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.

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.

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.).

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).

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).

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).

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.

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

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.

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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