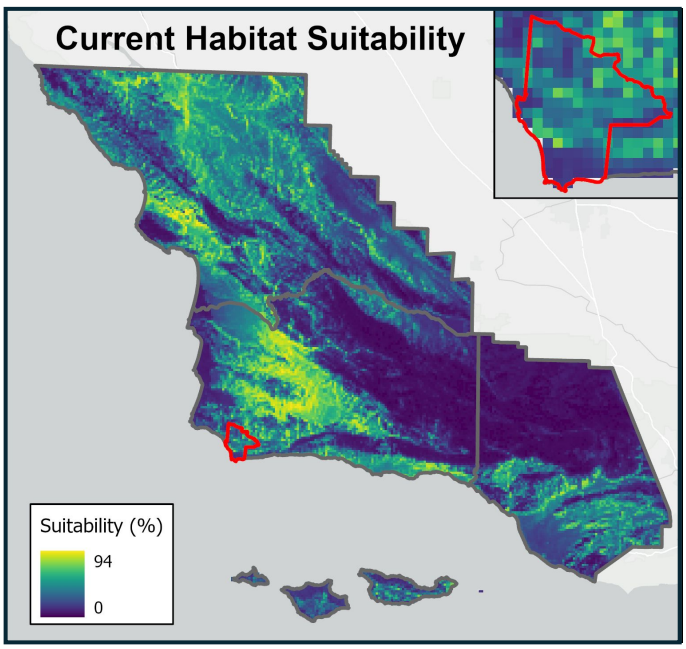
Pallid bats are a medium-large species of bat found throughout the western United States, Canada, and central Mexico.

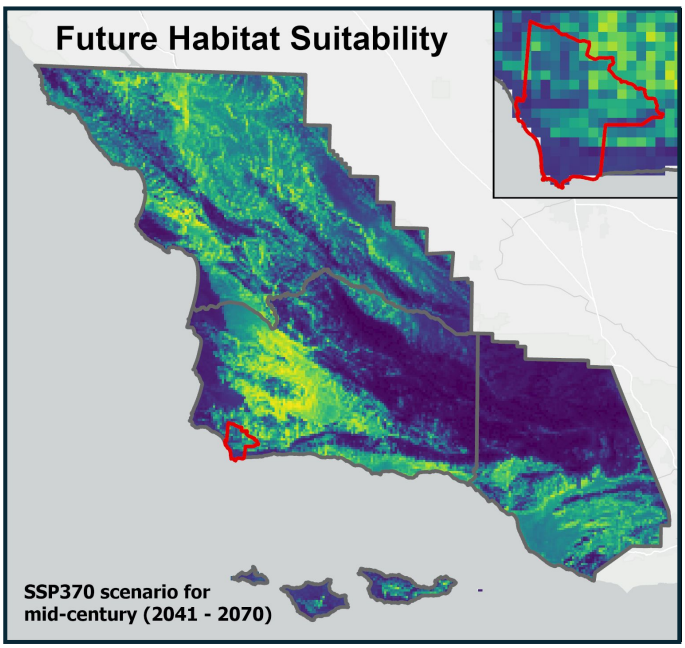
HABITAT

Occur in rocky arid deserts, grasslands, coniferous forests and roost in man-made structures, caves, mines, and tree hollows.

THREATS

Pallid bats are sensitive to noise pollution, as it can impact their ability to locate food sources.





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TOWNSEND'S BIG-EARED BAT

Corynorhinus townsendii

THREAT STATUS

LC SSC

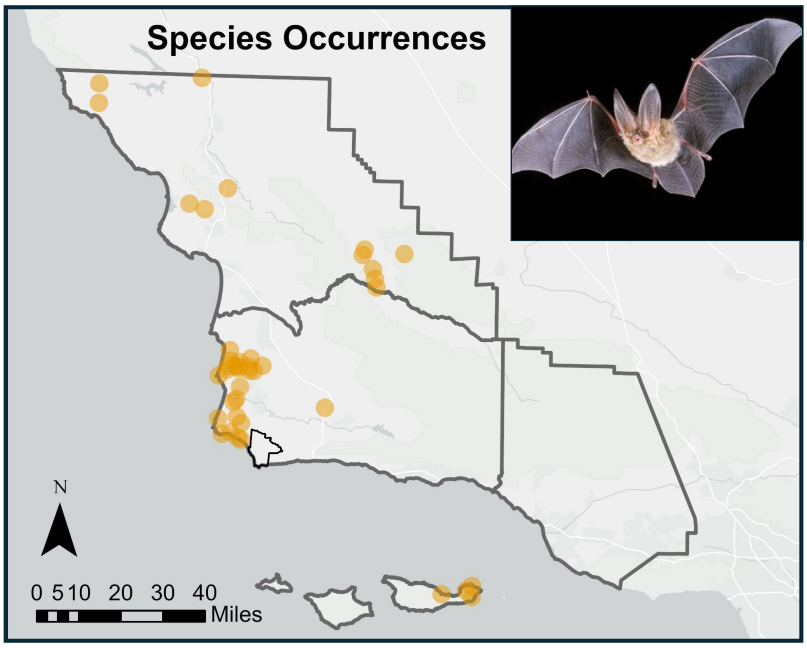


Photo credit: J. Scott Altenbach, Bat Photography, LLC

DESCRIPTION

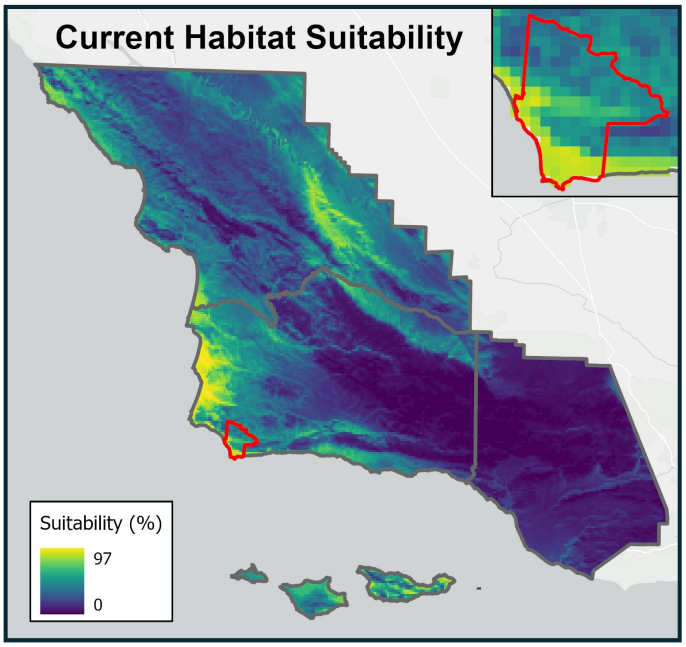
Townsend's big-eared bat is a medium-sized bat found in Canada, the United States, and Mexico, including Santa Cruz Island

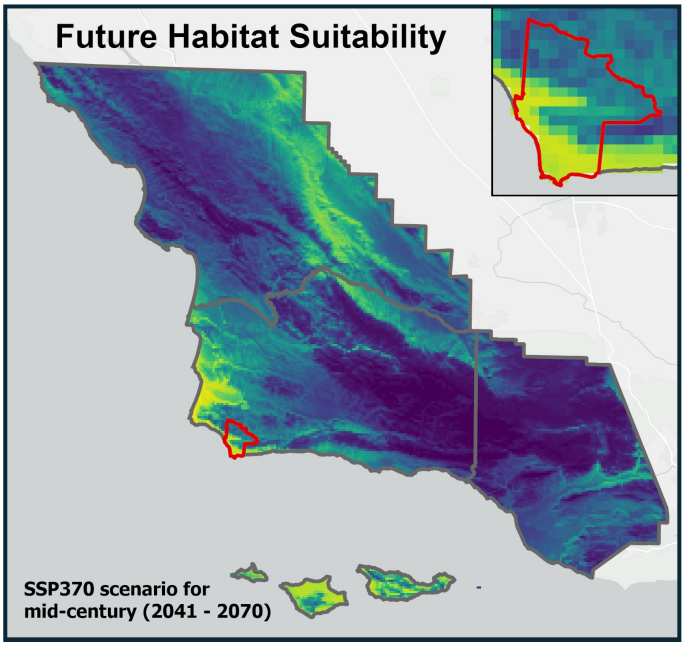
HABITAT

The bats inhabit rocky crevices, caves, mines, tunnels, and derelict buildings and hibernate in similar spaces. It feeds on moths and other small insects.

THREATS

Major threats are from habitat loss and disturbance from human activities like roost destruction or renovation but also wildfires and drought. Pesticides reduce prey.





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MOUNTAIN LION

Puma concolor

THREAT STATUS

LC SP

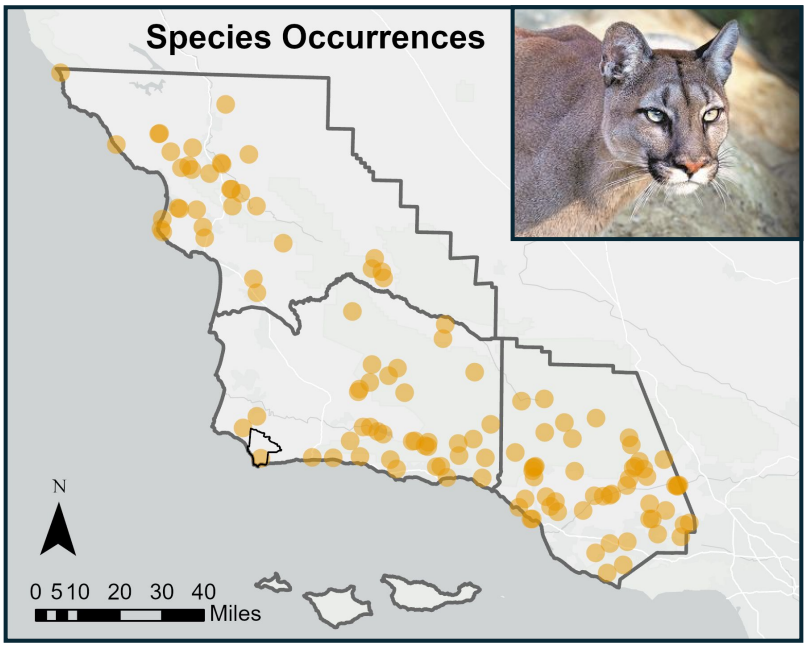


Photo credit: CA Department of Fish & Wildlife

DESCRIPTION

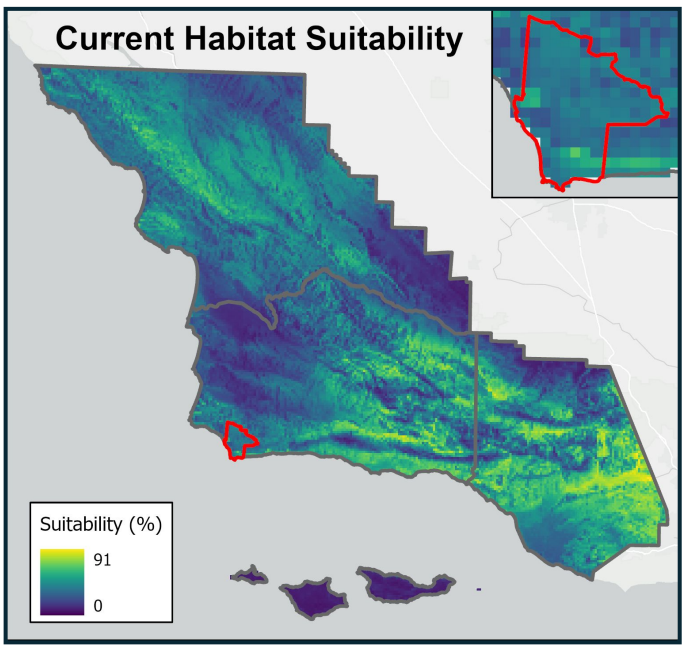
Mountain lions are the second largest felid in North America and are found throughout California. They feed on ungulates such as mule deer and elk.

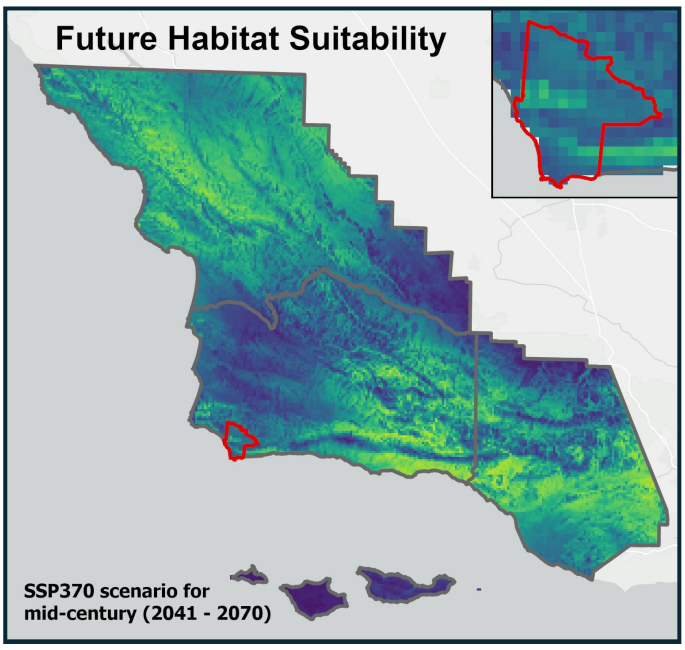
HABITAT

Inhabit many areas throughout California including temperate redwood forest, coniferous and deciduous forests, coastal chaparral, foothills and mountains.

THREATS

Mountain lions are severely impacted by habitat loss and fragmentation, leading to inbred populations and mortalities from attempts to cross roads.





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AMERICAN BADGER

Taxidea taxus

THREAT STATUS

LC SSC

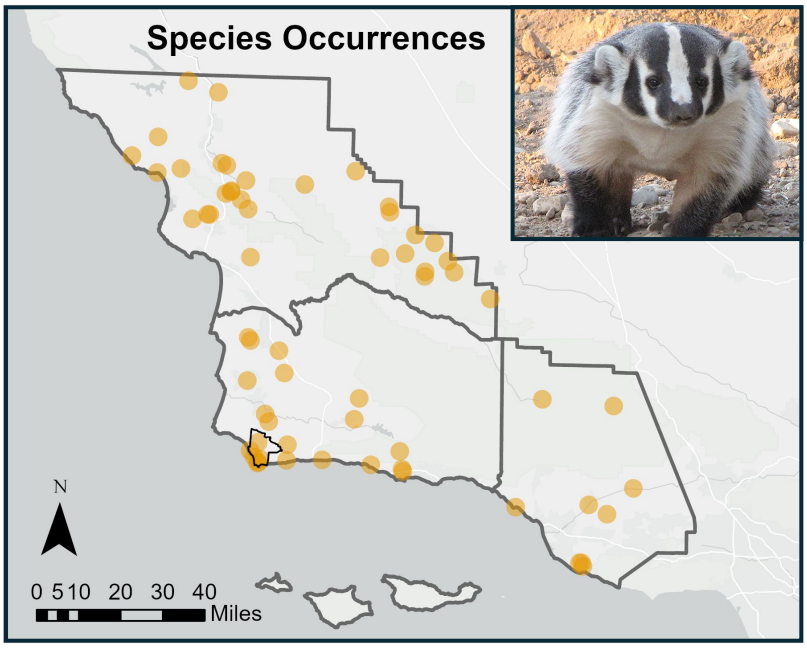


Photo credit: National Park Service

DESCRIPTION

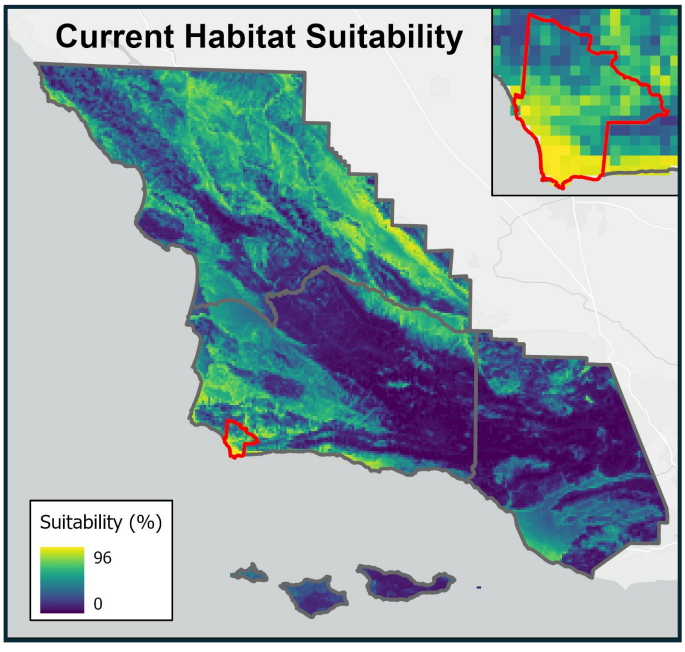
American badgers are fossorial carnivores found throughout North America. They prey on gophers, squirrels, and more small mammals.

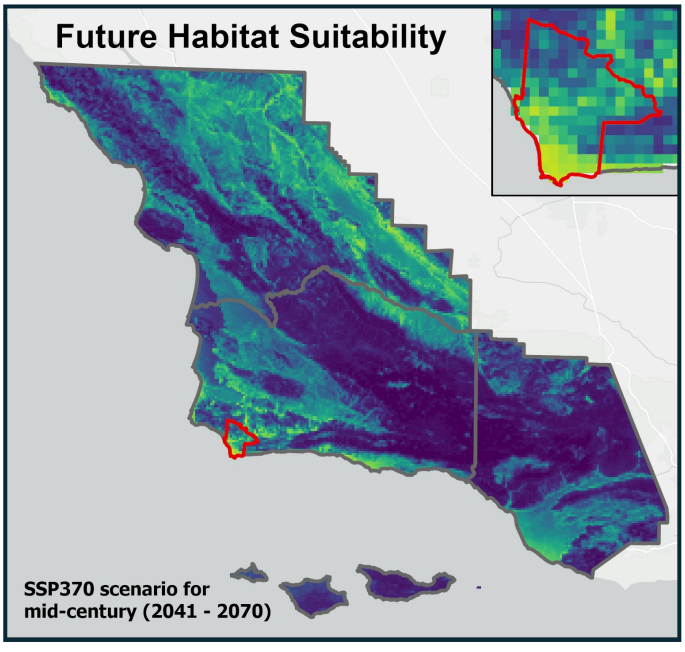
HABITAT

Inhabit dry scrub, grasslands, forests, and herbaceous habitats where prey are found.

THREATS

American badgers are threatened by habitat loss and fragmentation, road mortalities, and hunting.





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PLANT SPECIES

RED SAND VERBENA

Abronia maritima

THREAT STATUS 4.2

1

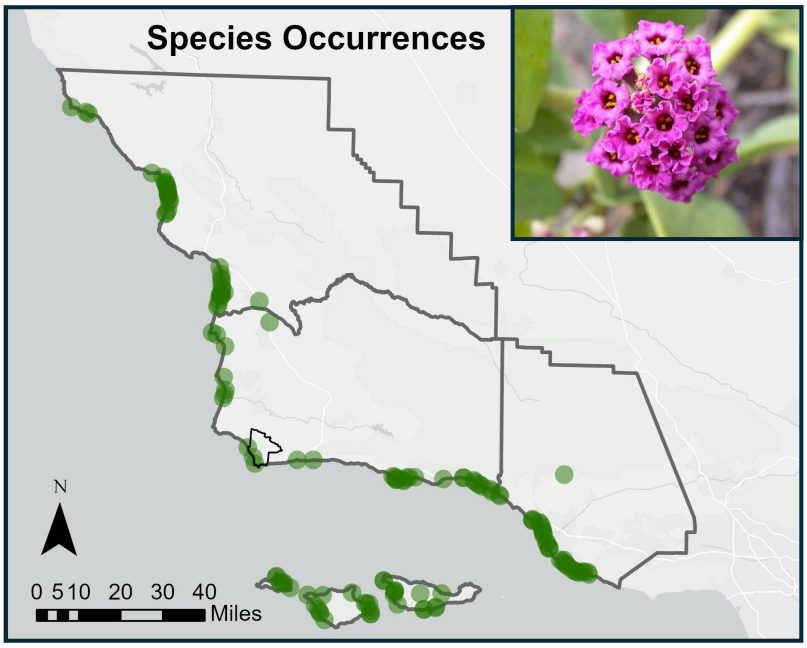


Photo credit: Gary A. Monroe, Calscape.org

DESCRIPTION

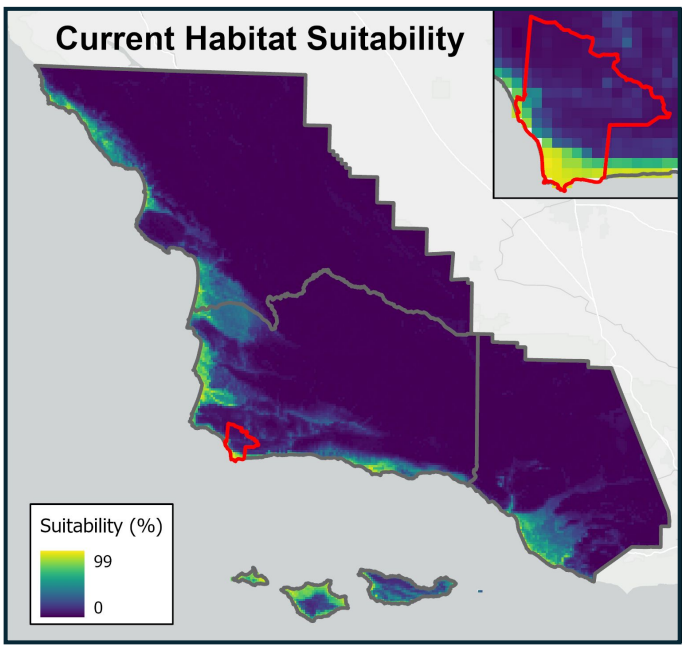
Red sand verbena is a perennial forb native to coast of southern and Baja California and the Channel Islands. Sensitive to prolonged dry conditions.

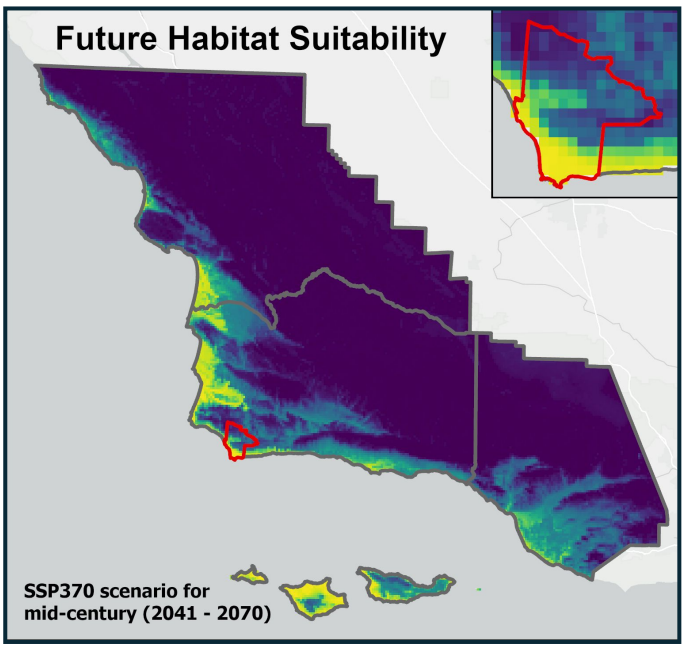
HABITAT

Grows on sandy substrate in foredunes and interdunes at elevations from 0 - 25 feet. Occurs in sparse cover in coastal dune and coastal strand habitat.

THREATS

Red sand verbena often grows in heavily-traveled beach areas and is susceptible to human activity-related disturbances, as well as coastal erosion.





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LA PURISIMA MANZANITA

Arctostaphylos purissima

THREAT STATUS

LC

1B .1

2

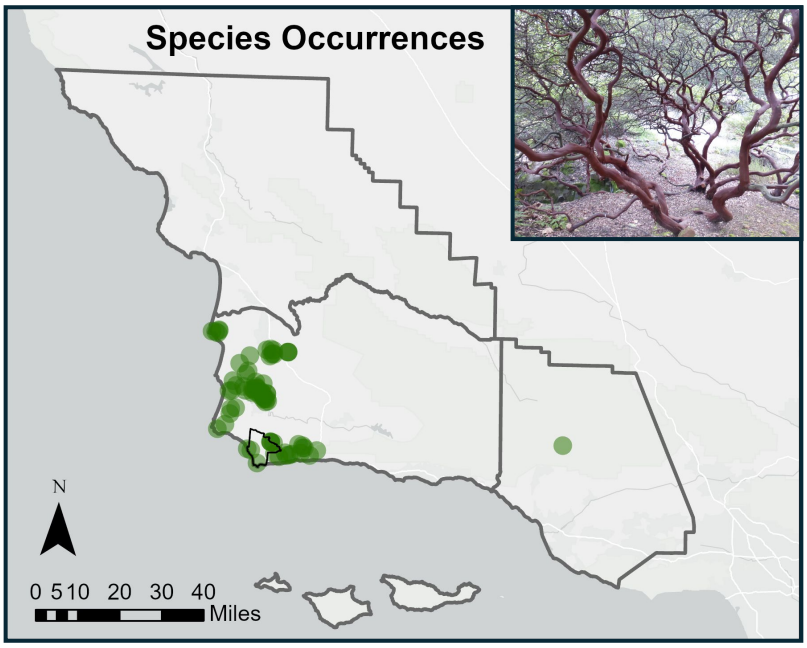


Photo credit: Zoya Akulova, Calscape.org

DESCRIPTION

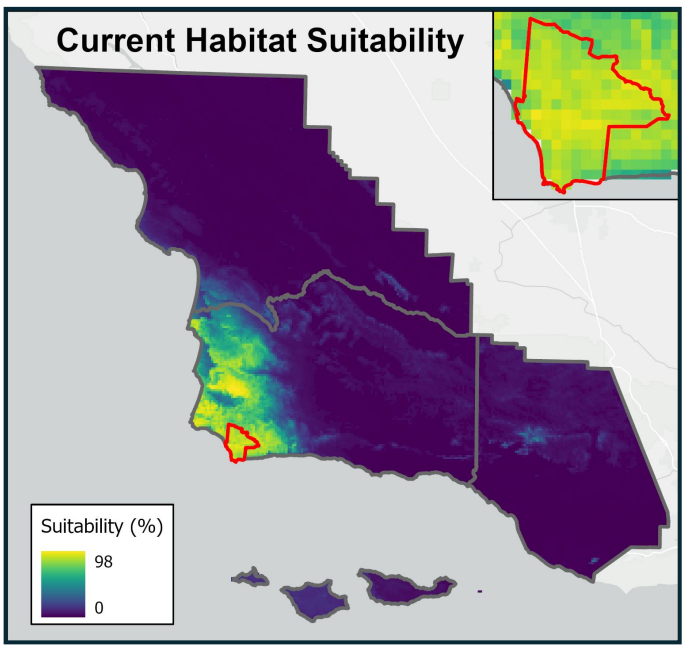
La Purisima Manzanita, also known as Lompoc Manzanita, is a perennial evergreen shrub endemic to a very small region in Santa Barbara County.

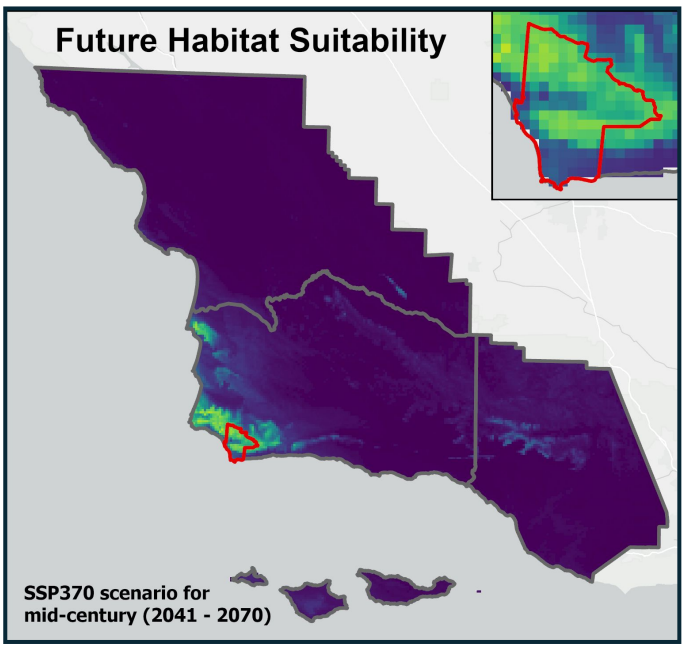
HABITAT

Grows in chaparral on sandy soils or coastal scrub at elevations from 180 - 1,200 feet. Associated with coast live oak woodland and chamise chaparral.

THREATS

Because its distribution is so narrow, La Purisima Manzanita may be particularly vulnerable to habitat degradation and climate change.





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NUTTALL'S MILKVETCH

Astragalus nuttallii var. *nuttallii*

THREAT STATUS 4.2

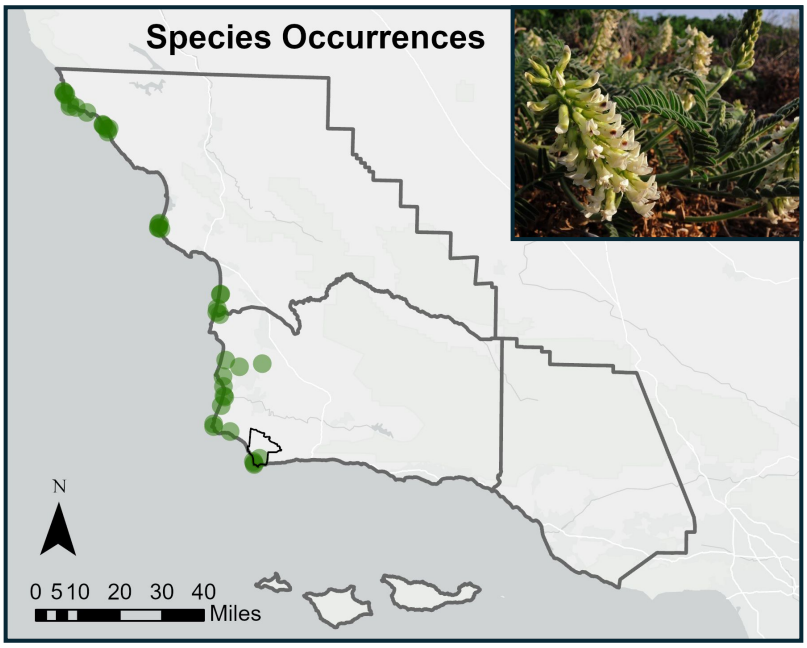


Photo credit: Jorg & Mimi Fleige, Calscape.org

DESCRIPTION

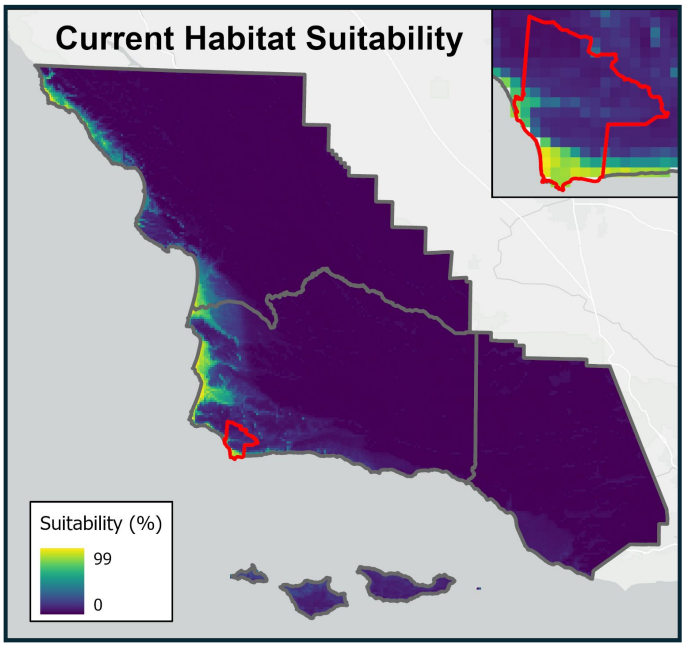
Nuttall's milkvetch is a perennial legume herb native to California and Baja California. Blooms from January to November.

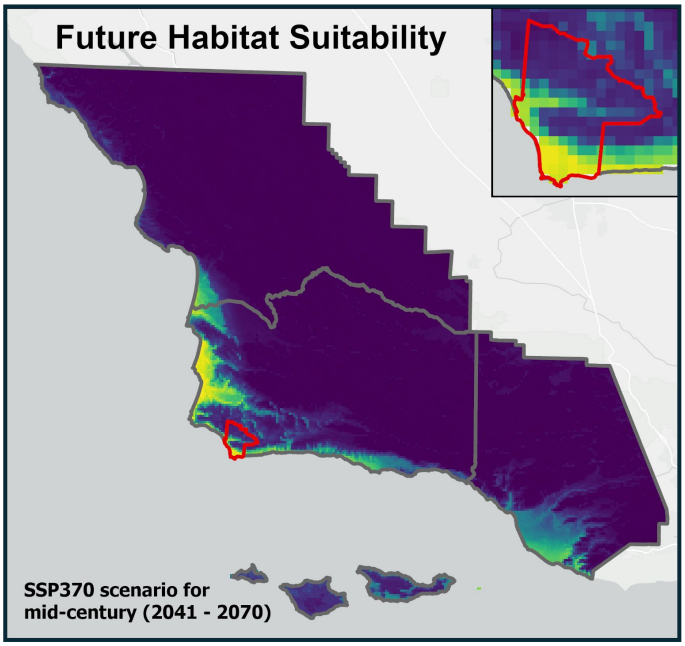
HABITAT

Grows in sandy soils of coastal habitat including coastal bluff scrub and coastal dunes at elevations from 10 - 390 feet.

THREATS

Nuttall's milkvetch occurs on coastal dunes and bluffs, making it especially vulnerable to coastal erosion and human disturbances.





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LATE-FLOWERED MARIPOSA LILY

Calochortus fimbriatus

THREAT STATUS

LC | FT | 1B .3 | ST

4

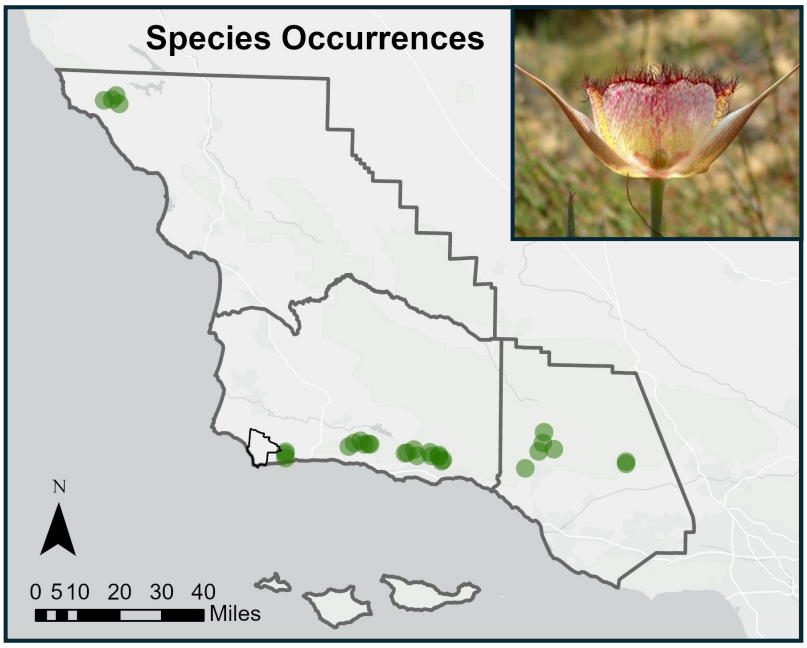


Photo credit: Christopher Christie, Calscape.org

DESCRIPTION

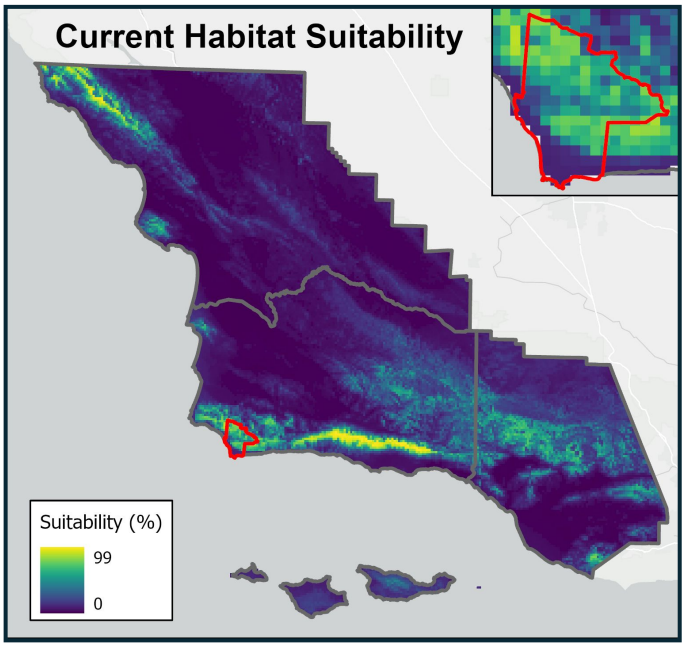
Perennial bulbiferous herb, blooms in late June or early July until mid-August. Blooms more vigorously following wildfire years.

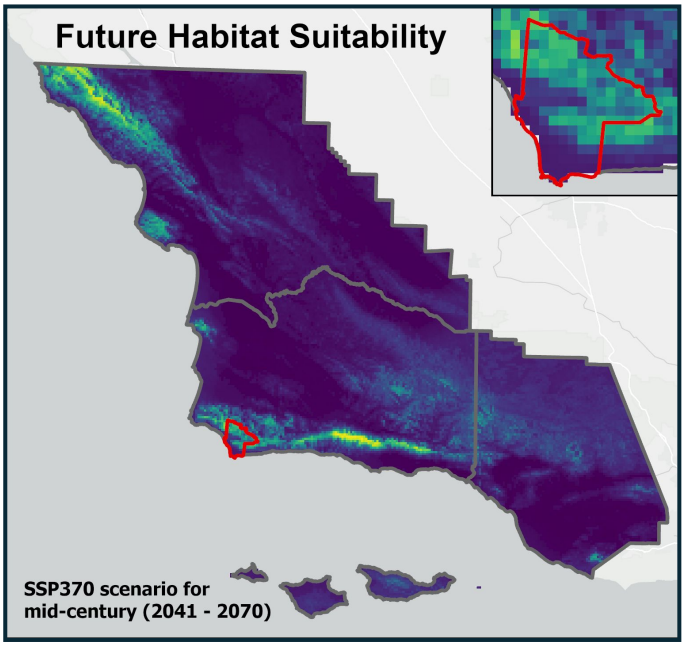
HABITAT

Grows in coastal mountain ranges in chaparral, cismontane woodland, and riparian woodland on serpentine soils at elevations from 825 - 5,715 feet.

THREATS

Late-flowered mariposa lily may be threatened by development, invasive plants, and fire suppression regimes.





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SURF THISTLE

Cirsium rhothophilum

THREAT STATUS

LC

1B.2

ST

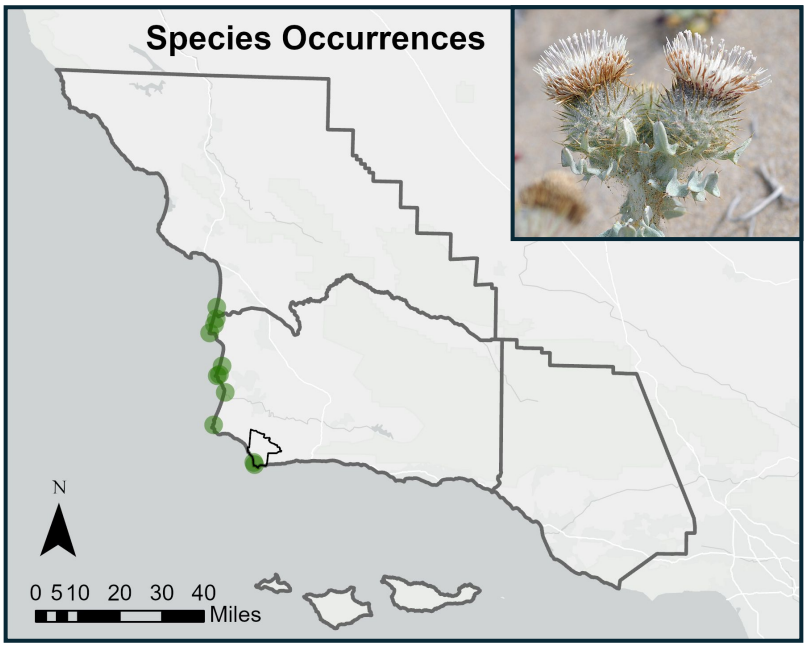


Photo credit: Chris Winchell, Calscape.org

DESCRIPTION

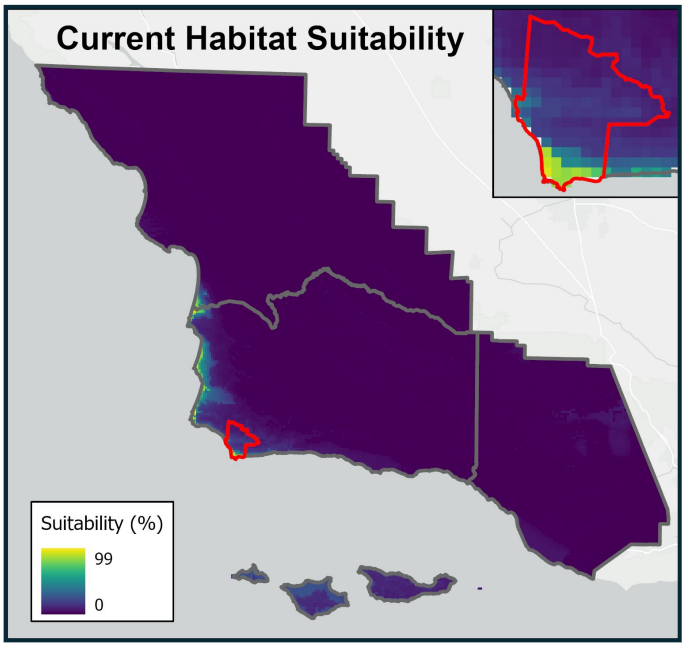
Rare species of thistle endemic to California growing between San Luis Obispo and Santa Barbara Counties.

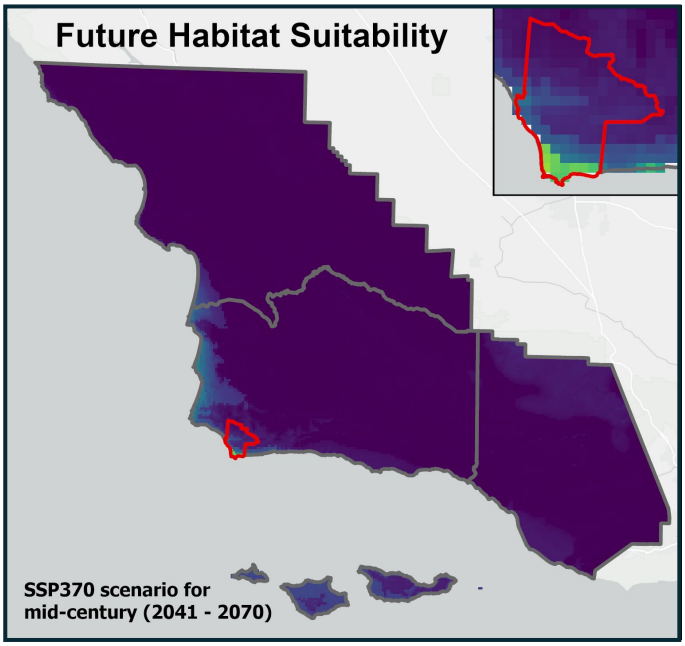
HABITAT

Surf thistle grows in sand dunes and coastal scrub near beaches at elevations between 0 - 30 ft.

THREATS

Surf thistle has a narrow range and grows exclusively on sand dunes and coastal scrub, so it may be especially threatened by coastal erosion and human activity.





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GAVIOTA TARPLANT

Deinandra increscens ssp. *Villosa*

THREAT STATUS

LC | FE | 1B .1 | SE

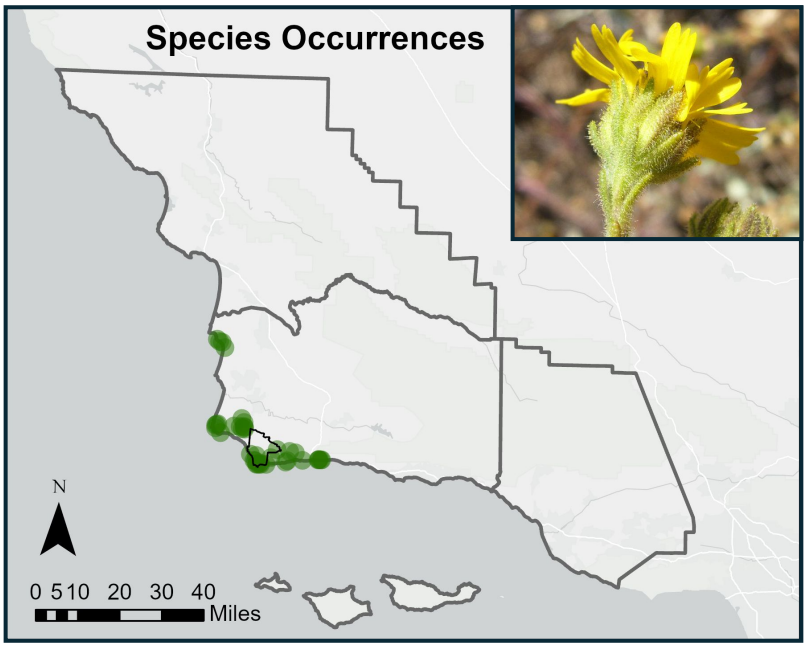


Photo credit: Zoya Akulova, Calscape.org

DESCRIPTION

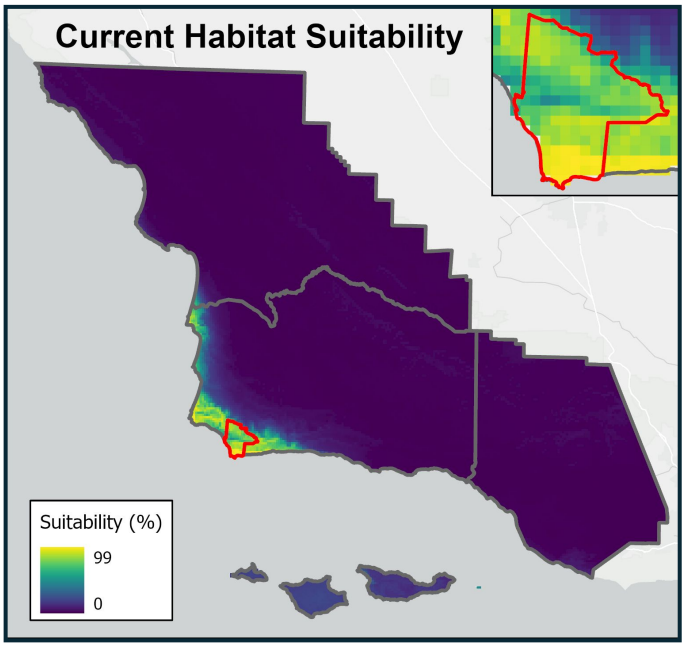
Gaviota tarplant is an annual herb that is native to California and endemic to the central coast region. It is listed as rare and endangered within California.

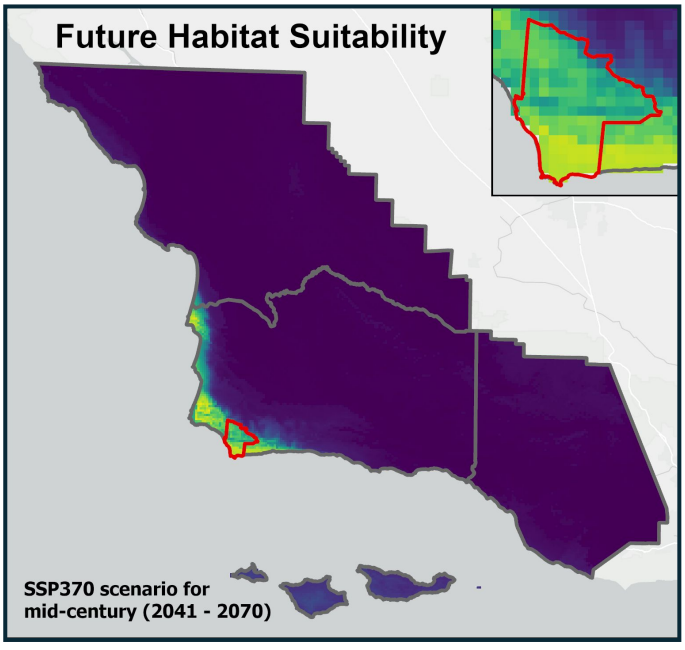
HABITAT

Gaviota tarplant is found in coastal areas including coastal sage scrub and valley grassland. Its present range is restricted to a small area around Point Conception.

THREATS

Gaviota tarplant is threatened by development and displacement by non-native species including iceplant.





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UMBRELLA LARKSPUR

Delphinium umbraculorum

THREAT STATUS

LC

1B .3

ST

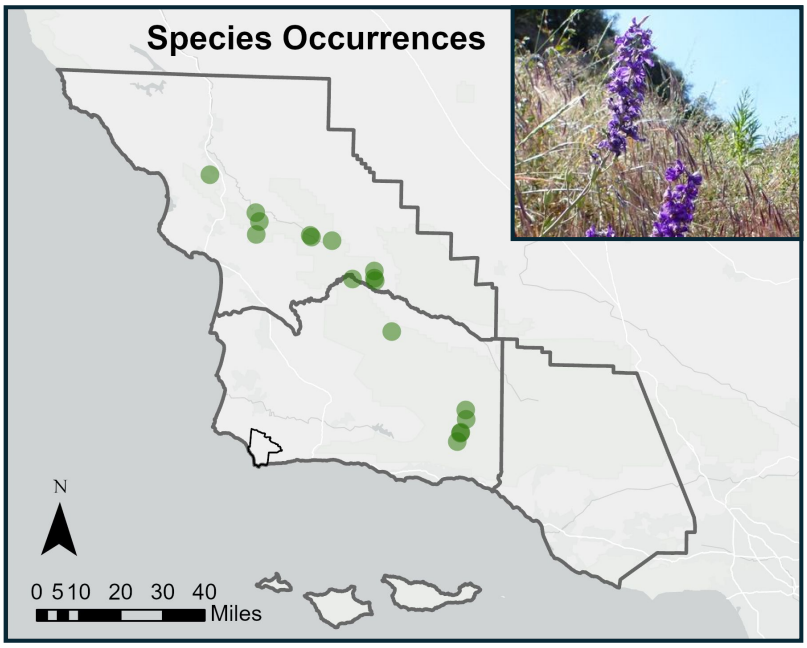


Photo credit: Amelia Ryan, Calscape.org

DESCRIPTION

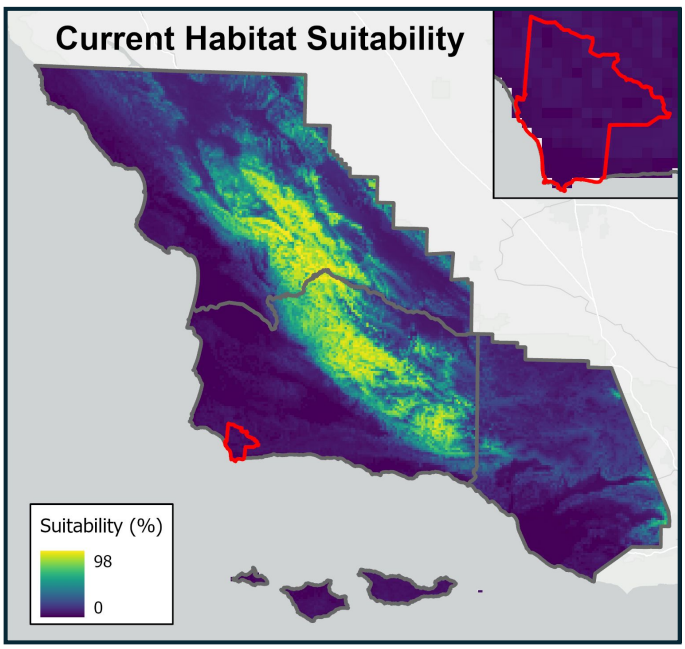
Umbrella larkspur is a fruiting, flowering perennial herb endemic to California in Ventura, Santa Barbara, and San Luis Obispo Counties.

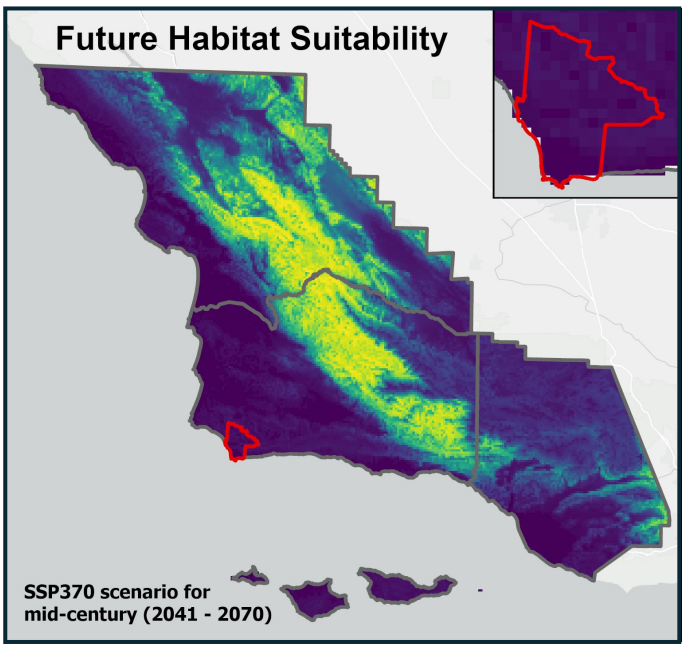
HABITAT

Grows in chaparral and cismontane woodlands at elevations from 1,200 - 4,800 feet.

THREATS

Umbrella larkspur is threatened by displacement from invasive species, as well as development and grazing.





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WESTERN DICHONDRA

Dichondra occidentalis

THREAT STATUS

LC

4
.2

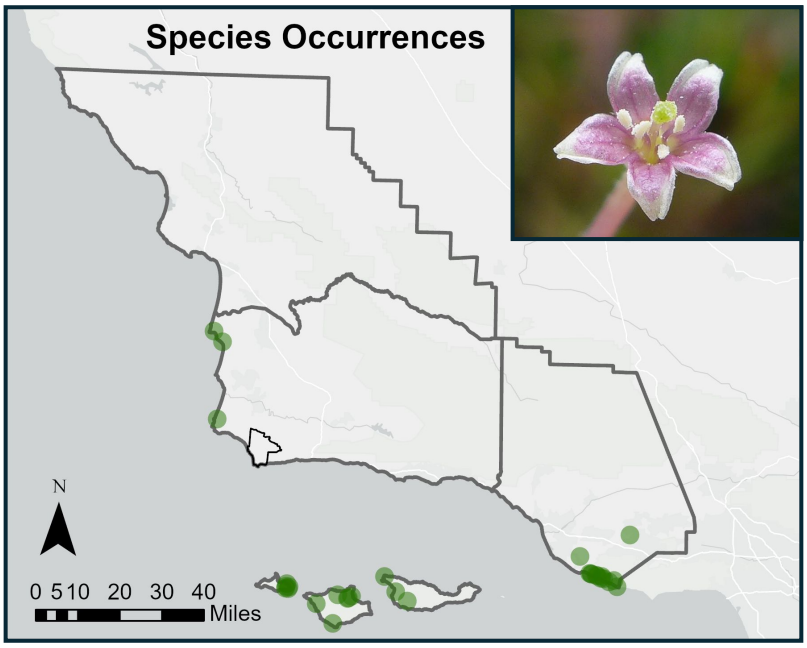


Photo credit: Keir Morse, Calscape.org

DESCRIPTION

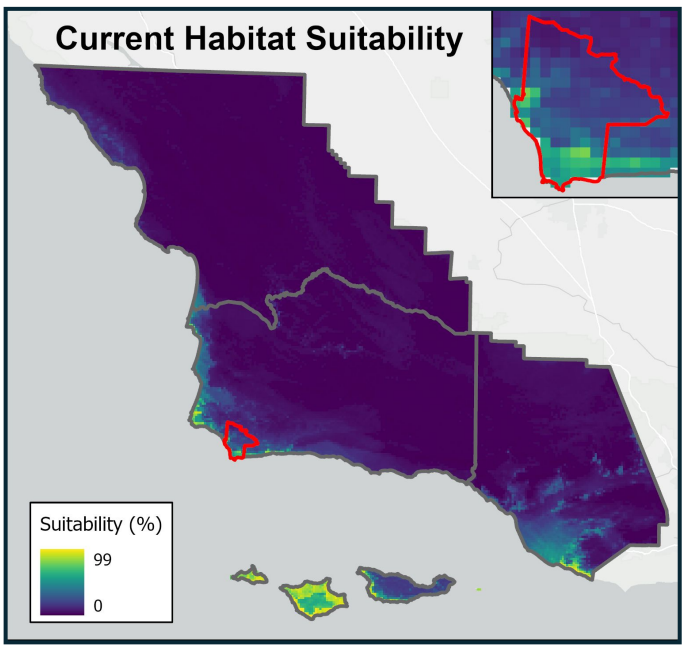
Also known as Western Ponyfoot, Western Dichondra is a perennial herb endemic to southern and central California. Blooms from March - July.

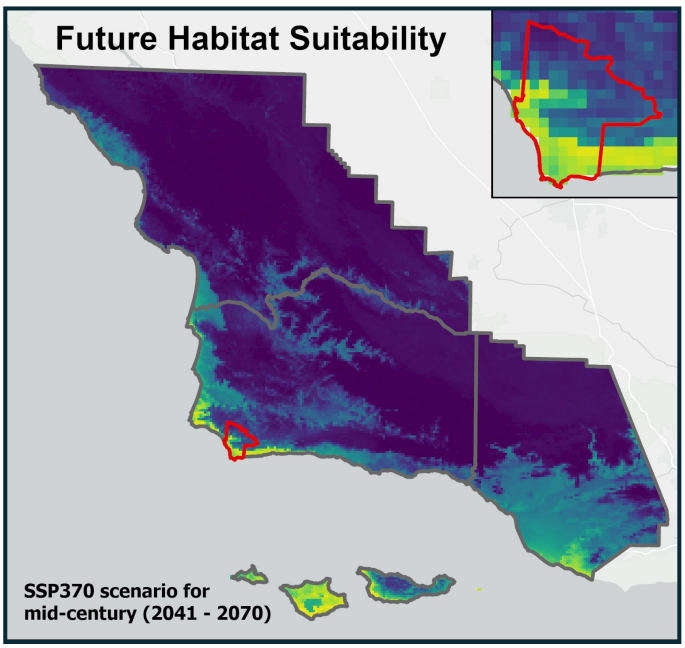
HABITAT

Grows in chaparral, cismontane woodland, coastal sage scrub, and valley/foothill grasslands. Tends to grow on slopes at elevations between 200 - 1600 feet.

THREATS

Western dichondra may be threatened by human disturbances, development, and invasive species.





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LOMPOC YERBA SANTA

Eriodictyon capitatum

THREAT STATUS

LC | FE | 1B .2 | SR

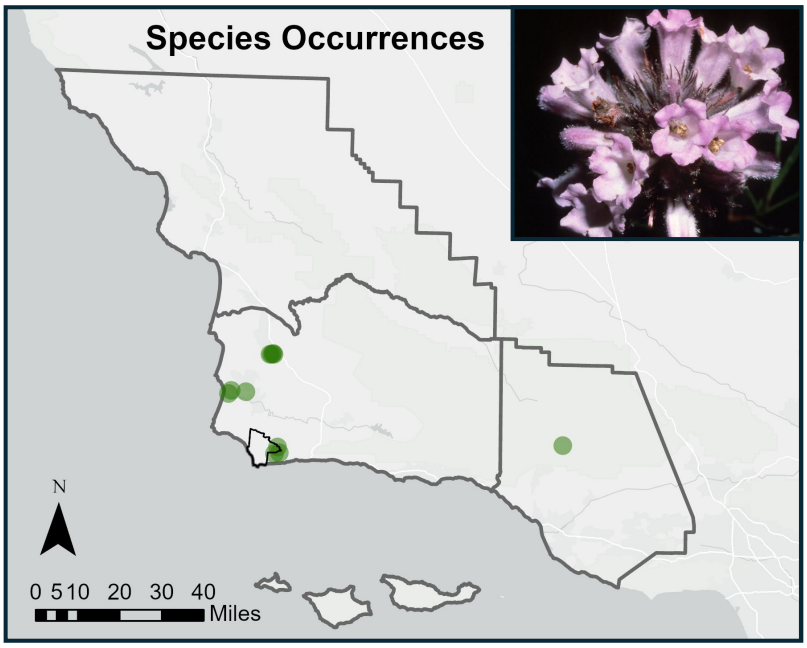


Photo credit: CNPS

DESCRIPTION

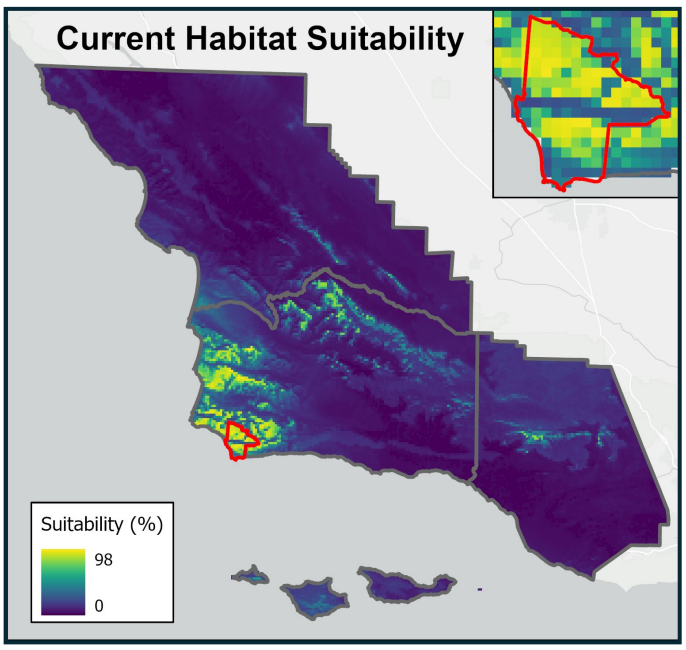
Lompoc Yerba Santa is a rare evergreen shrub with few known populations. Produces few seeds during reproduction.

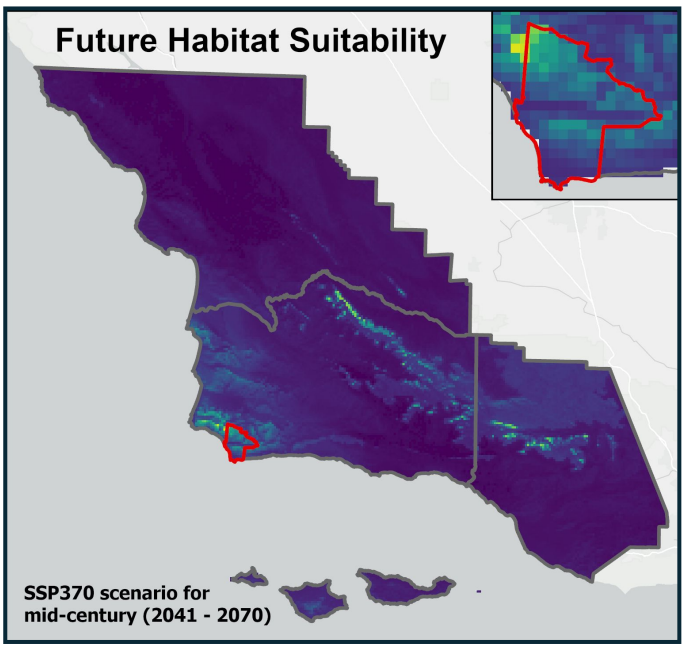
HABITAT

Grows in coastal sage scrub and chaparral habitat as well as coastal coniferous forests, often associated with buckbrush, black sage, sagebrush, and bishop pine.

THREATS

Non-native plants and fire management regimes may threaten the existence of Lompoc Yerba Santa.





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LARGE-LEAVED WALLFLOWER

Erysimum suffrutescens

THREAT STATUS

LC

4.2

ST

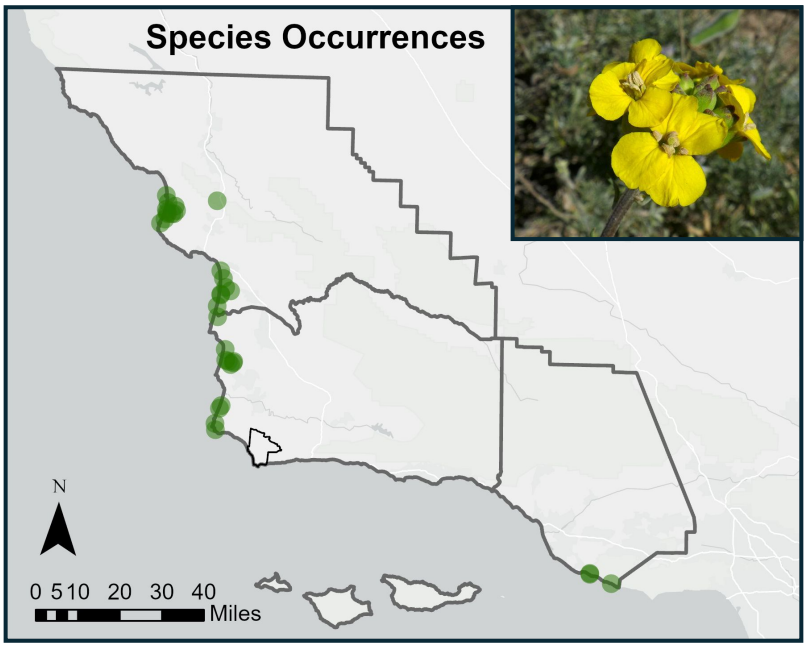


Photo credit: Calscape.org

DESCRIPTION

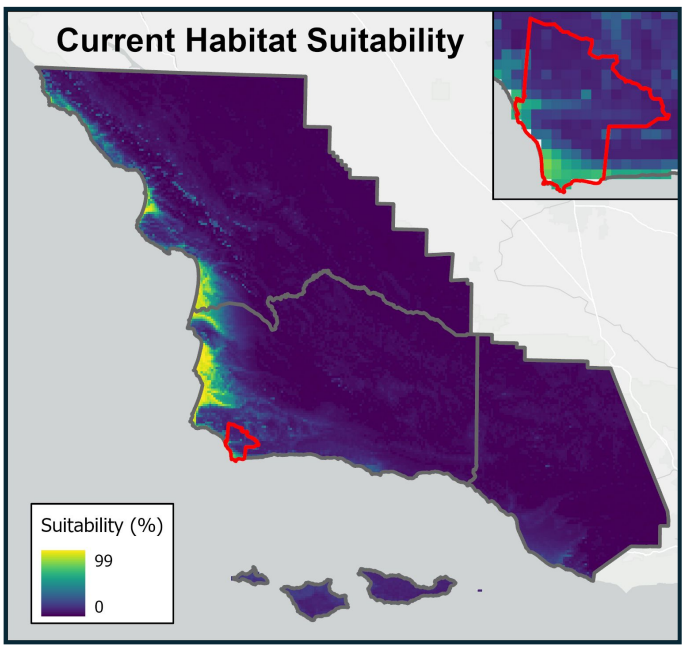
Also known as Suffrutescent Wallflower, Large-Leaved Wallflower is a perennial herb endemic to Southern and Central California.

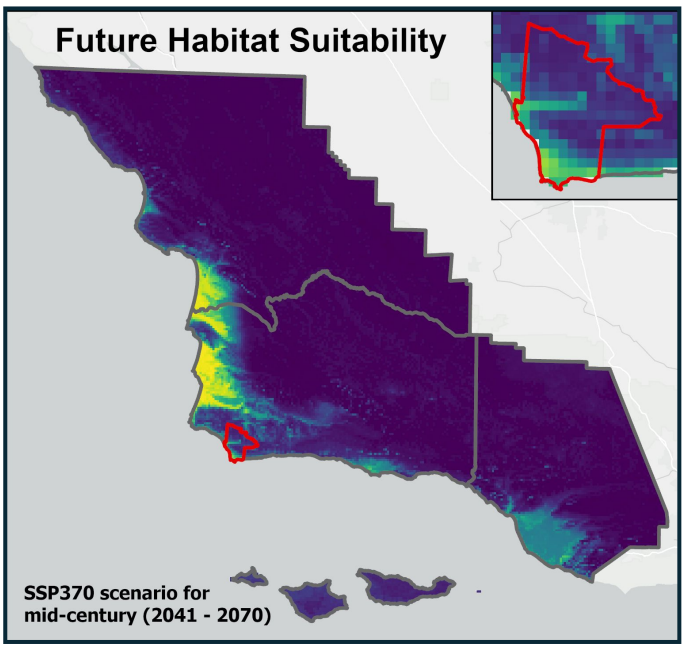
HABITAT

Grows in coastal bluff scrub, maritime chaparral, coastal dunes, and coastal scrub at elevations from 0 - 500 feet.

THREATS

Large-leaved wallflower may be threatened by coastal degradation, invasive species, human disturbances.





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KELLOGG'S HORKELIA

Horkelia cuneata sericea

THREAT STATUS

LC

1B .1

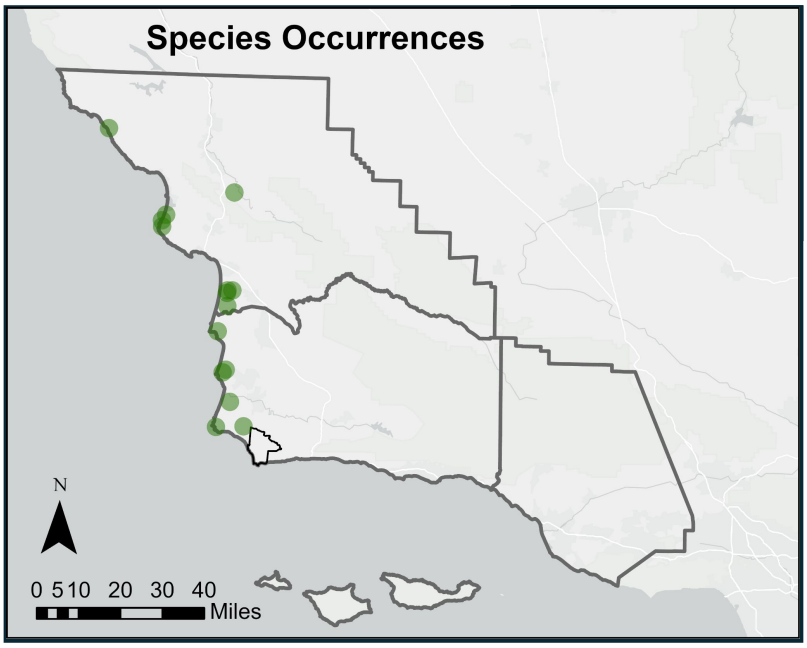


Photo credit: Neil Kramer, Calscape.org

DESCRIPTION

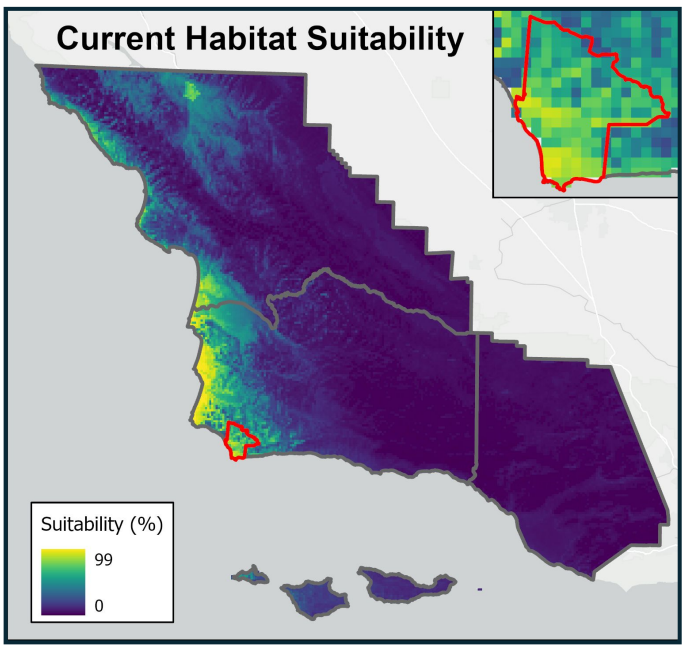
A rare native perennial herb that grows primarily in the Central Coast region of California.

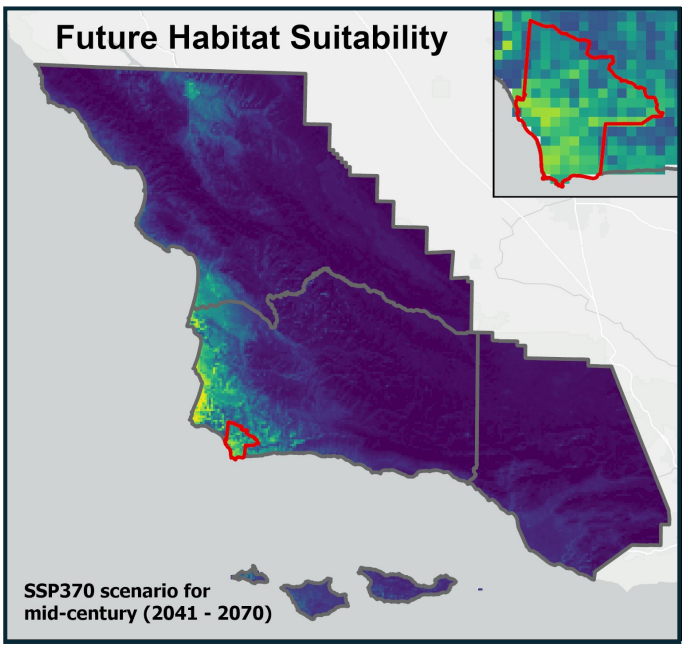
HABITAT

It tends to grow in dunes, at elevations from 0-2300 feet. Communities include Northern Coastal Scrub, Coastal Sage Scrub, and Closed-cone Pine Forest.

THREATS

Development and off-road vehicles destroy dunes while uprooting by feral pigs is direct threat. The plant has been extirpated in many parts of its natural range.





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SOUTHERN CALIFORNIA BLACK WALNUT

Juglans californica

THREAT STATUS

LC

4.2

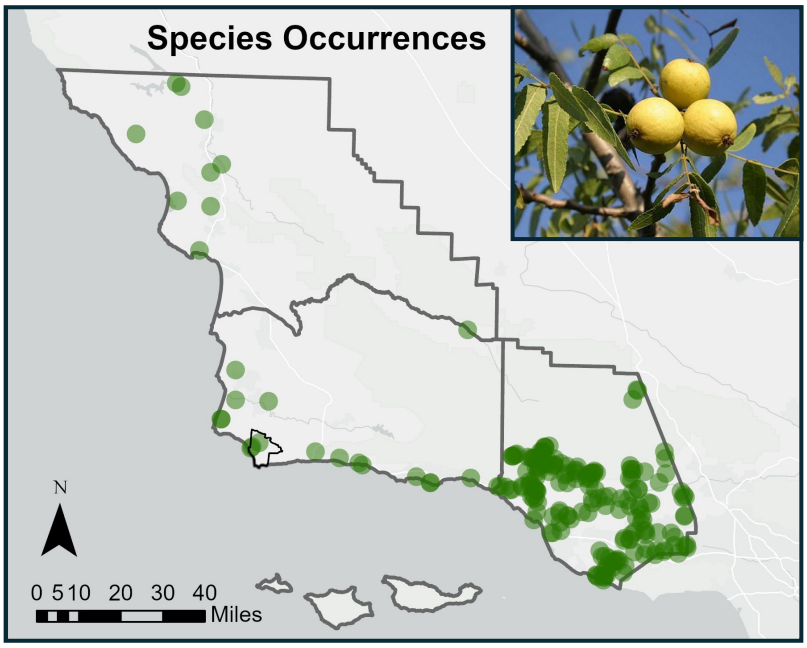


Photo credit: Joe Decruyenaere, Calscape.org

DESCRIPTION

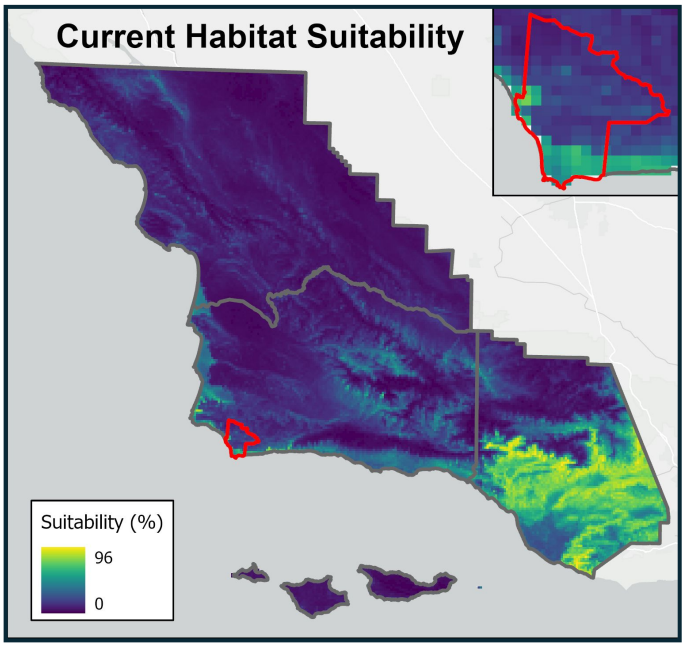
Southern California black walnut is a deciduous tree that blooms from March to August. It provides food and nesting habitat to a wide variety of bird species.

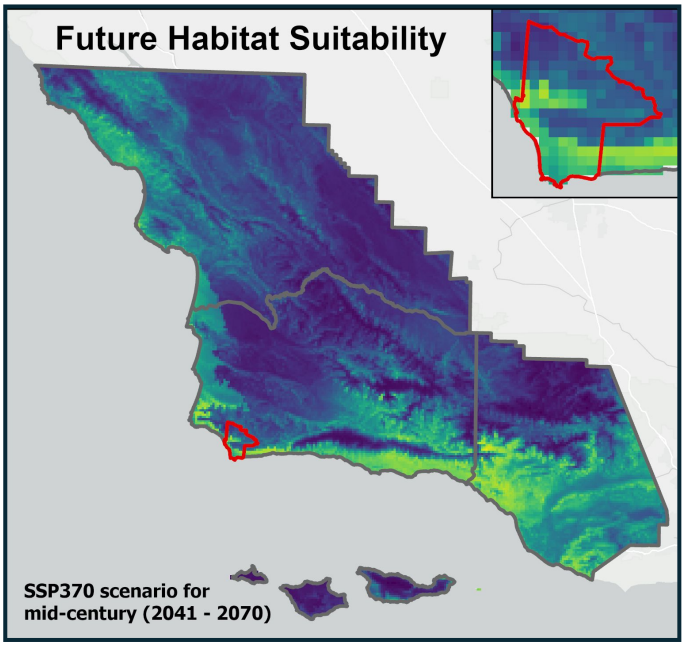
HABITAT

Typically grows on alluvial substrates in washes and alluvial fans in chaparral, cismontane woodland, and coastal scrub at elevations from 160 - 2925 feet.

THREATS

Southern California black walnut is threatened by human disturbances and development.





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OCELLATED HUMBOLDT LILY

Lilium humboldtii ocellatum

THREAT STATUS

LC

4.2

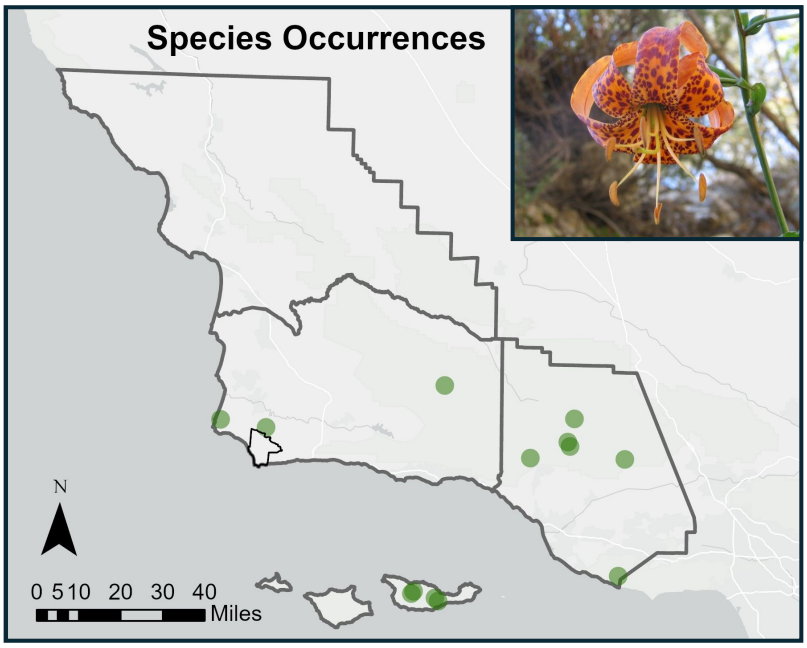


Photo credit: J. G. Riend, Calscape.org

DESCRIPTION

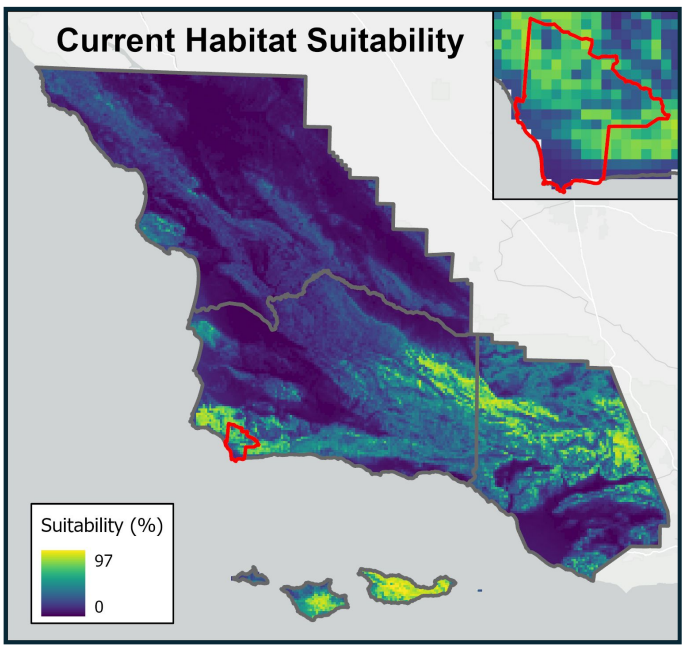
Perennial forb, blooms from March to August. Occurs in San Diego to Santa Barbara Counties and on some Channel Islands.

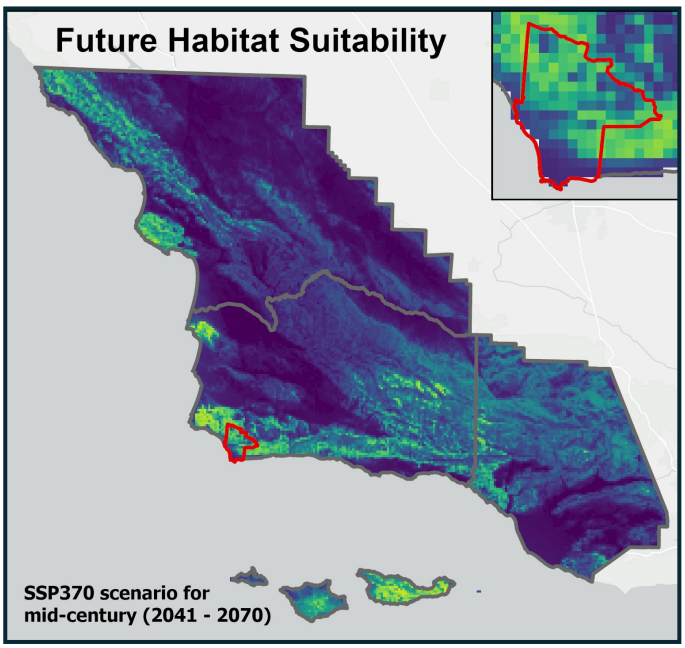
HABITAT

Typically grows in openings in chaparral, cismontane woodland, coastal scrub, lower montane coniferous forests, and riparian areas at elevations from 95 - 5850 feet

THREATS

Due to its narrow distribution, Ocellated Humboldt lily may be particularly threatened by human disturbances and climate change





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CLIFF ASTER

Malacothrix saxatilis var. *saxatilis*

THREAT STATUS

4
.2
ST

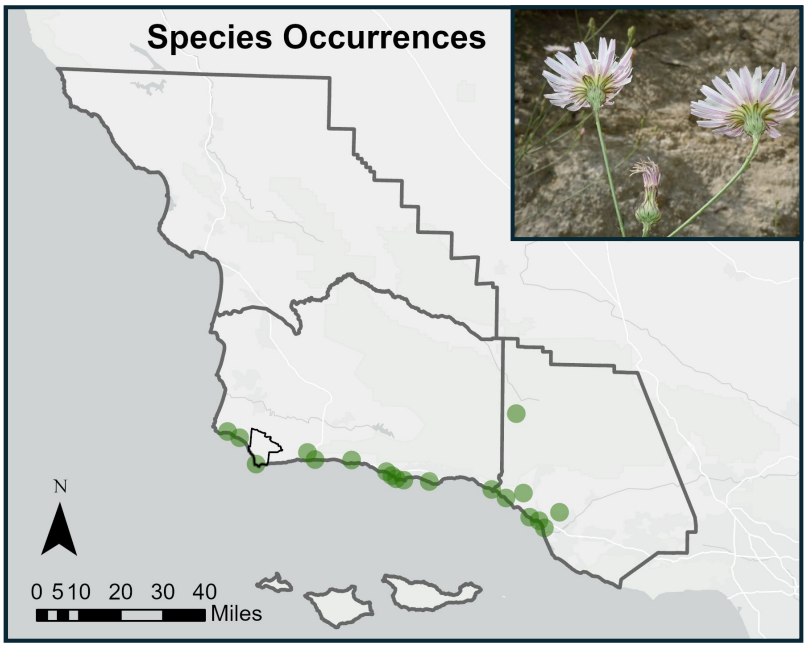
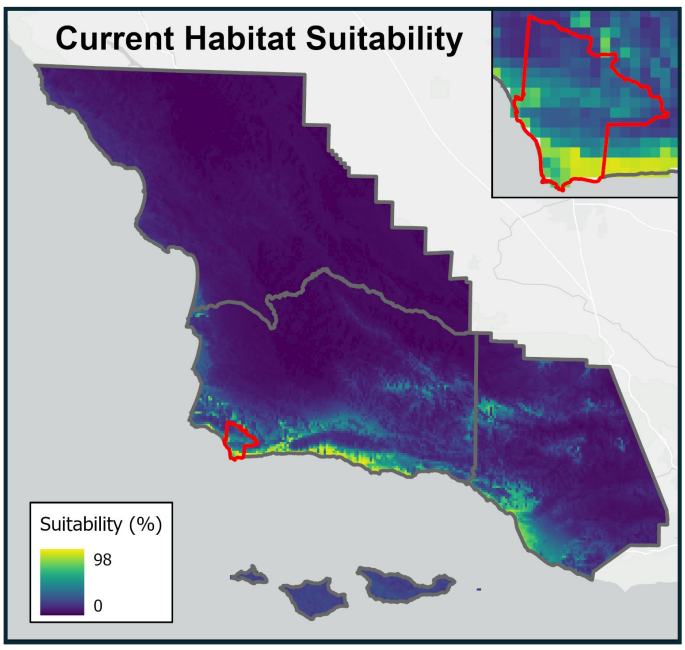


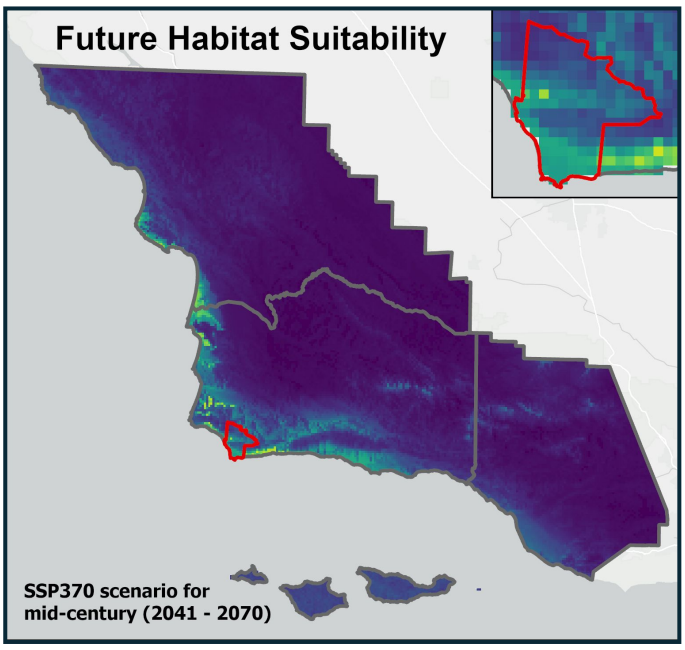
Photo credit:

DESCRIPTION
Cliff aster is perennial herb endemic to California. Flowers throughout the winter, summer, and fall.

HABITAT
Found in coastal hills and mountain ranges. Associated with coastal sage scrub, coastal strand, chaparral, and foothill woodland communities.

THREATS
Primary threats may include human development and invasive species.





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CALIFORNIA SPINEFLOWER

Mucronea californica

THREAT STATUS

4.2 ST

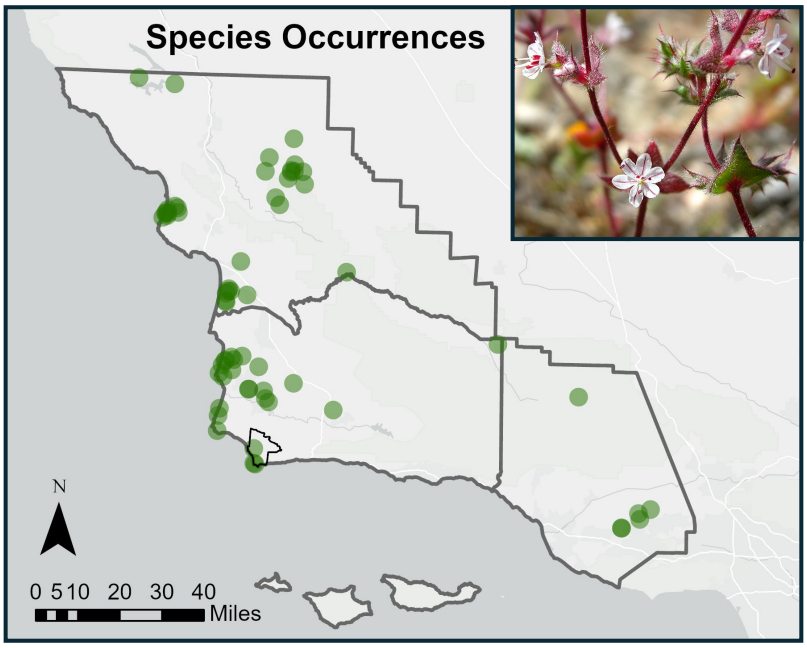


Photo credit: Christopher Christie, Calscape.org

DESCRIPTION

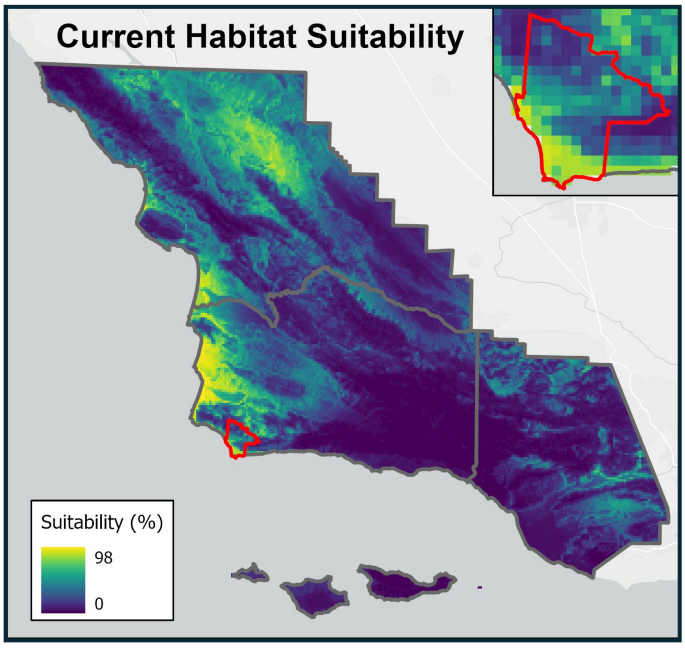
California spineflower is a rare annual herb found in southern and central California.

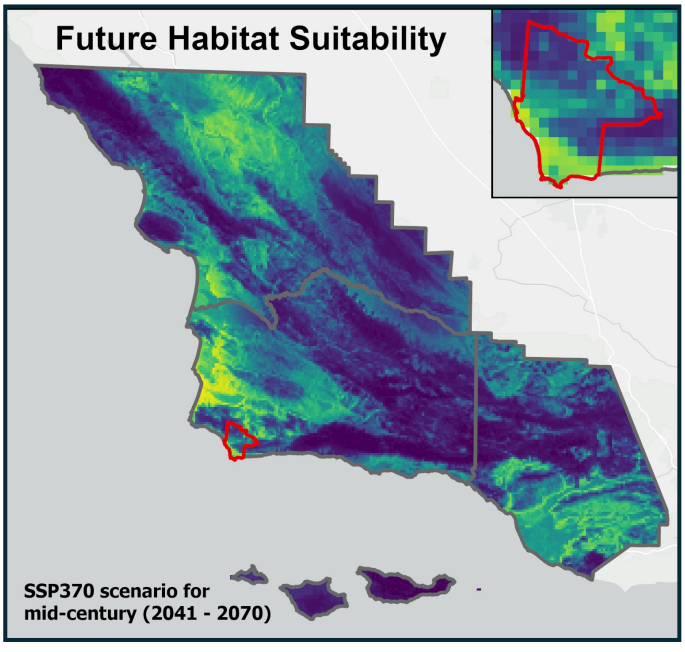
HABITAT

Can be found on dunes and coastal habitats, as well as sandy inland areas. Associated with coastal strand, coastal sage scrub, and chaparral communities.

THREATS

California spineflower is threatened by coastal erosion, development, and invasive species.





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HUBBY'S PHACELIA

Phacelia hubbyi

THREAT STATUS 4.2

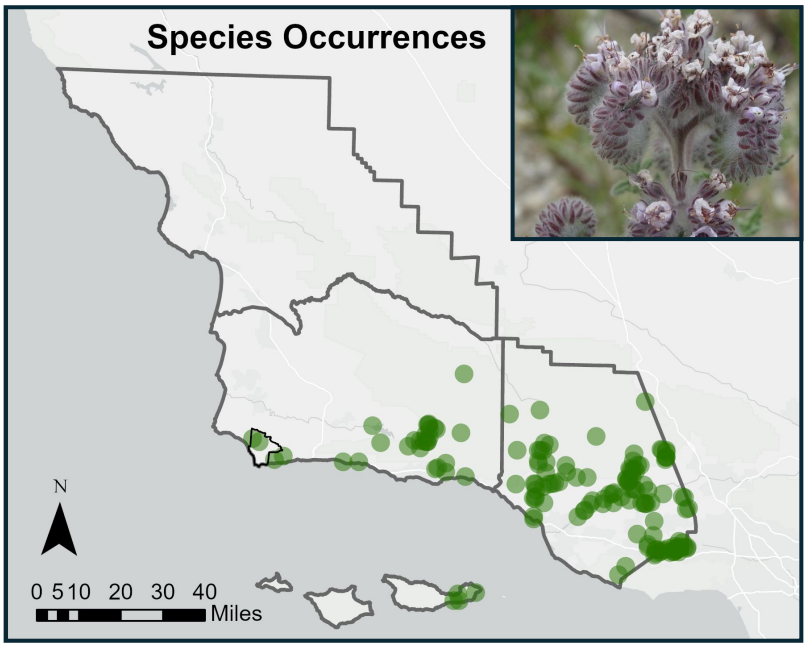


Photo credit: Ron Vanderhoff, Calscape.org

DESCRIPTION

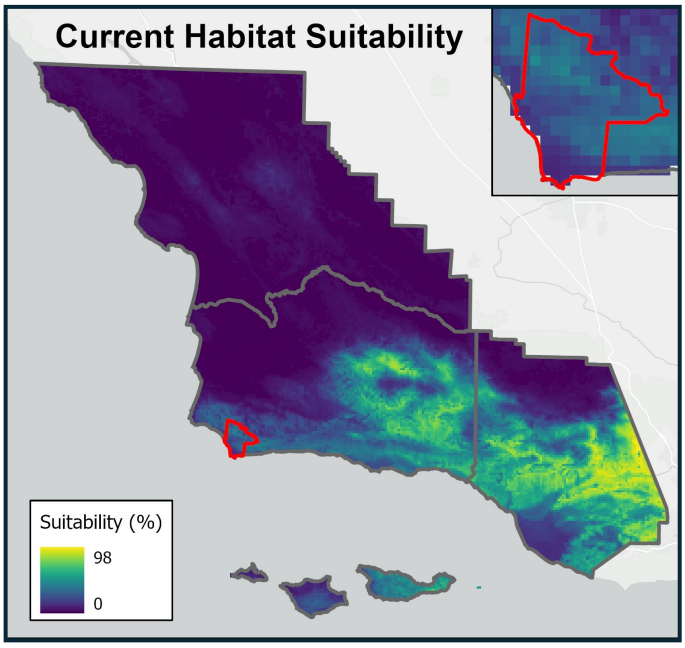
Hubby's phacelia is a fast-growing, annual endemic herb found in Los Angeles, Ventura, and Santa Barbara counties.

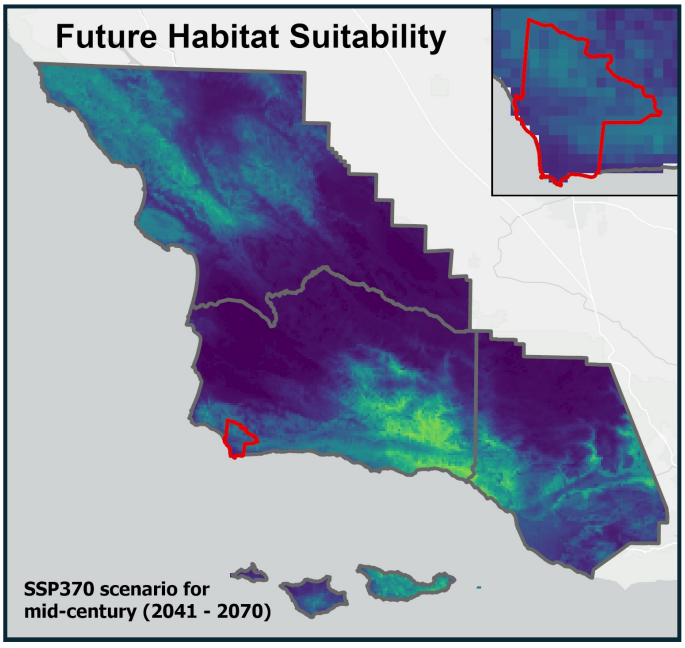
HABITAT

Grows in rocky areas in chaparral and coastal sage scrub habitats, as well as grasslands of foothills.

THREATS

May be threatened by development, habitat fragmentation, and invasive species.





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HOFFMAN'S BITTER GOOSEBERRY

Ribes amarum var. *hoffmannii*

THREAT STATUS 3

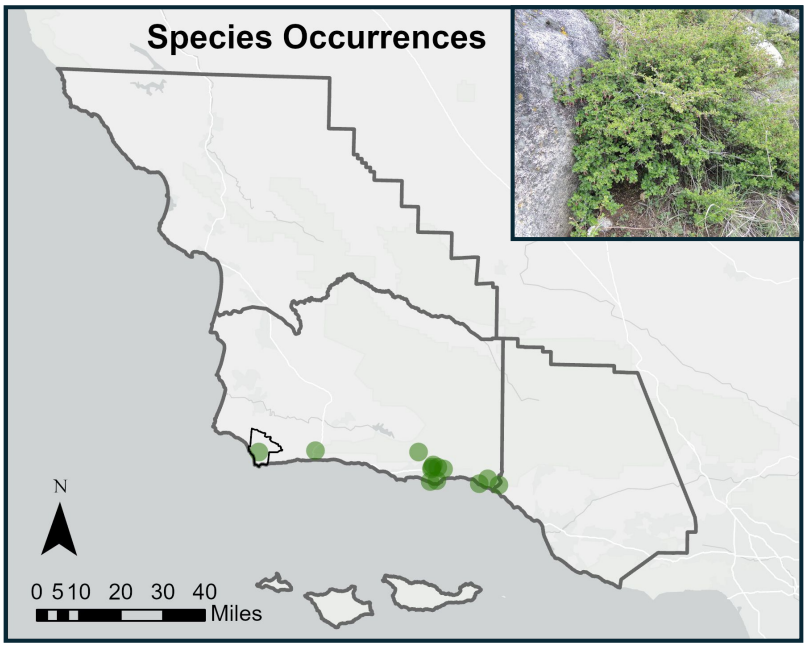
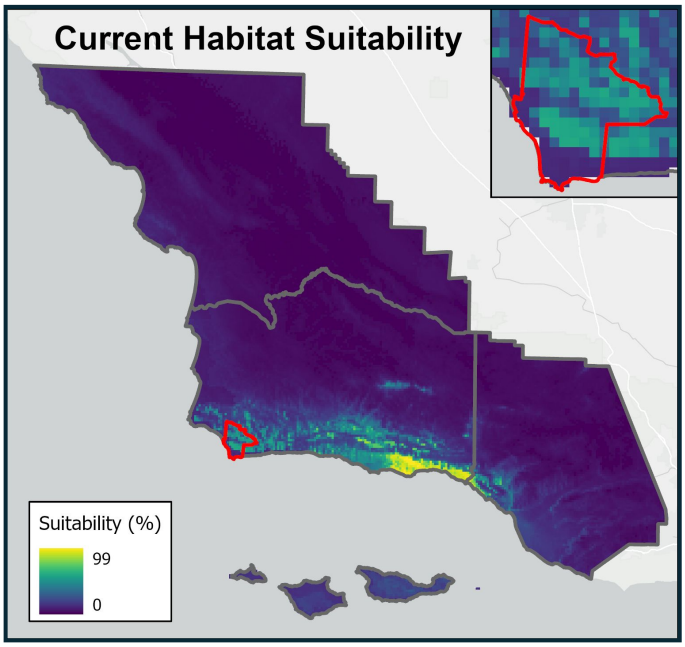


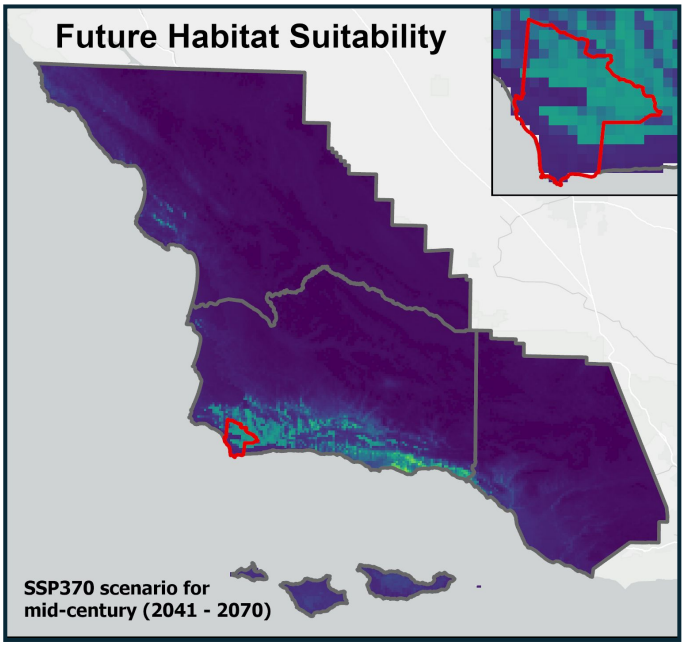
Photo credit: John Doyen, Calscape.org

DESCRIPTION
Perennial deciduous shrub endemic to California, found primarily in Santa Barbara County.

HABITAT
Occurs in chaparral and riparian woodland, growing at elevations from 5 to 1190 meters.

THREATS
Its limited distribution may make this species particularly vulnerable to climate change, as well as invasive species encroachment.





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BLACK-FLOWERED FIGWORT

Scrophularia atrata

THREAT STATUS 1B.2

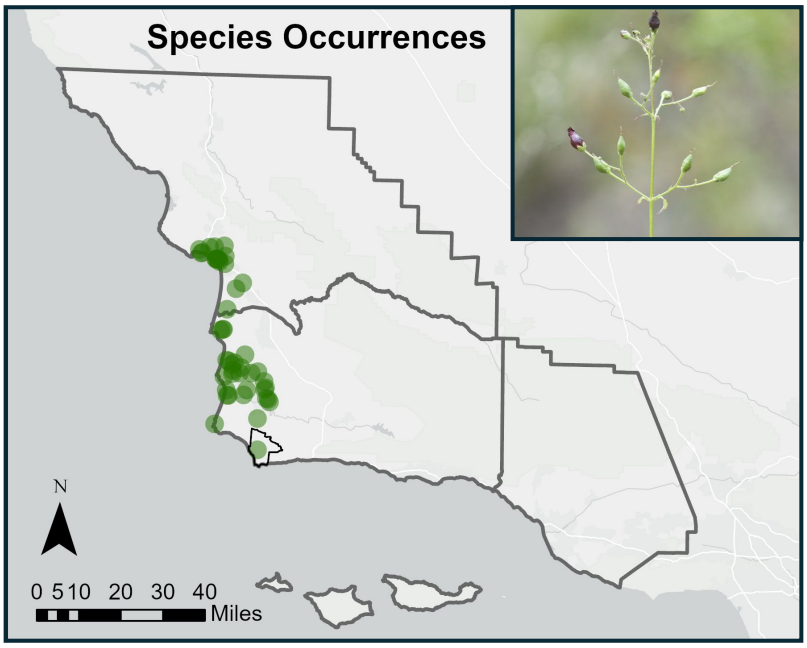


Photo credit: Chris Winchell, Calscape.org

DESCRIPTION

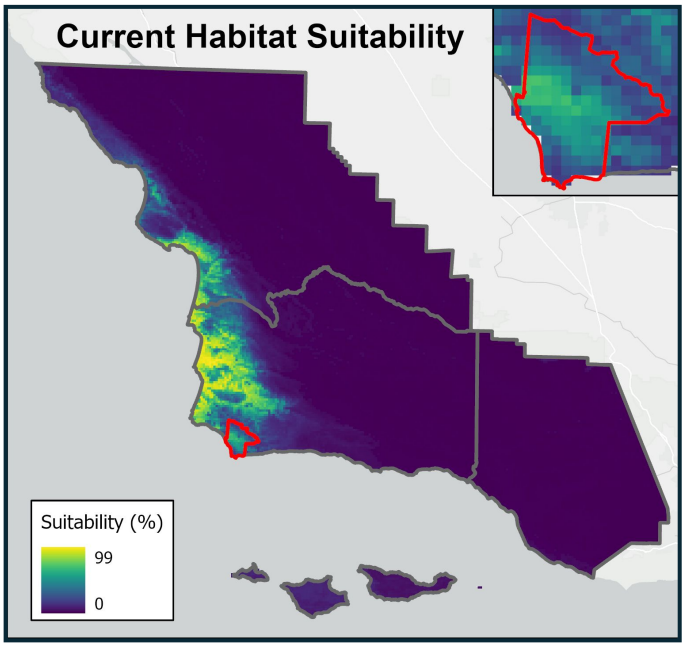
Black-flowered figwort is a perennial herb endemic to California and found only in San Louis Obispo and Santa Barbara Counties.

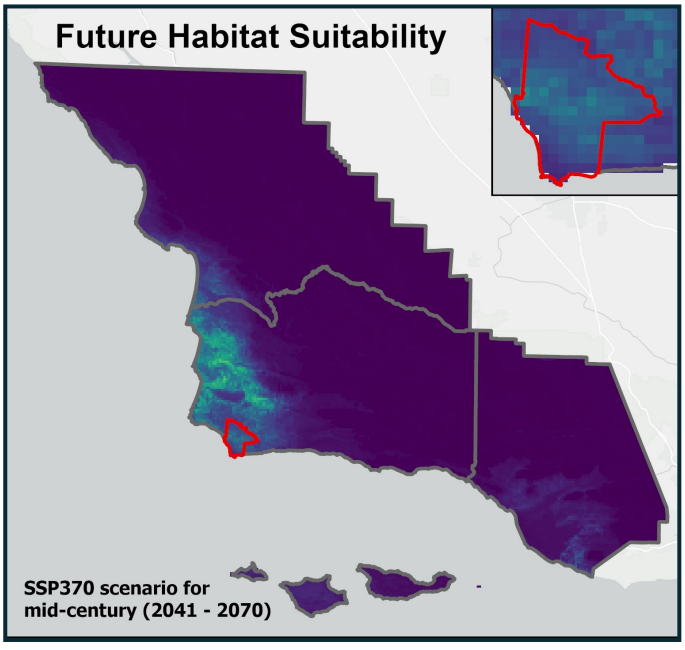
HABITAT

Grows in calcareous and diatomaceous soils in coastal canyons below 500 meters.

THREATS

Its limited range may make black-flowered figwort particularly vulnerable to climate change, human disturbances, and invasive species.





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DUNE (BLOCHMAN'S) RAGWORT

Senecio blochmaniae

THREAT STATUS 4.2

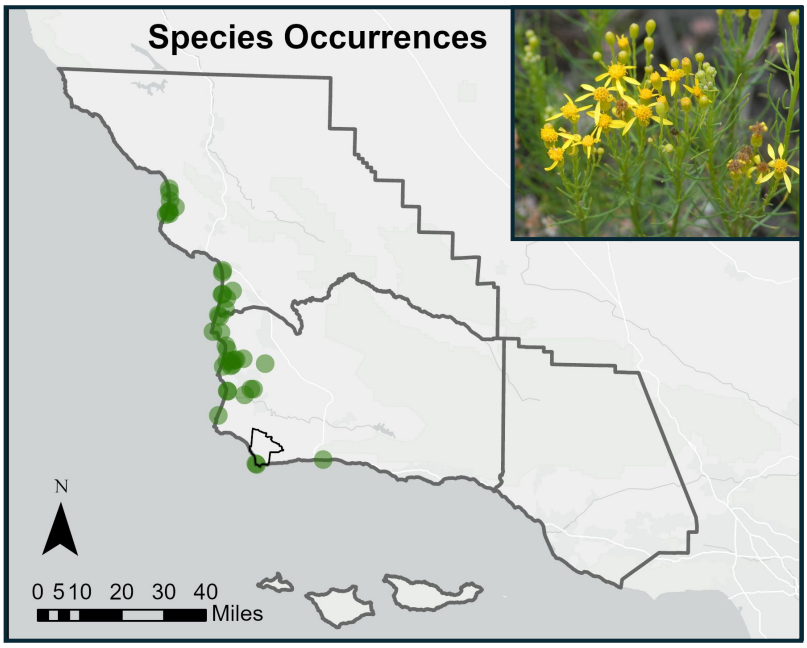
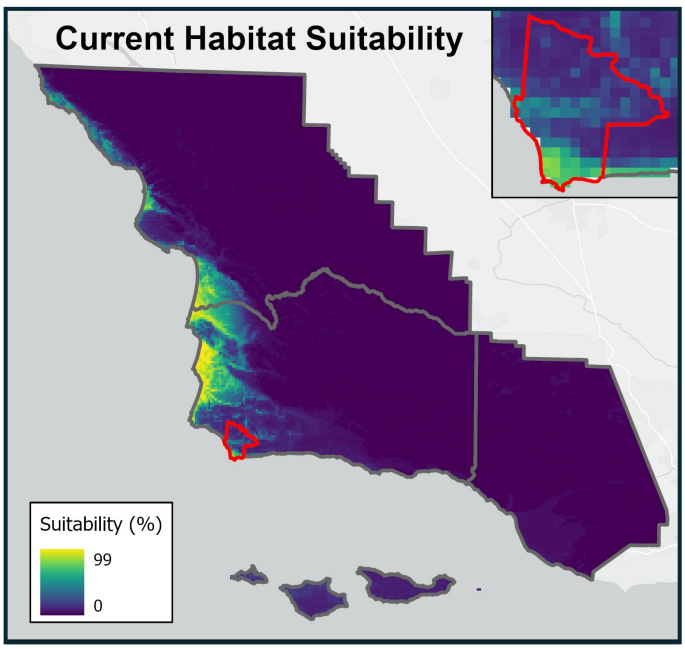


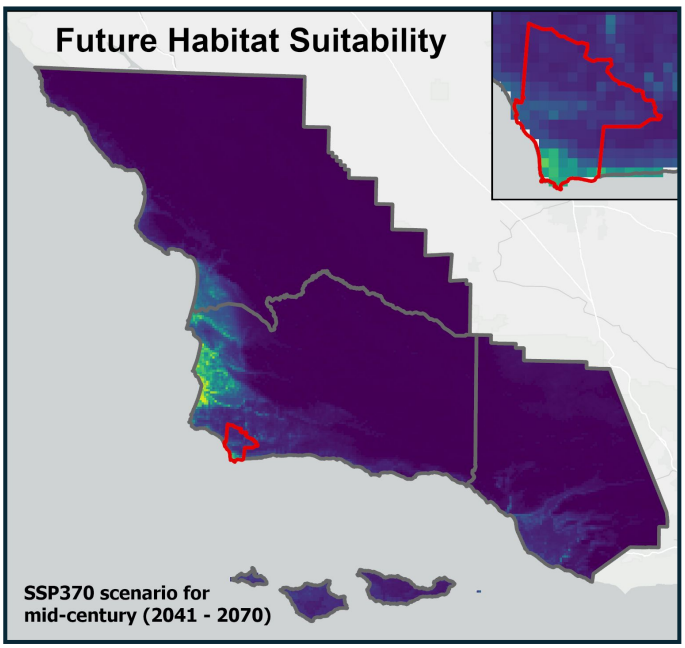
Photo credit: Chris Winchell, Calscape.org

DESCRIPTION
Flowering subshrub plant endemic to the Central Coast of California. Found on the coastline of San Luis Obispo and Santa Barbara Counties.

HABITAT
Dune ragwort grows in sand dunes and sandy areas around coastal floodplains.

THREATS
Dune ragwort may be threatened by coastal erosion, human disturbances, and invasive species.





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WOOLY SEABLITE

Suaeda taxifolia

THREAT STATUS 4.2

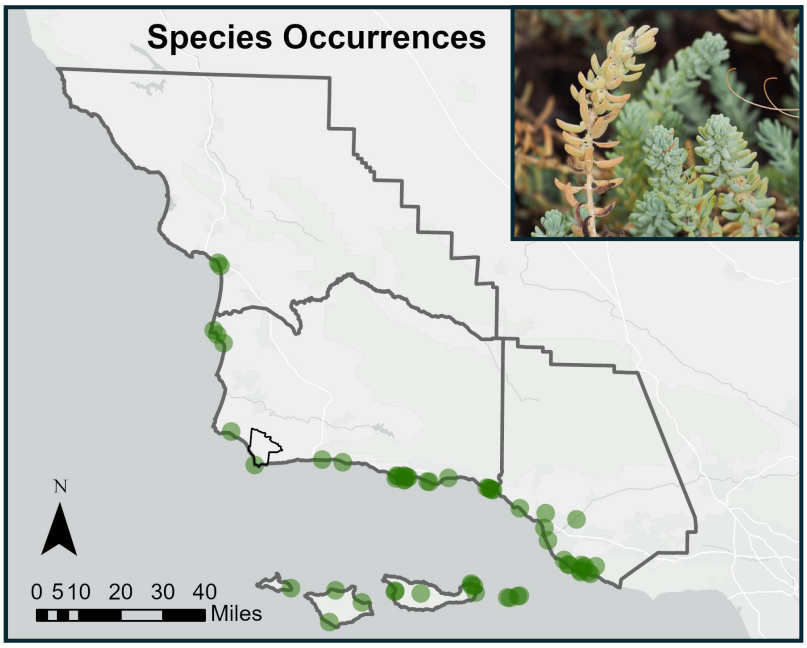


Photo credit: Keir Morse, Calflora

DESCRIPTION

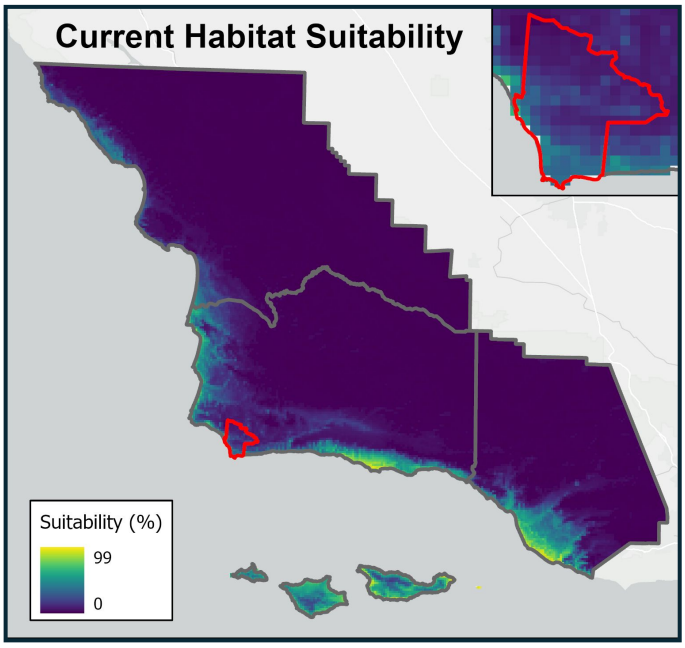
Wooly seablite is a flowering shrub/subshrub plant native to southern and Baja California. Generally variable in appearance.

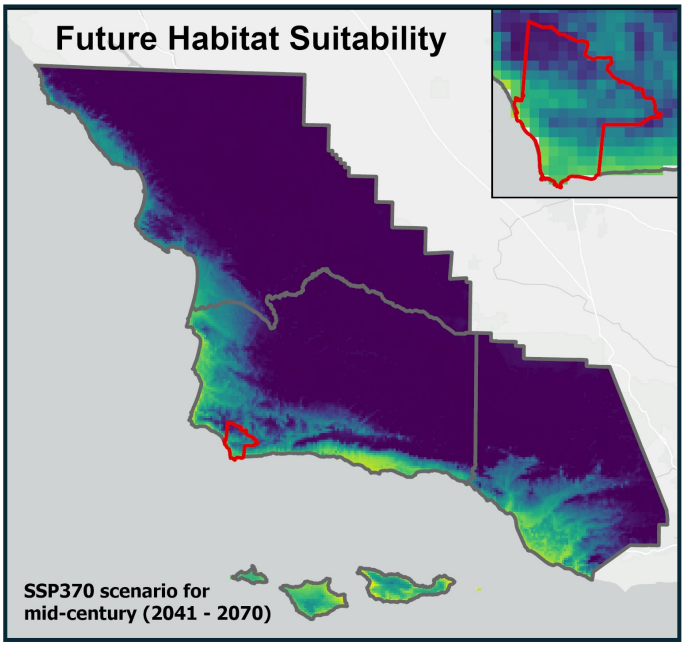
HABITAT

Wooly seablite grows in saline habitats such as salt marshes, beaches, dunes, and scrub.

THREATS

Threatened by coastal erosion, human disturbances, and invasive species.





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