California Rangeland Conservation Coalition

Biological Prioritization of Rangelands: Approach and Methods

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Overview

Rangelands represent one of the most threatened habitats throughout the western United States (Maestas et al. 2003; Theobald 2005). In addition to being threatened, these oak savanna and grassland habitats have relatively low levels of conservation management while maintaining high biodiversity values. Many grassland birds, native plants and threatened vernal pool species on this landscape benefit from responsible grazing practices (Marty 2005; Pyke and Marty 2005). Intact, privately-owned rangelands face threats from increased low density, rural residential housing development in the foothills and conversion to other uses.

Out of this concern environmentalists, cattlemen and government agencies have come together to form a most unlikely conservation partnership, the California Rangeland Conservation Coalition. This document describes the methods to generate priority conservation areas for the CRCC. The map illustrates the coalition's vision for rangeland conservation and restoration, but does not represent the full set of priorities for the Coalition's member organizations. The Rangeland Coalition works with willing private landowners to preserve ranches though conservation easements and to carry out habitat enhancement projects for common and threatened species.

Goal of Prioritization

The goal of this prioritization process is to identify areas of privately-owned rangelands that have high biodiversity value and require conservation action in the next 2-10 years. We assembled the most current and complete data for species and vegetation systems representative of rangeland ecosystems. Our approach is not solely driven by GIS data, as much critical information on the status, condition and economic viability of rangelands has not been formally captured in databases. As stakeholders are further engaged in this planning process, we will improve our prioritization through review and input. There are several key assumptions that guide our prioritization. These are:

- Areas that are intact and less fragmented from housing, commercial development and transportation provide higher biodiversity values for rangeland habitats and the species that depend on them.

- Proximity to existing conservation land protected in fee or through conservation easement should be a positive factor in identifying future conservation areas.

- While open rangeland by itself is an important conservation priority in California, areas that support multiple ecological values are the specific focus of this assessment. Such values include habitat for rare, endemic or threatened wildlife, concentrations of key focal or indicator species, or intact areas with low levels of fragmentation due to human infrastructure.

- Other factors, including political, economic and cultural, need to be incorporated into this geographic prioritization before it can be considered complete.

Role of Informed Opinion and GIS data
While spatial data used in GIS gives a limited view of the true extent and condition of many rangeland biodiversity elements, it is essential to use for several reasons. First, while scientific and anecdotal information on the status and trends of species and communities is critical to inform conservation planning, it is inherently biased toward those areas that people have studied or know well from living or working there. Observational data, such as the California Natural Diversity database (NDDB) is subject to the same limitations as informed opinion in that it is not a complete survey for rare species, but it organizes data into standardized fields that allow occurrences to be compared to each other across large areas and to themselves over time. Both informed opinion and GIS data are critical to set conservation priorities, as they are two sources of information that work best together as they fill gaps in the other.

Second, data systematically collected and entered into a standardized classification, such as that described in the Manual of California Vegetation can be monitored over time so that changes in the extent and condition of habitats can be detected. This helps inform adaptive management and conservation, so that resources are allocated to those species and systems most in need. Yet, further reconnaissance is always necessary before conservation strategies can be developed, as data gaps are inherent to any regional assessment.

Prioritization Methods

The steps in the prioritization process are described below:

1. Define Study Area, Planning Units and Subregions.
The study area is roughly 28 million acres in size and includes the foothills around the Central Valley and most of the southern Inner Coast Range. To the east and northwest, the boundary is based on the transition between Blue Oak Woodlands and Montane Hardwood or conifer forest. We excluded the moister coastal grasslands of the North and Central Coast ecoregions. The western boundary goes toward Highway 101 as it comes south through Lake County and follows 101 all the way to the Santa Ynez Range in Santa Barbara County. The boundary then cuts across the southern Central Coast ecoregion toward the crest of the Tehachapi Mountains.

The study area is divided into subregions for the assessment so that conservation areas could be identified across major latitudinal and elevational gradients. This ensures redundancy in the face of major habitat loss or disturbance and is a way to capture more of the genetic variability of a given conservation target. We subdivided the foothills into five subregions based on latitude and sides of the Valley and have four Valley floor subregions- the Delta, Sacramento Valley, San Joaquin Valley and Tulare Basin (Figure 1).

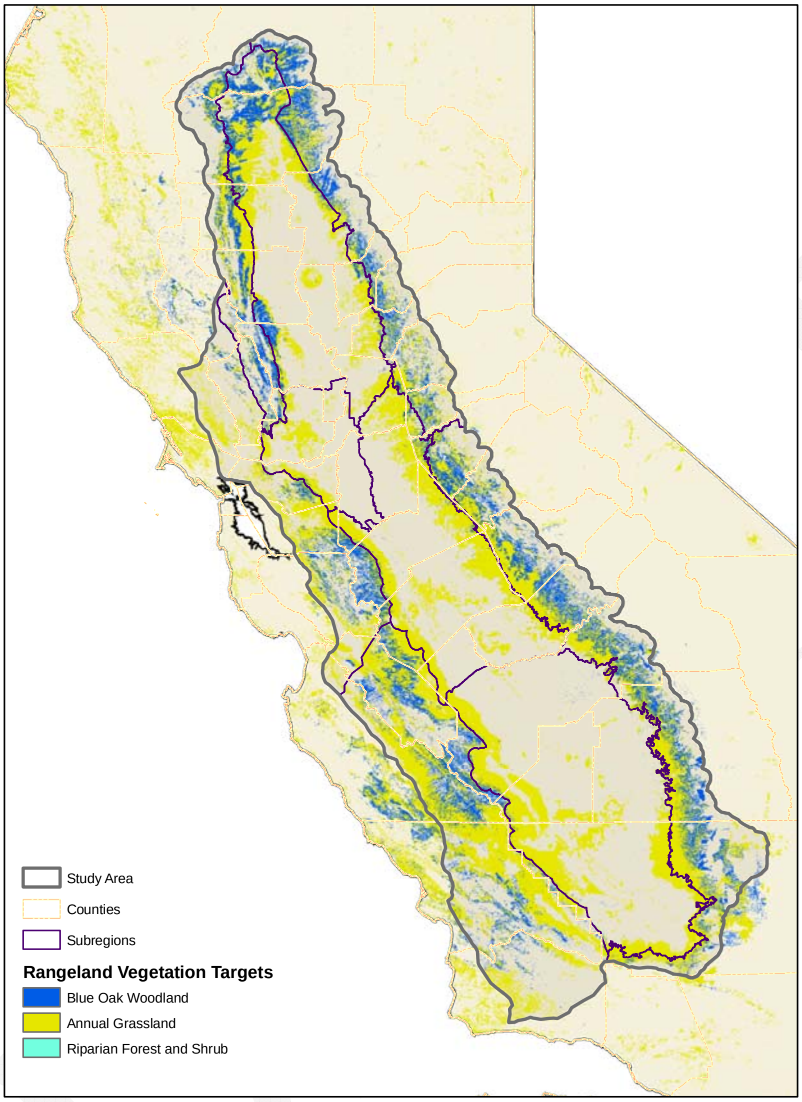

Figure1: Study area, major vegetation systems, and subregions

Planning units are used to assemble the habitat and species data into a format that allows the site-selection program, Marxan (Ball and Possingham 2000) to develop a network of priority areas. They are the building blocks of the analysis and define the smallest scale of the prioritization. Our planning units are 1235 acre (500 hectare) hexagons.

2. Define and Map Conservation Targets.
A conservation target is a species, vegetation community or habitat feature that is the focus of the prioritization. These are the elements of rangeland ecosystems that we aim to conserve. For this assessment, we have three types of targets: ecological systems, communities and species. An ecological system target represents the broadest scale of distribution and includes Annual Grassland and Blue Oak Woodland. Finer-scale

community targets embedded in these systems are also included in the prioritization, including vernal pools and riparian forest and shrubs. Riparian communities are broken into several types (Table 1). The vernal pool target for the Central Valley portion of the study area is based on a predictive model of richness of federally-listed vernal pool taxa. (Holland 2006). Areas with high richness (8-16 taxa potentially present) are given a higher goal than those with moderate richness (1-7 taxa potentially present). General conservation target distribution is mapped in Figure 2.

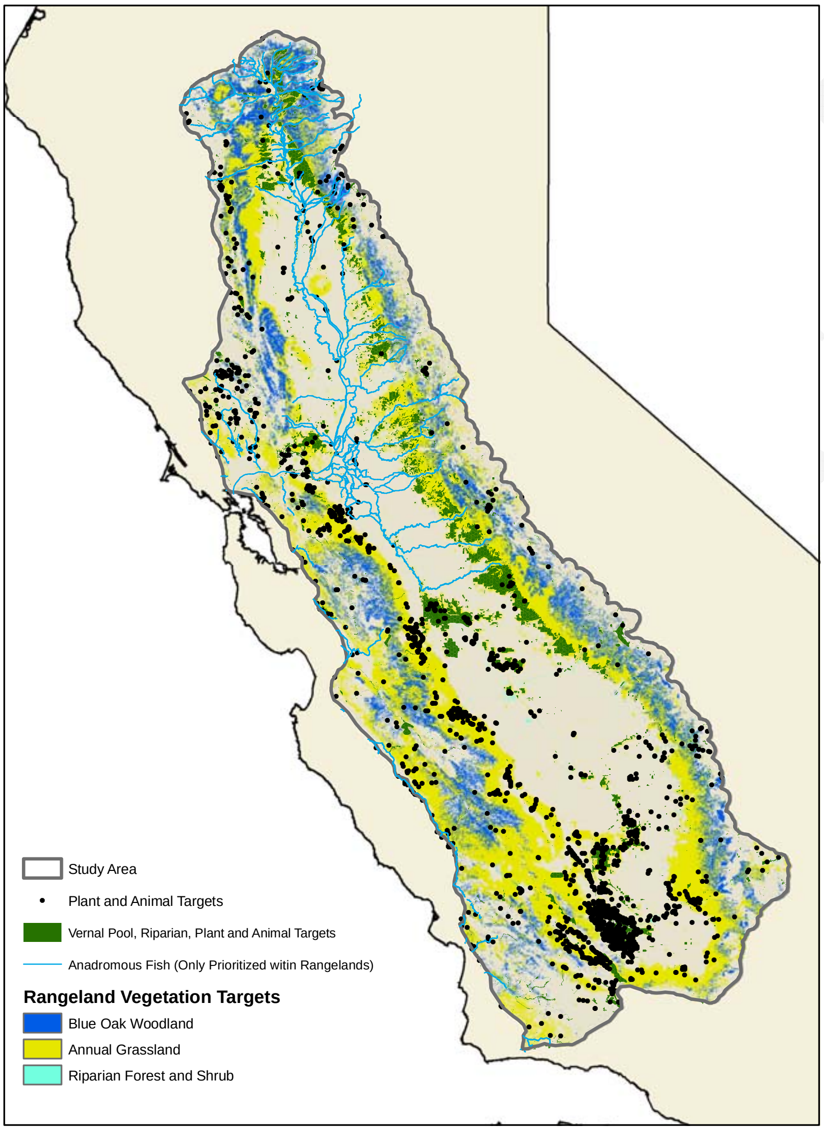

Figure 2. General map of conservation targets

Many of the targets that we included in this analysis can also occur outside of rangeland ecosystems, ***so we constrained the model so that only occurrences of targets that are embedded in rangelands were included in the prioritization. This is defined as planning units with an average of at least 20% Annual Grassland or Blue Oak Woodland within the local area.***

Target Name	Target Type	Notes	Data Sources
Grasslands	Ecological System	Primarily annual grasslands, but some natives grasses are present	- CA Multi-Source Land Cover (CDF 2002) - Calveg (CDF-USFS 1998-2004) - U.S. Bureau of Reclamation (2003) - CA DWR Land Use Surveys 1994-2003
Blue Oak Woodlands	Ecological System	Does not include Blue oak-Foothill pine communities at higher elevation	- CA Multi-Source Land Cover (CDF 2002) - Calveg (CDF-USFS 1998-2004) - U.S. Bureau of Reclamation (2003) - CDF Hardwood Pixel (199X)
Vernal Pool Taxa	Communities	For the Central Valley, we used a model of predicted federally listed taxa richness. Portions of the Central Coast ecoregion use only the vernal pool density mapping from 1998 as the source. Both the modeled richness and density layers were included only where the USFWS 1998 data layer showed there are still vernal pools.	- USFWS Vernal Pool density (1998) - Predicted vernal pool listed taxa richness (Holland, 2006)
Rare, Endemic or Sensitive Rangeland Animals	Blunt-nosed Leopard Lizard — Herpetofauna Giant Kangaroo Rat — Mammals Riparian (=san Joaquin Valley) Woodrat — Mammals San Joaquin Antelope Squirrel — Mammals San Joaquin Kit Fox — Mammals San Joaquin Pocket Mouse — Mammals Short-nosed Kangaroo Rat — Mammals Tipton Kangaroo Rat — Mammals Tulare Grasshopper Mouse — Mammals Fresno kangaroo rat — Mammals	Many of these species were part of the Recovery Plan for Upland Species in the San Joaquin Valley. The very large entries in CNDDB for kit fox were excluded from the analysis. CNDDB occurrences in CV ecoregion filtered on date (since 1980) and presence code = 1 (presumed extant). CV and Central Coast EOs with accuracy class 1-3 mapped as polygons, accuracy class 4 -9 mapped as centroids. This is an important consideration and limits the scale at which areas can be prioritized.	- CNDDB 2004-2006 - USFWS/CSU Stanislaus ESRP (1998)
Rare Plants	Species (N = 500)	Primarily ranked G1/S1 or G2/S2, but more common plants included if they are tracked by NDDB. Different goals set at these two levels.	- CNDDB (2004-2006)

Riparian Woodland & Scrub	Communities- these types are merged as Riparian Forest and Shrub in Central Coast ecoregion and broken out in Central valley: Great Valley Mixed Riparian Forest, Great Valley Cottonwood Riparian Forest, Great Valley Valley Oak Riparian Forest. Sycamore Alluvial Woodland was a unique target in the whole area.	There are many sources for riparian forest and shrub vegetation though none are comprehensive for very large areas. For the Central Valley portion these are tracked as different community targets and in the Central Coast are grouped as one target, with the exception of sycamore alluvial woodland.	- U.S. Bureau of Reclamation (2003) - DFG Veg mapping efforts - DU-DFG Wetlands and Riparian classification - TNC 2006
Anadromous Fish	Steelhead- Central Coast ESU, Central Valley ESU; Spring-Run Chinook- Central Valley ESU	These layers represent various habitat for different life stages. While we recognize the importance of watershed dynamics and habitat quality throughout the runs, we only used the portion of the run that was within our rangeland systems. We included the fish by prioritizing on the planning units that they intersected with, not the total watershed area.	- NOAA Fisheries, SW Regional Office (2004)
Breeding and Winter Grassland Bird Concentrations	Loggerhead Shrike Northern Harrier Lark Sparrow Ferruginous Hawk (Winter Only) Prairie Falcon White-tailed Kite	For winter bird distribution we used Christmas Bird Count (CBC) data (1999-2006)- only sites within study area surveyed at least 4 of last 8 years and with at least 32 party hours each year were included. Each average site abundance (number/ party hour) over the survey years was compared to the average for all sites for a given bird and scored based on that departure from average. These scores were assigned to a CBC point and then modeled across all potential habitat using an "inverse-distance weighting" technique that guesses at what abundance values would be based on nearest CBC location. For Breeding Bird Survey (BBS), we used the relative abundance data from USGS- Patuxent Wildlife Research Center that used average counts for target species from 1994-2003.	- USGS- Sauer, J. R., J. E. Hines, and J. Fallon. 2005. *The North American Breeding Bird Survey, Results and Analysis 1966 - 2005. Version 6.2.2006. USGS Patuxent Wildlife Research Center, Laurel, MD* - Christmas Bird Count data 1999-2006 http://www.audubon.org/bird/cbc

Table 1. Conservation targets, processing notes and data sources

3. Define Conservation Suitability Factors.

By defining targets we state what we aim to conserve, but not all landscapes are equally suited to conservation of these targets. The next stage is to identify what factors enable successful long-term conservation. The site selection model uses suitability factors to inform what areas are most feasible for conservation. These factors are combined into an index that represents the "cost" to achieve conservation, not in terms of dollars, but in effort to achieve conservation objectives (Figure 3). The factors that we included are housing density (2000 Census blocks), road density (weighted by class of road), and the percent of a planning unit in intensive agriculture (e.g. row crops, orchards, vineyards).

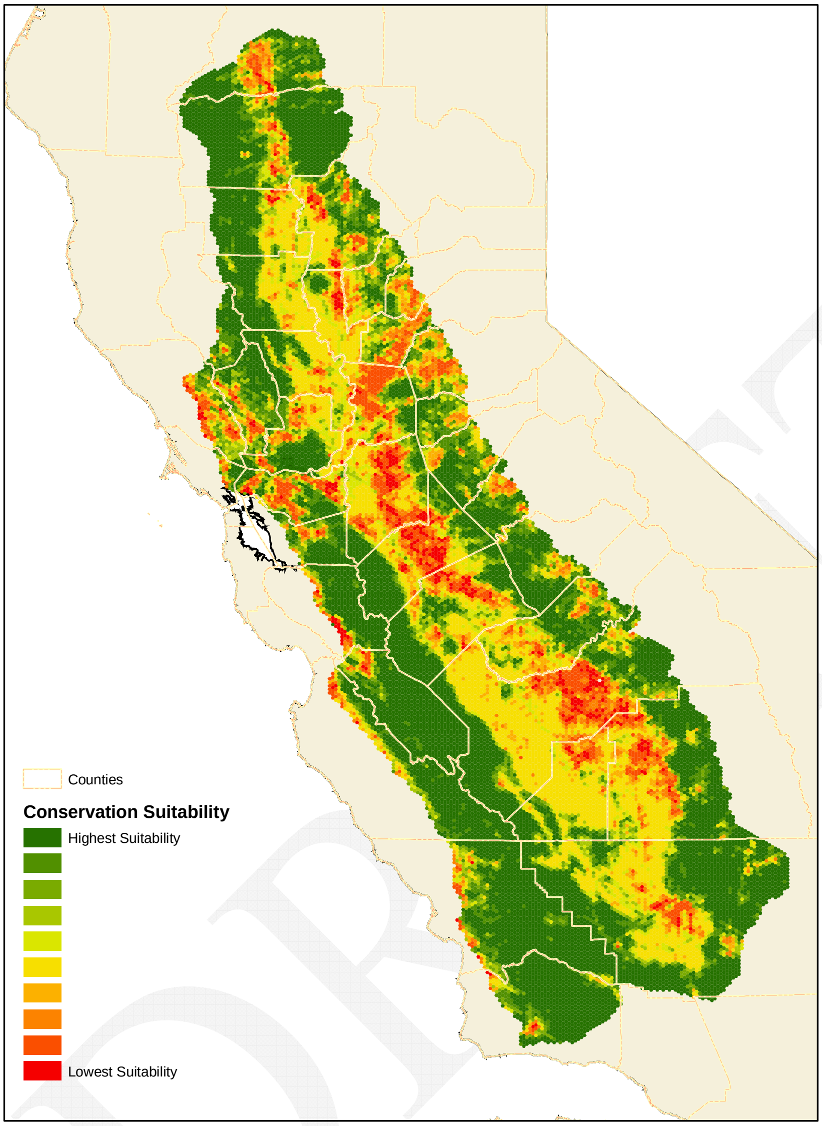

Figure 3 Suitability Index: Areas that are more "intact" and potentially more suitable for rangeland conservation. Suitability is measured as a function of housing density in 2000, intensive agriculture and road density. Green areas don't necessarily have rangeland targets though, so this doesn't represent important rangeland conservation areas.

Criteria	Data Sources	Weighting	Issues/Comments
Incompatible Land Use- Intensive Agriculture	- CA Multi-Source Land Cover (CDF 2002)	Moderate	**Avoid:** weighting based on the average amount of agriculture in one 500 ha planning unit
Incompatible Land Use- Housing Density	- Census block housing density (CDF 2000)	High	**Avoid:** higher density areas
Density of Roads	- Census Bureau TIGER transportation (US Census Bureau 2000)	Moderate	**Avoid:** areas with high road density

Table 2: Suitability factors

4. Set Conservation Goals for Targets.

If targets are the "*what to protect*" of the prioritization, the goals are the "*how much is needed*" to sustain that target for several decades. Goals are subjective but are based the rarity or level of imperilment of a target. Goals were set as follows:

Target Name	Goals
Grasslands	50% of total area
Blue Oak Woodlands	50% of total area
Listed Vernal Pool Taxa	High Richness: 95% of area Lower Richness: 60% of area
Rare, Endemic or Sensitive Rangeland Animals	95% of area
Rare Plants	G2S2 or rarer: 95% of area or occurrences G3S3 or more common: 50% of area or occurrences
Riparian Woodland & Scrub	General Riparian: 70% of area Named communities: 95% of area
Fish	70% of stream length with targets present embedded in rangeland systems
Grassland Birds	50% of total estimated abundance values for each bird/season combination

Table 3: Conservation goals for targets

5. Identify Land Currently Managed for Biodiversity Values

To ensure that future conservation builds on past conservation, we secured, or locked-in, those planning units that had more than ~250 acres (100 hectares, 20% of planning unit) of conservation land (Gap Status 1 and 2 fee or easement) and at least 250 acres of matrix rangeland systems (Blue Oak Woodlands or Annual Grasslands) (Davis et al. 1998). These nodes of existing conservation land act as magnets for the model as it selects new conservation priorities.

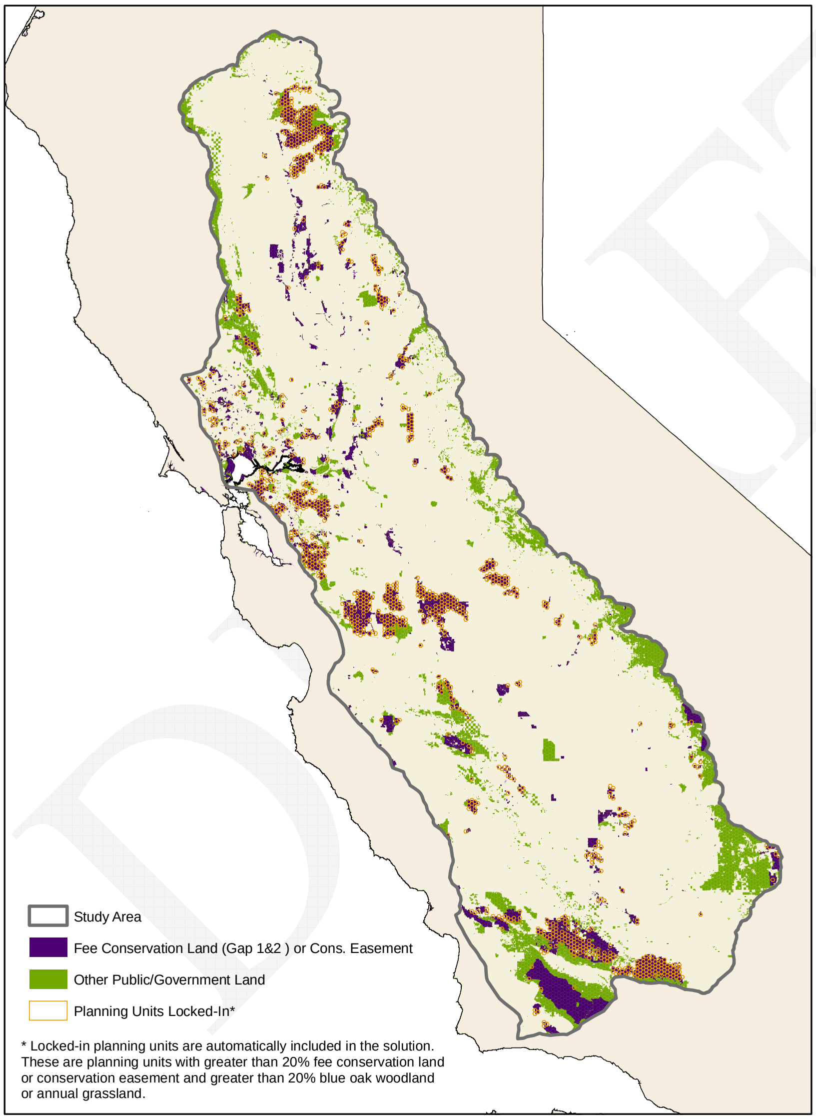

Figure 4: Existing conservation lands and planning units locked-in as part of the solution.

6. Run model to design priority network

Once the targets have been mapped, the suitability index created, the goals defined and the existing conservation lands mapped, then we use the model to find an arrangement of planning units to meet our goals in areas with the highest conservation suitability.

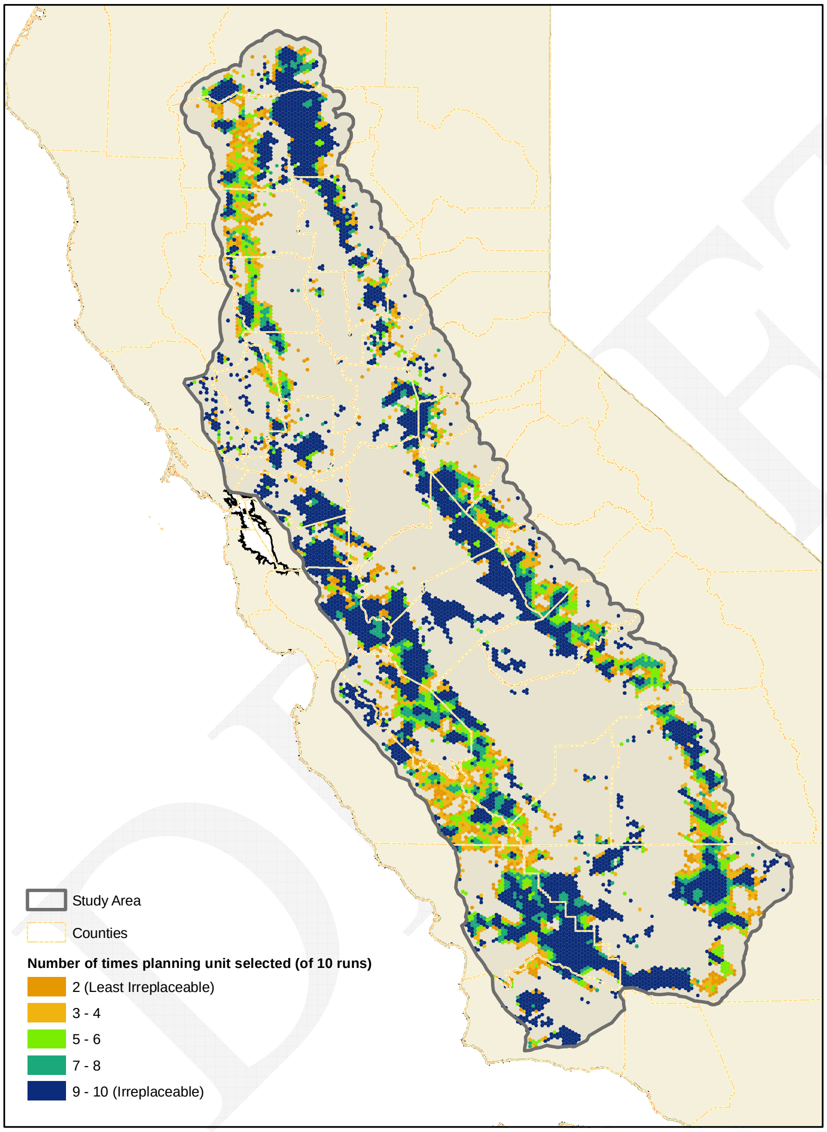

Figure 5: Prioritization model output

This map (Figure 5) shows the "summed solution" from the model, which is the number of runs out of the maximum (here 10 runs were used) that a planning unit is selected to meet goals. Darker blue (selected more times) means that the area is more "irreplaceable" or necessary to meet goals.

7. Evaluate Results, Assemble Priorities into Different Tiers based on Biodiversity Value

At this point, it is critical to review and simplify the results from the Marxan model to ensure that areas are not missing that should be included or that areas that are included are not already degraded and not suitable for conservation. Additionally, we can evaluate our selected priority areas based on how well they meet goals. This is summarized for vegetation targets in Table 4.

Target	Target Area Prioritized (ha)	Target Area Prioritized (acres)	Target Total Area (ha)	Target Total Area (acres)	% in Prioritized Areas (Level 1 or 2)	Protection Goal	Surplus/Deficit
Vernal Pool Higher Spp Richness	205,304	507,102	214,667	530,228	96%	95%	1%
Vernal Pool Lower Spp Richness	115,755	285,915	152,453	376,558	76%	60%	16%
Annual Grassland	2,076,608	5,129,222	3,209,774	7,928,141	65%	50%	15%
Blue Oak Forest / Woodland	793,772	1,960,617	1,181,893	2,919,276	67%	50%	17%
Great Valley Cottonwood Riparian Forest	1,094	2,701	1,100	2,716	99%	95%	4%
Great Valley Mixed Riparian Forest	923	2,279	950	2,345	97%	95%	2%
Great Valley Valley Oak Riparian Forest	832	2,054	898	2,219	93%	95%	-2%
Riparian Forest and Shrub	23,359	57,698	29,130	71,951	80%	70%	10%
Sycamore Alluvial Woodland	4,306	10,635	4,470	11,040	96%	90%	6%
Valley Sacaton Grassland	3,752	9,267	3,798	9,382	99%	95%	4%
Vernal Pools (Central Coast only)	1,284	3,172	1,711	4,227	75%	80%	-5%

Table 4: Progress toward goals for vegetation targets as represented in the priority areas

Once we have reviewed the model results, we assembled priorities into two groups based on the number of times a planning unit was selected by the site-selection model. If the planning unit was selected at least 3 and at most 7 times, it was classified as *Important* to meet goals. If it was selected 8 or more times, then it was called *Critical.* Below is a snapshot of the final draft prioritization (Figure 6). Areas in light blue are Important and areas in dark blue are Critical to meet CRCC's conservation goals.

Through initial review of Marxan output, we made some changes to the priority areas based on additional planning and data. We added planning units as *critical* that had been omitted by Marxan but were identified to have high rangeland biodiversity value in either TNC site conservation planning efforts in the Central Coast or as conservation priorities at Tejon Ranch by Conservation Biology Institute (CBI 2006). Additionally, to reflect recent changes in the landscape, we removed areas that had been selected as either important or critical that are at least 50% developed as mapped by the California

Department of Conservation (FMMP 2004). On Figure 6, green areas are in public ownership or are privately conserved through fee or conservation easement.

Future patterns of residential growth were also analyzed to show the relative impact on prioritized areas. For this, we analyzed patterns of projected future residential growth relative to prioritized areas. The areas in red below are prioritized (at either level) and are projected to be fragmented by 2030. We used the output of a national housing density growth model (Theobald 2005) and called land "fragmented" if there is projected to be at least one housing unit per 40 acres. This is a commonly used density cutoff for exurban or low density rural residential growth.

Another key component to evaluate is the current level of protection against conversion within priority areas. This is summarized in Table 5.

Priority Level	Total Area Priority (ha)	Total Area Priority (acres)	Area in Conservation Status by Protection Type (ha)	Area in Conservation Status by Protection Type (acres)	% in Conservation Status	Protection Type
Critical Areas	2,563,000	6,074,310	21,342	52,714	1%	Easement
		-	543,400	1,342,198	21%	Fee
Important Areas	1,396,500	3,309,705	3,254	8,037	0%	Easement
		-	171,090	422,592	12%	Fee
Totals	3,959,500	9,384,015	739,085	1,825,541	19%	All

Table 5: Conservation status of priority areas

Next Steps

Through ongoing outreach and engagement with stakeholders, CRCC will work to refine this prioritization to more fully address rangeland condition, threats and economic viability of ranching in the region. The map and this write-up represent a completed prioritization of rangeland conservation values using current data on biodiversity targets, protected lands, land use suitability and ongoing threats from housing development. As new data become available and as funding opportunities allow we will refine and update this document and associated database and map.

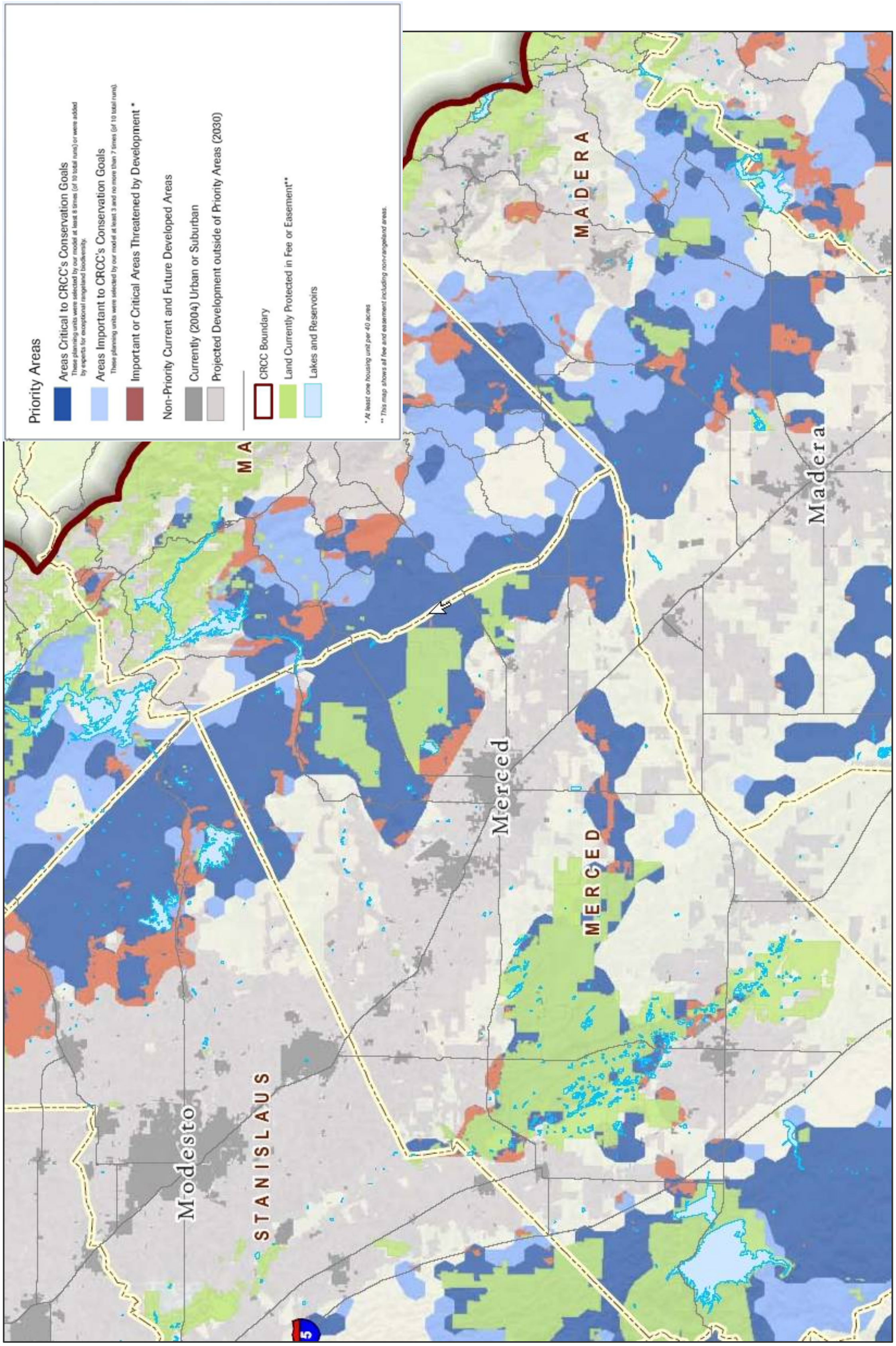

Figure 6: Snapshot of Final Prioritization

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