Conservation Assessment of
—Tejon Ranch—

December 2003

CONSERVATION BIOLOGY INSTITUTE

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Prepared by

Jerre Ann Stallcup
Michael D. White
James R. Strittholt
Wayne D. Spencer

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Acknowledgements

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Executive Summary

Tejon Ranch supports a multitude of irreplaceable biological resources, and the melding of these resources in one large, intact landscape makes the Ranch a regionally significant conservation target. Comprehensive land use planning is needed for this keystone property, which is surrounded by growing metropolitan and agricultural areas—the Los Angeles basin, Bakersfield and the San Joaquin Valley, Tehachapi and Cummings valleys in the Tehachapi Mountains, and Antelope Valley of the Mojave Desert. The cumulative effects of conservation and development in this region must be evaluated as part of designing a functional, landscape-scale reserve for Tejon Ranch. Understanding the distribution of conservation values on the Ranch and surrounding areas is critical to inform conservation design for the region. This report evaluates the distribution of conservation values on Tejon Ranch, as an incremental step towards developing a regional reserve design.

We used publicly available data and science-based conservation principles to describe and map selected conservation values for Tejon Ranch. Our assessment demonstrates that, although different areas of the Ranch support different sets of conservation values, virtually all areas of the Ranch support one or more sets of values. To spatially describe the distribution of these values on Tejon Ranch, we identified four landscape units that differentially support the conservation values considered in our analysis:

A. Lowland grasslands and oak savannas of the San Joaquin Valley (108,244 acres)

- Last remaining connection between grasslands on the east and west sides of the San Joaquin Valley
- Potential habitat for 5 listed plants, 5 listed animals, and 4 endemic plants considered in this analysis
- Almost 100,000 acres of grassland and oak savanna communities, which are under-represented regionally in protected open space

B. Closed-canopy oak woodland, montane hardwood, and montane hardwood-conifer communities on the northwest slope of the Tehachapi Mountains (81,836 acres)

- Irreplaceable landscape linkage and habitats for foothill and montane species between the Sequoia and Los Padres National Forests
- 58,000 acres of the highest integrity watershed basins
- 74,500 acres of the highest diversity of vegetation communities on the Ranch
- 63,578 acres of roadless areas, including the largest area of roadless habitat >10,000 acres on the Ranch
- Potential habitat for 3 listed animal species considered in this analysis

C. Oak woodland, chaparral, and pinyon-juniper communities on the southeast slope of the Tehachapi Mountains (26,518 acres)

- Irreplaceable landscape linkage and habitats for foothill and montane species between the Sequoia and Los Padres National Forests
- High integrity watershed basins (60% of unit)
- High diversity of vegetation communities (87% of unit)
- Over 20,000 acres of roadless areas, including 7,800 acres of roadless habitat >10,000 acres
- Potential habitat for 2 listed animals and 2 endemic animals considered in this analysis

D. Lowland Joshua tree woodland, grassland, and desert scrub communities of the Mojave Desert (53,613 acres)

- Landscape linkage and habitats for lowland and desert species
- Over 25,000 acres of grasslands, which are under-represented regionally in protected open space
- Over 25,000 acres of roadless habitat (almost half of the unit)
- Potential habitat for 1 listed animal and 2 endemic animals considered in this analysis

Reserve designs for Tejon Ranch must, at a minimum, capture these values while ensuring the maintenance and management of ecological processes within and between landscape units. Similarly, conservation planning must ensure integration and connection of these landscape units with others in the region, along with a regional plan for long-term management and biological monitoring. Without careful and comprehensive consideration, land use plans for Tejon Ranch could irretrievably alter the biological functions and values of this keystone landscape.

Introduction

Tejon Ranch is a 270,000-acre private property located in the Tehachapi Mountains and including portions of the adjacent San Joaquin and Antelope valleys (Figure 1). A previous assessment of the region (White et al. 2003) demonstrated that the Ranch comprises a unique and diverse biological core area with high habitat integrity, intact, functioning watersheds, and significant roadless areas. Conservation of Tejon Ranch is critical to ensuring landscape connectivity between the Sequoia National Forest and the Los Padres National Forest, and significant conservation on the Ranch is crucial to ensuring that these and other existing conservation investments in the region remain intact and functional (Penrod et al. 2003). The Ranch meets virtually all of the California Resources Agency priority criteria for conservation, as described by the California Legacy Project (2002).

Comprehensive land use planning is needed to effectively conserve the irreplaceable natural resource values of Tejon Ranch. This study uses publicly available data and science-based conservation principles to describe and map selected conservation values for Tejon Ranch, as an incremental step towards developing a regional conservation reserve design.

This study recognizes that conservation design is a systematic, iterative, and adaptive process that benefits from peer review and public comment. The major premises of this study are:

- Tejon Ranch supports a multitude of irreplaceable biological resources. The melding of these resources in one large, intact landscape makes the Ranch a regionally significant conservation target (White et al. 2003, Penrod et al. 2003).
- Reserve design is the process of optimizing the capture of multiple biological values in an effective and sustainable configuration. Various factors influence the strategic decisions that guide the reserve design process, such as regional conservation priorities, threats to resource values, conservation opportunities, and available conservation mechanisms.
- Understanding the distribution of resource values is critical to informed conservation design.

Objectives

The objectives of this study were to:

1. Identify the spatial distribution of various conservation values on Tejon Ranch.
2. Illustrate how the distribution of different conservation values can influence reserve design.
3. Identify landscape units on Tejon Ranch and describe how each captures unique and diverse conservation values.
4. Identify strategic decisions that influence implementation of reserve designs.

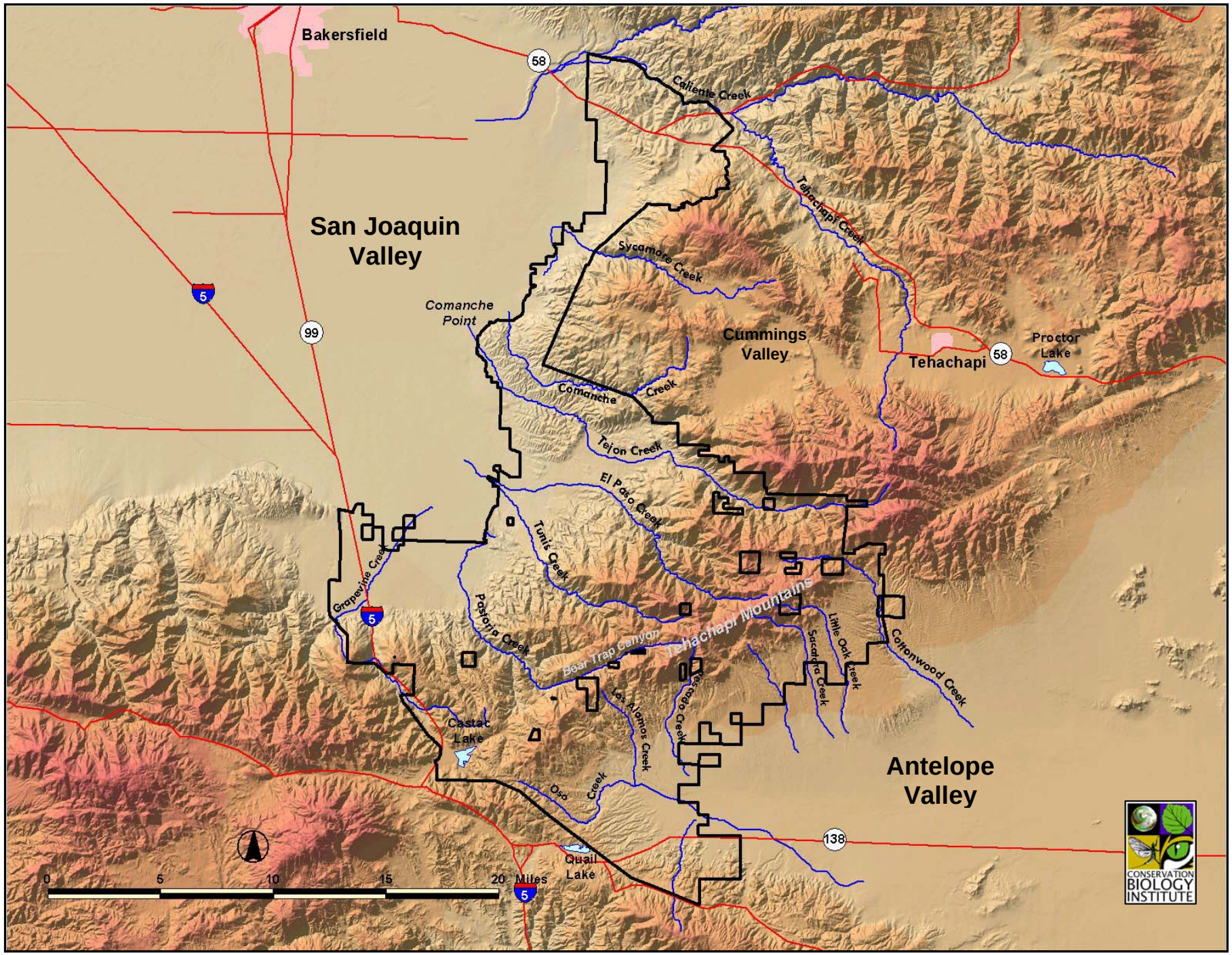


Figure 1. Geography of Tejon Ranch

Different standards and criteria have been used to assess conservation values, develop conservation priorities, and design reserve systems (Noss et al. 1997, Soulé and Terborgh 1999, Groves et al. 2000, 2002; Margules and Pressey 2000, Carroll et al. 2001, Noss 2002). Conservation assessments generally focus on specific conservation values or objectives, depending on the information available for the assessment and the ultimate implementation strategies. For example, assessments may prioritize protection of endemic or imperiled species or species requiring large areas for survival (focal species analysis), conservation of biogeographically unique or representative resources (representation analysis), or conservation of areas exhibiting high landscape integrity or connectivity, or some combination of these. Because each set of conservation targets will likely have a unique distribution, different conservation approaches may prioritize different areas of the landscape. Combining and integrating different conservation criteria results in the most robust and defensible reserve designs (Kirkpatrick and Brown 1994, Noss et al. 1999). Furthermore, protecting ecosystem integrity across a landscape supports the full range of environmental variation in the region, which is necessary to maintain long-term viability of resources and ecological processes (e.g., Noss 1983, Poiani et al. 2000).

In practice, however, conservation reserves often do *not* capture the full range of regional biodiversity and ecological processes. Scott et al. (2001) show that nature reserves in the U.S. are most frequently found at higher elevations and on less productive soils, while the distribution of plants and animals suggests that the greatest number of species occurs at lower elevations. They argue that conservation efforts should capture the full geographical and ecological range of land cover types and species distributions to ensure that reserves are representative of biodiversity patterns.

Process

Regardless of the criteria and strategies involved, conservation planning processes should be systematic, scientifically defensible, and fully transparent for stakeholder and scientific review. This report documents the conservation principles and analytical approaches for assessing selected conservation values on Tejon Ranch. The following sections describe the process for our analyses:

- Refining land cover data for Tejon Ranch.
- Assessing various conservation values that could be used in developing reserve designs for the Ranch:
    - Habitat connectivity
    - Listed and endemic species
    - Watershed integrity
    - Unique, diverse, and under-conserved vegetation communities
    - Roadless areas
- Defining and describing landscape units that reflect these different values.

Finally, this report discusses goals and considerations for regional reserve design efforts in the vicinity of Tejon Ranch.

Refining Land Cover Data for Tejon Ranch

Many conservation design efforts rely on high-resolution land cover data that can be used to define surrogates for overall biodiversity targets (e.g., the distributions of special elements, representative vegetation associations, and focal species). Tejon Ranch supports at least 23 different vegetation communities from four distinct ecoregions—Sierra Nevada, South Coast, Great Central Valley, and Mojave Desert—in one contiguous area, and we have suggested that the convergence of floristic and other biogeographic elements from each of these four ecoregions underlies the remarkable biodiversity of the Ranch (White et al. 2003). However, the complex spatial patterns and species compositions of vegetation communities on the Ranch complicate delineation and classification of vegetation communities with generalized classification systems, such as publicly available California Fire and Resource Assessment Program (FRAP) land cover data. Only by using a floristically-based classification scheme (e.g., Sawyer and Keeler-Wolf 1995) could the unique nature of the vegetation associations on Tejon Ranch be accurately described. For example, at least four distinct oak communities co-occur on Tejon Ranch; elements of oak woodlands, grasslands, desert scrub, and Joshua tree woodlands co-mingle within a single community; and pinyon-juniper communities intergrade with chaparral communities.

Therefore, a major component of this study involved refining and updating digital land cover and roads data layers using multi-spectral satellite imagery and aerial photography (digital orthophoto quadrangle maps). Spectral signatures on the imagery were field-verified in publicly accessible areas on the Ranch perimeter, and photographs taken by Andrew Harvey (Harvey 2003) helped us interpret spectral signatures and visualize the mixing of vegetation associations on the Ranch. We utilized a 30-m digital elevation model to refine the vegetation community boundaries, as some communities appear to strongly correlate with elevation, slope, and aspect. As we were unable to distinguish species dominance for individual vegetation community signatures, in some cases we used vegetation classification categories in the refined land cover that are more general than those used in the FRAP vegetation data. However, we were able to distinguish vegetation types on the Ranch that are not mapped in the FRAP land cover data (i.e., cottonwood-willow riparian woodland, oak savanna, sycamore woodland, Joshua tree woodland) and to map the general vegetation types at a finer level of resolution than the FRAP data (Figure 2). The result is a land cover map that we believe more accurately reflects the complexity of vegetation types on the Ranch than the FRAP data and includes updated information on roads, development, and agriculture. Appendix A describes the data sources and methods used to refine the land cover data.

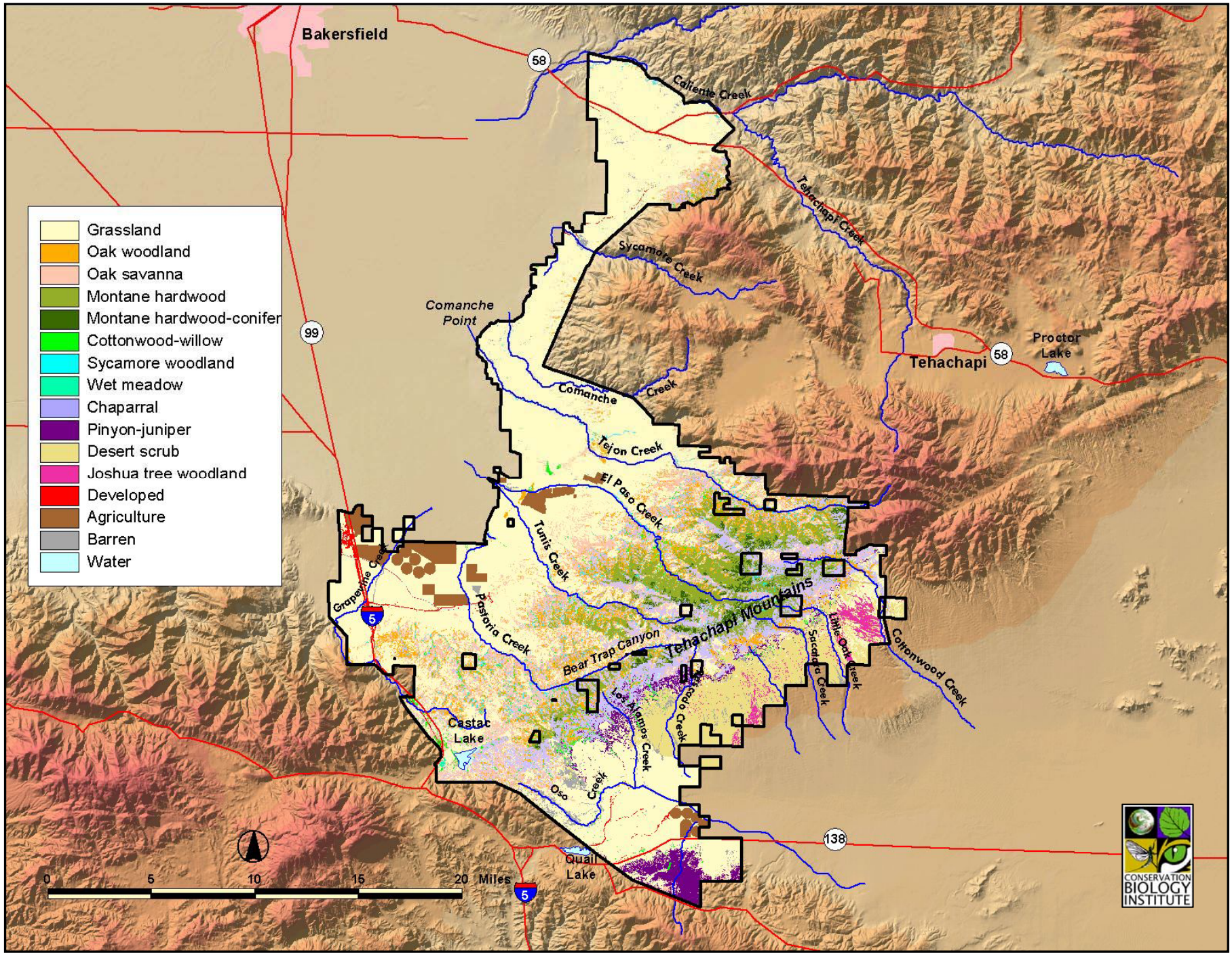


Figure 2. Land cover on Tejon Ranch

Assessing Conservation Values of Tejon Ranch

White et al. (2003) assessed conservation values in a regional context, using a 6.5-million acre area centered on Tejon Ranch as the area of analysis. That assessment found that the Ranch supports several regionally important conservation values, including significant acreages of vegetation communities that are under-represented in open space preserves in the region, large roadless areas, regionally important areas of high habitat integrity and landscape connectivity, and the potential to support as many as 20 state and federally listed species and over 60 other rare and endemic species. This study identifies areas of the Ranch that support particular conservation values and demonstrates how the spatial patterns of conservation values may affect the design of a conservation reserve system. The conservation values previously identified as regionally important for Tejon Ranch and used in the current assessment emphasize a diverse and multi-scale set of wildland characteristics:

- Habitat connectivity
- Listed and endemic species
- Watershed integrity
- Unique, diverse, and under-conserved vegetation communities
- Roadless areas

Using accepted conservation principles as a foundation, we developed criteria-based models to map the distribution of these values across the Ranch, using a Geographic Information System (GIS). Each model of a particular conservation value may represent one "conservation scenario," based on the criteria used. Multiple conservation scenarios can then be used to develop alternative reserve designs for evaluating impacts of conservation and development on species, habitats, and other environmental factors in the region. Appendix B describes GIS modeling approaches and the data used in these assessments.

Habitat connectivity

Conservation principles

- Protection of habitat linkages between existing areas of conserved open space is essential to maintain functional landscapes and evolutionary processes (Noss 1987, 1991; Saunders et al. 1991, Beier and Noss 1998, Crooks 2002).
- Top predators are particularly vulnerable to extirpation from fragmented habitats (Noss 1983, Soulé et al. 1992), which can precipitate further changes to ecological communities.
- Linkages must have species-specific characteristics to be functional for a given focal species (e.g., Soulé 1991, Beier and Loe 1992).

Assessment of conservation value

To map the distribution of areas important for maintaining habitat connectivity, we used the Linkage Design for the Tehachapi Connection developed for the South Coast Missing Linkages

Project (Penrod et al. 2003 and Appendix B). The final Linkage Design includes the results of landscape permeability analyses to identify potential routes between existing protected areas for nine focal species that represent a range of habitat requirements and movement characteristics:

- Blunt-nosed leopard lizard
- Burrowing owl
- Tehachapi pocket mouse
- Tipton kangaroo rat
- Western gray squirrel
- Mule deer
- San Joaquin kit fox
- Badger
- Mountain lion

The best potential movement routes (least-cost corridors) for each species were combined to form a Least Cost Union. Patch size and configuration of suitable habitat were analyzed within the Least Cost Union for 33 species (Appendix B). The final Linkage Design (Figure 3) includes the Least Cost Union and other areas essential to the needs of the 33 species, as identified by patch size and configuration analyses (Penrod et al. 2003).

Figure 3 illustrates how much of the Ranch is important to maintaining landscape linkages between the Sequoia National Forest and Bureau of Land Management lands (Protection Node #1 on Figure 3) and the Los Padres National Forest and Wind Wolves Preserve (Protection Node #2 on Figure 3). The Linkage Design includes the full diversity of vegetation types present on the Ranch, from low-elevation grasslands and scrub communities, to higher elevation woodlands and chaparral. Of particular note is the inclusion of San Joaquin Valley grasslands in the Linkage Design, illustrating the importance of the last remaining connection between grasslands on the east and west sides of the San Joaquin Valley. Severing this grassland connection on Tejon Ranch would result in permanent isolation of grassland communities on opposite sides of the valley and preclude movement and genetic exchange between grassland species in these areas (USFWS 1998, Penrod et al. 2003, White et al. 2003). Similarly, the coniferous forests in the central portion of Tejon Ranch serve as a linkage for higher elevation communities and species in the national forests to the north and south.

Listed and endemic species

Conservation principles

- Tejon Ranch lies within an area of high species endemism (White et al. 2003).
- Grasslands at the extreme southern end of San Joaquin Valley are critical to recovery of many listed species (USFWS 1998) and support several endemic species.
- Tejon Ranch supports designated Critical Habitat for the endangered California condor. This area of the Ranch is considered essential to the recovery of the condor, which requires huge, unfragmented, relatively open landscapes for foraging (USFWS 1998).
- The distributions of many listed and endemic species have not been adequately documented on Tejon Ranch, because they are secretive (e.g., salamanders) or have not been surveyed for over an adequate period of time or in suitable conditions (e.g., annual plant species whose germination is weather-dependent). At least one undescribed endemic salamander is suspected to be present on the Ranch (D. Wake pers. comm.).

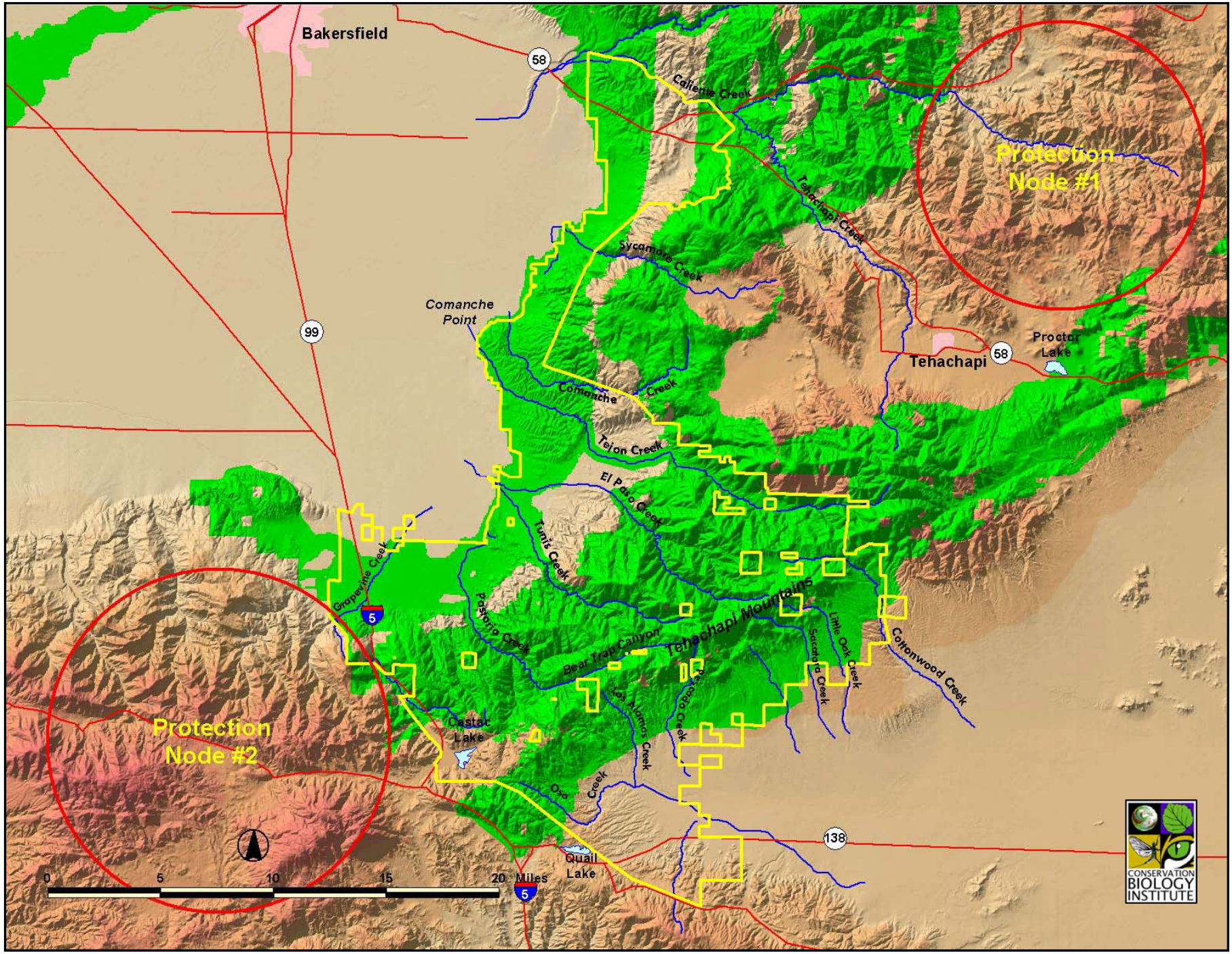


Figure 3. Linkage design for the Tehachapi connection (Source: South Coast Wildlands Project, Penrod et al. 2003)

Assessment of conservation value

Because the distribution of listed and endemic species is not well documented on Tejon Ranch, we modeled habitat suitability for selected species to predict areas of listed and endemic species richness (Appendix B). We used expert-based habitat suitability models developed for the South Coast Missing Linkages Project (Penrod et al. 2003), analogous models using information provided by other experts, species records obtained from museums, scientific literature, and the California Natural Diversity Database (CNDDB 2002), and the Critical Habitat designation for the California condor. Modeling species distributions is limited by our lack of knowledge about the species' autecology and lack of sufficiently detailed digital data for modeling. For example, digital soils data are unavailable for portions of the Ranch, which limited our ability to model potential plant habitat.

Figures 4a-4e show areas of the Ranch most important to:

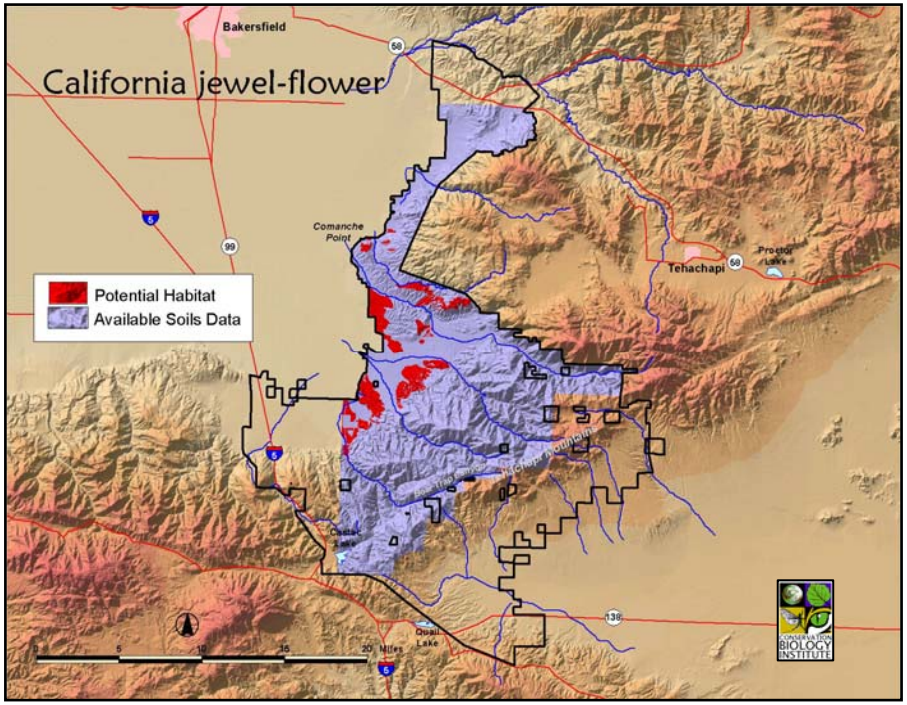
- California jewel-flower, San Joaquin adobe sunburst, striped adobe lily, San Joaquin woollythreads, and Bakersfield cactus
- Vasek's clarkia, Tejon poppy, Comanche Point layia, and Piute Mountains navarretia
- Blunt-nosed leopard lizard, Tehachapi slender salamander, and yellow-blotched salamander
- Tehachapi pocket mouse, San Joaquin kit fox, Tipton kangaroo rat, and San Joaquin antelope squirrel
- California spotted owl and California condor

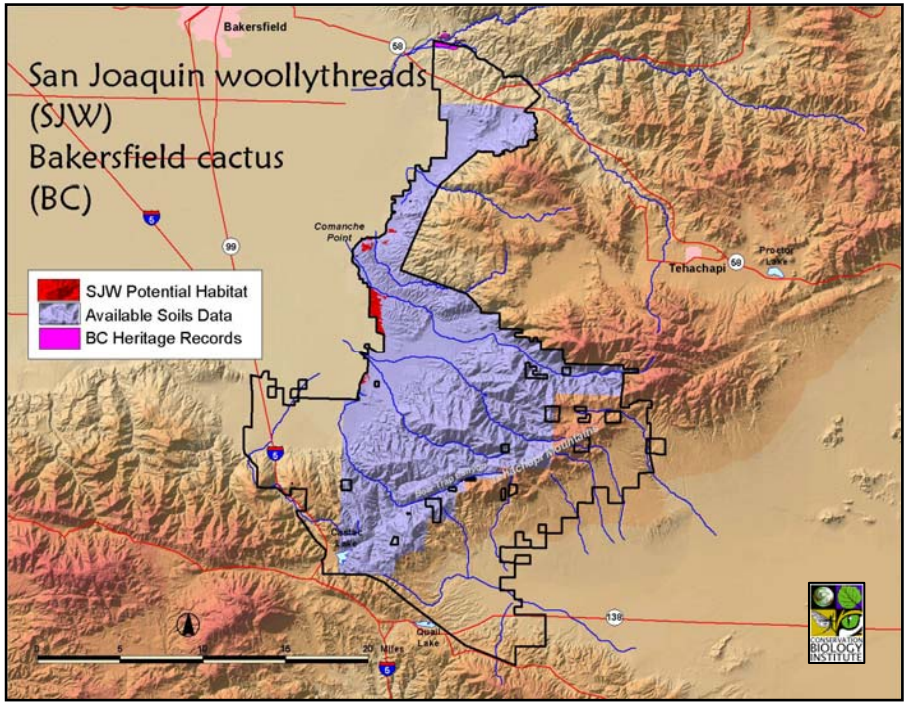
The valley floor and grasslands support the majority of the species modeled in this exercise. However, the California condor and California spotted owl prefer the oak savannas and higher elevation woodlands of the foothill and mountain regions of the Ranch, and the salamanders are known from intermediate elevations of north-draining canyons on the Ranch. Of the species evaluated in this study, only the Tehachapi pocket mouse prefers the mix of vegetation communities on the Mojave Desert side of the Ranch.

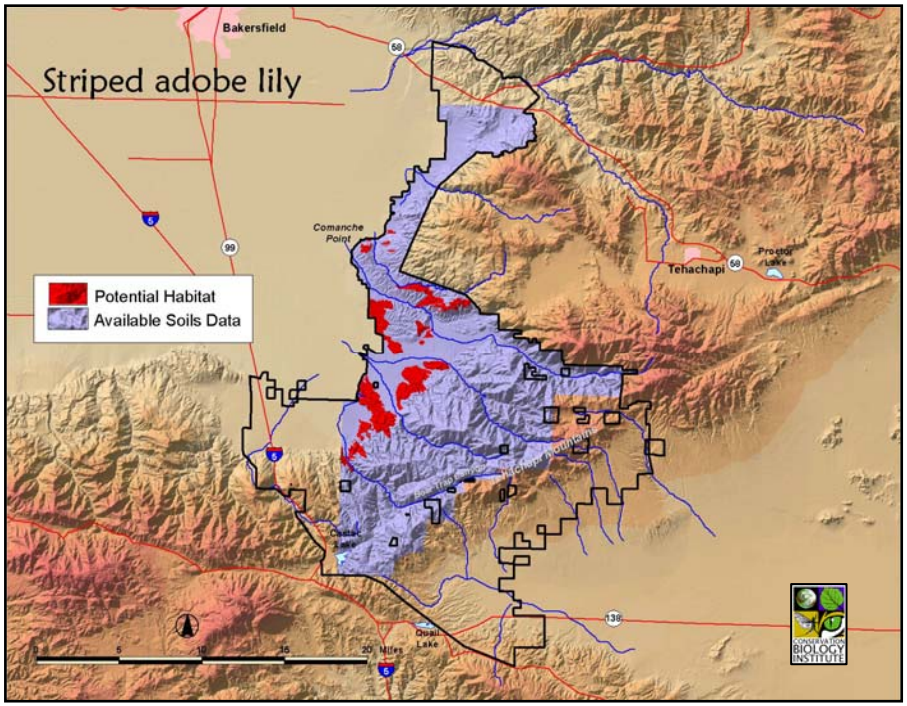
Watershed integrity

Conservation principles

- High physical integrity in watersheds maintains natural hydrologic, chemical, and physical processes of the ecosystem. Land cover changes and roads reduce the physical integrity of watershed basins, which can alter ecosystem properties (Reed et al. 1996, Poff et al. 1997).
- The effects of land cover changes in upper portions of watersheds cascade to downstream portions of watersheds (Klein 1979, White and Greer 2002).
- Changes in natural watershed processes can result in reduced habitat quality and the loss of native aquatic and riparian species (Paul and Meyer 2001).







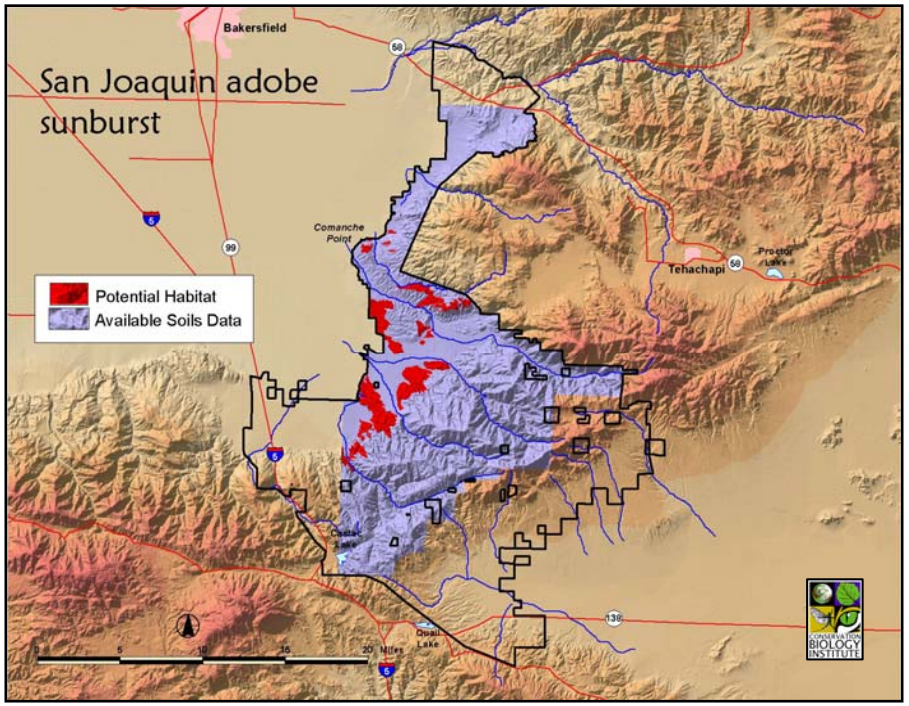
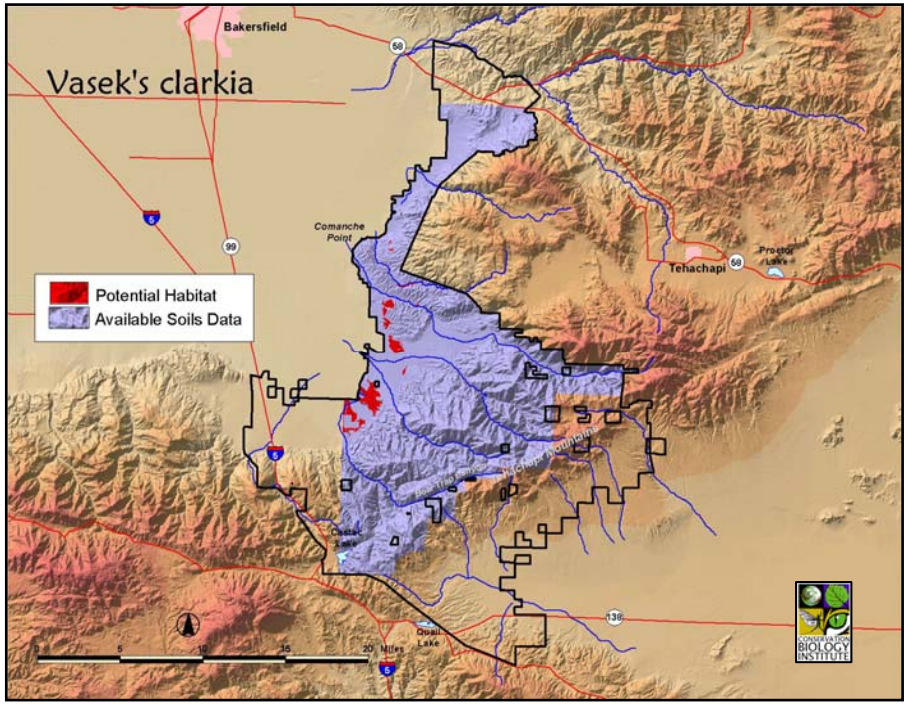
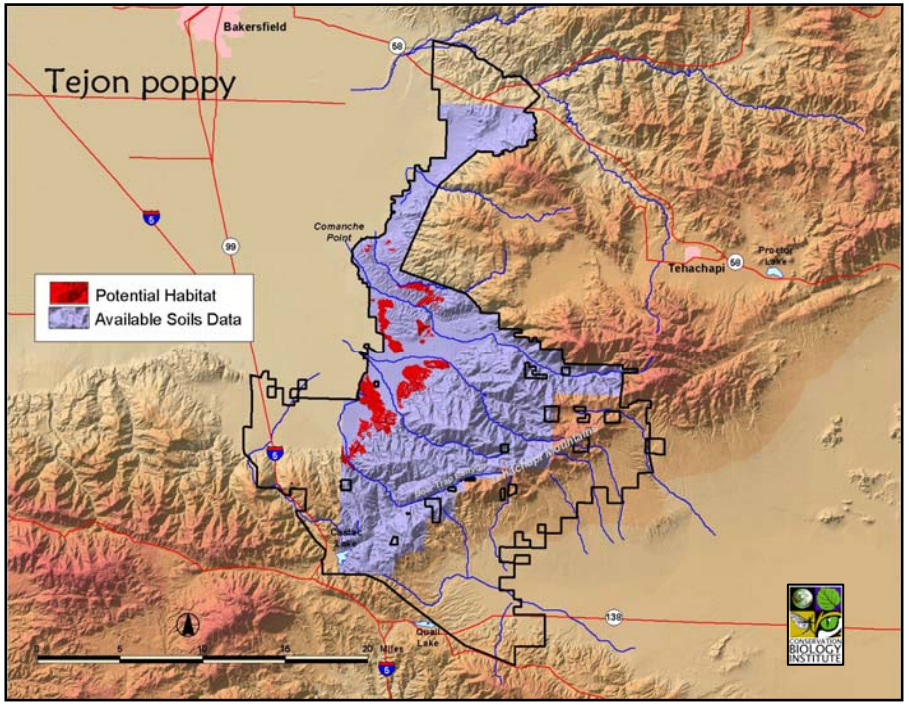
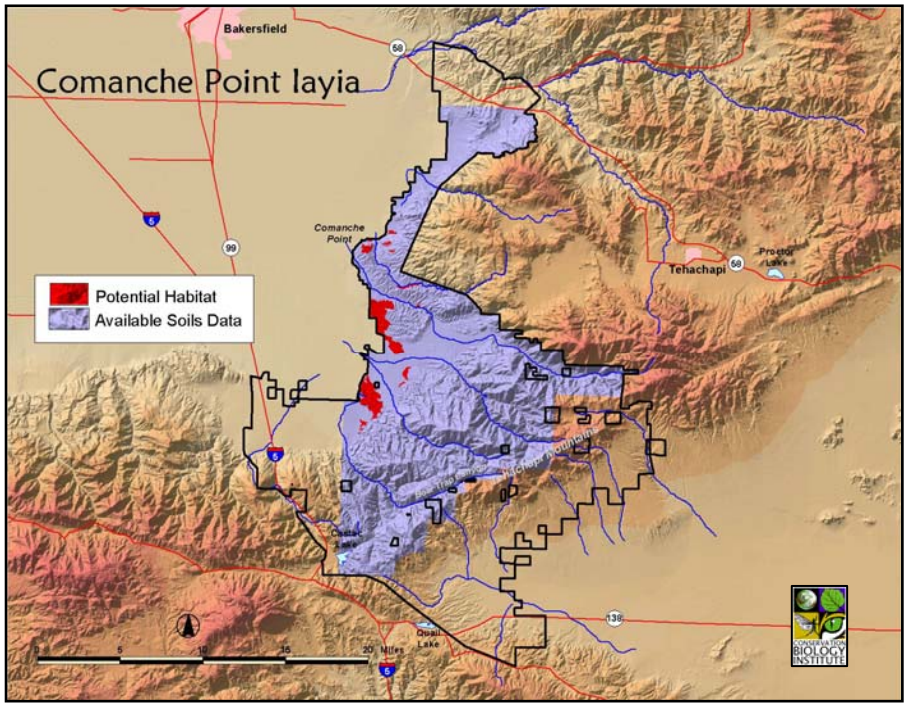


Figure 4a. Potential habitat for listed plant species







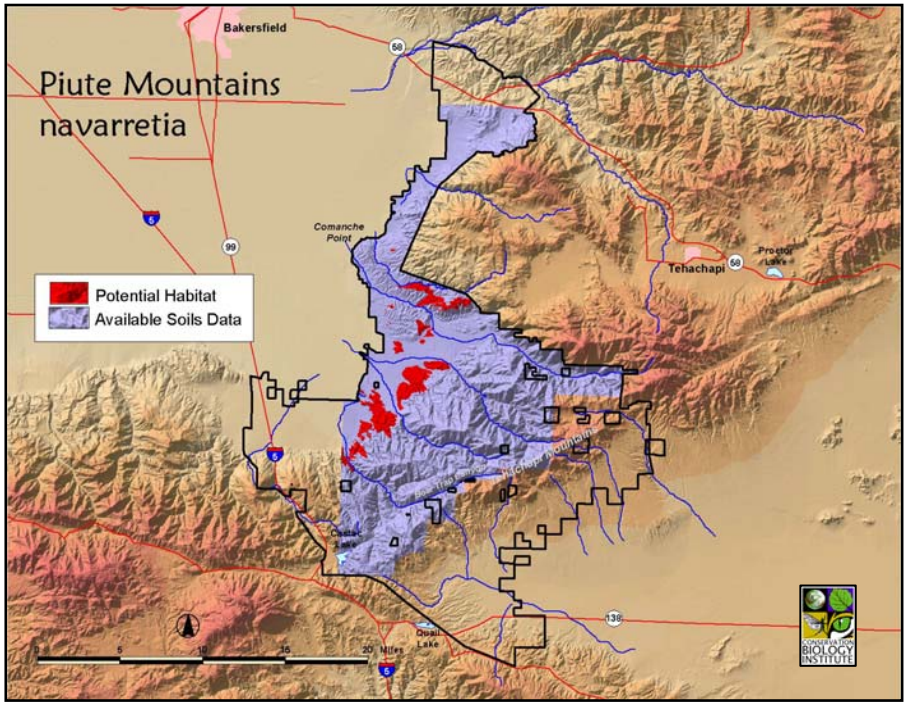


Figure 4b. Potential habitat for endemic plant species

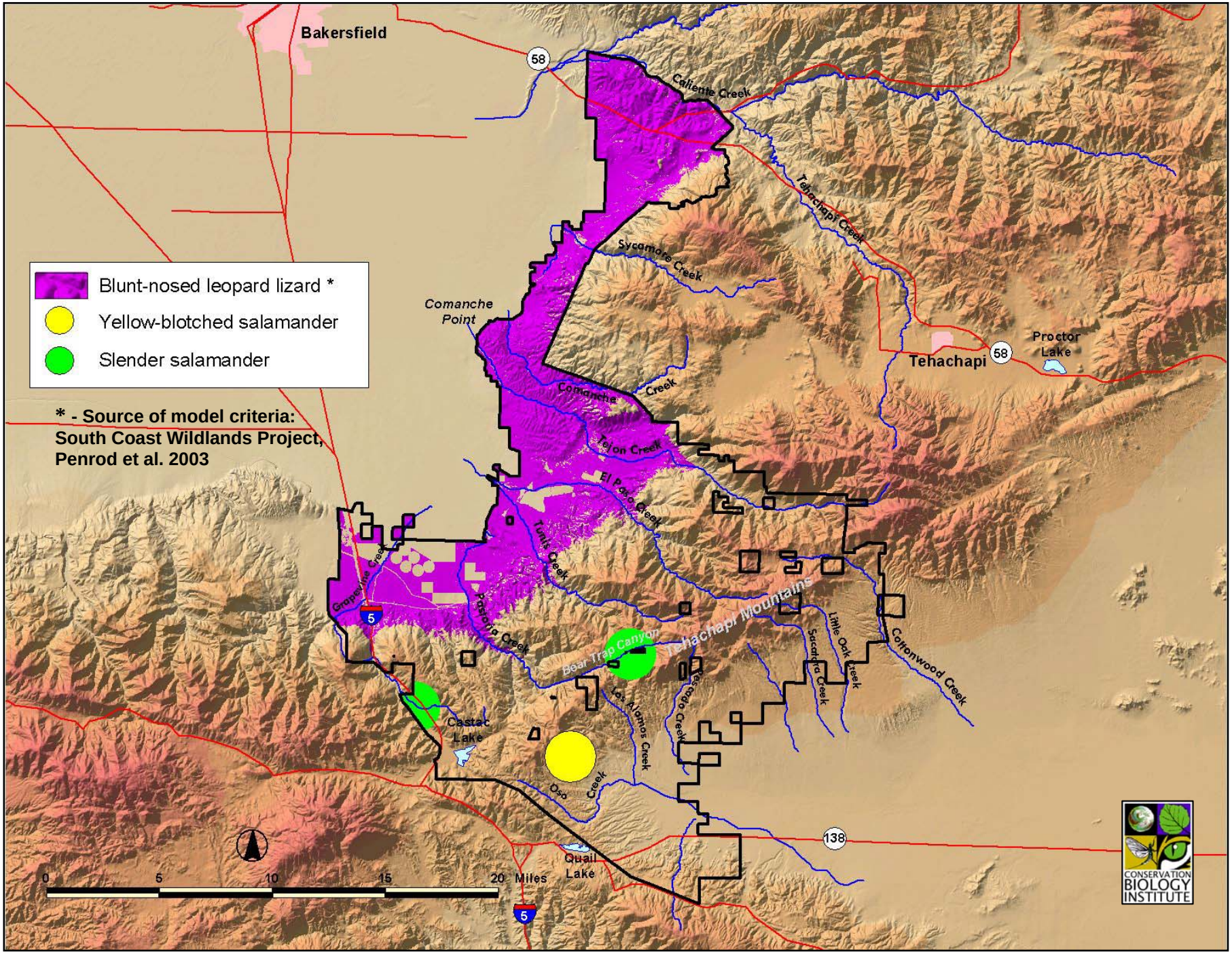


Figure 4c. Potential habitat for selected amphibians and reptiles

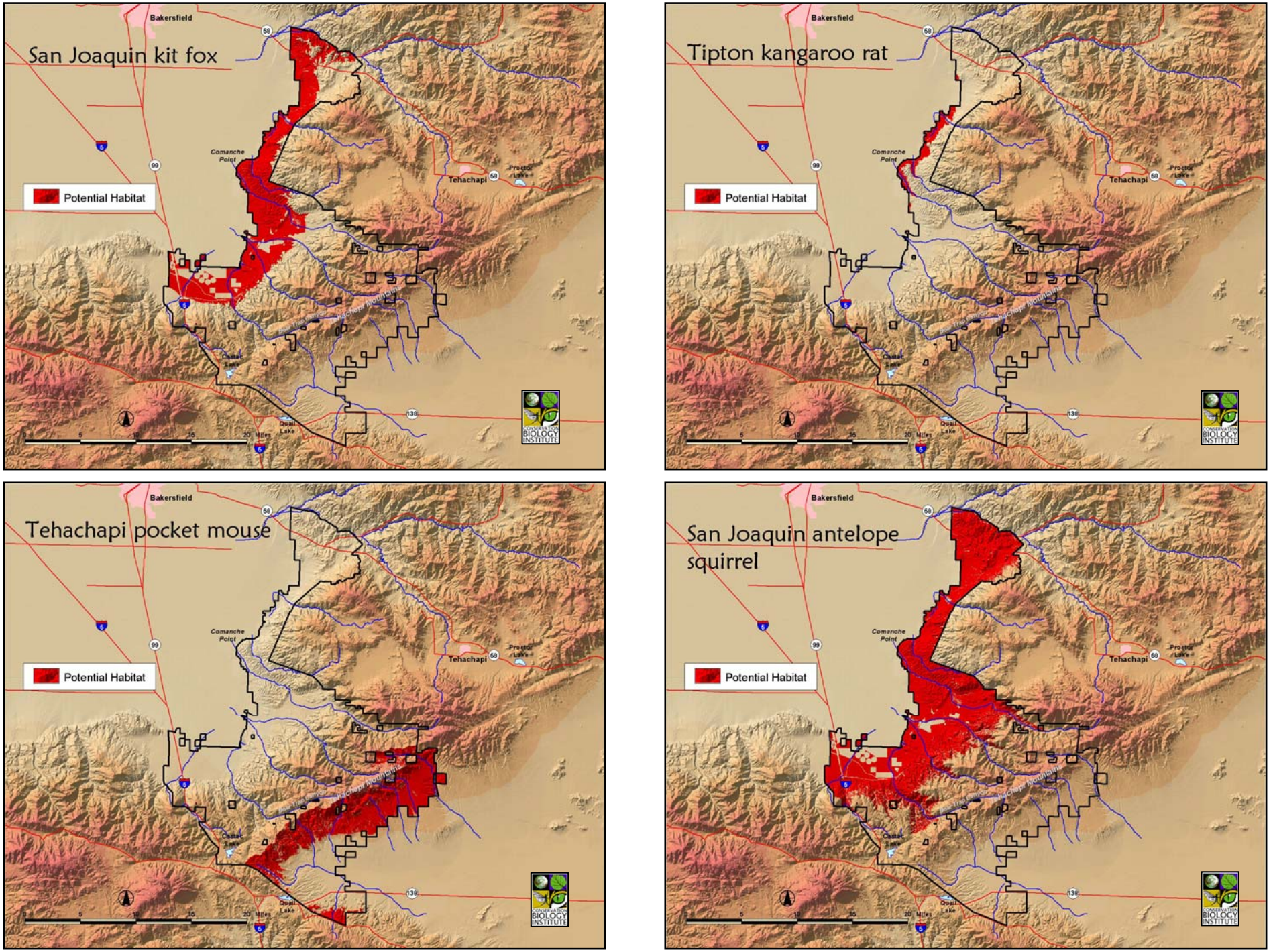
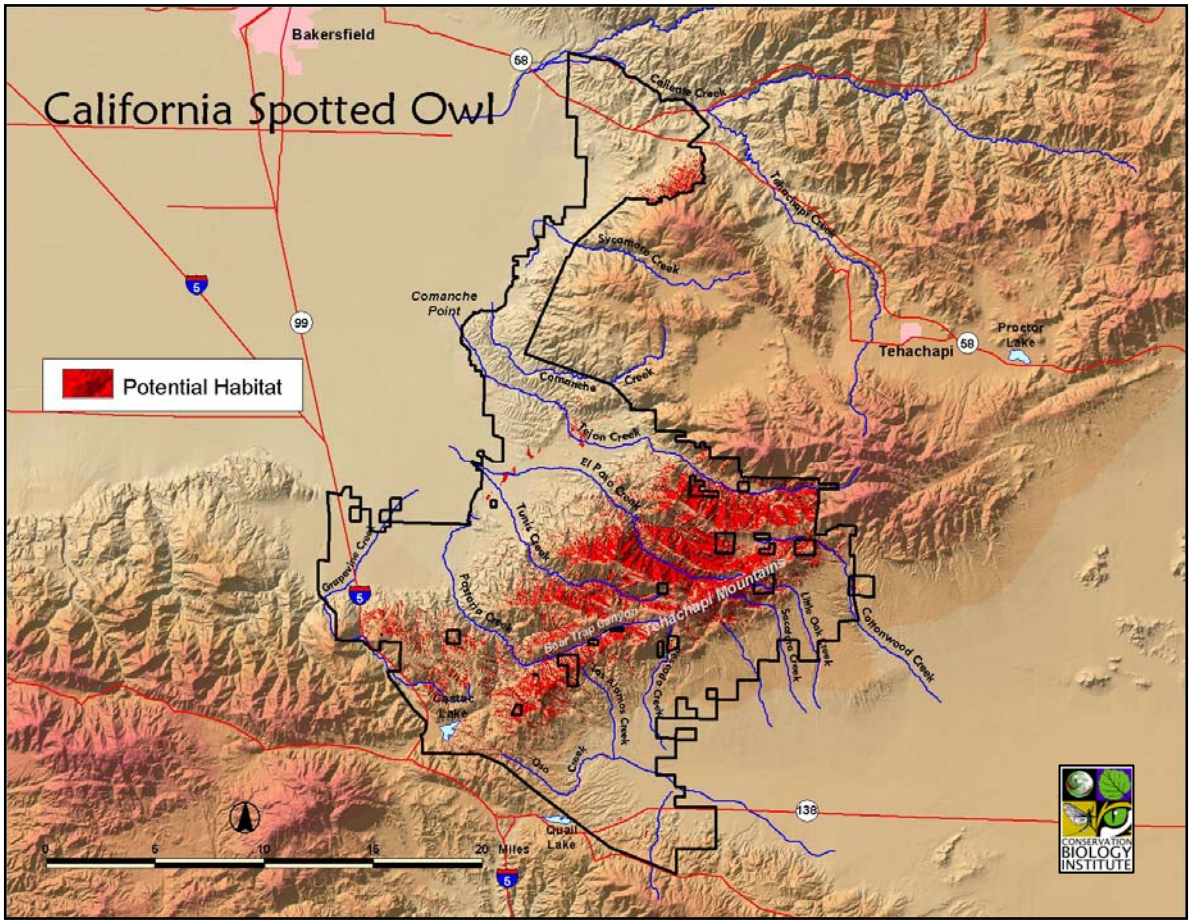


Figure 4d. Potential habitat for four mammal species (Source of model criteria: South Coast Wildlands Project, Penrod et al. 2003)



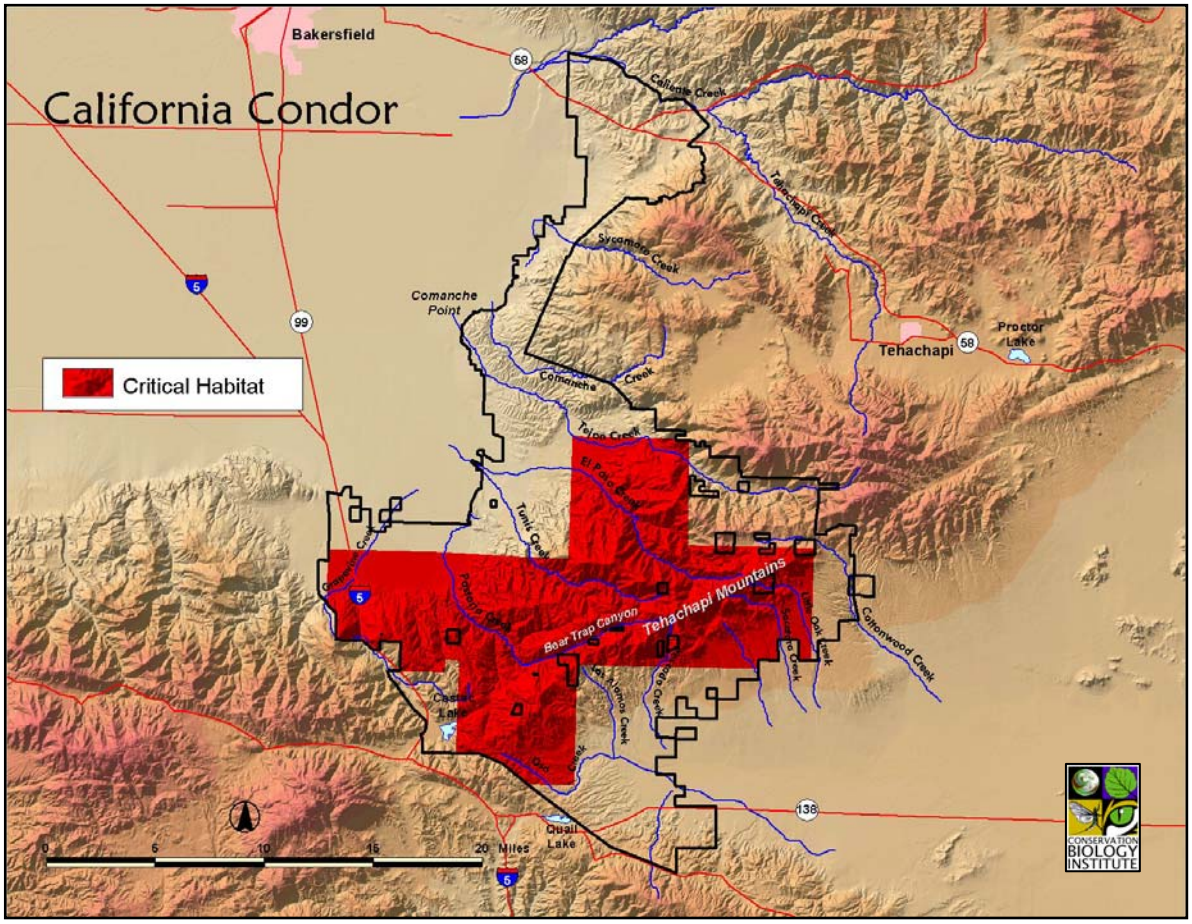


Figure 4e. Potential habitat for CA spotted owl and critical habitat for CA condor

Assessment of conservation value

Watersheds that intersect Tejon Ranch, and individual subbasins within these watersheds, were delineated using a 30-m digital elevation model. Watershed integrity was estimated for each subbasin using the following criteria:

- Percent natural vegetation cover
- Percent roadlessness
- Road density
- Number of road-stream intersections

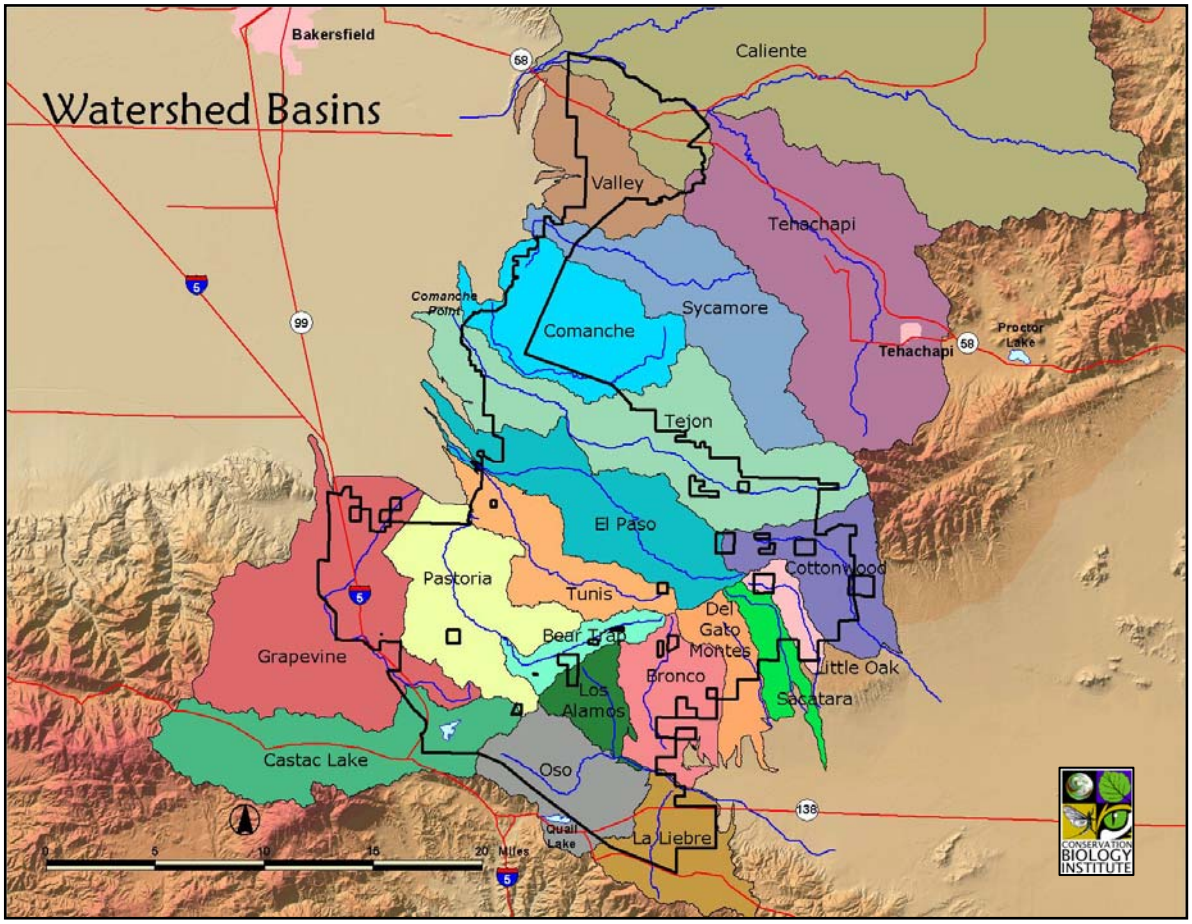
The percentage of *natural vegetation cover* in a watershed basin reflects the degree to which land cover has been converted to agricultural or urban land uses, which can alter natural watershed processes. However, as roads are narrow linear features, their relatively large impact on watershed integrity is not adequately quantified with land cover metrics alone. Therefore, we used three additional criteria to address the impacts of roads on watershed integrity. The percentage of *roadless areas* in a watershed reflects the degree to which watershed processes may be adversely affected by road building, but as a separate category of land cover change than urban and agricultural development. We quantified *road density* as an additional criterion to measure the greater degree of adverse impacts to watershed processes associated with greater road density. Finally, because stream road-crossings are potentially responsible for the greatest alterations of watershed processes by roads, we measured the *number of road-stream intersections* as a criterion for quantifying watershed integrity. Individual subbasins were scored separately for each of the four criteria, and the results were summed to provide a final integrity score (see Appendix B).

The Tehachapi Mountains and foothills support the areas of highest watershed integrity on Tejon Ranch (Figure 5). Currently, the headwater subbasins of Tejon Creek, Pastoria Creek, and Cottonwood Creek on Tejon Ranch all have high to very high integrity scores. Conversely, lowland subbasins on the Ranch, particularly in the San Joaquin Valley, generally have low to very low integrity. The integrity of the headwater subbasins of Tehachapi Creek and Sycamore Creek have been compromised by land cover changes (development, agriculture, and road building) in the Tehachapi, Cummings, and Bear valleys, and future development in these valleys will threaten the integrity of headwater subbasins of Tejon Creek and Comanche Creek.

Unique, diverse, and under-conserved vegetation communities

Conservation principles

- Conserving the full range of vegetation community types and species assemblages present in a particular region is important to maintain the existing biodiversity of that region (Scott et al. 2001).
- Areas of high vegetation type diversity generally support high species diversity (Meffe and Carroll 1997).



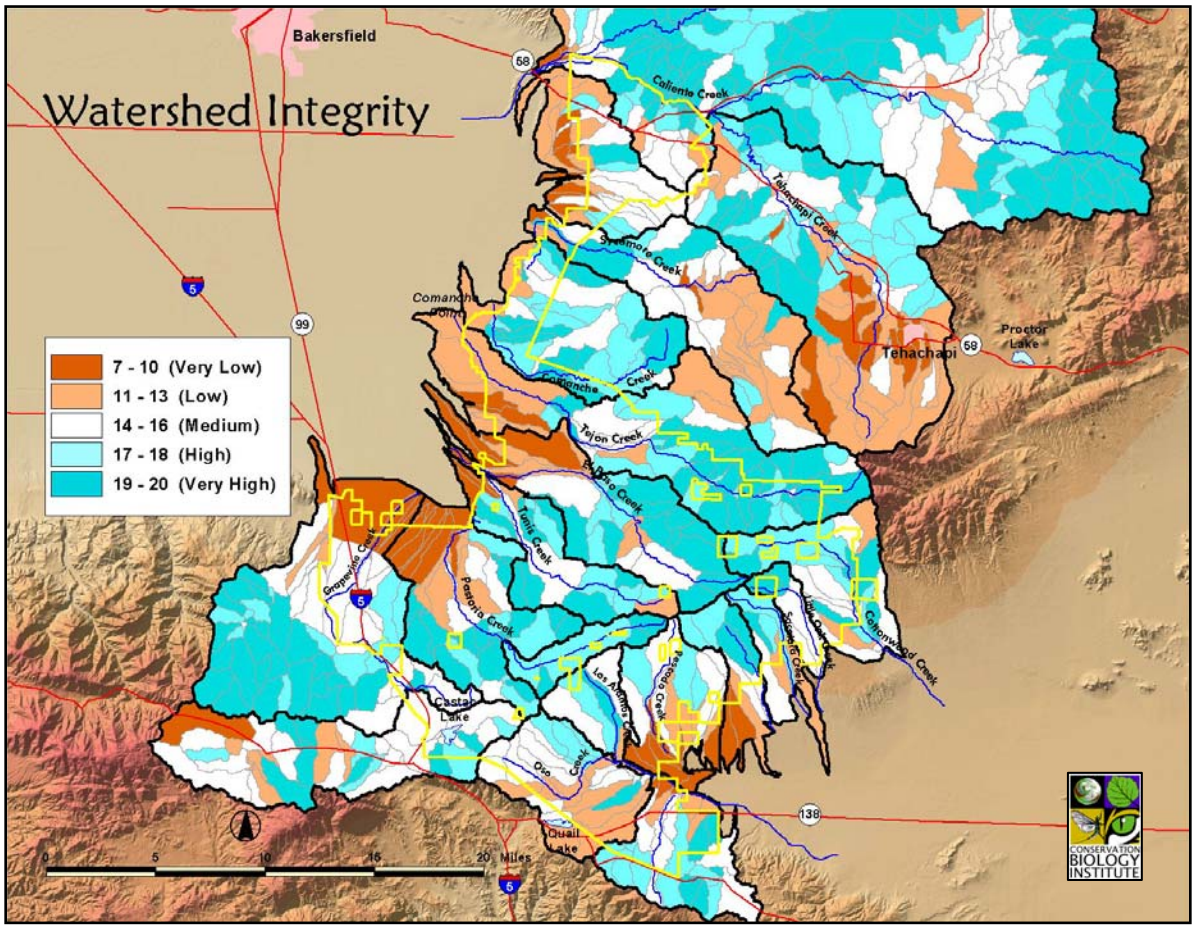


Figure 5. Watershed basins and watershed integrity

Assessment of conservation value

White et al. (2003) identified valley oak woodland, blue oak woodland, and grassland as under-protected vegetation communities in the Tejon Ranch region. The vegetation data used for that regional analysis was too coarse to capture other vegetation communities known to occur on Tejon Ranch. Using the refined land cover data in this study, we identified the following vegetation types as priority conservation targets for the Ranch:

- Grassland
- Oak woodland
- Oak savanna
- Sycamore woodland
- Cottonwood-willow riparian woodland

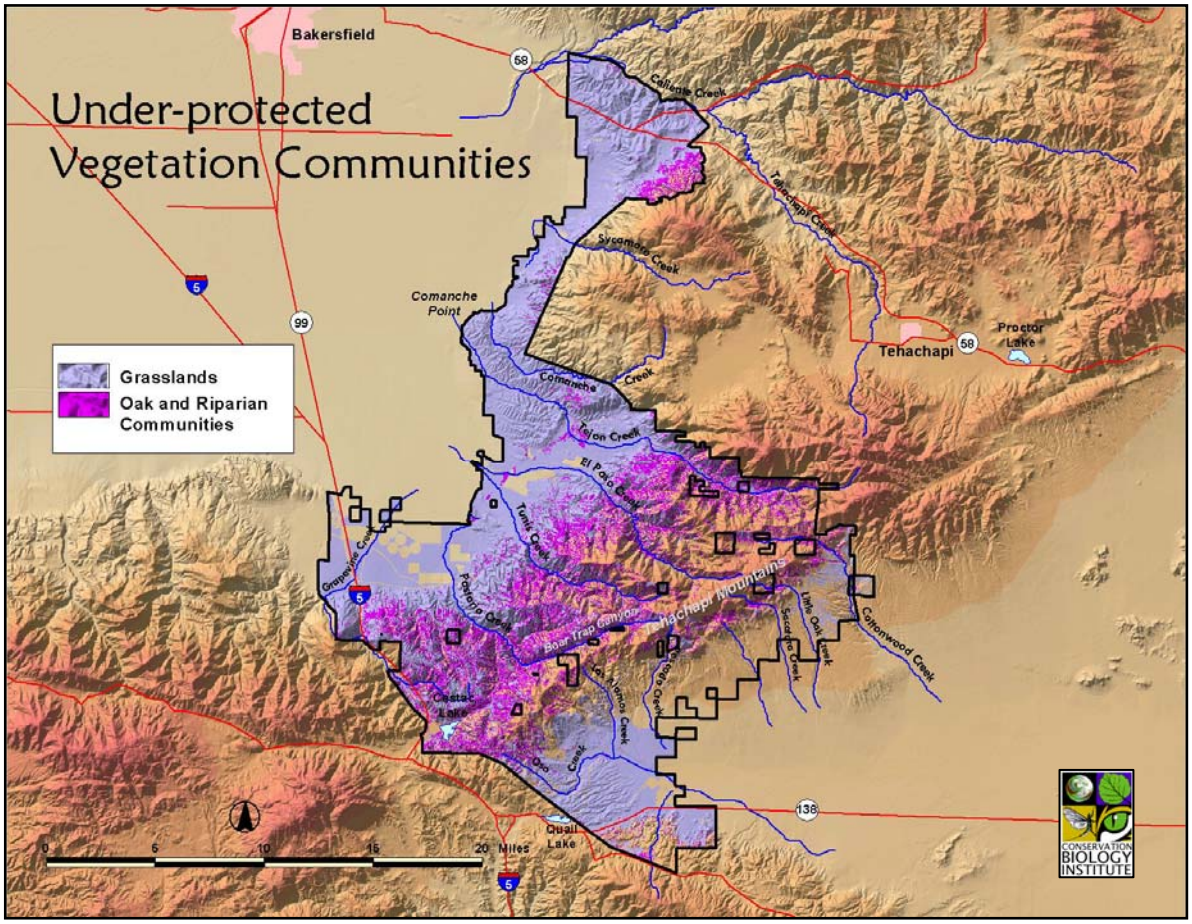
These vegetation types represent the regionally under-protected grassland and oak communities, as well as two types of riparian communities mapped on the property, which are regionally rare and high value communities. Within the Tejon Ranch region, the majority of protected areas are at elevations above 3,500 ft, with less than 5% of protected areas below 1,650 ft. Thus, existing protected areas do not capture the full range of regional biodiversity (White et al. 2003). Tejon Ranch represents a significant opportunity to conserve priority vegetation types that occur at lower elevations on the San Joaquin Valley side and in the western Antelope Valley portion of the Ranch (Figure 6).

We also evaluated the diversity of vegetation communities as a surrogate for species diversity on Tejon Ranch. Vegetation diversity was quantified by counting the number of mapped vegetation communities within a moving 1,000-ft radius circular "neighborhood" across the Ranch (see Appendix B). The areas supporting the highest vegetation diversity on the Ranch are the canyons and ridges of the mountains and foothills (Figure 6), where physical diversity of the landscape (i.e., slope, aspect, elevation, soil type) is highest. Vegetation community diversity is relatively lower in the grassland and scrub habitats in the lower elevations of the Ranch.

Roadless areas

Conservation principles

- Roads and road maintenance have been shown to increase erosion, air and water pollution, spread of invasive exotics, road mortality, alteration of movement patterns, and habitat fragmentation (Spellerberg 1998, Strittholt et al. 2000, Trombulak and Frissell 2000, Jones et al. 2000, Czech et al. 2001, Paul and Meyer 2001).
- Maintaining roadless areas is critical to maintaining wildland values (Strittholt et al. 2000). Tejon Ranch represents the only contiguous block of roadless habitats connecting the adjacent roadless areas of the Los Padres and Sequoia National Forests (White et al. 2003).



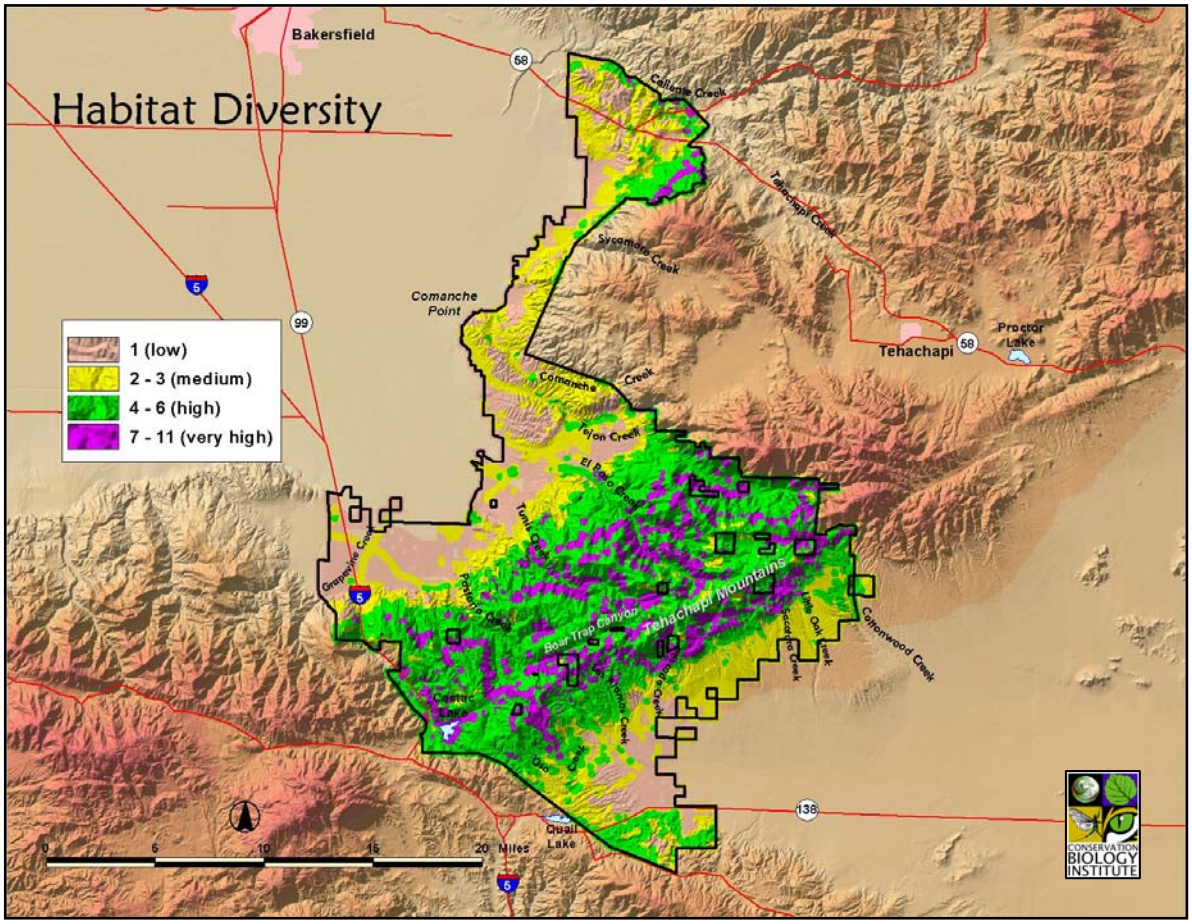


Figure 6. Under-protected vegetation communities and habitat diversity

Assessment of conservation value

We defined roadless areas as lands with 1,000 acres or more of contiguous natural vegetation cover not crossed by roads. There are 55 such roadless area blocks on or intersecting Tejon Ranch, totaling 160,523 acres on the Ranch itself. Roadless areas are concentrated in the Tehachapi Mountains and foothills region of Tejon Ranch (Figure 7).

Size of Roadless Area (acres)	Number	Area (acres)
1,000 - 5,000	42	78,577
5,000 - 10,000	7	37,968
>10,000	6	43,978
Total	**55**	**160,523**

Summary of results

These analyses demonstrate that different areas of the Ranch support different sets of conservation values, and virtually all areas of the Ranch support one or more sets of conservation values. The distribution of conservation values on Tejon Ranch, as determined by our assessment, can be summarized as follows:

- **Habitat connectivity**—most of the Ranch is important as landscape linkages for the focal species evaluated for the South Coast Missing Linkages Project, except perhaps the Mojave Valley floor (Penrod et al. 2003).
- **Listed and endemic species**—the San Joaquin Valley grassland and oak communities are the primary areas of the Ranch supporting these species. Montane hardwood and montane hardwood-conifer associations support the endangered California spotted owl. The endemic Tehachapi pocket mouse is known only from the Mojave Desert side of the Ranch.
- **Watershed integrity**—the headwater basins of Tejon, Pastoria, and Cottonwood creeks, in the higher elevations of the Tehachapi Mountains, support the highest watershed integrity values on the Ranch.
- **Unique, diverse and under-represented vegetation communities**—grasslands, oak, and riparian communities are under-protected in the region. The highest diversity of vegetation communities on the Ranch itself is in the mountains.
- **Roadless areas**—the Tehachapi Mountains and foothills support the largest roadless areas on the Ranch.

These analyses within the Ranch boundaries support the conclusions of the regional analyses (Penrod et al. 2003, White et al. 2003) that Tejon Ranch represents a very high priority conservation target. Additional site-specific data for the Ranch would undoubtedly confirm this conclusion and provide more quantitative data for use in regional reserve design.

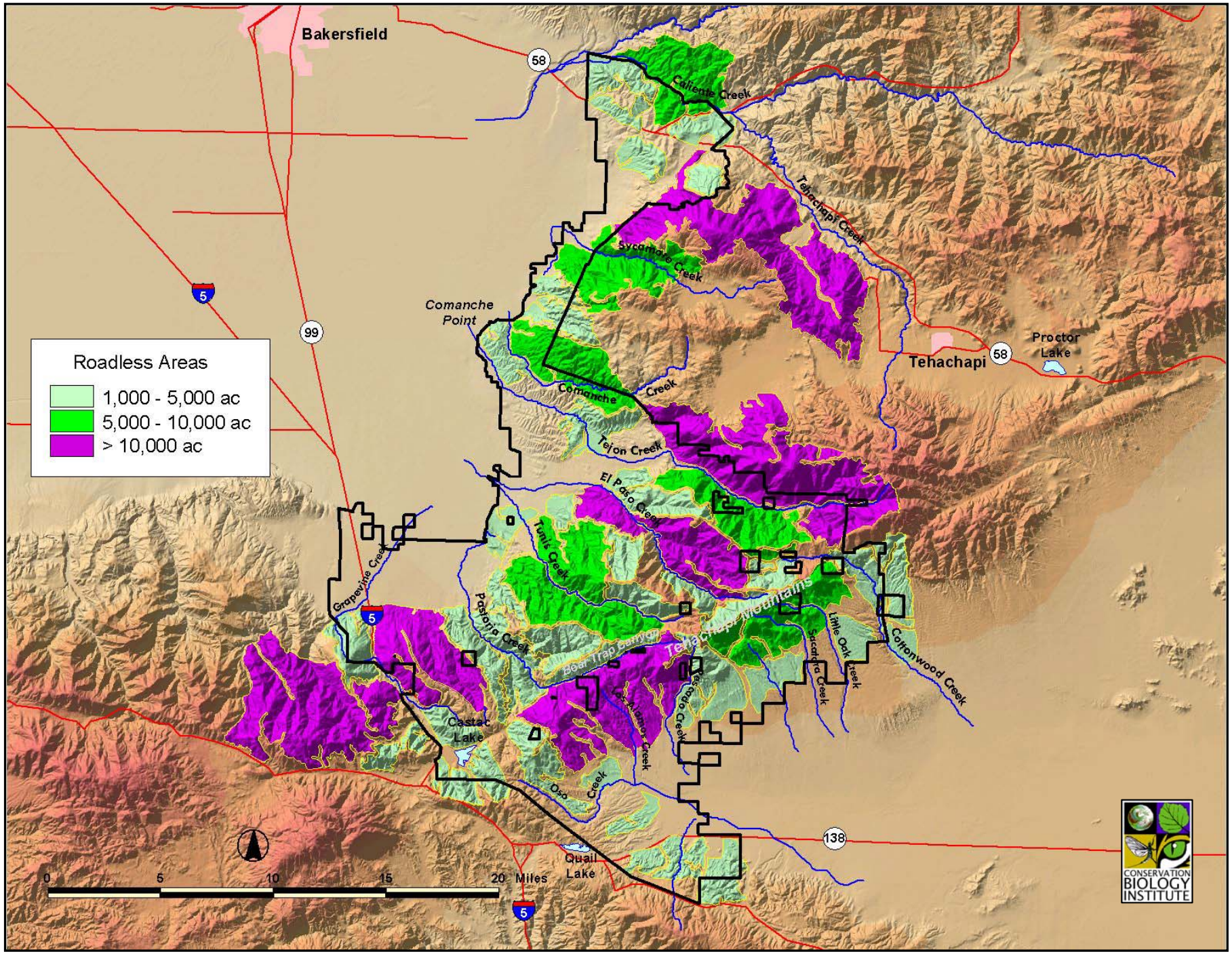


Figure 7. Roadless areas on Tejon Ranch

Regional Conservation Planning

Conservation planning on Tejon Ranch should be conducted within a regional context that considers the regional impacts of conservation and development of the Ranch. The biological resources of the Ranch function as crucial elements of a largely intact and biologically important landscape, and effective conservation planning must recognize the functions and values of the Ranch at large landscape scales. It is not the intent of this document to advocate a particular reserve design for Tejon Ranch or the region. Rather, our analyses are intended to illustrate the trade-offs implicit in designing conservation reserves and to inform future reserve design efforts, which must also consider an array of other environmental factors, such as air quality, transportation, agriculture, and cultural resources, and the potential regional effects of significant new development in a largely undeveloped area.

This section suggests additional factors that should be considered and addressed in a regional plan for conservation and development—the integration of landscape units that support the various conservation values summarized above, physical and biological threats and their impacts to biological resources in the vicinity of the Ranch, and conservation goals that should be used to evaluate alternative designs for a regional open space reserve system.

Landscape units

The landscape mosaic is an appropriate unit of study and management for Tejon Ranch. Forman and Godron (1981) define *landscape* as a *kilometers-wide area where a cluster of interacting stands or ecosystems is repeated in similar form*, i.e., an ecological unit with a distinguishable structure (Noss 1983). For the purpose of this assessment, we delineated four landscape units on Tejon Ranch (Figure 8). Table 1 quantifies and describes the distribution of conservation values relative to these four landscape units. Reserve designs for Tejon Ranch must, at a minimum, capture these values while ensuring the maintenance and management of ecological processes within and between landscape units. Similarly, conservation planning must ensure integration and connection of these landscape units with others in the region, along with a regional plan for long-term management and biological monitoring.

The four landscape units on Tejon Ranch were delineated based on vegetation communities, topography, and elevation, as follows:

Unit A. Lowland grasslands and oak savannas of the San Joaquin Valley

Unit B. Closed-canopy oak woodland, montane hardwood, and montane hardwood-conifer communities on the northwest slope of the Tehachapi Mountains

Unit C. Oak woodland, chaparral, and pinyon-juniper communities on the southeast slope of the Tehachapi Mountains

Unit D. Lowland Joshua tree woodland, grassland, and desert scrub communities of the Mojave Desert

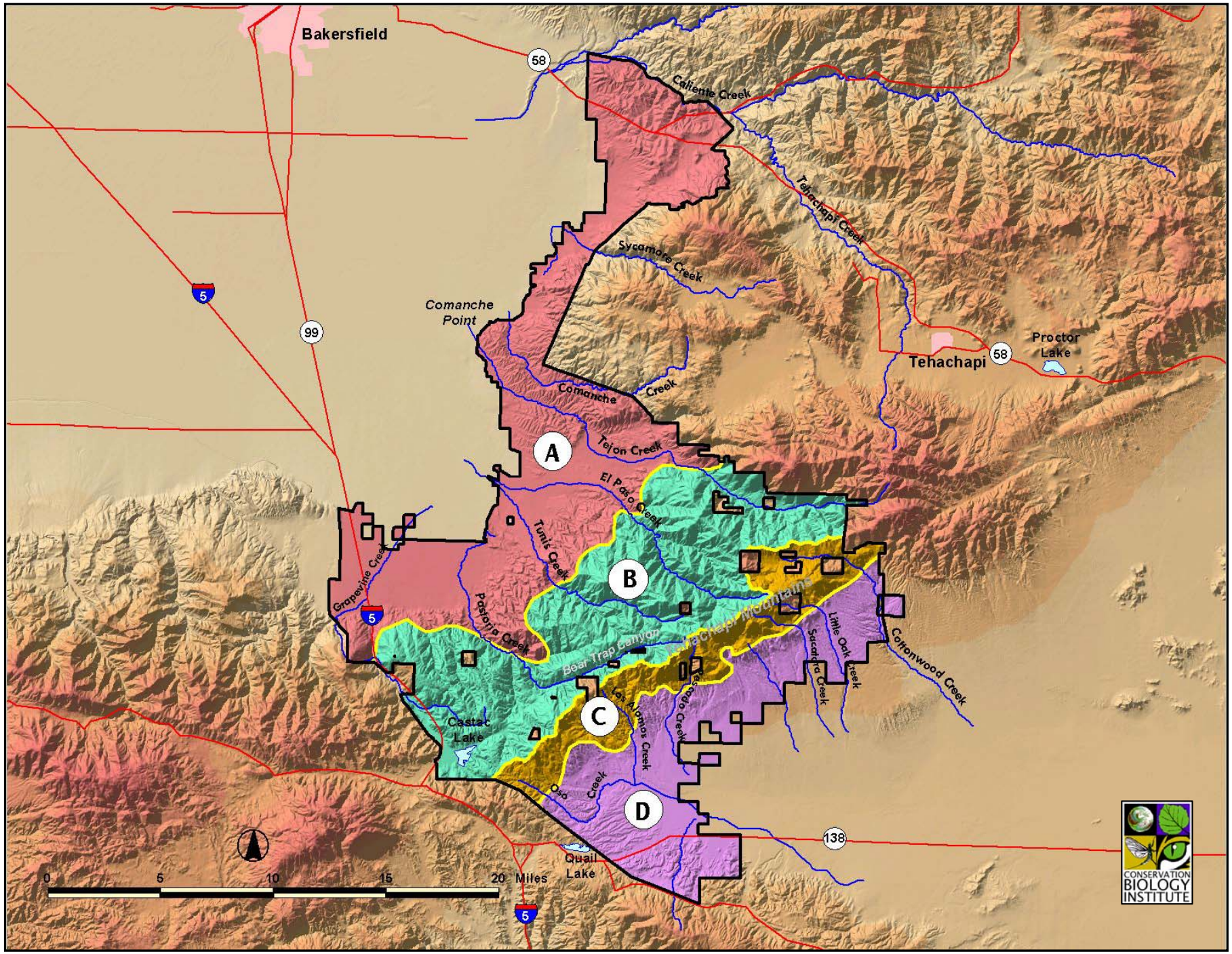


Figure 8. Landscape units on Tejon Ranch

Table 1. Summary of conservation values by landscape unit

Conservation Values*	**Unit A** 108,244 ac	**Unit B** 81,836 ac	**Unit C** 26,518 ac	**Unit D** 53,613 ac
Habitat connectivity[1]				
% of unit	72%	91%	97%	46%
Listed species[2]				
Number of listed plants	5	0	0	0
Potential plant habitat (% of unit)	12%	<1%	0%	0%
Number of listed animals	5	3	2	1
Endemic species[3]				
Number of endemic plants	4	0	0	0
Potential plant habitat (% of unit)	10%	<1%	0%	0%
Number of endemic animals	0	0	2	2
Watershed integrity[4]				
High or very high integrity				
Acres	36,208	58,185	15,982	17,183
% of unit	33%	71%	60%	32%
Under-protected vegetation communities[5]				
Acres	98,686	52,048	9,692	25,252
% of unit	91%	64%	37%	47%
Vegetation community diversity[6]				
Scores of 1-3				
Acres	89,420	7,316	3,498	42,547
% of unit	83%	9%	13%	79%
Scores of 4-11				
Acres	16,540	74,512	23,023	10,905
% of unit	15%	91%	87%	20%
Roadless areas[7]				
Size >1,000 acres				
Acres	51,448	63,578	20,280	25,129
% of unit	48%	78%	76%	47%
Size >10,000 acres				
Acres	7,252	25,361	7,844	3,437
% of unit	7%	31%	30%	6%

Table 1 (continued). Summary of conservation values by landscape unit

*Conservation Values

[1]**Habitat connectivity**:

- % of unit is the percentage of the area of each respective landscape unit supporting the Linkage Design for the Tehachapi Connection developed for the South Coast Missing Linkages Project (Penrod et al. 2003).

[2]**Listed species:**

- Number of listed plants is the total number of listed plants evaluated (California jewel-flower, striped adobe lily, San Joaquin woollythreads, Bakersfield cactus, San Joaquin adobe sunburst) that occur within each respective landscape unit.
- Potential plant habitat is the percentage of the area of each respective landscape unit supporting predicted potential habitat for the listed plant species evaluated.
- Number of listed animals is the total number of listed animals evaluated (Tehachapi slender salamander, blunt-nosed leopard lizard, California spotted owl, San Joaquin antelope squirrel, Tipton kangaroo rat, San Joaquin kit fox) that occur within each respective landscape unit. The California condor, with Critical Habitat that occurs in all of the landscape units, was not included in this analysis.

[3]**Endemic species:**

- Number of endemic plants is the total number of endemic plants evaluated (Vasek's clarkia, Tejon poppy, Comanche Point layia, Piute Mountains navarretia) that occur within each respective landscape unit.
- Potential plant habitat is the percentage of the area of each respective landscape unit supporting predicted potential habitat for the endemic plant species evaluated.
- Number of endemic animals is the total number of endemic animals evaluated (yellow-blotched salamander, Tehachapi pocket mouse) that occur within each respective landscape unit.

[4]**Watershed integrity:**

- Watershed integrity is summarized for watershed subbasins that have a high or very high integrity score.
- Acres is the area of each respective landscape unit that supports watershed subbasins with the specified score.
- % of unit is the percentage of the area of each respective landscape unit with subbasins of the specified score.

[5]**Under-protected vegetation communities:**

- Acres is the area of each respective landscape unit that supports under-protected vegetation associations (see text for definition).
- % of unit is the percentage of the area of each respective landscape unit that supports under-protected vegetation associations.

[6]**Vegetation community diversity:**

- Vegetation diversity is summarized separately for areas that have a diversity score of 1-3 (low diversity) and those that have a diversity score of 4-11 (high diversity).
- Acres is the area of each respective landscape unit that supports the specified diversity of vegetation.
- % of unit is the percentage of the area of each respective landscape unit supporting the specified diversity.

[7]**Roadless areas:**

- Roadless areas are summarized separately for two size categories: >1,000 acres and >10,000 acres.
- Acres is the area of each respective landscape unit that supports each specified roadless area category.
- % of unit is the percentage of the area of each respective landscape unit supporting each specified roadless area category.

Unit A. Lowland grasslands and oak savannas of the San Joaquin Valley

Unit A is the largest of the four landscape units, covering about 40% of the Ranch. Over 70% of Unit A supports regional landscape linkages (Penrod et al. 2003). Unit A supports habitat for the highest number of listed plants (five) and endemic plants (four) evaluated and the highest number of listed animals evaluated (five). One-third of Unit A supports high to very high watershed integrity values. Although Unit A supports a relatively lower diversity of vegetation communities than the other landscape units, these are largely the high value, under-protected vegetation communities in the region. Almost half of Unit A supports roadless areas greater than 1,000 acres, but less than 10% of Unit A supports roadless areas greater than 10,000 acres.

Unit B. Oak woodland, montane hardwood, and montane hardwood-conifer communities, northwest slope of Tehachapi Mountains

This is the second largest landscape unit, covering 30% of Tejon Ranch. Over 90% of Unit B supports regional landscape linkages (Penrod et al. 2003). Unit B supports habitat for three listed animal species evaluated—California spotted owl, San Joaquin antelope squirrel, and Tehachapi slender salamander. Unit B supports the greatest area of high to very high watershed integrity basins on the Ranch. Nearly all of Unit B supports a high diversity of vegetation communities, and 64% supports regionally under-protected vegetation communities. Approximately 78% of Unit B is roadless, the largest area of roadless areas on Tejon Ranch, including the largest area of roadless areas greater than 10,000 acres.

Unit C. Oak woodland, chaparral, and pinyon-juniper communities, southeast slope of Tehachapi Mountains

Unit C is the smallest of the four landscape units (10% of the Ranch), but it supports the greatest relative percentage of regional landscape linkages (Penrod et al. 2003). It probably does not support habitat for the listed and endemic plants or listed animals evaluated in this study, but it does support potential habitat for the endangered California spotted owl, threatened Tehachapi slender salamander, endemic yellow-blotched salamander, and endemic Tehachapi pocket mouse. Approximately 60% of Unit C supports high or very high watershed integrity values. The majority of Unit C supports a high diversity of vegetation communities, but a relatively low percentage of under-protected communities. Approximately 76% of Unit C is roadless, including a high percentage of roadless areas greater than 10,000 acres.

Unit D. Lowland Joshua tree, grassland, and desert scrub communities of the Mojave Desert

Unit D covers 20% of Tejon Ranch. Almost half of this unit (46%) supports regional landscape linkages (Penrod et al. 2003). Unit D probably does not support habitat for the listed and endemic plants evaluated, but it does support habitat for the two endemic animal species evaluated and possibly the California spotted owl. One-third of Unit D supports high to very high integrity watershed basins. Unit D supports a lower diversity of vegetation communities, relative to the other units, but a high percentage of under-protected communities. Almost half of Unit D is roadless, but less than 10% is roadless areas greater than 10,000 acres.

Threats

Tejon Ranch is surrounded by major metropolitan and agricultural areas—the Los Angeles basin, Bakersfield and San Joaquin Valley, Tehachapi and Cummings valleys in the Tehachapi Mountains, and Antelope Valley in the Mojave Desert (Figure 9). These centers of rapid land use change are supported by several major highways, including Interstate-5 and State Routes 58, 99, and 138, which also facilitate the expansion of urban and agricultural land uses from these existing development nodes. These growing communities can adversely alter the regional landscape by impacting natural land cover, habitat integrity, watershed processes, fuel and fire regimes, habitat connectivity, air and water quality, inter-specific interactions, species movement patterns, and abundance of exotic plant and animal species (White et al. 2003). Significant development on Tejon Ranch itself, in the absence of a comprehensive, regional plan for conservation and development, may be the single largest threat to biological diversity and ecological integrity in this region. The cumulative effects of conservation and development in the region, particularly the areas immediately adjacent to Tejon Ranch, must be evaluated when developing a functional, landscape-scale reserve design for the Tejon Ranch region.

Reserve design considerations

Reserve design is an iterative process of capturing multiple biological values in an effective configuration that involves analyses of population viability and habitat loss, using site-specific data on populations and communities. Various factors influence the strategic decisions that comprise a reserve design. These include, but are not limited to:

- Threats and vulnerability
    - Proximity to existing infrastructure and development
    - Areas requiring intensive management or restoration
- Incentives for conservation
    - Permitting and mitigation needs
    - Financial resources available for acquisition
    - Managing as a "working landscape"
    - Temporal opportunities and constraints
- Regional impacts of development or conservation
    - Cascading effects of conservation and development in the region
    - Irreplaceability of resources
    - Regional viability

Suggested conservation goals

Designing a reserve system encompassing Tejon Ranch must entail development of explicit conservation goals that embody the desired conservation values. This section outlines conservation goals for the values used in this assessment. Many additional goals should be considered in a future reserve design process, which should include explicit criteria for evaluating these goals and assessing effects on species viability, ecological processes, etc.

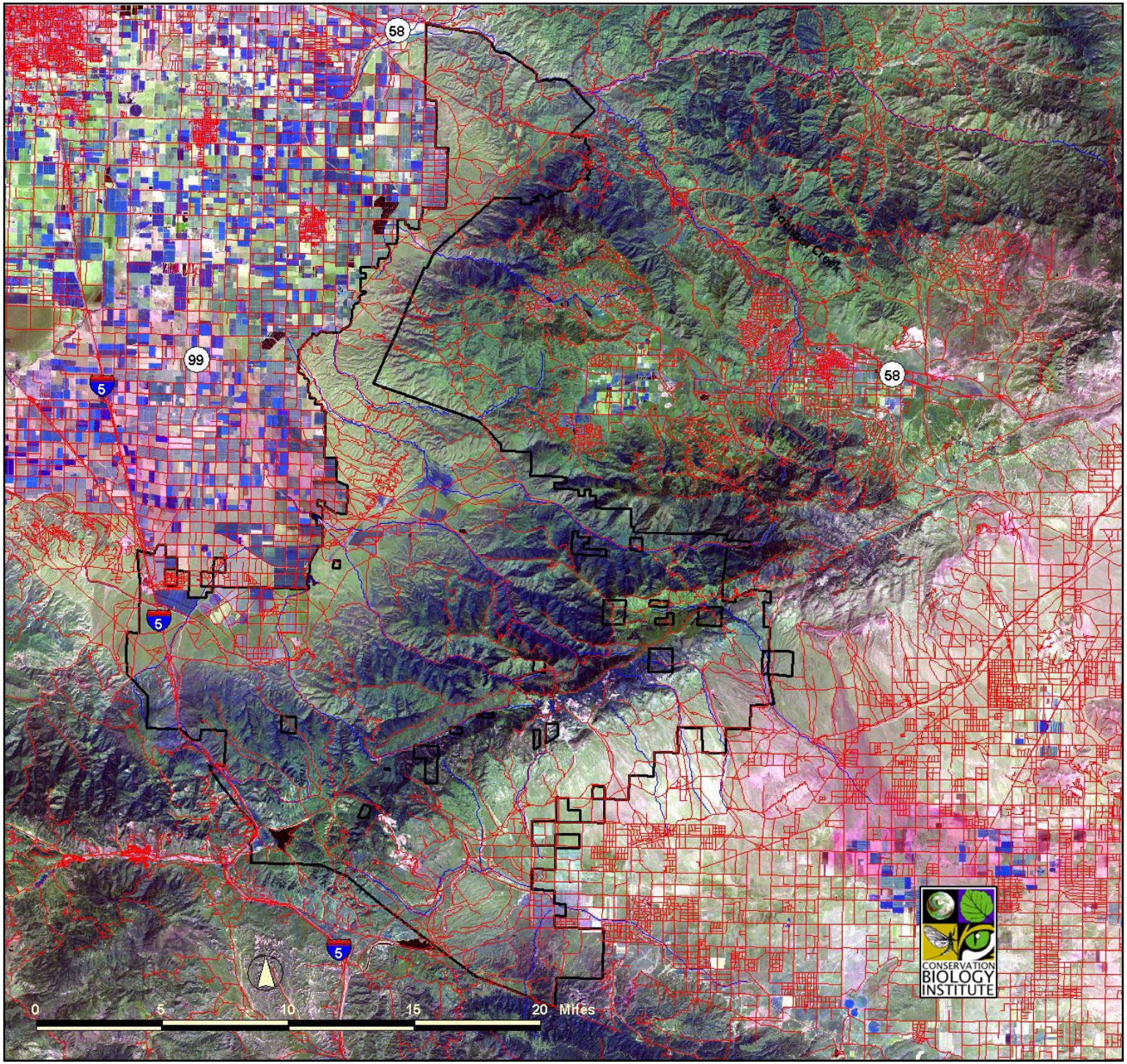


Figure 9. Satellite image of Tejon Ranch and vicinity (roads shown in red)

Habitat connectivity

- Provide landscape-scale linkages between the Sequoia National Forest and the Los Padres National Forest and other public lands.
- Protect appropriate, contiguous habitats to maintain the viability of a diverse suite of focal species within the linkages.
- Protect the grassland on the valley floor portion of Tejon Ranch, which is part of the linkage *Southwest, Southern, and Southeastern Valley edge, McKittrick south to Maricopa, east and north to Kern River* that must be maintained for recovery of San Joaquin Valley species (USFWS 1998, Recovery Task #5.3.8).

Listed and endemic species

- Conserve suitable habitat, both occupied and unoccupied, to maintain viable populations of listed and endemic species on Tejon Ranch.
- Conserve large, intact, and connected landscapes adequate to allow evolutionary processes to continue.
- Conserve areas of Critical Habitat for the California condor (USFWS 1976) to contribute to recovery of the species on the Ranch.
- Conserve 100% of the clay soils areas of the Bena Hills-Caliente Hills region of Tejon Ranch, which is the only known location for Vasek's clarkia and supports potential habitat for other sensitive plant species (USFWS 1998, Recovery Task 2.2.18).
- Conserve 75% of the habitat in the Caliente-Bena Hills and Comanche Point regions of Tejon Ranch occupied by Bakersfield cactus (USFWS 1998, Table 4).
- Conserve 100% of the clay soils areas of the Comanche Point-Tejon Hills region of Tejon Ranch, which supports habitat for Comanche Point layia, Tejon poppy, and Bakersfield cactus (USFWS 1998, Recovery Task 2.2.20).
- Survey the entire San Joaquin Valley floor region of Tejon Ranch, which supports suitable habitat for the Hoover's woolly-star, San Joaquin woolly-threads, blunt-nosed leopard lizard, Tipton kangaroo rat, and San Joaquin kit fox, and conserve occupied habitat (USFWS 1998, Recovery Task 3.2.19).

Watershed integrity

- Conserve high-integrity subbasins to maintain ecological processes.
- Restore lower integrity subbasins in strategic locations (e.g., headwater basins) to increase the overall function of target watersheds.

Unique, diverse, and under-conserved vegetation communities

- Conduct floristic-level surveys to describe and map the true diversity of vegetation communities and habitat quality on the Ranch.
- Conserve adequate areas of vegetation communities on the Ranch to ensure that functional, representative examples of all regional vegetation community types are adequately conserved.
- Conserve large areas of lower elevation vegetation community types (grasslands, oak woodlands, oak savannas) that are under-represented in conserved lands in the region.
- Conserve 100% of sycamore woodland and cottonwood-willow riparian woodlands.

Roadless areas

- Conserve all existing roadless areas greater than 5,000 acres in size.
- Conserve roadless areas 1,000-5,000 acres in size as needed to achieve other conservation goals.

Conclusions

Tejon Ranch is the keystone of a highly complex landscape that supports a wide variety of conservation values. However, these values are not distributed uniformly across the landscape. Therefore, decisions regarding conservation and management in the region must consider landscape-scale variability and ecological processes. Furthermore, given its size, location within the landscape, and unique biogeographic characteristics, Tejon Ranch undoubtedly supports a complexity of additional conservation values not addressed by this study. We urge comprehensive natural resource assessments on the Ranch and surrounding areas before any decisions are made that could irretrievably alter the functions and values of this important part of California's natural heritage. These assessments and planning efforts must be conducted with public scrutiny and open, scientific peer review.

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Appendix A
Land Cover Classification and Roads

Data sources

Name	Data Type	Scale/ Resolution	Date	Source
Cities of California	Polygon	1:250,000	2000	ESRI
Counties of California	Polygon	1:100,000	2000	U.S. Bureau of the Census
TIGER roads	Line	1:100,000	2000	U.S. Bureau of the Census
Tejon Ranch boundary	Polygon	1:24,000	1994	GreenInfo Network
Rivers and streams	Line	1:100,000	varies	U.S. Geological Survey
Lakes	Polygon	1:100,000	varies	U.S. Geological Survey
Elevation—Digital Elevation Model	Raster	30 m	varies	U.S. Geological Survey
Vegetation of California	Raster	100 m	2002	California Dept. of Forestry and Fire Protection (FRAP)
National Land Cover Database (NLCD)	Raster	30 m	1992	U.S. Geological Survey
Digital orthophoto quadrangles (black & white aerial photos)	Raster	1 m	mid-1990s	U.S. Geological Survey
Satellite imagery Landsat 7 ETM+	Raster	30 m	2002	EROS Data Center
Satellite imagery ASTER	Raster	15 m	2003	EROS Data Center
A. Harvey unpublished photographs	Photos	NA	2003	www.visualjourneys.net

Land cover classification and roads

Existing land cover data for Tejon Ranch was spatially too coarse (e.g., 100 m resolution FRAP data) or thematically too simple (e.g., NLCD does not contain detailed plant community information). Many of the regionally under-represented vegetation communities are grassland, oak savanna, and riparian forest communities not included in the FRAP data. The goal for producing a new land cover classification for Tejon Ranch was to identify and map these and other communities at a higher spatial resolution. We based the new classification on ASTER imagery, supplemented by ground-truthing the Ranch perimeter during a 1-day field reconnaissance. We tiled together the available Digital Orthophoto Quadrangles to guide the classification and used the Landsat 7 ETM+ image to provide seasonal information. Elevation data were incorporated to divide different aspects in the mountains. FRAP and NLCD were used as ancillary data.

The ASTER imagery was classified using an Optimal Iterative Unsupervised Classification (OIUC) procedure, which subdivides the raw imagery according to meaningful areal subsets and uses unsupervised classification (or ISODATA) for determining spectral classes. The process is iterative in that readily distinct spectral classes are characterized and set aside while the more confused pixel clusters are reclassified for more definitive spectral separation. The 16 classes mapped for Tejon Ranch included:

- Grassland
- Oak woodland
- Oak savanna
- Montane hardwood
- Montane hardwood-conifer
- Sycamore woodland
- Wet meadow
- Cottonwood-willow riparian woodland
- Chaparral
- Pinyon-juniper
- Desert scrub
- Joshua tree woodland
- Developed
- Agriculture
- Barren
- Water

Roads were digitized using the satellite imagery and digital ortho quadrangles.

Appendix B
Assessing Conservation Values

Habitat connectivity

As part of the South Coast Missing Linkages Project, the South Coast Wildlands Project and its science advisors conducted landscape permeability analyses for 9 species (marked with * in Table B-1) to identify preferred movement routes between existing protected areas. They then combined the best potential route (least-cost corridor) for each species to form a Least Cost Union. Patch size and configuration of suitable habitat were analyzed within the Least Cost Union for all 33 species in Table B-1. The final Linkage Design includes the Least Cost Union and other areas essential to the needs of a particular species, as identified in the patch size and configuration analyses. See Penrod et al. (2003) for details.

Table B-1. Focal Species Used to Develop Linkage Design (Penrod et al. 2003)

Plants
- Tejon poppy (*Eschscholzia lemmonii kernensis*)
- Bakersfield cactus (*Opuntia basilaris var. treleasei*)
- Blue oak (*Quercus douglasii*)
- California black oak (*Quercus kelloggii*)
- White alder (*Alnus rhombifolia*)
- White fir (*Abies concolor*)
- California buckeye (*Aesculus californica*)
- Jeffrey pine (*Pinus jeffreyi*)
- Singleleaf pinyon (*Pinus monophylla*)

Invertebrates
- Linsley's rain beetle (*Pleocoma linsleyi*)
- Lined lomatium longhorned borer (*Brachysomida vittigera*)
- Tejon longhorned borer (*Crossidius coralinus tejonicus*)
- Bright blue copper butterfly (*Lycaena heteronea clara*)
- San Emigdio blue butterfly (*Plebulina emigdionis*)
- Callippe fritillary (*Speyeria callippe macaria*)
- Bear sphinx moth (*Arctonotus lucidus*)

Amphibians and Reptiles
- Yellow-blotched salamander (*Ensatina eschscholtzii*)
- Western pond turtle (*Clemmys marmorata*)
- Coast horned lizard (*Phrynosoma coronatum*)
- Blunt-nosed leopard lizard (*Gambelia sila*)*
- Long-nosed leopard lizard (*Gambelia wislizenii*)

Birds
- California thrasher (*Toxostoma redivivum*)
- Acorn woodpecker (*Melanerpes formicivorus*)
- Burrowing owl (*Athene cunicularia*)*
- California spotted owl (*Strix occidentalis occidentalis*)

Mammals
- Tehachapi pocket mouse (*Perognathus alticola inexpectatus*)*
- Tipton kangaroo rat (*Dipodomys nitratoides nitratoides*)*
- Heerman's kangaroo rat (*Dipodomys heermanni*)
- Western gray squirrel (*Sciurus griseus*)*
- Mule deer (*Odocoileus hemionus*)*
- San Joaquin kit fox (*Vulpes macrotis mutica*)*
- Badger (*Taxidea taxus*)*
- Mountain lion (*Puma concolor*)*

*Landscape permeability analyses conducted for these 9 species.

Listed and endemic species

Table B-2 lists data sources for GIS habitat suitability models for selected species with the potential to occur on Tejon Ranch. Potential habitat was mapped for five federally listed endangered plants species and four endemic plant species within Tejon Ranch, using soil preferences, the detailed DEM data, and the updated land cover data described in Appendix A. Bakersfield cactus records from the CNDDB were mapped along Caliente Creek in the northern-most portion of the Ranch. Table B-3 lists the plant species and habitat mapping criteria.

Table B-4 lists the animal species and habitat mapping criteria. Potential habitat was modeled using the detailed DEM data and the updated land cover data described in Appendix A. Reported locations for two salamander species—yellow-blotched salamander and Tehachapi slender salamander—were buffered by 2 km (6,562 ft).

Table B-2. Data sources for habitat suitability models*

Plants	
California jewel-flower	Vegetation community/elevation/soils preferences
Vasek's clarkia	Vegetation community/elevation/soils preferences
Tejon poppy	Vegetation community/elevation/soils preferences
Striped adobe lily	Vegetation community/elevation/soils preferences
Comanche Point layia	Vegetation community/elevation/soils preferences
San Joaquin woollythreads	Vegetation community/elevation/soils preferences
San Joaquin adobe sunburst	Vegetation community/elevation/soils preferences
Piute Mountains navarretia	Vegetation community/elevation/soils preferences
Bakersfield cactus	CNDDB records
Animals	
Blunt-nosed leopard lizard	Penrod et al. (2003) criteria for habitat suitability
Spotted owl	Penrod et al. (2003) criteria for habitat suitability
Tehachapi pocket mouse	Penrod et al. (2003) criteria for habitat suitability
San Joaquin kit fox	Penrod et al. (2003) criteria for habitat suitability
Tipton kangaroo rat	Penrod et al. (2003) criteria for habitat suitability
San Joaquin antelope squirrel	CBI criteria for habitat suitability
California condor	Critical Habitat coverage provided by USFWS
Tehachapi slender salamander	CNDDB and distribution data from Jockusch and Wake 2002, Jockusch et al. 1998, Wake 1996, Wake and Jockusch 2000
Yellow-blotched salamander	Data from Jackman and Wake 1994, Stebbins 2003

* California Natural Diversity Database (CNDDB) 2002
SSURGO Soils 1:24,000, USDA 1980 (available for only a portion of the Ranch)
30m x 30m Digital Elevation Model
See Appendix A for land cover classification methods.

Table B-3. Selected listed and endemic plant species potentially occurring on Tejon Ranch

Species	Vegetation Community	Elevation	Soils*	Distribution in Vicinity of Tejon Ranch
California jewel-flower *Caulanthus californicus*	grassland, pinyon-juniper	75-900 m (240-2,880 ft)	subalkaline sandy or sandy loam #119, 120, 127, 144, 145, 146, 159, 160, 161, 162, 201	Bena Hills-Caliente Hills
Vasek's clarkia *Clarkia tembloriensis* ssp. *calientensis*	grassland	275-335 m (880-1,072 ft)	subalkaline sandy or sandy loam #119, 120, 127, 144, 145, 146, 159, 160, 161, 162, 201	Caliente Creek, Caliente Hills, Bena Hills
San Joaquin woollythreads *Monolopia congdonii*	grassland	60-260 m (192-832 ft)	subalkaline sandy or sandy loam #119, 120, 127, 144, 145, 146, 159, 160, 161, 162, 201	Bena Hills, Caliente Creek
Tejon poppy *Eschscholzia lemmonii* ssp. *kernensis*	grassland	250-600 m (800-1,920 ft)	adobe clay #119, 120, 121, 122, 123, 127, 149, 159, 160, 161, 162, 163, 164	Comanche Point, Tejon Hills, Tejon Ranch hdqrtrs, Bena Hills-Caliente Hills, San Joaquin Valley
Striped adobe lily *Fritillaria striata*	grassland, oak savanna, oak woodland, montane hardwood-conifer	135-1,455 m (432-4,656 ft)	adobe clay #119, 120, 121, 122, 123, 127, 149, 159, 160, 161, 162, 163, 164	Tejon Hills
Comanche Point layia *Layia leucopappa*	grassland	150-350 m (480-1,120 ft)	adobe clay #119, 120, 122, 123, 127, 159, 160, 161, 162, 163, 164	Comanche Point, Tejon Hills, Tejon Creek, Tejon Ranch house, Bena Hills, Caliente Hills, San Joaquin Valley floor
San Joaquin adobe sunburst *Pseudobahia peirsonii*	grassland, oak savanna, oak woodland, montane hardwood-conifer	90-800 m (288-2,560 ft)	adobe clay #119, 120, 122, 123, 127, 159, 160, 161, 162, 163, 164	Tejon Hills
Piute Mountains navarretia *Navarretia setiloba*	grassland, pinyon-juniper, oak savanna, oak woodland, montane hardwood-conifer	305-2,100 m (976-6,729 ft)	adobe clay #119, 120, 121, 122, 123, 127, 149, 159, 160, 161, 162, 163, 164	Caliente
Bakersfield cactus *Opuntia basilaris* var. *treleasei*	desert scrub, oak woodland	140-260 m (448-832 ft)	sandy, gravelly cobbly #139, 165	Caliente-Bena Hills, Comanche Point, Tejon Hills, Cottonwood Creek, Wheeler Ridge-Pleito Hills, Caliente Creek
Shading indicates endemic species; non-shaded species are federally and state-listed species.				
Source: CNPS 2001, CNDDB 2002, museum records, and proposed recovery areas (USFWS 1998).				

Table B-3. Selected listed and endemic plant species potentially occurring on Tejon Ranch

*Soil Map Units		Soil Descriptions	
Soils on alluvial fans, floodplains, and terraces on the eastern edge of the San Joaquin Valley			
119-120	Chanac-Pleito complex	sandy clay loam	
122-123	Cibo cobbly clay	cobbly clay	
127	DiGiorgio sandy clay loam	sandy clay loam	
139	Haploxerolls, hilly	gravelly alluvial fan	
144-146	Hesperia sandy loam	sandy loam	
159-160	Pleito sandy clay loam	sandy clay loam	
161-162	Pleito-Chanac sandy clay loam	sandy clay loam	
163	Porterville clay	clay	
164	Porterville cobbly clay	cobbly clay	
201	Wasioja sandy loam	sandy loam	
Soils on uplands and in valleys of the Sierra Nevada and Tehachapi Mountains			
121	Chino Variant	clay loam	
149	Los Osos Variant clay loam	clay loam	
165	Psamments-Xerolls complex	gravelly	

Source: USDA Soil Conservation Service 1976. Soil survey of Kern County, California, Southeastern Part.

Table B-4. Selected listed and endemic animal species potentially occurring on Tejon Ranch

Species	Vegetation Community	Elevation	Distribution in Vicinity of Tejon Ranch**
Blunt-nosed leopard lizard *Gambelia sila*	grassland, cottonwood-willow	98 - 2,395 ft	Restricted to San Joaquin Valley side of Ranch
California spotted owl *Strix occidentalis occidentalis*	Oak woodland, montane hardwood, montane hardwood-conifer, cottonwood-willow, sycamore woodland	3,500 - 6,000 ft	Tehachapi Mountains and foothills
San Joaquin kit fox *Vulpes macrotis mutica*	grassland, oak savanna	below 1,500 ft	Restricted to San Joaquin Valley side of Ranch
Tipton kangaroo rat *Dipodomys nitratoides nitratoides*	grassland	235 ft - 750 ft	Restricted to San Joaquin Valley side of Ranch
San Joaquin antelope squirrel *Ammospermophilus nelsoni*	grassland, oak savanna	below 3,600 ft	Restricted to San Joaquin Valley side of Ranch
Tehachapi pocket mouse *Perognathus alticola inexpectatus*	Joshua tree, grassland, pinyon-juniper, desert scrub, chaparral, agriculture	3,500 - 6,000 ft	Restricted to Mojave Desert side of Ranch
Shading indicates endemic species; non-shaded species are federally and state-listed species.			
Source: Penrod et al. 2003, modifications by W.D. Spencer, CBI.			

Vegetation community diversity

Using the new land cover data layer (a grid file), a "neighborhood statistics" calculation was performed in ArcView (version 3.2a). Search shape was a circle with a radius of 1,000 ft (312.5 m). Neighborhood calculation was set to "Variety," which tabulates the number of different land cover types within the moving window function using the size and shape settings described above. Developed and Agriculture land cover types were reclassified as "No Data" before conducting the calculation. The areas with higher totals possess greater natural vegetation community diversity.

Watershed integrity

Twenty watershed basins intersect the Tejon Ranch boundary. Smaller catchments (subbasins) were generated using the 30 m x 30 m DEM and the ArcHydro extension to ArcGIS. A total of 815 catchments were delineated for the area in and around Tejon Ranch. For each of these smaller catchments, four surrogates for approximating watershed integrity were evaluated:

1. **Percent natural cover**—based on the new land cover data for the Ranch itself and updated NLCD for the area outside the Ranch boundary.
2. **Percent roadless**—based on the process outlined in the following section.
3. **Road density (km/sq km)—**based on 1:24,000 roads data (updated by heads-up digitizing from the most recent ASTER imagery).
4. **Number of road-stream intersections**—based on 1:24,000 roads data and 1:100,000 streams data, using an ArcView Avenue script.

Each of the four components was evaluated separately and given an ordinal score of 1-5, with 5 being most intact. Scoring was made using either natural breaks (percent natural cover and road-stream intersections), equal interval (percent roadless), or based on known biological thresholds (road density). Table B-5 shows each criterion, the range of values, and how they were scored. The final watershed integrity score was simply an addition of the four criteria scores.

Table B-5. Watershed integrity criteria and scores

Percent Natural Cover		Percent Roadless		Road Density		Road-Stream Intersections	
0-18	1	0-20	1	0.000-0.226	5	0-2	5
19-46	2	20-40	2	0.226-0.511	4	3-6	4
47-73	3	40-60	3	0.511-0.873	3	7-12	3
74-91	4	60-80	4	0.873-1.559	2	13-20	2
92-100	5	80-100	5	1.559-2.774	1	21-30	1

Roadless areas

Roadless areas were mapped for the entire watershed extent, using the steps outlined below:

1. TIGER/Line 2000 road data (outside the Ranch) was combined with the new roads data layer (inside the Ranch), and the composite file was converted to a raster (or GRID) file with a spatial resolution of 30m x 30m.
2. Using the raster road file (30m x 30m resolution), a grid file denoting the distance (in meters) away from each road was generated using the Find Distance function in ArcView.
3. The neighborhood statistics function was then run on the results using the following settings:
   Statistic Type: Mean
   Neighborhood: Rectangle
   Neighborhood Settings
   Height: 3
   Width: 3
   Units: cells
   Output Resolution: 30 meters
4. Results from the neighborhood statistics were recoded as follows:
   0 = 0 - 500
   1 = 500 - max distance
5. A region group function was then performed, assigning a unique ID to all cell clusters (value = 1) larger than 1,000 acres.
6. Human disturbances were erased from the roadless areas using the combination of the updated NLCD (outside the Ranch) and the new land cover data (inside the Ranch). This was done by assigning Developed and Agriculture land classes as "1" and all natural land classes as "0." Developed and Agriculture land cover classes were then erased from the roadless areas file using Boolean logic in Map Calculator in ArcView.
7. The area of resulting roadless areas was checked again, and all clusters less than 1,000 acres were deleted.
8. Summary statistics were calculated on the intersection between the Tejon Ranch boundary and three roadless areas size classes (1,000 - 5,000 acres; 5,000-10,000 acres; and >10,000 acres).

Landscape units

Four landscape units (A, B, C, and D) were delineated for Tejon Ranch using a combination of elevation and land cover classes. Unit A represents the San Joaquin Valley region up to 1,700 ft elevation, the point where closed-canopy forest communities begin to dominate the land cover. Unit B includes the more mountainous terrain on the San Joaquin Valley side of the Ranch. The boundary used between Units B and C is the crest of the Tehachapi Mountains. Unit C includes the southeast side of the Tehachapi Mountains down to the vegetation transition between primarily tree-dominated classes and shrub or grass-dominated classes (approximately 3,500 ft elevation). Unit D forms the remaining land below 3,500 ft on the Mojave Desert side of the Ranch.

Attributes were evaluated for each of the four landscape units, using the "tabulate areas" command in ArcView (version 3.2a).