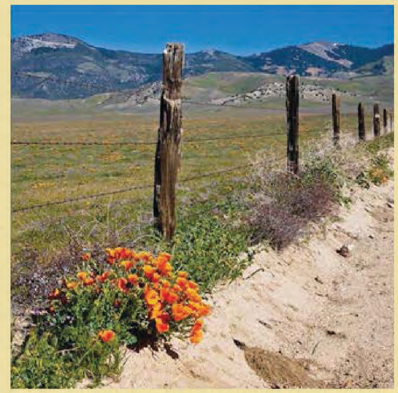
TEJON RANCH CONSERVANCY

Ranch-wide Management Plan



VOLUME 1:

Natural Community Descriptions

Tejon Ranch CONSERVANCY

P.O. Box 216
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JUNE 2013

ACKNOWLEDGMENTS

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To one and all – funders, partners, consultants, and volunteers – a heartfelt thank you. We quite literally could not have come this far without you!

TABLE OF CONTENTS

Chapter/Section **Page**

FIGURES

TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

BLM	U.S. Bureau of Land Management
BMPs	Best Management Practices
CNAP	Scripps Institution of Oceanography's California Nevada Applications Program
Conservancy	Tejon Ranch Conservancy
DFG	California Department of Fish and Game (until 2011)
DFW	California Department of Fish and Wildlife (since 2011)
ft	feet
GCM	general circulation model
GFDL	Geophysical Fluid Dynamics Laboratory
I-5	Interstate 5
km	kilometers
kV	kilovolt
lbs/ac	pounds per acre
mph	miles per hour
msl	above mean sea level
MYA	million years ago
NCAR	National Center for Atmospheric Research
NOAA	National Oceanographic and Atmospheric Administration
NWR	National Wildlife Refuge
PCM	Parallel Climate Model
PLM	Private Lands Wildlife Enhancement and Management Area
QDM	Quality Deer Management
Ranch	Tejon Ranch
Ranch-wide Agreement	Tejon Ranch Conservation and Land Use Agreement
RDM	residual dry matter
REL	UC Berkeley Range Ecology Lab
RHJV	California Riparian Habitat Joint Venture

RWMP	Ranch-wide Management Plan
SAP	Scientific Advisory Panel
STM	state-and-transition model
TMV	Tejon Mountain Village
TRC	Tejon Ranch Company
TU MSHCP	Tehachapi Uplands Multiple Species Habitat Conservation Program
UC	University of California
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
WCB	California Wildlife Conservation Board
YBP	years before present

1 INTRODUCTION AND BACKGROUND

Tejon Ranch (Figures 1-1 and 1-2) has held a special place in the minds of conservationists for generations. Its unique location at the intersection of four ecological regions, the importance of the Ranch as habitat for the iconic California condor and myriad other special-status species, and its pivotal position as a potential linkage between vast tracts of protected land all combine to make it one of the most ecologically significant single ownerships in North America. In recognition of that significance, the Tejon Ranch Company (TRC) and five of California's leading environmental groups engaged in a 2-year process to find a new way to achieve conservation at Tejon Ranch. That effort culminated in the historic Tejon Ranch Conservation and Land Use Agreement (Ranch-wide Agreement) that was signed in June 2008. (A summary of the agreement is provided in Appendix A.)

The signing of the Ranch-wide Agreement was appropriately hailed and celebrated in the media as an historic achievement on many levels. First and foremost, the Ranch-wide Agreement set a conservation and land use plan for the entirety of the Tejon Ranch, the largest contiguous private property in California with some 270,000 acres. The Ranch-wide Agreement was also visionary in anticipating the scope and complexity of the conservation achievement by establishing the independent Tejon Ranch Conservancy (Conservancy) and a funding stream to ensure strong, perpetual stewardship of the Ranch. The nature of the Ranch-wide Agreement and the utilization of conservation easements as the vehicle for conservation are emblematic of perhaps the single most notable element of the Ranch-wide Agreement, extraordinary collaboration.

The TRC and the five "Resource Groups" that signed the Ranch-wide Agreement (Appendix A) chose a new path that sought collaboration over conflict and cooperation over litigation. That new way was centered on collaboration via the Conservancy to achieve numerous conservation milestones in the first few years after signing of the Ranch-wide Agreement. This Ranch-wide Management Plan (RWMP) continues that spirit of collaboration, setting a stewardship vision that balances TRC's Ranch Uses (referred to as Ranch Uses in the Ranch-wide Agreement) with the goal of enhancing and restoring the conservation values of Tejon Ranch.

The RWMP comprises four volumes:

- **Volume 1, *Natural Community Descriptions,*** summarizes background information on the conservation significance, resources, and land uses of Tejon Ranch; reviews the scientific literature on the ecology, desired conditions, and potential land management strategies to achieve these conditions; and presents conceptual models that describe the Conservancy's assumptions, uncertainties, and management hypotheses for priority ecosystems at Tejon Ranch.

- **Volume 2, *Conservation Activities and Best Management Practices,*** describes the adaptive management structure and process that will be used to implement management actions and BMPs; presents the Conservancy's conservation goals and objectives; identifies and prioritizes strategies (Conservation Activities) for achieving goals and objectives, and presents BMPs for TRC Ranch Uses. It serves as the Conservancy's overall conservation management strategy for the next 5-year period. The volume is supported by several technical appendices that provide recommendations on weed management, grazing and wildlife management practices, and BMPs for Designated Use Areas.

- **Volume 3, *Public Access Plan,*** discusses opportunities and constraints for public access programming on Tejon Ranch and lays out the near-term Public Access Plan for the Ranch.

- **Volume 4, *Summary of Agency Review,*** summarizes the aspects of the RWMP reviewable by the U.S. Fish and Wildlife Service (USFWS) to evaluate compliance with the provisions of the Tehachapi Uplands Multiple Species Habitat Conservation Program (TU MSHCP) and federal Endangered

Species Act, and the aspects reviewable by the California Wildlife Conservation Board (WCB) to evaluate compliance with conservation easement conditions in the Acquisition Areas.

1.1 TEJON RANCH CONSERVATION AND LAND USE AGREEMENT

The Ranch-wide Agreement placed 240,000 acres of Tejon Ranch into conservation (i.e., the Conserved Lands), set up the Conservancy, and established guidelines to govern the long-term stewardship of the Conserved Lands (Appendix A). The following sections summarize major components of the Ranch-wide Agreement to provide context for this RWMP. Terms defined by the Ranch-wide Agreement are indicated with capital letters. It is important to note that this RWMP covers the 207,000 acres of Tejon Ranch outside of the existing Tejon Ranch Commerce Center and TRC Headquarters in Lebec, and proposed Development Areas of Centennial, Tejon Mountain Village (TMV), and Grapevine (Figures 1-3 and 1-4), which will collectively include a minimum of 33,000 acres of Conserved Lands within their planning area boundaries. The Conservancy may ultimately have stewardship responsibilities over portions of the Conserved Lands in these areas. Stewardship plans for the additional 33,000 acres will be specified in relevant environmental documents for these developments or in future revisions of the RWMP (as described further below).

1.1.1 TEJON RANCH CONSERVANCY

The Ranch-wide Agreement details the founding of the Conservancy, a 501(c)(3) charitable organization, and the mission, funding, articles of incorporation, and bylaws are all detailed therein. The Conservancy has adopted the Land Trust Alliance Standards and Practices as the organizational and administrative guidance for the organization and has registered to be an Accredited Land Trust in the 2014 round of accreditation. The Conservancy is governed by a 12-member, independent Board of Directors, with four Directors appointed by the Resource Groups that signed the Ranch-wide Agreement, four members appointed by TRC, and four independent members jointly selected by the full Board. Long-term funding for the Conservancy is through the use of a Conservation Fee Covenant to be recorded by TRC on residential lots within the development areas of Centennial, TMV, and Grapevine. In recognition of the fact that TRC's developments would take years to realize, the Ranch-wide Agreement imposed a requirement for interest-free payments, known as Advances, from TRC to the Conservancy. These payments fund the vast majority of Conservancy operations until 2022.

The mission of the Conservancy is to

> preserve, enhance and restore the native biodiversity and ecosystem values of the Tejon Ranch and Tehachapi Range for the benefit of California's future generations. The Conservancy will work collaboratively with TRC to promote the long-term science-based stewardship of the Ranch and to provide for public enjoyment through educational programs and public access.

The Conservancy's vision is to lead the way in understanding and protecting the exceptional biodiversity and ecosystem values of Tejon Ranch and the Tehachapi Range. By applying state-of-the-art conservation science and land management principles, the Conservancy envisions an interconnected landscape that protects and enhances the integrity of natural communities and ecosystem processes, such as the movement of wildlife through the region. To help guide its Science Program and stewardship planning, the Conservancy has created a five-member Scientific Advisory Panel (SAP). Objectives for the SAP include:

- bringing current scientific information and relevant expert knowledge into management planning and implementation for the Conserved Lands at Tejon Ranch;
- incorporating the experiences of land managers in the region into the selection of management strategies most relevant to the ecology of species and natural communities on Tejon Ranch; and
- providing a forum for Conservancy staff to vet proposals for scientific research and monitoring on Tejon Ranch and potentially the broader Tehachapi Region.

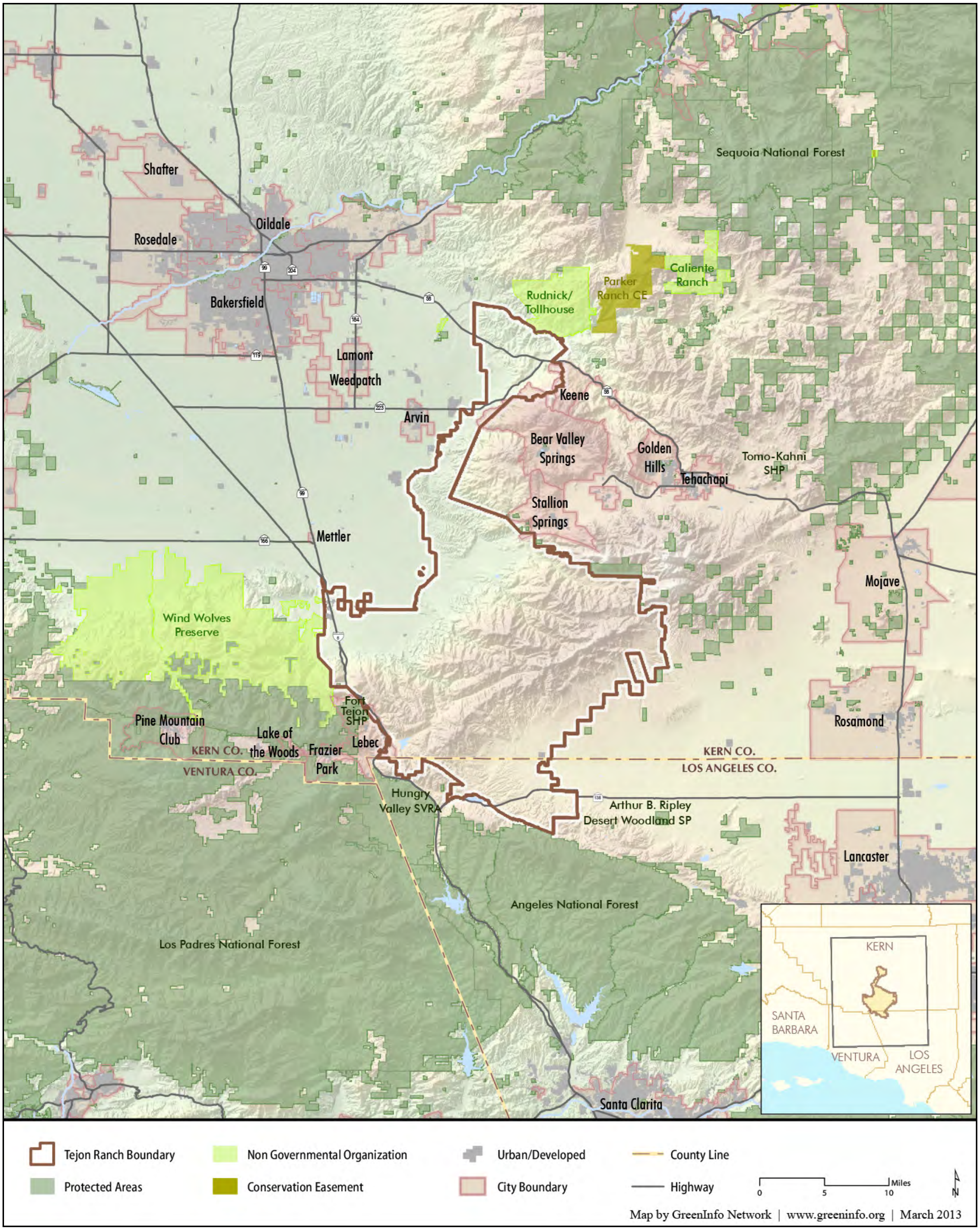


Figure 1-1. Regional Location of Tejon Ranch Showing Protected and Developed Areas Surrounding the Ranch

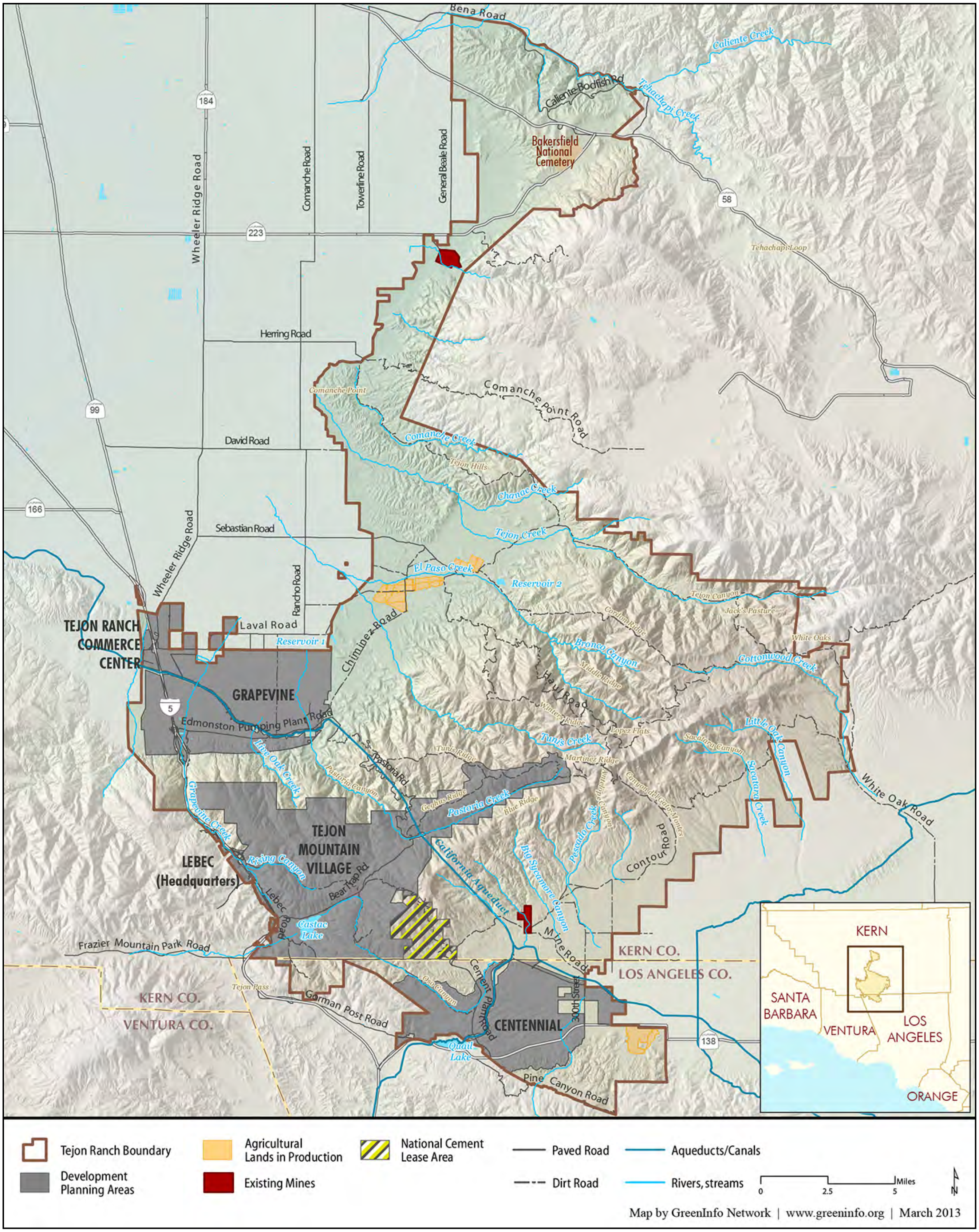


Figure 1-2. Detail of Tejon Ranch

People and collaboration are vital to the mission of the Tejon Ranch Conservancy. This planning process is an example of the ongoing extraordinary collaboration created by the Ranch-wide Agreement. Those who maintain traditional land-use practices in a working landscape like Tejon Ranch will have an opportunity to balance those uses with conservation and restoration objectives. Current and future generations of Californians will have the opportunity to visit and explore Tejon Ranch. Students and researchers are provided with a natural laboratory to deepen their understanding of the ecological significance of this landscape, which in turn will help the Conservancy to implement its stewardship mission. The Conservancy seeks to provide opportunities for environmental education and appropriate recreational uses that are vital to fostering an appreciation of wild places. Ultimately, the Conservancy's impact should reach far beyond the Tehachapi Range through these public access and environmental education programs.

The Tejon Ranch Conservancy is guided in all of its activities by a core set of values:

Conservation Science

Understanding and applying the best available conservation science is our foundation for stewardship, restoration and protection of native biodiversity and ecosystem values.

Independence

The Tejon Ranch Conservancy is committed to maintaining our independence to help to ensure the integrity of our actions.

Collaboration

The Tejon Ranch Conservancy was born out of an extraordinary collaboration. We seek to continue in that spirit by proactively seeking partnerships on key elements of our work.

Openness

The Tejon Ranch Conservancy is committed to a culture of openness in our activities and our decisions.

1.1.2 Acquisitions

The Ranch-wide Agreement conveyed time-limited options to purchase conservation easements over five areas of the Ranch comprising 62,000 acres, referred to in the Ranch-wide Agreement as the Acquisition Areas. These five areas are named White Wolf, Old Headquarters, Michener, Bi-Centennial, and Tri-Centennial (Figure 1-3). These five conservation easements were purchased from the Tejon Ranch Company in March 2011 by the Tejon Ranch Conservancy with funding from the WCB. The WCB is entitled to review the portions of the RWMP that apply to the Acquisition Areas to evaluate compliance with the terms of the easements.

1.1.3 Dedicated Conservation Easements

In addition to providing options for conserving the Acquisition Areas, the Ranch-wide Agreement set forth a schedule of phased conservation easement dedications to the Conservancy for 135,000 acres of the Ranch (Figure 1-3), tied to TRC's achievement of "Development Milestones." As defined in the Ranch-wide Agreement, the first such Development Milestone was achieved on June 4, 2012, with the approval of regulatory documents for the TMV development project. Accordingly, TRC dedicated a conservation easement over the 37,000-acre TMV-A portion of Tejon Ranch in December 2012. Under the Ranch-wide Agreement, TRC also agreed to dedicate a 10,000-acre conservation easement over the viewshed corridor of the potential realignment of the Pacific Crest Trail through Tejon Ranch. That conservation easement dedication is anticipated to occur in summer 2013. The easements over the remaining 88,000 acres of conserved lands will be dedicated to the Conservancy in phases over a 30-year timeframe.

The remaining 33,000 acres of dedicated conservation easements under the Ranch-wide Agreement consist of open space within the Development Areas (Figure 1-3). These conservation easements will be linked directly to the regulatory review and approval of TRC's developments and are not subject to this RWMP. Subsequent RWMPs will address the management of these areas if and when the Conservancy holds an easement interest. Importantly, despite the 30-year timeline for the dedication of conservation easements, TRC agreed to manage the 207,000 acres of Conserved Lands outside of the Development Areas as though the easements already exist. Therefore, this RWMP covers 207,000 acres—the entirety of the lands conserved outside of the Development Areas in the Ranch-wide Agreement (Figure 1-4).

1.1.4 State and Federal Uses

The Ranch-wide Agreement highlighted three potential state and federal partnerships on Tejon Ranch: the U.S. Forest Service, for the potential relocation of the Pacific Crest Trail; the California Department of Parks and Recreation, for the potential siting of a State Park; and the University of California Regents, for the potential siting of a U.C. Natural Reserve. The status of these efforts is discussed in Volume 3, *Public Access Plan.* In addition, TRC proudly donated 500 acres to the U.S. Department of Veterans Affairs to establish the Bakersfield National Cemetery in the White Wolf section of Tejon Ranch (Figure 1-2). This cemetery is not part of the Conserved Lands and is not subject to the RWMP.

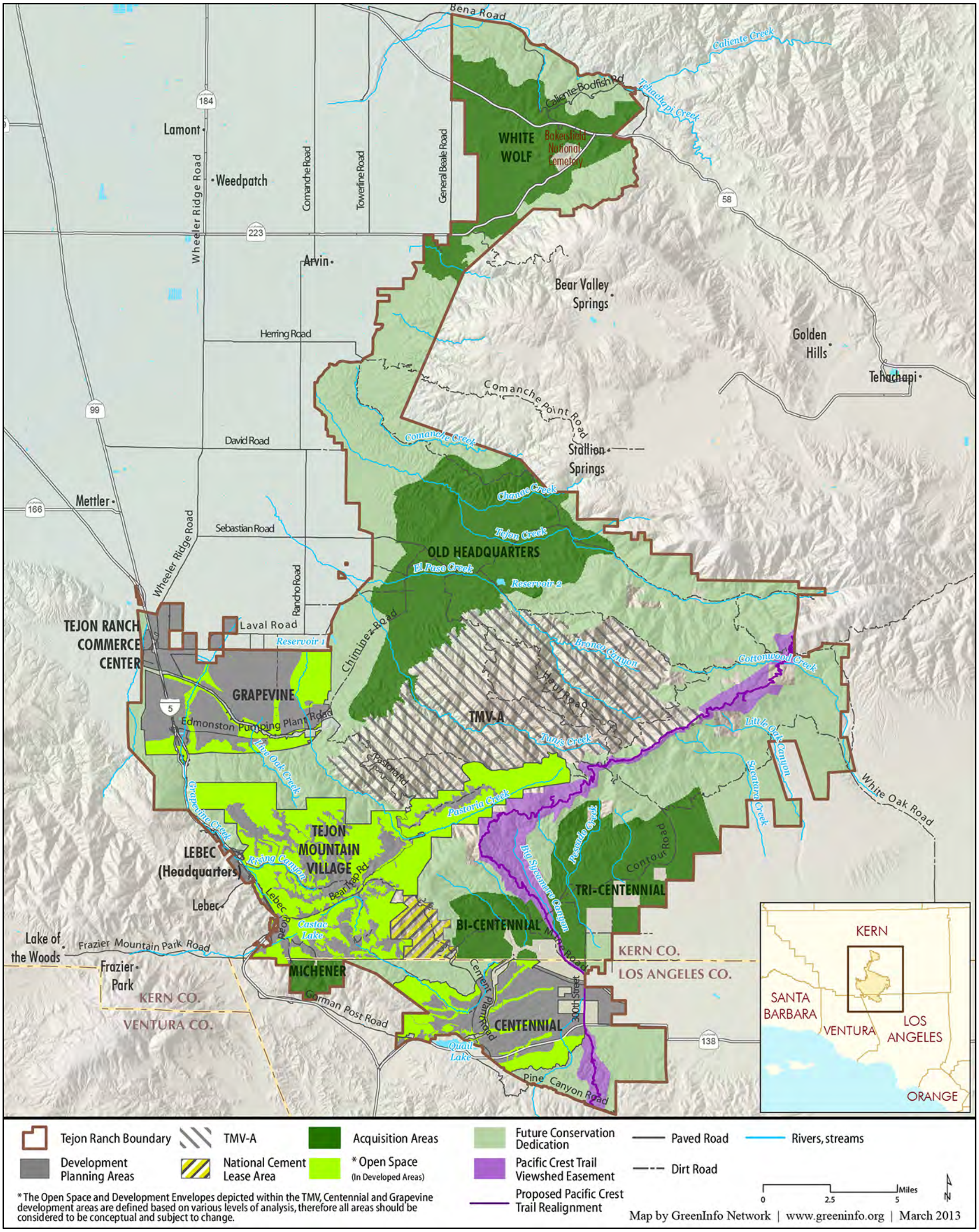
1.1.5 Public Access Program

The Ranch-wide Agreement and the Conservancy place a high priority on creating and maintaining a robust Public Access Program. The guidance from the Ranch-wide Agreement is for the RWMP to include a Public Access Plan as a required element. The Public Access Plan is Volume 3 of the RWMP.

1.2 Ranch-wide Management Plan

The Ranch-wide Agreement set forth the process for preparing the RWMP, summarized below, and embraced adaptive management as the approach for implementing stewardship activities on Tejon Ranch. The adaptive management tenets dictated by the Ranch-wide Agreement and embraced by the Conservancy are features of conservation planning frameworks internationally. Federal land management agencies and the community of conservation organizations are striving to implement conservation management in an adaptive fashion that explicitly acknowledges uncertainties in our knowledge of the functioning of ecological systems and that deliberately involves learning and adaptation as part of the management process. This RWMP proposes a spectrum of management strategies, ranging from well-accepted practices that can be implemented immediately to more speculative management hypotheses whose efficacy must be tested experimentally. Monitoring the results of the Conservancy's stewardship activities will be an integral component of this RWMP, along with continued research to better understand the ecology of Tejon Ranch.

The fact that the Conservancy seeks to balance human dimensions and traditional land uses (i.e., Ranch Uses) with ecological objectives also embodies contemporary conservation. In recent years, as a result of global-scale challenges such as climate change and resource limitations in public land management agencies, conservationists have identified private lands conservation strategies as being integral to ecological sustainability. Particular focus has been brought to the landscape mix of private and public lands and the way in which management of private land affects the sustainability of biodiversity on public lands. Another current issue and a central focus of this RWMP is conservation management within a "working landscape." Specifically, the Conservancy seeks to refine and adapt TRC's Ranch Uses for the betterment of native biodiversity and ecosystem values while respecting TRC's economic uses. This is a fundamental tenet of the Ranch-wide Agreement and a novel approach of this RWMP. The private Tejon Ranch is geographically situated between vast tracts of public lands with varying degrees of human extractive uses and conservation management emphasis, and this RWMP provides an opportunity to further conservation of the Working Lands in the Tehachapi Range. By doing so, the Conservancy can help inform working landscape stewardship in the region.



Note: Refer to text for acreages.

Figure 1-3. Conserved Lands and Proposed Development Areas at Tejon Ranch

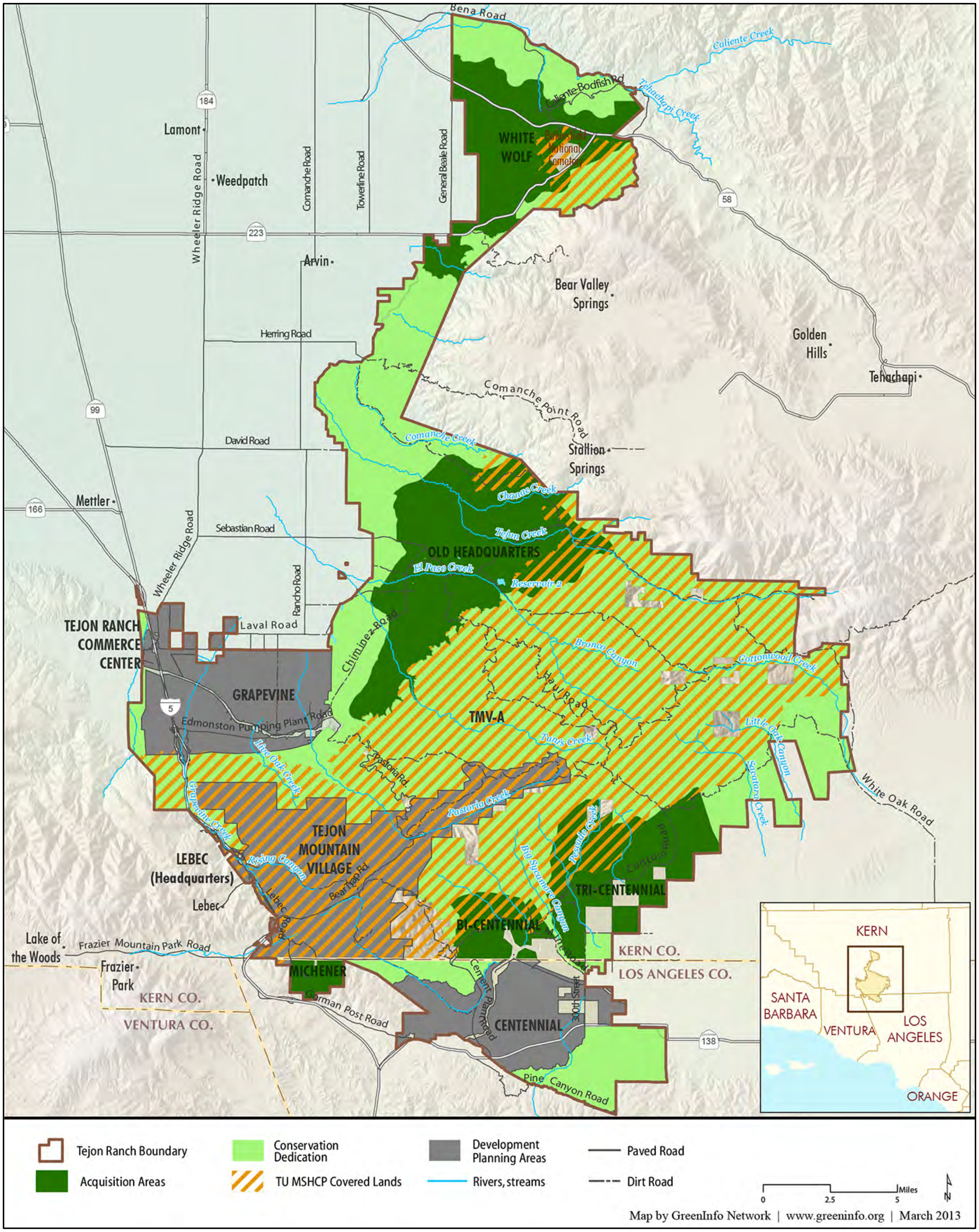


Figure 1-4. Conserved Lands Covered by This Initial RWMP

1.2.1 GUIDANCE ON PREPARATION OF THE RWMP

The Ranch-wide Agreement sets forth the specific goals, parameters, and approval process for creating the Ranch-wide Management Plan. This included the requirement for TRC to prepare an Interim RWMP within 1 year of the signing date of the Ranch-wide Agreement. That first-of-its-kind plan focused mainly on documenting existing practices and was adopted by the Conservancy in 2009.

The Ranch-wide Agreement states that the Initial RWMP (this document; hereafter, the RWMP) shall be completed 5 years after the signing of the Ranch-wide Agreement or June 2013. In recognition of the need for and benefits of the adaptive management process, the RWA directs the Conservancy to update the RWMP every 5 years as detailed below. Under the Ranch-wide Agreement, this RWMP clearly establishes the conservation goals and objectives designed to preserve and enhance the Conservation Values on Tejon Ranch. The Ranch-wide Agreement calls for collaboration between the Conservancy and TRC in preparing the RWMP. The Conservancy Board established a Stewardship Committee to work with and advise staff on preparation of the RWMP.

According to the guidance from the Ranch-wide Agreement on preparation of the RWMP, the RWMP shall:

(a) Identify and assess the Conservation Values of the Conservation Easement Area and opportunities for protection, enhancement, and restoration of those Conservation Values.

(b) Establish sustainable strategies for stewardship of the Conservation Easement Area, with appropriate provision for both the protection of the Conservation Values of the Conservation Easement Area and the continued use of the Conservation Easement Area for the Ranch Uses.

(c) Establish reasonable and economically feasible conservation goals and objectives for the Conservation Easement Area, including goals and objectives with regard to the following:

- (i) Promotion and restoration of native biodiversity and ecosystem values
- (ii) Protection and enhancement of natural watershed functions and stream and aquatic habitat quality
- (iii) Maintenance of healthy, diverse native forests
- (iv) Protection of human life and property, public safety, and natural resource values from wildfire, recognizing that fire is a natural ecological process
- (v) Protection and appropriate restoration and interpretation of significant historical and cultural resources
- (vi) Protection of scenic vistas and rare visual resources

(d) Achieve the RWMP goals and objectives through the establishment of Best Management Practices (BMPs) for permitted uses of the Conservation Easement Area. This can be accomplished by identifying appropriate Conservation Activities, monitoring programs, and research consistent with Paragraph 3 of Exhibit M [of the Ranch-wide Agreement] and providing flexibility to implement BMPs and Conservation Activities in an adaptive fashion, all in accordance with the applicable Management Standard.

(e) Provide opportunities for significant, well-managed public access through a Public Access Plan developed in accordance with Section 3.11 of the Ranch-wide Agreement.

(f) Establish environmental education and outreach programs, including maintaining relationships with local Native American groups.

BMPs are practices and procedures established in the RWMP that apply to the exercise of TRC's Reserved Rights, other than the Core Activities on the Conserved Lands (i.e., Ranch Uses). These BMPs are (a) based on the best available scientific information; (b) feasible, both economically and technologically; and (c) reasonable and practicable methods to reduce or minimize adverse impacts to natural resources and Conservation Values resulting from those activities that are subject to BMPs. BMPs must also be consistent with the applicable Management Standard and, with respect to the Long-Term Stewardship Standard (discussed below), reasonably necessary to achieve such Management Standard. BMPs are also used within the Oil and Gas, Mining, and Farming Designated Use Areas, but priority is given to TRC's economic use of those areas. BMPs are intended to balance Ranch Uses with practices that reduce their environmental impacts and help achieve conservation goals.

Conservation Activities are activities that are determined to be necessary to further the Conservation Purpose, are consistent with the Long-Term Stewardship Standard, and are consistent with reasonable detail set forth in the RWMP. Conservation Activities shall be carefully coordinated with TRC's use of the Easement Property and then-existing leases, easements, and other agreements. Conservation Activities are subject to BMPs and include the following, as described in more detail in the Ranch-wide Agreement and Conservation Easement:

- vegetation planting and management
- animal control
- condor feeding program (if directed by USFWS)
- signage
- fencing
- weed and nonnative plant control
- wetlands and stream course restoration

Conservation Activities also include other programs or activities to restore or enhance the Conservation Easement Area (which may be undertaken with the Grantor's prior consent that will not be unreasonably withheld).

The Ranch-wide Agreement states that the Conservancy shall update the RWMP every 5 years after the Initial Period and as otherwise needed. In the update process, the Ranch-wide Agreement sets forth specific consultation and review requirements. Outside the 5-year update process, either the Conservancy or TRC can request an update and the parties are expected to meet and confer in good faith on the need for and merits of the proposed changes. Any such changes will be subject to USFWS and WCB review.

Since the signing of the Ranch-wide Agreement, the Conservancy has been conducting baseline studies and ecological monitoring to develop an understanding of the ecological systems on Tejon Ranch, identify stewardship priorities, and to identify conservation goals and objectives for the RWMP. The results of these investigations and research are described in Volume 1 of this RWMP. However, it is important to note that the Conservancy's understanding of the Ranch is still in its infancy and all parties will continue to learn about and refine their understanding of the ecology of the Ranch for many years to come.

1.2.2 RWMP Management Standards

The Ranch-wide Agreement sets forth two types of Management Standards that govern the extent of the Conservancy's mandate to set management practices (Conservation Activities) and BMPs affecting TRC's activities on the Ranch (i.e., the Ranch Uses). The Management Standards and the management practices under them describe measures and practices to maintain and enhance conditions on Tejon Ranch.

Long-term Stewardship Standard

The Management Standard governing the establishment of BMPs and Conservation Activities for the vast majority of the Conserved Lands is the Long-Term Stewardship Standard. This standard contains the following guidelines:

1. The Long-Term Stewardship Standard shall be at least as protective as the Interim Stewardship Standard that governed the preparation of the Interim RWMP.
2. The continued economic use of the Conserved Lands, as a whole, will be respected.
3. Over time the goal is that the native biodiversity and ecosystem values of the Conserved Lands will be enhanced.
4. High-priority areas of particular sensitivity identified in the RWMP will be the focus of the Conservancy's Conservation Activities, and in such areas, the Conservation Purpose will take precedence over economic uses.
5. The enhanced biological and physical conditions resulting from previously approved Conservation Activities within such areas will be maintained.
6. Conservation Activities shall be carefully coordinated with TRC's use of the Conserved Lands and then-existing leases, easements, and other agreements.

The Long-Term Stewardship Standard governs the establishment of BMPs on Ranch Uses, including ranching and livestock management, wildlife management (hunting), filming, fuel management, construction of new or replacement fences or the removal of fencing, signage, private recreational use by TRC, design and construction of power generation facilities serving existing or reasonably anticipated uses on the Conserved Lands, and the expansion of new Incidental Ranch Facilities outside of the Disturbance Areas.

Designated Area Standards

Designated Area Standards collectively refer to the management standards that govern the Conservancy's planning in the Designated Use Areas (Figure 1-5): the Farming Area Standard, Mining Area Standard, and Oil and Gas Area Standard. Each of these areas has its own management standard, but BMPs throughout the Designated Use Areas shall not substantially affect TRC's economic use of the Designated Use Area. An additional Designated Use Area was added subsequent to the Effective Date of the Ranch-wide Agreement, the Designated Water Bank Area. However, only the installation of power generation facilities is subject to the BMPs in this area. Designated Area Standards are described in more detail in RWMP Volume 2.

1.2.3 Resource Agency Review of the RWMP

Management of roughly 80% of the lands covered by this RWMP will be subject to agency review as follows.

WCB Review

As a condition of the $15.7 million grant funding the acquisitions of conservation easements over White Wolf, Old Headquarters, Michener Ranch, Bi-Centennial, and Tri-Centennial Acquisition Areas, WCB retained a right of review of the Conservancy's RWMP for those areas. The Conservation Easements covering these Acquisition Areas (Figure 1-3) contain specific provisions providing for the review by the WCB of the Reviewable Aspects of the Conservancy's RWMP. Essentially, these easement provisions provide for the geographic scope and the timing of review by WCB.

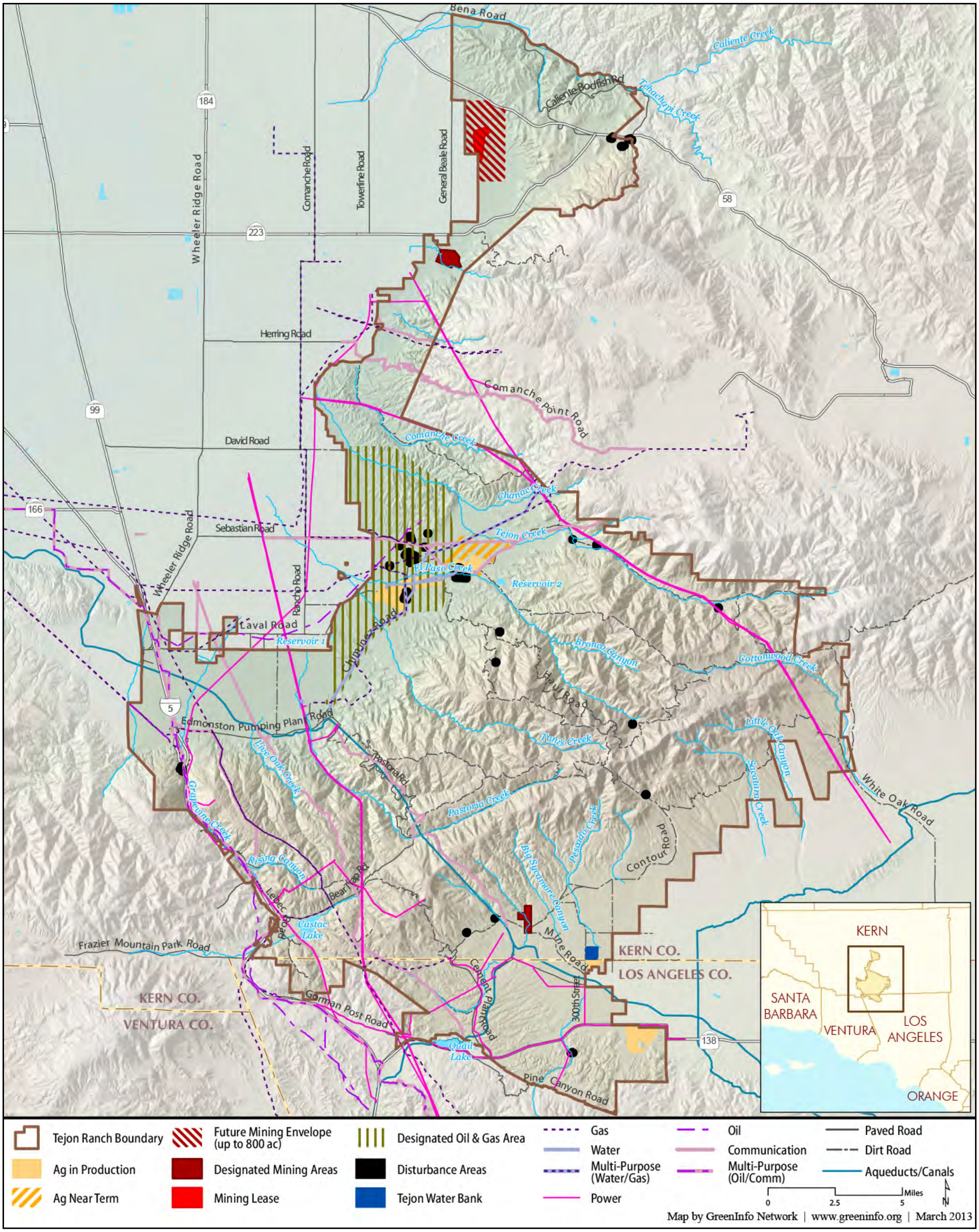


Figure 1-5. Designated Use Areas, Disturbance Areas, and Utilities at Tejon Ranch

USFWS Review

On April 30, 2012, USFWS issued an incidental take permit under the Federal Endangered Species Act in association with the TU MSHCP, which covers a portion of the Conserved Lands consisting of 141,886 acres, called the Covered Lands (Figure 1-4). The permit and the TU MSHCP require review and approval by USFWS of the Conservancy's RWMP as pertains to the Covered Lands under the permit. TU MSHCP Covered Lands include the 28,534 acres in the TMV planning area and 113,352 acres of Conserved Lands outside of TMV. After permit approval and during the permit term, the portion of each RWMP, and any proposed amendment to it, related to the Covered Lands will be reviewed and approved by USFWS. The review is limited to the geographic area covered by the permit an is specifically intended to provide USFWS the right to ensure consistency with the TU MSHCP, any Conservation Easements recorded pursuant to the permit, and the federal Endangered Species Act. Accordingly, USFWS retains a perpetual right of review and approval over the Conservancy's Public Access Plan in Covered Lands.

1.2.4 Public Access Plan

The Ranch-wide Agreement provides specific guidance concerning preparation of the Public Access Plan (Volume 3 of the RWMP). The Ranch-wide Agreement places a high priority on providing public access to Tejon Ranch (but does not provide a right of access to the general public). The Conservancy is charged with providing and managing "significant and appropriate" public access. The Ranch-wide Agreement also makes clear that TRC and the Conservancy shall collaborate closely on planning and providing public access. In this regard, TRC retains an explicit right of approval over the Public Access Plan. Also, although the Conservancy is planning BMPs in the Designated Use Areas, any public access to these areas requires the prior written consent of TRC.

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2 LANDSCAPE DESCRIPTION

2.1 REGIONAL ECOLOGICAL SIGNIFICANCE

Tejon Ranch straddles the Tehachapi Mountains and lies at the convergence of two major floristic provinces (California Floristic Province and Desert Province) and four major ecological regions (Great Central Valley, Sierra Nevada, Mojave Desert, and Southwestern California) nested within these provinces. Thus, the diversity of plants and animals found on Tejon Ranch reflects its position at a "biogeographic crossroads" (White et al. 2003), where species unique to each of these regions occur together on the Ranch. Portions of Tejon Ranch are included within Audubon California's Tehachapi Mountains and Antelope Valley Important Bird Areas. The Conserved Lands on the Ranch support more than 60 special-status species (Appendix B), including the iconic California condor (*Gymnogyps californianus*). The Ranch is also characterized by a complex terrain with more than 6,000 feet of elevation change, major north-south and east-west–trending canyons, and a high diversity of slopes and aspects, thereby providing high landscape diversity and potential refuges for species in the face of climate change.

Tejon Ranch supports more than two dozen major vegetation communities, representing more than 60% of the vegetation communities in the region (White et al. 2003). Not only do the Conserved Lands at Tejon Ranch capture a good representation of the biodiversity of the region, they also conserve many tens of thousands of acres of grasslands and oak woodlands that are under-protected in the region. Within the 240,000-acre Conservation Area of the Ranch, more than 84,000 acres of various oak woodlands exist, representing a substantial increase in the conservation of these vegetation communities in the region. Likewise, more than 100,000 acres of grasslands are present in the Conservation Area, including high-quality grasslands in some areas of the Ranch that area dominated by native grass, forb, and bulb species.

2.2 TERRAIN AND GEOLOGY

The Tehachapi Mountains are the southernmost extension of the Sierra Nevada (Norris and Webb 1990). The southwest-northeast–oriented Tehachapis connect the Sierra Nevada to the Transverse and Coast ranges and separate the Great Central Valley from the Mojave Desert. The Tehachapis reach an elevation of 6,803 feet (ft) above mean sea level (msl) on Tejon Ranch at Blue Ridge; taller peaks, such as Double Peak (7,981 ft), Cummings Mountain (8,000 ft), San Emigdio Mountain (7,495 ft), Frazier Mountain (8,013 ft), and Mount Pinos (8,831 ft), lie east and west of the Ranch. The southernmost portion of the San Joaquin Valley extends onto the northern portion of the Ranch, with elevations on the Ranch ranging from about 500 ft to about 3,000 ft. The southern part of Tejon Ranch includes the extreme western end of the Mojave Desert (the Antelope Valley), ranging in elevation from 3,000 ft to 4,000 ft, and the northern flank of Liebre Mountain, part of the Transverse Ranges, to an elevation of about 4,000 ft.

The terrain and types of rock found on Tejon Ranch (Figure 2-1) reflect the region's long and complex geologic history and are ultimately responsible for many of the biological patterns seen on the Ranch today. Some of the oldest rocks on Tejon Ranch include gneisses, schists, and metasedimentary roof pendants comprising sediments likely laid down in an oceanic environment at the edge of the North American continent more than 250 million years ago (MYA). As the Farallon Plate was subducted under the western edge of the North American Plate, the overlying sediments were metamorphosed by the granitic plutons "floating" up from the melting Farallon Plate. Formations of gneiss and schist are exposed in places along the Garlock Fault running through the Tehachapis (Chapman et al. 2010). The metasedimentary roof pendants (quartzites and marbles) are exposed along the Tehachapi foothills on the southeast side of the Ranch, where they are mined for production of cement at the National Cement site (Wiese and Fine 1950), and these deposits may contribute calcareous sediments to the alluvium on the desert side of the Ranch.

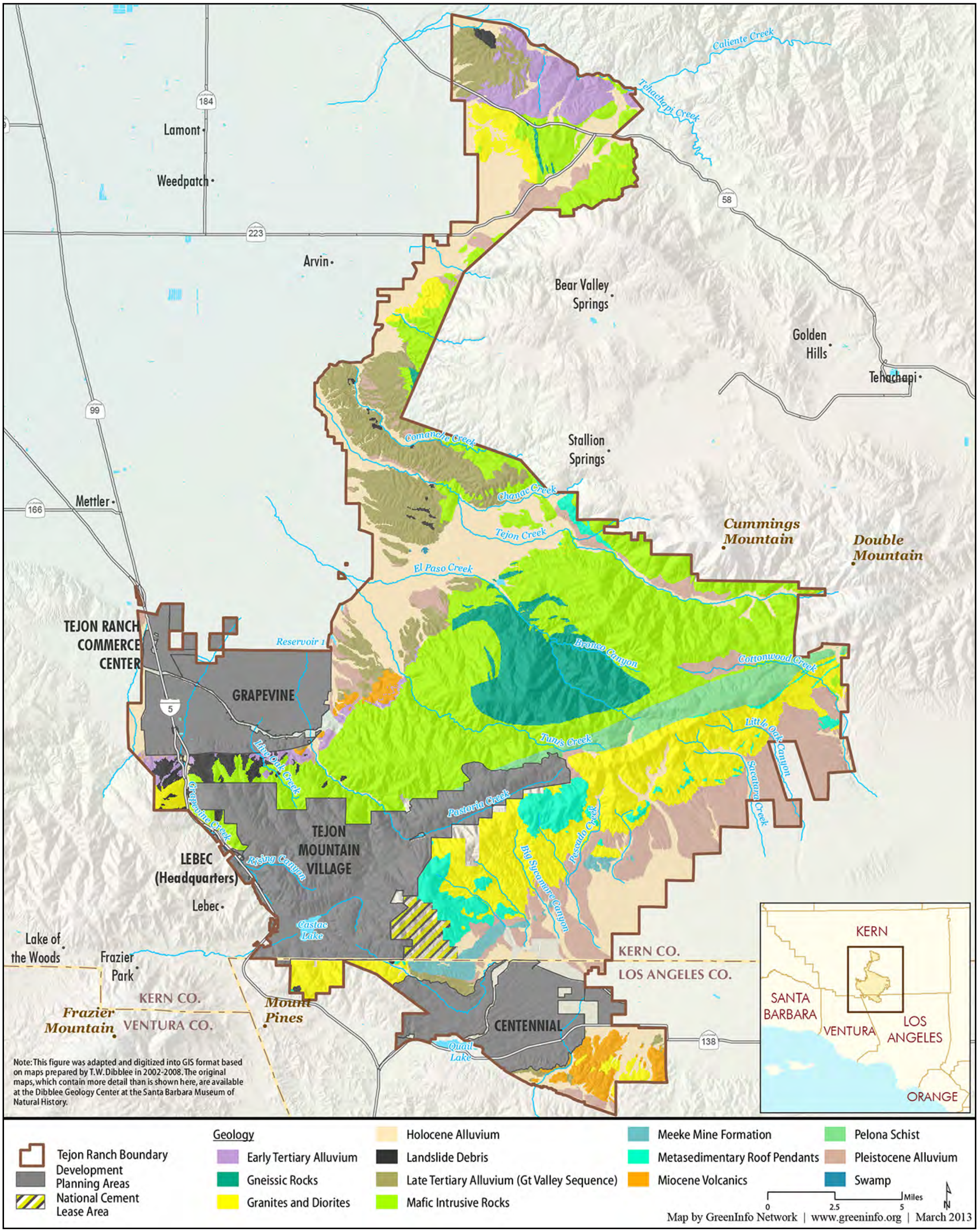


Figure 2-1. Tejon Ranch Geology

As the Farallon Plate was subducted under the western edge of the North American continent between 140 and 85 MYA, the crust of the plates melted and the magma rose through the upper mantle of the earth. As the magma cooled, it formed the immense blocks of igneous rock that constitute the granitic "basement rock" or batholith of the Sierra Nevada and Tehachapi Mountains (Millar 2012). The majority of the mountainous portions of the Ranch are underlain by these granitic rocks (Millar 2012, Hall 2007). The granitic basement rock of the Tehachapis comprises the southern portion of the greater Sierra Nevada Batholith, which was emplaced at substantially greater depths that the portions of the Sierra Nevada Batholith to the north (Saleeby pers. comm.). Complex tectonics, depths at which granitic plutons were emplaced, and movements along faults have produced granitic rocks of different mineral compositions in the Tehachapis (Chapman et al. 2010). In general, the northern side of the Tehachapis supports an older (140–99 MYA), more mafic rock (tonalite), and to the south is a younger (90 MYA), more felsic rock (granodiorite) that has been shattered and texturally degraded by regional tectonics (Wood and Saleeby 1997, Saleeby pers. comm.). This texturally degraded granite forms the southern foothills of the Tehachapis, where it weathers relatively rapidly to produce a coarse sandy alluvium that is characteristic of many of the soils on the desert side of the Ranch. The mafic granite characteristic of the northern portion of the Ranch generally weathers more slowly. In the late Cretaceous Period (about 85 MYA), crustal extension and rotation drove the Tehachapi Mountains into their current east-west orientation (Chapman et al. 2010, Chapman et al. 2012), which created the mountainous connection between the Coast Ranges and Sierra Nevada and produced ecologically important patterns in climate, local weather, and stream flow.

As the Farallon Plate was subducting under the North American Plate, it brought the trailing Pacific Plate into contact with the North American Plate about 30 MYA. This changed the nature of the contact between tectonic plates from subduction to lateral shear, which initiated formation of the ancestral San Andreas Fault system at the western edge of the continent (Millar 2012). At this time, the southern San Joaquin Valley was still an ocean embayment (the San Joaquin Sea), as the terrane supporting the future Coast Ranges was still south of its current position. The southernmost portion of the San Joaquin Sea, where it lapped against the ancestral Tehachapi Range, is known as the Tejon Embayment. During the Neogene Period (about 24–2 MYA), sea levels in the Tejon Embayment rose and fell, but by the end of this period the San Joaquin Sea was completely cut off from the ocean by the Coast Ranges. As a result, alluvium eroding from the rapidly rising Tehachapi Mountains was deposited in either a shallow sea or coastal lagoon environment or in a more terrestrial setting at the edges of the Tejon Embayment. These alluvial deposits comprise the Bena Gravels (derived from alluvial streams), Santa Margarita (beach and shallow offshore deposits), and Chanac (delta formations) geologic formations, which intergrade with one another and have been uplifted by faulting to form the Tejon Hills. Just before the onset of the Pleistocene Epoch around 2 MYA, before the uplift of the Transverse Ranges, the southeastern side of the Tehachapis drained west to the sea, forming a series of freshwater lakes in what is now the western Antelope Valley. Deep clay beds associated with these streams and lakes can be found today in the western Antelope Valley portion of the Ranch.

During the Pleistocene Epoch (from about 2.67 MYA to 11,000 years ago), massive erosion of the Tehachapis continued and extensive alluvial fans were laid down on both sides of the mountains. These alluvial fans were subsequently uplifted and dissected by erosion, as exemplified by large aprons of alluvium along the foothills of the Tehachapis or elevated terraces along existing stream courses. The Tehachapis are still rapidly uplifting (Saleeby pers. comm.), and evidence of massive ancient (Pleistocene Epoch) regional landslides and more recent (Holocene Epoch) landslides can be found on the Ranch. Rapid uplift and landslides are an important and ongoing process in the Tehachapis.

The most recent (Holocene Epoch) alluvial material is associated with currently active stream channels and is generally deposited at the lower elevations around the margins of the San Joaquin and Antelope valleys and within the floodplains of active streams. Much of the lowest elevation land in the San Joaquin and Antelope valleys has been converted to agricultural use. On Tejon Ranch, areas supporting recent alluvium can be found in the Antelope Valley but only a few unconverted areas remain at the edges of the San Joaquin Valley side of Tejon Ranch.

The terrain of Tejon Ranch can be classified into a number of distinct landforms that are a product of faulting and tectonics. The mountainous portions of the Tehachapis north of the Garlock Fault are characterized by a series of long ridges (e.g., Cordon Ridge, Winter's Ridge, Tunis Ridge) and deep stream valleys (e.g., Tejon Canyon, El Paso Canyon, Tunis Canyon) extending from Blue Ridge in a northwest orientation. The uplifted Neogene Period alluvial formations associated with the Tejon Embayment are characterized by highly dissected, low rolling hills, often with badland characteristics, located around the edge of the San Joaquin Valley side of the Ranch. South of the Garlock Fault (on the Mojave Desert side of the Ranch), the Blue Ridge drops steeply to rolling foothills at the base of the Tehachapi Mountains. These rolling foothills are underlain by granitic basement rock and metasedimentary roof pendants (on the Mojave Desert side), and outcroppings of these rocks are visible along the fronts of the range. Below the foothills are older alluvial terraces and bajadas that have been dissected by more recent erosion.

2.3 Weather and Climate

The climate in the Tejon Ranch region is quite variable and is a product of its regional geography and terrain. The regional climate is largely Mediterranean, with cold, wet winters and hot, dry summers, although some summer monsoonal precipitation is typical. Winter storms generally form in the Gulf of Alaska and move into the region from the northwest. Thus, at similar elevations, the northern slopes of the Tehachapi Mountains typically receive more rainfall than the southern slopes, which lie in a rain shadow. Although the southern portion of the Ranch lies within the Mojave Desert ecological region, the desert portion of the Ranch receives significantly more average annual rainfall than parts of the Mojave Desert to the east. Based on a regional analysis of rainfall, soils, and species life history requirements, the lowest elevations on the San Joaquin Valley side of the Ranch have recently been suggested to be part of a heretofore unrecognized desert, the San Joaquin Desert (Germano et al. 2011).

The Tehachapi Mountains are also windy, as evidenced by the boom of wind power projects proposed on the desert side of the mountains east of Tejon Ranch. Average monthly wind velocities (1996–2006) range from 4.5 to 7.7 miles per hour (mph) in Bakersfield but rise to a range of 11.9–15.5 mph at Sandberg (south of the Ranch). Wind direction is generally out of the north and northwest in the spring and summer, shifting to the east and northeast in the late fall and early winter (Western Regional Climate Center 2012). Updrafts from the San Joaquin Valley floor are used by soaring bird species, such as California condor, and carry insects to aerial insectivorous birds such as the purple martin (*Progne subis*). These warm winds out of the San Joaquin Valley (San Joaquin Desert) can also contribute to very dry conditions at higher elevations of the Ranch during summer months.

The rugged terrain of Tejon Ranch also produces diverse microclimates, and this condition has important implications for species distributions and their stability in the face of climate change. The elevational diversity of Tejon Ranch, with its long ridges and deep valleys, creates a landscape with widely varying combinations of elevation, slope, aspect, steepness, daily exposure to sun, and water availability. Tejon Ranch has no real snowpack in the strict sense of a long-term accumulation of snow layers, but pockets of snow can remain on some shady northern slopes all winter and late into the spring. Cold air from high elevations can sink long distances down along canyon bottoms. Radiation fog (tule or ground fog) is typical at low elevations of the San Joaquin Valley during winter months. Hoar frost is common at higher elevations when moisture in low clouds or fog forms ice sheaths over vegetation in freezing temperatures.

2.3.1 Current Climate

The Conservancy used the PRISM (Parameter-elevation Regressions on Independent Slopes Model) climate mapping system to characterize the climate across Tejon Ranch (PRISM 2012). Table 2-1 shows three climate variables (1971–2000 averages)—minimum temperature, maximum temperature and precipitation—for four locations on the Ranch: Comanche Point (800 ft msl), Old Headquarters (1,470 ft msl), top of Blue Ridge (6,600 ft msl), and the Antelope Valley (3,550 ft msl).

Table 2-1. Climate Characterization (1971–2000 Averages)

Site	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
Average Minimum Temperature (ºF)													
Comanche Point	40.5	44.4	47.3	51.0	57.9	64.3	70.1	68.9	65.0	56.7	46.0	39.8	54.3
Old Headquarters	37.2	40.1	43.5	47.3	54.2	61.4	66.7	65.6	61.2	53.0	42.7	36.7	50.9
Blue Ridge	32.1	32.4	33.0	36.1	42.8	50.3	56.2	57.0	53.5	44.6	37.9	32.2	42.3
Antelope Valley	33.1	34.9	36.6	41.0	48.3	56.4	62.1	61.1	55.3	46.0	37.3	33.0	45.4
Average Maximum Temperature (ºF)													
Comanche Point	58.2	64.9	69.0	77.2	85.2	94.0	99	97.5	92.2	82.0	67.3	58.2	78.7
Old Headquarters	58.4	63.2	67.0	74.0	82.4	91.1	96.5	95.2	90.0	80.4	66.7	58.3	77.0
Blue Ridge	48.0	49.3	52.7	58.2	68.0	77.1	83.6	82.2	77.2	67.3	55.9	48.2	64.0
Antelope Valley	53.8	56.8	60.0	69.6	77.4	86.8	95.4	94.7	89.3	77.6	61.4	53.9	73.1
Average Precipitation (Inches)													
Comanche Point	1.4	1.4	1.9	0.7	0.3	0.1	0.0	0.1	0.3	0.5	0.8	0.8	8.2
Old Headquarters	2.1	1.8	2.8	1.1	0.4	0.1	0.0	0.1	0.3	0.6	1.3	1.1	11.8
Blue Ridge	4.0	4.1	4.2	1.5	0.6	0.2	0.1	0.4	0.5	0.8	1.8	2.7	20.8
Antelope Valley	2.4	3.1	2.5	0.7	0.4	0.1	0.02	0.3	0.4	0.4	1.0	1.6	13.0
Source: PRISM 2012													

Seasonal temperature patterns at Tejon Ranch are typical of inland areas of California. Highest mean monthly temperatures occur from July to September and the coldest temperatures occur from December to February. Mean monthly minimum temperatures are well above freezing at locations below 1,500 ft on the San Joaquin Valley side of the Ranch, although freezing temperatures are recorded there periodically. In contrast, mean monthly minimum temperatures are near freezing from December to March at the top of Blue Ridge and during December and January in the Antelope Valley. Mean monthly maximum temperatures are highest on the San Joaquin Valley side of the Ranch, with average maximum temperatures exceeding 90ºF from June to September. In the Antelope Valley, average maximum temperatures only exceed 90 ºF in July and August, and the highest elevations of the Ranch never exceed an average maximum temperature of 85 ºF.

The rainy season at Tejon Ranch generally occurs between November and March, with more than 75% of average annual precipitation recorded during these 5 months at all four locations in Table 2-1. The Antelope Valley portion of the Ranch has high rainfall relative to the rest of the Mojave Desert ecological region because of the orographic effect of the Tehachapi Mountains and Transverse Ranges to the south and its relatively high elevation in the Tehachapi foothills.

Analysis of historical climate trends from 1918 to 2006 shows that significant increases of both maximum and minimum annual temperatures have occurred across most regions of California, and that this warming trend has accelerated during the last 36 years of the period (Cordero et al. 2011). Likewise, precipitation across much of the southwestern United States has been increasing, albeit at a lower rate than temperature, and in recent decades precipitation appears to be falling more as rain than snow (Regonda et al. 2005).

2.3.2 Climate Change

The effect of climate change on natural resources is a primary concern of conservationists and land managers, and a great deal of research has focused on documenting and projecting responses of natural systems to changing climates (e.g., Crimmins et al. 2011, Moritz et al. 2008, USEPA 2008, Kueppers et al. 2005, Walther et al. 2002). To project future climates, scientists must make assumptions concerning the trajectory of greenhouse gas concentrations in the atmosphere in the future and rely on a set of climate models that can vary in the specifics of their predictions. Due to the fact that these models provide projections that are uncertain, strategies for coping with climate change effects need to be adaptive and flexible. To provide a general picture of the anticipated change in climates at Tejon Ranch, the Conservancy used climate change information provided by the California Energy Commission's Cal-Adapt website (http://cal-adapt.org/), which summarizes climate research and climate change scenarios for California. The results of the various climate change scenarios are displayed on the Cal-Adapt website in grids of approximately 3,810 ft (12.5 kilometers [km]) on a°side.

For the climate change summary used in this RWMP, the Conservancy relied on two global climate models (general circulation models or GCMs)—the National Center for Atmospheric Research (NCAR) Parallel Climate Model (PCM) and the National Oceanographic and Atmospheric Administration (NOAA) Geophysical Fluid Dynamics Laboratory (GFDL) CM2.1 Model. The Conservancy also looked at two of Cal-Adapt's future emissions scenarios, a moderate to high future emissions scenario (A2) and a low future emissions scenario (B1), with the A2 scenario corresponding more closely to carbon emission trends over the last decade (Cayan et al. 2006). For a single grid cell located in the center of the Ranch encompassing a wide range of elevations, Table 2-2 summarizes the percent changes in annual precipitation, maximum annual temperature, and minimum annual temperature from 2000 to 2050.

While the scale at which these GCMs operate is far too large to capture the finer scaled topographic complexity of the Ranch and cannot accurately predict changes on Tejon Ranch, they are useful tools to evaluate the general patterns and magnitudes projected for the Region. Both models under both emissions scenarios forecast significant climate changes at Tejon Ranch. Minimum annual temperature is forecast to increase more than maximum annual temperature, rising by as much as 45% by 2050 (Table 2-2). As dramatic as the modeled changes in minimum annual temperature are, the forecasted changes in precipitation on the Ranch are just as dramatic, falling by as much as 43% by 2050.

Table 2-2. Summary of Potential Climate Change Effects at Tejon Ranch

Model	Emissions Scenario A2 (High)	Emissions Scenario B1 (Low)
Minimum Temperature (% change)		
GFDL	37%	19%
PCM	25%	45%
Maximum Temperature (% change)		
GFDL	8%	8%
PCM	5%	11%
Precipitation (% change)		
GFDL	-37%	-19%
PCM	-43%	-20%

Notes: Temperature and precipitation data were generated for the Cal-Adapt project (http://cal-adapt.org) by the Scripps Institution of Oceanography: California Nevada Applications Program (CNAP). See text for explanation of emissions scenarios.

Source: California Energy Commission 2011

Hall and colleagues (2012) downscaled 20 GCMs around Los Angeles County, including Tejon Ranch, to a 1.2-mile (2-km) region to model projected warming using a higher "business as usual" emissions scenario (RCP8.5) and a lower "mitigation" emissions scenario (RCP2.6). Hall and colleagues (2012) found that by mid-century (2041–2060), the region is projected to warm by approximately 4.6ºF under the "business as usual" scenario, and that inland areas separated from the coast by a mountain complex, such as Tejon Ranch, warm 20–50% more than coastal areas. Average projected warming was less in the mitigation scenario, but inland areas such as Tejon Ranch still exhibit significant warming and increases in days with extreme heat.

2.4 Fire Ecology and History

Fire is an important physical and ecological process, particularly in Mediterranean climates such as at Tejon Ranch. Many plant and animal species have evolved adaptations to deal with fire regimes particular to their specific habitats. When fire regimes deviate significantly from their historical ranges of variability, ecosystems and associated species can be adversely affected. Fire regimes can be characterized by their temporal attributes (seasonality and return interval), spatial attributes (size and patchiness), and magnitude (energy released, severity, and flame front pattern) (Sugihara et al. 2006).

Fire regimes can be altered by land management practices such as fire suppression, changes in vegetation composition or structure, or increasing frequency of anthropogenic ignition sources. Applebaum and colleagues (2010) analyzed fire perimeter data for Tejon Ranch for the period 1950–2008, dividing it into a historical period (1950–1979) and a recent period (1980–2008). Approximately 87% of the Ranch has not burned since 1950 (Figure 2-2a). However, the frequency and size of fires on the Ranch have been increasing since 1980 relative to the historical fire regime, whereas the average size of fires in the immediate vicinity of the Ranch has fallen over the same time frame (Applebaum et al. 2010, Baumgarten et al. 2012). On Tejon Ranch, fires are most frequent along public highways (Figure 2-2b), presumably due to increased human-caused ignitions and vehicles (Baumgarten et al. 2012). Approximately 70% of fires on Tejon Ranch occur in June and July and more than 90% of fires occur from June through September (Applebaum et al. 2010).

Fire return interval is the length of time between fires in a given landscape (Sugihara et al. 2006). Specific ecosystems or natural communities have characteristic ranges of variability of fire return intervals, and extreme departures from the range of variability before European settlement. Pre-European settlement range of variability for a given natural community can result in shifts in its species composition and structure. At Tejon Ranch, departures are estimated by comparing the number of fires over the last 130 years (1878 is the oldest fire in the record) to the estimated pre-settlement fire return interval. Baumgarten et al. (2012) summarized the departures from historical fire return intervals for natural communities at Tejon Ranch, although there is substantial variation in the estimated fire return intervals for many natural communities. In general, much of the Ranch exhibits moderate to extreme lengthening of historical fire return intervals, which can adversely affect natural communities that evolved under more frequent fire return intervals. This is particularly true for much of the grassland on both the San Joaquin Valley and Antelope Valley sides of the Ranch, which have historically had a median fire return interval of 3 years and a maximum of 8 years as a result of Native American burning practices (Baumgarten et al. 2012, Stephens et al. 2007). However, Native American burning practices were likely less common in interior portions of California (Stephens et al. 2007), and some pre-contact grassland types (e.g., Antelope Valley grasslands and forb-dominated San Joaquin Valley grasslands) may not have supported adequate fuels to burn this frequently (e.g., fire return intervals have been estimated at more than 300 years at Carrizo Plain National Monument [BLM 2010]). Oak woodlands typically exhibit moderate departures from historical fire return intervals, which are thought to vary from 7 to 45 years depending on the specific type of oak community. White fir–dominated conifer forests, which are characteristic of Tejon Ranch, are considered to have a fire return interval of 9–50 years. Conifer forests at Tejon Ranch exhibit moderate departures from historical fire return intervals. Chaparral has a fire return interval ranging from a median of 60 years to more than 90 years. Between 1987 and 1990, TRC implemented four prescribed fires of about 13,000 acres (Figure 2-2), much of that in areas of chaparral (Applebaum et al. 2010).

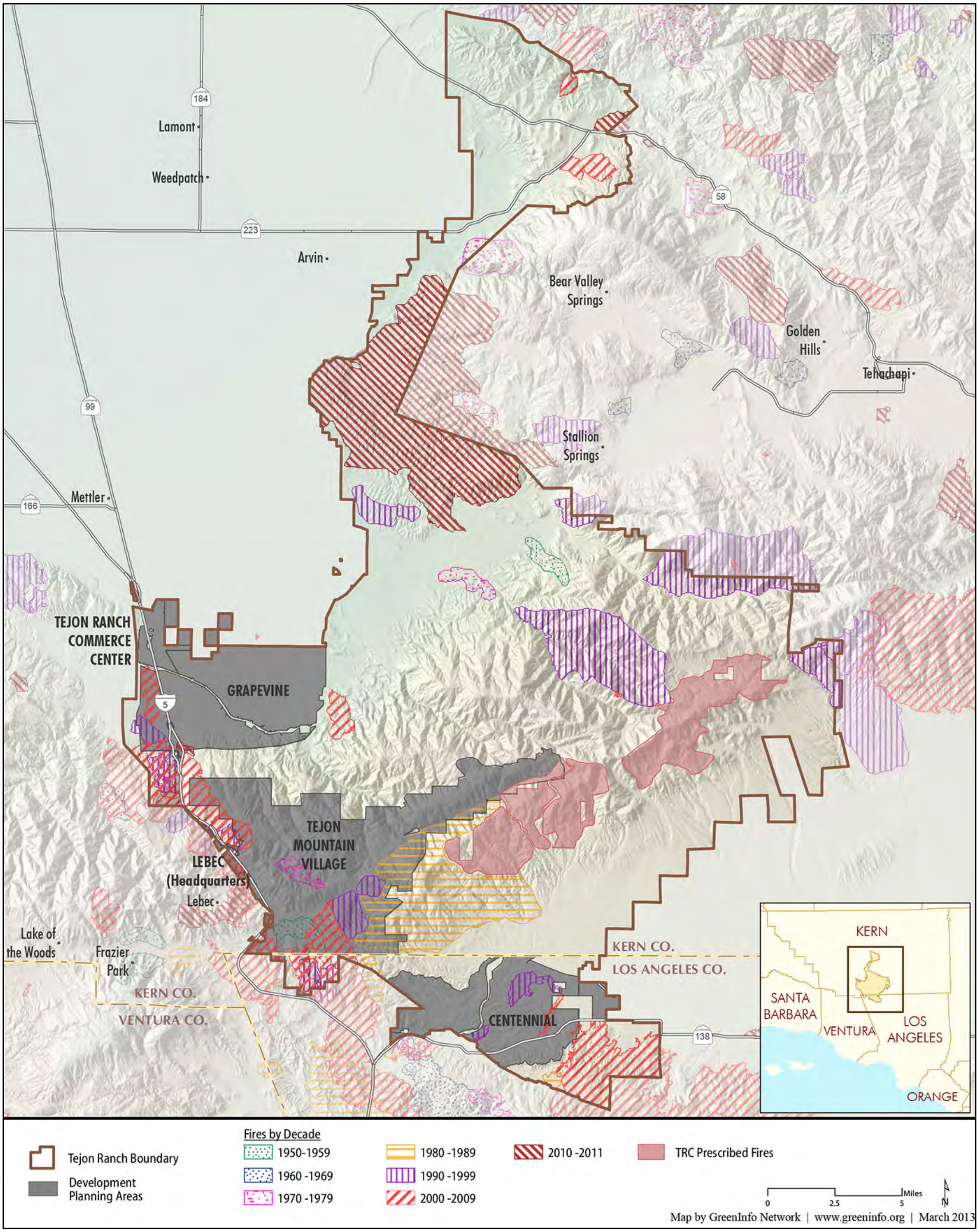


Figure 2-2a. Fire History at Tejon Ranch: Fire History by Decade

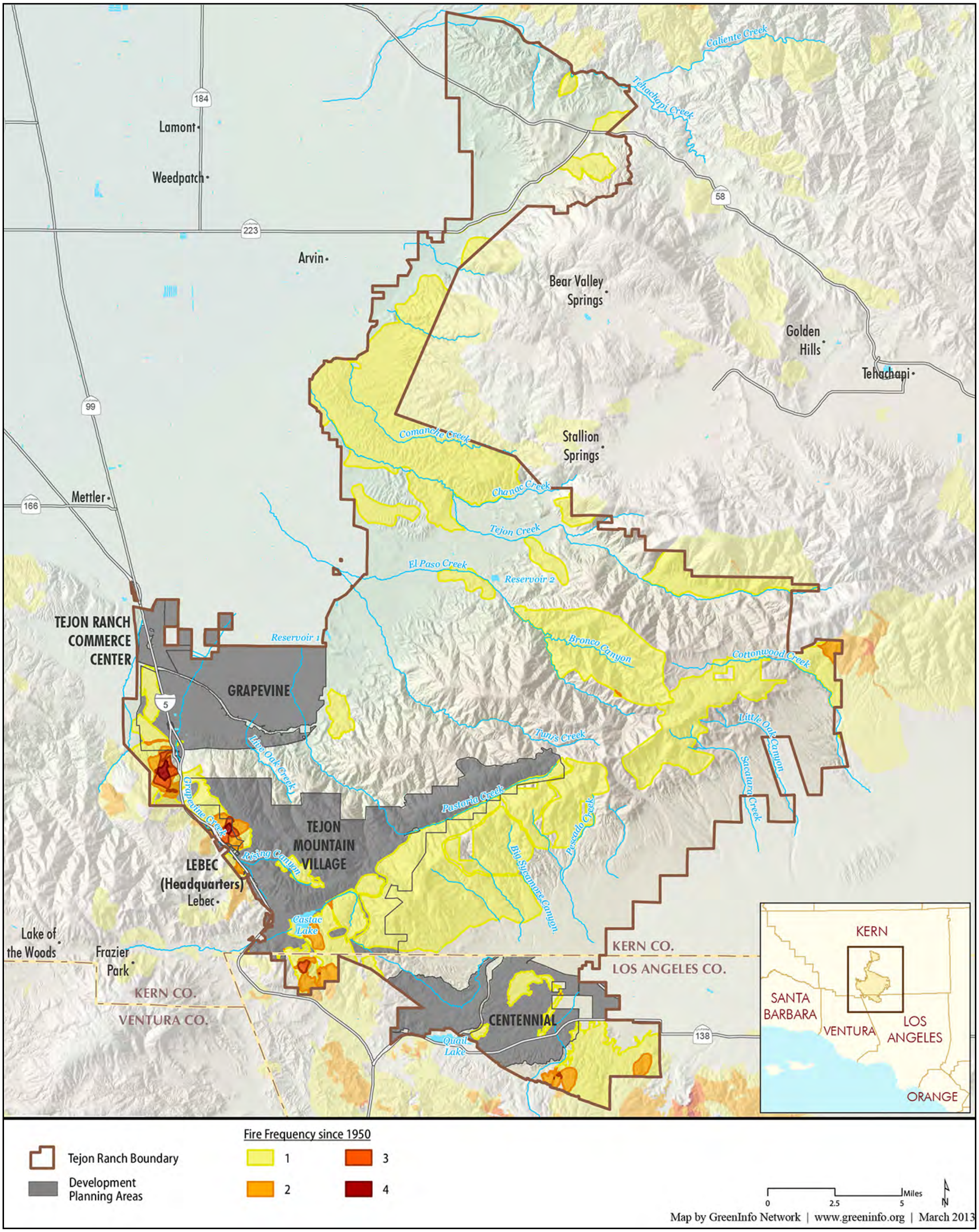


Figure 2-2b. Fire History at Tejon Ranch: Fire Frequency since 1950

2.5 HYDROLOGIC RESOURCES

An important characteristic of Tejon Ranch is the prevalence of water associated with the high number of watersheds and springs on the Ranch (Figure 2-3). Riparian and wetland vegetation communities support a high diversity of biological resources in relation to their area (NRC 2002), and perennial water is an important resource for wildlife in this arid part of California. Because the Ranch straddles the crest of the Tehachapi Mountains, it encompasses watersheds draining both the San Joaquin Valley and the Antelope Valley. Stream diversions are used by TRC in the lower reaches of several streams (discussed further below). The watersheds on the Ranch have relatively high integrity, with the only human-induced land cover changes being ranch roads and a few structures; thus, relatively natural hydrologic regimes are still present above the diversion points. However, feral pigs and livestock appear to be causing damage (e.g., removal of vegetation, churning of soil) to stream courses and adjacent upland areas, and are likely altering the cover of vegetation on slopes within watersheds on the Ranch. These changes to vegetation cover, in turn, can alter rates of sedimentation, water infiltration, and runoff.

At the base of the granitic basement rock of the Tehachapis are deep layers of sediments that have been eroded from the mountains and deposited in the adjacent valleys. Groundwater formed via the infiltration of rain, and snowmelt travels down-slope and accumulates in these alluvial groundwater basins. The faulting prevalent in the region produces fractures through which groundwater moves to the surface rather than continuing down-gradient, expressing as springs or seeps of water. The dynamics of groundwater on Tejon Ranch are not well understood, but many areas support features such as wet meadows, seeps, and springs associated with high water tables. These features are particularly evident on the desert side of the Ranch where, they can support surface water and wetlands within annual grasslands.

2.5.1 WATERSHEDS AND SURFACE WATER RESOURCES

Tejon Ranch supports all or portions of 20 watersheds (Table 2-3), some of which (for the purposes of this discussion) represent groupings of smaller watersheds. Approximately 70% of the Ranch drains to the San Joaquin Valley and 30% to the Antelope Valley. The largest watersheds on the Ranch (e.g., Tejon Creek, El Paso Creek, Tunis Creek, Pastoria Creek) support perennially flowing streams that drain to the San Joaquin Valley. Three of these streams (Tejon, El Paso, and Tunis) have water diversion structures in their lower reaches that divert water for agricultural use on the Ranch (Figure 2-3). Other streams (e.g., Los Alamos, Bronco, and Cottonwood) have perennial flow in isolated reaches but otherwise have ephemeral or intermittent flow regimes. Average stream gradients range from around 1% to more than 6%, with the smaller desert-draining streams often having higher gradients than the larger San Joaquin watersheds.

Little quantitative information is available on the water resources of the Ranch. Average discharge for the streams on Tejon Ranch has not been estimated, and water quality has not been measured. Given the land uses on the Ranch, suspended solids and bacteria are likely to be the only water quality constituents of potential concern. Anecdotally, some areas of hillslope erosion are apparent in several watersheds and large deposits of fine sediments can be observed in many stream reaches. The Tehachapi Mountains are rapidly uplifting, and mass wasting and sediment generation are likely to be important ongoing physical processes on the Ranch. In addition, livestock and other wildlife species (in particular, the large number of feral pigs on the Ranch) likely increase sediment transport above background levels by removing vegetation and disturbing soils, and are also potential sources of bacteria and other pathogens in surface waters.

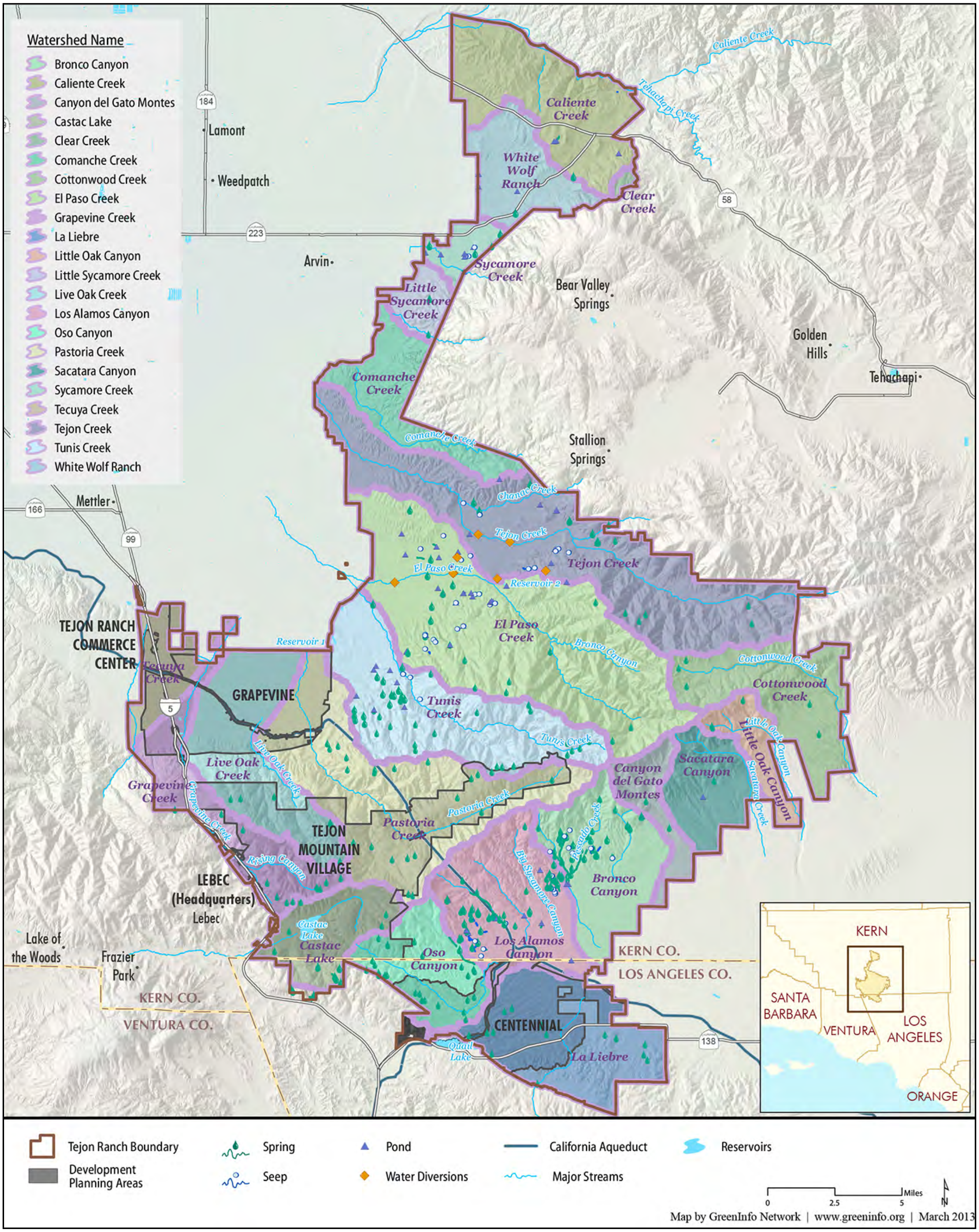


Figure 2-3. Tejon Ranch Watersheds, Showing Major Streams, Springs, Lakes, Reservoirs, and Stream Diversion Points

Table 2-3. Characteristics of Watersheds on Tejon Ranch			
Watershed	**Acreage on Tejon Ranch**	**Watershed Entirely on Tejon Ranch?**	**Comments**
Caliente Creek	15,669	No	Large watershed mostly off of the Ranch with perennial reaches
White Wolf Ranch	8,179	Largely	A small watershed with ephemeral flow
Sycamore Creek	2,650	No	Intermittently creek flows through the Granite Mining Designated Use Area
Little Sycamore Creek	3,024	No	Small watershed with ephemeral flow
Comanche Creek	9,083	No	Ephemeral flow in its upper reaches but perennial in its spring-fed lowest reach; spring water has high dissolved solids (salts)
Tejon Creek	32,081	No	Includes the Chanac Creek watershed draining the Cummings Valley to the east; perennial flow except in lower alluvial valleys
El Paso Creek	37,153	Yes	Largest watershed on the Ranch. Perennial flow
Tunis Creek	19,909	Yes	Perennial flow in some reaches
Pastoria Creek	26,918	Yes	Intermittent stream flow with some perennial reaches but wet meadows in areas indicative of high groundwater
Live Oak Creek	15,198	Yes	Small watershed with ephemeral or intermittent flow
Tecuya Creek	5,362	No	Lower, ephemerally flowing stream reach crosses the Ranch
Grapevine Creek	11,183	No	Can include runoff from Castac Lake in high water years
Castac Lake	7,946	No	Large watershed mostly off the Ranch
Oso Canyon	9,106	Largely	Small, ephemerally flowing watershed with wet meadows in areas with higher groundwater
Los Alamos Creek	15,237	Yes	Aggregation of several small canyons; probably intermittent flow with perennial reaches
Bronco Canyon	13,169	Yes	Includes Pescado Creek; perennial flow or surface saturation from spring flow in many reaches
Canyon del Gato Montes	4,493	Yes	No obvious stream channel in this watershed
Sacatara Canyon	7,578	Yes	Aggregation of several small canyons; wet meadows and spring flow in most canyons
Little Oak Canyon	4,345	Yes	Small watershed with ephemeral or intermittent flow
Cottonwood Creek	12,791	No	Perennially flowing in much of the upper watershed with adjacent wet meadows in headwaters
La Liebre	16,121	Largely	Rolling terrain with numerous canyons and small draws with ephemeral flow
Source: Tejon Ranch Conservancy unpublished observations			

2.5.2 Groundwater Resources

As with surface waters on the Ranch, little quantitative information is available on the Ranch's groundwater resources. Stream flow, rain, and melting snow infiltrate into alluvial sediments in the San Joaquin Valley or Antelope Valley groundwater basins. Groundwater in the San Joaquin Valley is typically flowing away from recharge areas in the mountains and foothills into the adjacent alluvial valleys (Faunt 2009). Groundwater flow in the Antelope Valley functions similarly, moving away from the Tehachapi and San Gabriel mountains towards Rosamond and Rodgers dry lakes (Lahontan Regional Water Quality Control Board 2004).

Groundwater in the southern San Joaquin Valley generally lies between 150 and 500 ft below ground surface (Faunt 2009). The groundwater elevations in the western Antelope Valley are between 100 and 300 ft below ground surface, and groundwater elevations rose between 1975 and 1998 (Carlson and Phillips 1998). However, groundwater moves to the surface via springs and seeps in many areas on the Ranch (Figure 2-3). High groundwater elevations are particularly evident in fault zones, such as the Springs, Garlock, and San Andreas faults, where willows, cottonwoods, and other wetland and riparian vegetation are present.

2.6 Landscape Connectivity

The northeast-southwest–trending Tehachapi Mountain Range is the spine of regional landscape linkage between the Coast and Transverse Ranges to the west and the Sierra Nevada to the east, and it includes a full elevational range from the valley floors to mountain tops (White and Penrod 2012). Tejon Ranch's location at the center of this regionally significant linkage contributes immeasurably to its conservation significance. This linkage includes the last grassland corridor around agricultural lands in the southern San Joaquin Valley; oak and pinyon-juniper woodlands that connect to the west and east slopes of the Sierra Nevada, respectively; and "sky islands" of conifer habitat connecting the more extensive conifer forests in the adjacent Transverse Range and Sierra Nevada.

Significant public and private conservation investments have been made in this Tehachapi linkage, including the Los Padres, Angeles, and Sequoia National Forests, the Wildlands Conservancy's Wind Wolves Preserve, Bitter Creek National Wildlife Refuge, Carrizo Plain National Monument, and other lands administered by the U.S. Bureau of Land Management, as well as private lands protected from development via current use tax incentives (Williamson Act) and conservation easements. The Conserved Lands on Tejon Ranch represent a major contribution toward securing this linkage and have created leverage for additional conservation to complete this statewide conservation priority.

A regional linkage design for the Tehachapi region (Figure 2-4) was developed by the South Coast Wildlands Project using expert-based habitat suitability and least cost path models for 34 focal plant and animal species (Penrod et al. 2003). The linkage design provides connectivity functions through three major life zones:

- San Joaquin Valley floor and northern Tehachapi Mountain foothills serving connectivity needs for San Joaquin Valley grassland and shrubland species such as San Joaquin kit fox (*Vulpes macrotis mutica*), blunt-nosed leopard lizard (*Gambelia sila*), burrowing owl (*Athene cunicularia*), Tejon poppy (*Eschscholzia lemmonii* ssp. *kernensis*) and Bakersfield cactus (*Opuntia basilaris* var. *treleasei*)

- Tehachapi Mountains providing connectivity for chaparral, oak woodland, and conifer species such as mountain lion (*Puma concolor*), mule deer (*Odocoileus hemionus*), California spotted owl (*Strix occidentalis occidentalis*), acorn woodpecker (*Melanerpes formicivorus*), and hardwood and conifer tree species

- Southern Tehachapi Mountains foothills and Antelope Valley floor providing connectivity for Mojave Desert shrubland and grassland species such as Tehachapi pocket mouse (*Perognathus alticolus inexpectatus*) and badger (*Taxidea taxus*)

Tejon Ranch lies at the heart of this regional linkage and supports connectivity functions for all of the major life zones remaining in this linkage. Thus, landscape connectivity functions are a significant Conservation Value for the Conserved Lands at Tejon Ranch. Other than the camera studies conducted by Tejon Ranch regarding movement of species across Interstate 5 (I-5) (Dudek 2012), little additional empirical data exists on the movement of species through this landscape or the implications of potential barriers to movement of some species (e.g., I-5, State Highways 223 and 58).

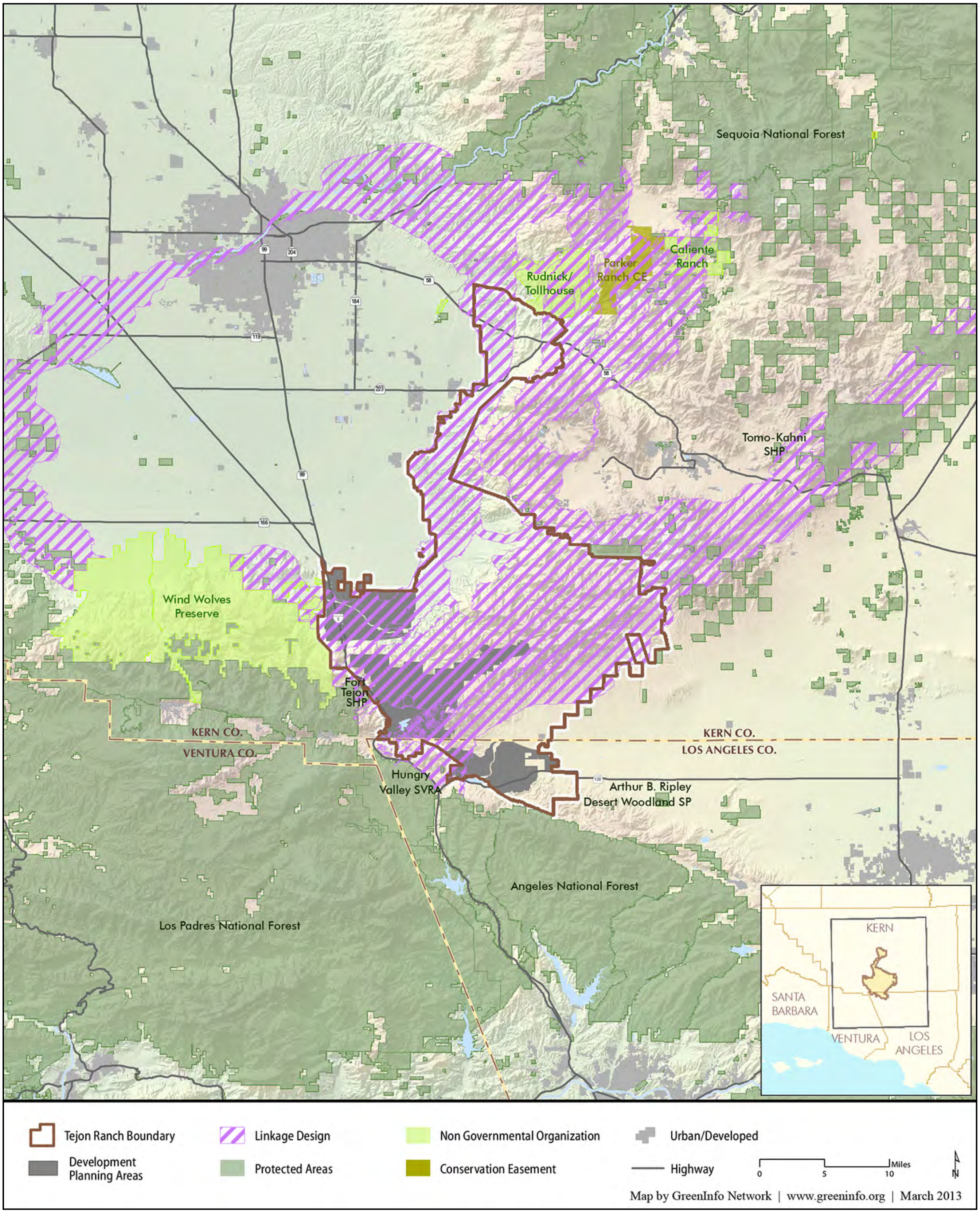
The Tehachapis also sit in the middle of an important but poorly understood north-south migratory corridor for birds and bats. Canyons on the San Joaquin Valley side of the Ranch are used extensively by fall migrants heading south to their wintering grounds. Large kettles of Swainson's hawks, white pelicans, snow and white-fronted geese, white-faced ibis, waterfowl, swifts, swallows, and various songbirds ride wind currents up these canyons and over the Tehachapis on their way south. In the spring, large numbers of songbirds and shorebirds have been observed dropping into the canyons and waterholes on the Antelope Valley side of the Ranch some of the first water and cover available after their migration over the Mojave Desert. Thus, the Conserved Lands on Tejon Ranch provide an important and unobstructed route for migratory species that are increasingly threatened with land use changes that are degrading their migratory corridors.

2.7 Historical Land Uses

The earliest human presence in the region dates to 11,500–9000 years before present (YBP). The earliest known substantial human occupation of Tejon Ranch dates to about 4000 YBP, and the Ranch is considered to have been continuously occupied since then (W&S Consultants 2004). At least four, and possibly five, tribal groups occupied portions of the Ranch during the last few hundred years. From south to north, these were:

- Takic-speaking Tataviam, in the Antelope Valley area;
- Takic-speaking Kitanemuk, in the central and eastern Tehachapis, extending down to the edge of the San Joaquin Valley floor;
- The Hokan-speaking Chumash, from Castac Lake to the western edge of the Ranch, and also down to the San Joaquin Valley floor;
- The Penutian-speaking Yauelmani (southern Valley) Yokuts, on the San Joaquin Valley floor proper; and
- Probably the Numic-speaking Kawaiisu, on the northeastern margin of the Ranch toward the town of Tehachapi.

In 1772, Capitan Pedro Fages led the first Spanish expedition into the San Joaquin Valley following the Grapevine Canyon route over the Tehachapis (Crowe 1957). Spanish missionary Father Francisco Garcés was the first European to cross into the San Joaquin Valley via the Cottonwood Creek/Tejon Canyon pass, where he encountered the large Kitanemuk village at the mouth of what is now known as Tejon Canyon. In 1806, Father José María Zalvidea, diarist for the Lieutenant Francisco Ruiz expedition from Santa Barbara into the San Joaquin Valley, named Tejon Canyon after a dead badger (called a *tejón* in Spanish) that he found in the canyon (Scott 2002). Circa 1800, the Tehachapi Mountains region became a multi-tribal refuge for people escaping from the Spanish missions, which were generally established along coastal areas of California. This included especially Chumash and Fernandeño/Gabrielino/Tongva.



Source: Penrod et al. 2003

Figure 2-4. South Coast Wildlands Project Regional Linkage

Following the Mexican War of Independence from Spain in 1821, what is now the state of California became part of Mexico. Between 1843 and 1846, Mexican Governors of the Californias, made four land grants (*Rancho El Tejón*, *Rancho Castac*, *Rancho Los Alamos y Agua Caliente*, and *Rancho La Liebre*) in the Tehachapi region to Mexican citizens. These four land grants would ultimately form the property boundaries of Tejon Ranch. In 1848, Mexican *Alta California* became part of the United States.

In 1853, the first Indian reserve in the United States was identified on what is now Tejon Ranch under the supervision of General Edward Fitzgerald Beale. People from diverse tribes were forcibly relocated to the Sebastian Indian Reserve, where they lived in a series of *rancherias* along the southern edge of the San Joaquin Valley. The total population on the reservation was estimated at about 1,000 people (Whitely unpublished report) and lived by hunting, gathering, and farming along stream terraces. The Sebastian Reservation was disbanded in 1864. In 2012, the Tejon Tribe's federal recognition was reconfirmed by the U.S. Department of Interior. Fort Tejon was established at its current location in Grapevine Canyon in 1854, immediately adjacent to the Tejon Ranch boundary.

Between 1855 and 1865, General Beale purchased the four Mexican land grants and eventually acquired additional public land to form the Tejon Ranchos, then encompassing about 300,000 acres. During Edward Beale's ownership of Tejon Ranch, the focus was on use of the property for sheep grazing. At one point, as many as 125,000 head of sheep were run on the Ranch (Crowe 1957). In 1880, Beale began to transition the ranching operation from sheep to cattle. In the 1890s, irrigated agriculture of oranges, figs, and vineyards was initiated on Tejon Ranch in the vicinity of the old Headquarters, which continued to expand during the early 20th century. Following the death of Edward Beale in 1893, ownership of Tejon Ranch was transferred to his son Truxton Beale. Truxton Beale sold the Ranch to a group of investors led by Harry Chandler (the eventual publisher of the *Los Angeles Times*) and Moses Sherman (developer of Sherman Oaks, California) in 1912. Harry Chandler incorporated the Tejon Ranch Company in 1936, and shares of TRC stock were first sold to the public.

2.8 HUMAN USE AREAS

Intensive human uses on Tejon Ranch are remarkably limited in scope given the long, rich history of the Ranch. In the Ranch-wide Agreement, the human use areas are categorized as Disturbance Areas, Hunting Cabins, or Designated Use Areas. Additional human infrastructure can be classified as either infrastructure that is necessary for the exercise of the Ranch Uses (particularly ranching and hunting) or regional infrastructure that crosses the Ranch. The sites of various old homesteads, such as Madson Cabin, Quinn Place, Knight Place, and Basque Encino, are distributed across Tejon Ranch and do not fit into any of these categories. Most of these sites have no structures still standing, but historical land uses associated with these homesteads would have had an unknown influence on the natural resources in their immediate vicinity. BMPs for Disturbance Areas and Designated Use Areas are presented in Volume 2 of the RWMP. In addition, numerous inholdings (few with structures) are scattered across the Ranch (shown without color in Figure 1-4) that are not part of the Conserved Lands. The 2,439-acre National Cement lease area, the site of a limestone quarry and cement plant under lease until 2066, and the 500-acre Bakersfield National Cemetery (Figure 1-3) are also excluded from Conserved Lands.

2.8.1 DISTURBANCE AREAS

Figure 1-5 illustrates the Disturbance Areas. These areas are subject to a "meet and confer" standard under the Ranch-wide Agreement concerning the enlargement, construction, and relocation of new and existing structures. The following Disturbance Areas are identified in the Ranch-wide Agreement:

- Disturbance Areas in the White Wolf Acquisition Area include the residential areas, with houses and outbuildings, south of Bena Road.

- Disturbance Areas in the Old Headquarters Acquisition Area include the residential areas along Sebastian Road, with numerous sheds and outbuildings; the Old Headquarters neighborhood area, with the picnic area and outbuildings; structures associated with Oil and Gas operations, the Vaquero hunting camp, and three residences near the Laval Farms and shop in the Lower Citrus farming area.
- Disturbance Areas in the TMV-A Dedicated Easement Area (i.e., the Condor Study Area) include three historical ranching homesteads: the McKenzie home site along the Haul Road, the Winter's homestead on a low flank of Winter's Ridge, and the Sandberg Cabin along upper El Paso Creek.
- Disturbance Areas within the Tejon Canyon area include the Native American schoolhouse and cemetery in the Old Headquarters Acquisition Area and the Area 5 hunting cabin farther up the canyon.
- The Grapevine Pump Station Facilities for Exxon-Mobil is located near the Grapevine development area.
- The site of the former Cluff homestead is in Canyon del Gato Montes.
- Disturbance Areas in the Bi-Centennial Acquisition Area consist of a historical shack known as either the Tin Miners Shed or the Mexican Camp, as well as an old mine site.
- The Beale Adobe, which serves as the headquarters for the High Desert Hunt Club, is located south of State Route 138.

2.8.2 Designated Use Areas

Under the Ranch-wide Agreement, the three Designated Uses of Farming, Mining, and Oil and Gas (Figure 1-4) were specifically called out as land uses that would be subject to a Management Standard specific to that use. Further descriptions of these uses, as well as the Management Standards and specific BMPs applicable thereto, are detailed in Volume 2. The Designated Farm Area has about 1,800 acres in current production and about 1,000 acres set aside for future use. This acreage is split between approximately 2,095 acres in Old Headquarters and approximately 705 acres in the Centennial-A Dedicated Easement Area. The Designated Oil and Gas Area is entirely in the San Joaquin Valley portion of the Ranch and consists of approximately 15,400 acres. The Designated Mining Area consists of three distinct areas: the existing 277-acre Granite Construction mine; a "floating envelope" of 800 acres for future mining development in the White Wolf area of the Ranch; and the 198-acre La Liebre mine in the Bi-Centennial Acquisition Area. Only the La Liebre mine is located within the TU MSHCP Covered Lands.

2.8.3 Hunting Cabins

The Ranch-wide Agreement specifies that TRC owns and maintains nine Hunting Cabins on Tejon Ranch. Any one of these may be moved with the consent of the Conservancy. Two of the cabins may be enlarged. The RWMP applies to any cabin relocation or expansion activities. One Hunting Cabin is located in the Old Headquarters Acquisition Area. Hunting Cabins are referred to as Backcountry Cabins in the TU MSHCP. Eight of the Hunting/Back Country Cabins are located in the TU MSHCP Covered Lands.

2.8.4 Regional Infrastructure

The most significant features of regional infrastructure crossing Tejon Ranch are the four major transportation corridors (Figure 1-4): Interstate 5 is an eight-lane freeway that cuts through the Ranch for 16 miles along its western boundary, State Highway 138 crosses the southern portion of the Ranch for 5 miles, and State Highway 223 runs northeast–southwest near White Wolf for 6.5 miles and then joins at its north end with State Highway 58, which runs east–west through White Wolf for 7 miles.

In addition to these significant roadways, Tejon Ranch is traversed by a variety of utility corridors (Figure 1-4). These include the California Department of Water Resources Aqueduct, which travels more than 30 miles of the Ranch; 500-kilovolt (kV) power lines owned by Southern California Edison that run 25 miles through the Ranch, crossing through Tejon Canyon to the Antelope Valley; 230-kV power lines, also owned by Southern California Edison, that travel 30 miles across the Ranch; and a Southern California Gas Company gas line that travels underground through 15 miles of the Ranch. Many of these regional utilities are located in the TU MSHCP Covered Lands and cross Acquisition Areas.

2.9 WILDLIFE MANAGEMENT

Wildlife in the Tehachapi region has been managed and harvested since humans have occupied the landscape. Tejon Ranch was created from four Mexican land grants purchased by General Edward Fitzgerald Beale in the 1860s, and before 1950 hunting on the Ranch was a private, unstructured activity. The commercial wildlife management operation was first developed on Tejon Ranch in the 1950s. TRC's current Wildlife Management operation developed in the 1980s, with the enrollment of Tejon Ranch in the California Department of Fish and Wildlife's (formerly known as the California Department of Fish and Game) Private Lands Wildlife Enhancement and Management Area (PLM) Program (Tejon Ranch Company 2009). Tejon Ranch is the largest property enrolled in the PLM Program.

The intent of the State's PLM Program is to protect and improve wildlife habitat by encouraging landholders to manage their property for the benefit of fish and wildlife (California Department of Fish and Game 2008). The program offers landholders incentives, including flexible seasons, to permit wildlife hunting for recreational purposes on their property. Landholders may collect fees for access to hunting opportunities. In return for the opportunity to generate revenue from recreational hunting, the landholder must prepare a wildlife management plan and complete specific wildlife habitat improvements on the PLM property. The PLM wildlife management plan is revised, subject to California Fish and Game Commission approval, every 5 years. Tejon Ranch provides an education program for all hunters to ensure that they are following the rules of the Ranch and State and Federal laws concerning wildlife harvest. In particular, TRC has instituted a lead ban, prohibiting use of lead ammunition for hunting or depredation activities. TRC has also implemented numerous wildlife enhancement projects on the Ranch as part of the PLM Program, such as enhancing cover and improving water distribution.

Regulations and policies regarding the management and use of fish and wildlife in California are established by the California Fish and Game Commission, and the California Department of Fish and Wildlife is charged with implementing these policies and regulations. Management regulations and intensity vary among classes of wildlife. Due to their imperiled status, threatened and endangered species have more intensive management and associated regulations than large game and waterfowl, which in turn are managed more closely than upland and small game because the latter are considered more resilient to harvest. Management of nongame species varies depending on their conservation status. These species range from nuisance species (harvest possibly allowed, depending on species) to sensitive species for which no harvest is allowed and for which work is often done to promote the population status. TRC's wildlife management can be more restrictive than state regulations, although population management objectives for harvested species are not explicit. For example, TRC has suspended harvest of American badgers on the Ranch beginning in 2013 and encourages selective harvesting of legally harvestable mule deer to improve the condition of the herd as part of the Tejon Ranch Quality Deer Management (QDM) program. In 2013, TRC is selling access or guided hunting experiences for hunting of mule deer, Rocky Mountain elk (*Cervus canadensis* ssp. *nelsoni*), wild turkey (*Meleagris gallopavo*), upland game birds (e.g., California quail [*Callipepla californica*], mourning dove [*Zenaida macroura*], and band-tailed pigeon [*Columbia fasciata*]), and feral pig (*Sus scrofa*). Once access to Tejon Ranch has been purchased by a hunter, other species legally harvestable in California (such as coyote, bobcat, and ground squirrel) can be taken with appropriate tags or permits where necessary, unless specifically prohibited by TRC. Additional information on the Tejon Ranch Wildlife Management Program and focal wildlife species is summarized by Kunkel (2013). Hunting will continue throughout the Ranch, but it is not a Covered Activity under the TU MSHCP. Wildlife Management BMPs are found in RWMP Volume 2.

2.9.1 California Condor

It is worth acknowledging the long history of involvement by TRC in California condor management and recovery efforts on the Ranch. California condor is listed as Endangered by the USFWS and as Endangered and Fully Protected by the State of California. Condor critical habitat was designated by the USFWS in 1976 and includes portions of Tejon Ranch. California condors use Tejon Ranch for foraging and roosting, but no nesting occurs, or has historically occurred, on the Ranch. The California condor population showed a steady decline until 1987, when all individuals were removed from the wild and placed in a captive breeding program (Dudek 2012). Before that time, TRC cooperated with the National Audubon Society and USFWS as far back as the 1960s to conduct condor censuses and to locate and rescue injured condors on the Ranch. Condor feeding stations were established by the USFWS in the Winter's Ridge and Tunis Ridge areas, and condors currently forage extensively on carcasses and gut piles generated by the Tejon Ranch Wildlife Management Program. A major concern for California condor recovery is the presence of lead in food items, and TRC banned the use of lead ammunition on Tejon Ranch prior to enactment of the Ridley-Tree Condor Conservation Act (which banned the use of lead center fire rifle and pistol ammunition in the range of condor in California) in 2007. TRC is committed to California condor conservation and recovery efforts, in cooperation with the USFWS and the California Department of Fish and Wildlife (collectively referred to as the Resource Agencies), as part of the regulatory approvals for the TU MSCHP (Dudek 2012) for the TMV development project. The conservation measures in the TU MSHCP will guide California condor recovery efforts on Tejon Ranch, and the Conservancy will continue to collaborate with TRC and the Resource Agencies on these efforts as appropriate. Condor BMPs are presented in RWMP Volume 2.

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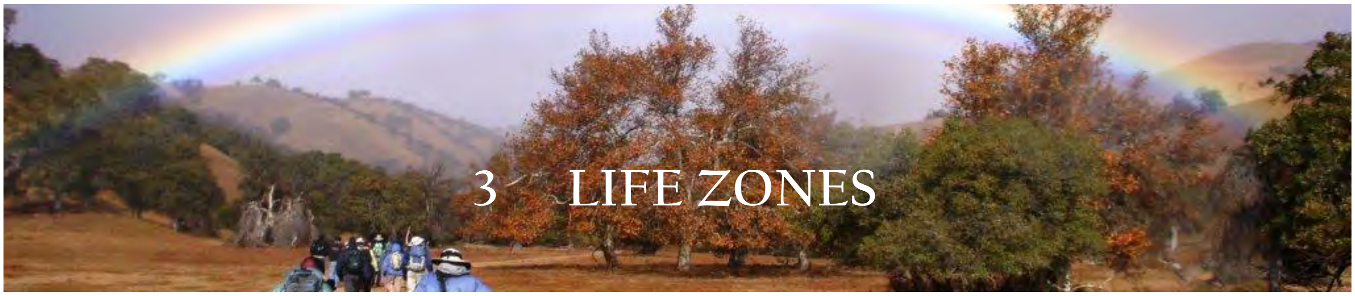


3 LIFE ZONES

This section of the RWMP provides a description of the natural resources within the Conserved Lands of Tejon Ranch, organized into five general life zones: the San Joaquin Valley, Antelope Valley, Northern Tehachapi Mountains Foothills, Southern Tehachapi Mountains Foothills, and Montane. Life zones support similar plant and animal communities that can occur within broader ecological regions. The boundaries of these life zones are loosely defined, driven by the interplay of factors such as elevation, slope, and aspect. Therefore, life zones have not been mapped but rather are used as a means of organizing information on important ecological characteristics, such as major vegetation types (Figure 3-1) and processes. The description of each life zone contains the following elements:

- a literature review focusing on what is known about the biological structure, functions, and processes characteristic of the dominant ecological systems;
- a description of the current understanding of conditions in these ecological systems on Tejon Ranch;
- a literature review of desired conditions for conservation targets at Tejon Ranch and potential management approaches that have been employed in other locations to achieve desired conditions (proposed Conservation Activities and BMPs for Tejon Ranch are presented in Volume 2); and
- simplified conceptual models that lay out the Conservancy's assumptions and hypotheses for managing these systems.

It is important to recognize that all life zones on Tejon Ranch have been affected to varying degrees by changing climates and human activities since the end of the last ice age, and we are unlikely to be able to fully understand the myriad effects that these factors have wrought over this region. Thus, establishing the reference condition of these systems for management purposes would require picking a specific time frame as the reference. For example, rainfall in California was much higher 4,000–6,000 years ago, supporting a more mesic flora (Wigand et al. 2007). Native Americans often burned specific vegetation communities on a regular basis to manage resources since their arrival in California at least 12,000 YBP (Anderson 2006). With the arrival of European settlers, fire regimes changed, and they changed again with the implementation of modern–era fire suppression efforts.

Native American village sites and later home sites of settlers were scattered across Tejon Ranch, and the nature, extent, and effects of human uses in these areas is unclear. Livestock grazing has been a significant human land use throughout much of the region in the last 170 years and is likely responsible for many undocumented changes in the composition and structure of a variety of ecological systems. As is discussed further below, a wide variety of nonnative plant and animals species have become established in the region, and in some cases have become ubiquitous members of biological communities.

In addition, two top carnivores, the grey wolf (*Canis lupus*) and grizzly bear (*Ursus arctos horribilis*), were eradicated from the region in the 1800s, and two prominent herbivores, the pronghorn and tule elk (*Cervus canadensis* ssp. *nannodes*), were extirpated from the San Joaquin Valley portion of Tejon Ranch in about the same period. The consequences of these extirpations were likely far reaching. For example, grey wolves can be important predators of coyotes, and coyote populations have likely increased as a result of reduced predation pressure following the extirpation of wolves. Similarly, grizzly bears were formerly abundant in the region, and their elimination has allowed black bears to successfully invade lower elevation habitats they previously did not occupy in great numbers. Large herds of pronghorn and tule elk once grazed San Joaquin grasslands, shaping the composition and structure of these vegetation communities. Most recently, feral pigs have become firmly established in the Tehachapis and, as is discussed below, are likely responsible for a wide range of adverse effects in virtually all life zones.

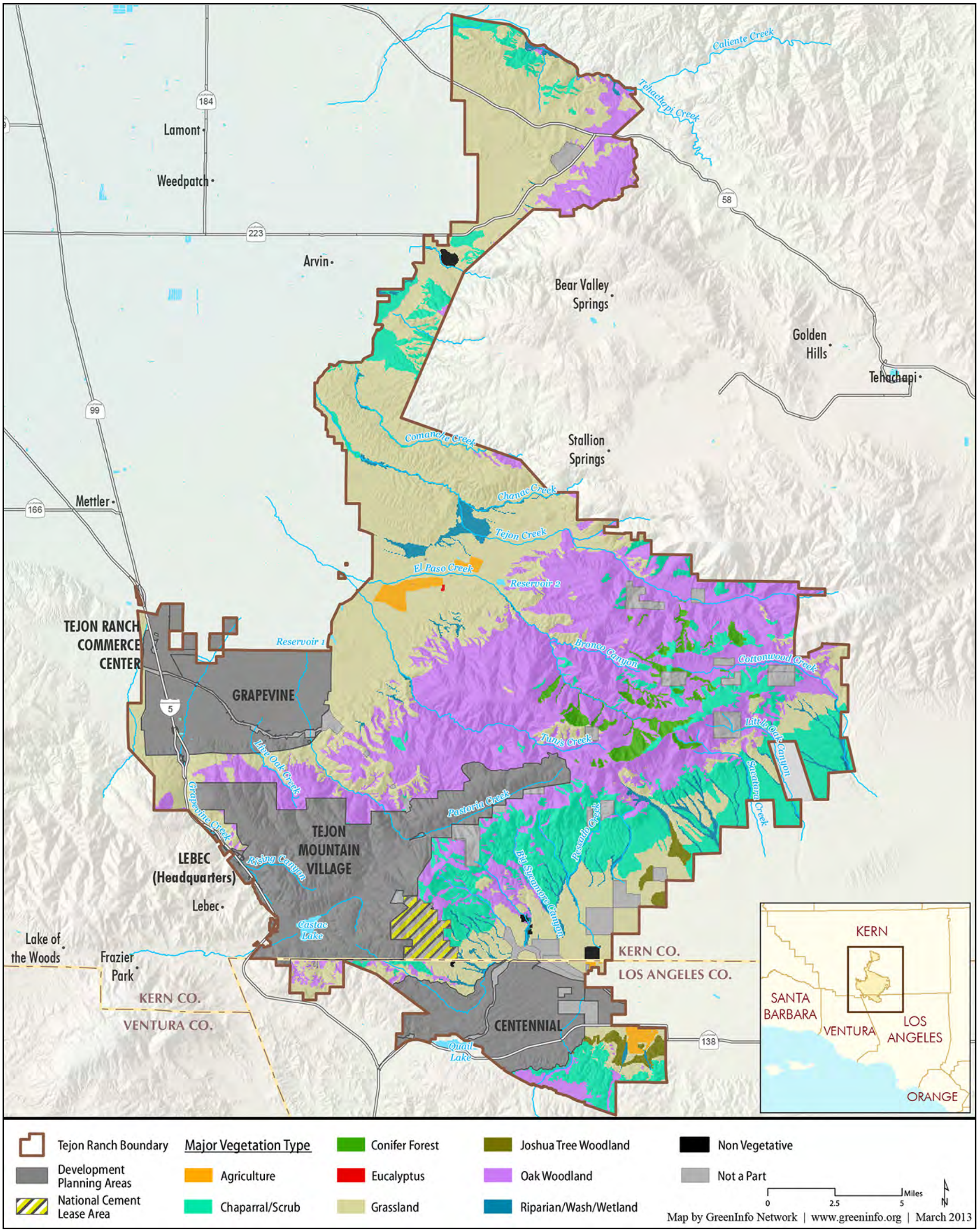


Figure 3-1. Major Vegetation Types at Tejon Ranch

3.1 San Joaquin Valley

The San Joaquin Valley life zone can be broadly characterized as a low-elevation, semi-arid ecological region. In actuality, this ecosystem historically consisted of a vast mosaic of grasslands, shrublands, wetlands, and riparian vegetation communities, all of which are characterized by extensive complexity and variability resulting from both spatial and temporal fluctuations in local conditions. Ecological dynamics within this life zone exhibit marked seasonality, driven by precipitation and temperature patterns characteristic of the region's Mediterranean climate (Heady 1977). Precipitation in this life zone occurs almost exclusively as rain, most of which falls from October to April. Inter-annual conditions can range from extreme and extended drought to intense and prolonged precipitation resulting in extensive flooding.

Spatial variation is primarily a function of climatic gradients, topography, aspect, and soils. North-south, east-west, and elevational precipitation gradients result in increasing aridity in the southern and western portions of the valley as well as at lower elevations. Topographically higher or more rugged areas tend to have better drained soils and are less prone to flooding or water accumulation. Northern and eastern aspects maintain more soil moisture than do southern and western aspects. Soils in the region range from sandy loams to dense clays, which have widely differing water retention capacities. Thus, habitat conditions and associated species assemblages vary immensely across this landscape, at both coarse and fine scales. These conditions and assemblages are also temporally dynamic, with annual abundance of many species potentially ranging from undetectable to hyper-abundant.

Animal populations also are influenced by these seasonal and spatial patterns in precipitation, temperature, and plant phenology. Invertebrate abundance and diversity are affected by floristic diversity and biomass. Likewise, life cycles of herbivorous species track plant phenological patterns, with reproductive peaks being seen in the spring. Concomitantly, life cycles of insectivorous and carnivorous species track these trends with reproductive efforts that correspond with the availability of invertebrate and vertebrate prey. Thus, floral and faunal diversity and biomass are highest in late winter through spring, and then decline through summer and fall until the onset of winter rains reinitiate the cycle.

Vast portions of the San Joaquin Valley have been irreparably altered, directly and indirectly, through anthropogenic actions, including conversion (for agricultural, urban, or industrial uses), hydrologic alteration, and introduction of nonnative species (Kelly et al. 2005, USFWS 1998, Sawyer et al. 2009). However, a significant remnant of this ecoregion persists on Tejon Ranch thanks to historical property protections and land uses. This remnant of the San Joaquin Valley includes more than 90,000 acres of grassland and shrublands, as well as riparian corridors and isolated wetlands associated with springs and seeps. These vegetation communities occupy much of the northern portion of the Ranch from elevations of about 500 to 2,100 feet, where they abut converted agricultural land. Unlike remnants elsewhere in the San Joaquin Valley, which generally are relatively small, the remnants of this ecoregion on Tejon Ranch are comparatively large in size, presumably allowing a greater proportion of ecological function to persist.

3.1.1 Uplands

The original structure and composition of vegetation communities in the San Joaquin Valley are uncertain because invasion by nonnative species, particularly annual grasses, occurred early and rapidly (Hoover 1935, Piemeisel and Lawson 1937, Randall et al. 1998, Minnich 2008). However, based on available evidence, the vegetation communities in this life zone now classified as "grasslands" had a much different appearance and plant composition prior to European settlement. Indeed, much of the uplands of the southern San Joaquin Valley were likely shrub-dominated desert scrub or alkali sink vegetation communities or forb-lands, and grasses likely were only a minor constituent of the original floristic community (Hoover 1935, Wester 1981, Keeley 2006, Wills 2006, Schiffman 2007, Minnich 2008, Germano et al. 2011). Vegetation maps prepared for the area by the Wieslander Vegetation Type Mapping Project (2012) in 1930–1931 show grasslands across the lower elevations of Tejon Ranch but extensive areas immediately adjacent to the Ranch dominated by alkali saltbush (*Atriplex polycarpa*) and "cactus," presumably Bakersfield cactus. These maps also show extensive cultivation of the southern San Joaquin Valley by this date. Following the convention of a recent synthesis of California grassland community classification and nomenclature (Keeler-Wolf et al. 2007), this report refers to all herbaceous-dominated non-agricultural communities as grasslands, regardless of their functional group composition (e.g., grass-dominated vs. forb-dominated).

Herbaceous communities were likely dominated by annual forbs that germinated with the winter rains and blossomed in the spring; as conditions dried and warmed with the approach of summer, these plants senesced, dispersed seed into the soil seed bank, and then dessicated (Minnich 2008). As plants died and dessicated from late spring into early fall, some remained as standing stalks or ground thatch (e.g., most grasses, some forbs) while others disintegrated leaving little recognizable trace (e.g., most forbs). Thus, except for the presence of some perennial species, such as spiny saltbush (*Atriplex spinifera*), alkali saltbush, bladderpod (*Peritoma arborea*), alkali goldenbush (*Isocoma acradenia*), cheesebush (*Ambrosia salsola*), and Bakersfield cactus (Sawyer et al. 2009), the landscape consisted of wide expanses of bare ground with occasional patches of remnant dried vegetation for a large portion of the year. A number of visitors to the southern San Joaquin Valley in the early 1800s described the region in summer and fall as a desert with exceedingly sparse vegetation except for thin strands along streams and wetland margins (Minnich 2008). Native perennial bunch grasses (e.g., *Stipa* spp., *Poa* spp., *Elymus* spp.) may have been present in higher elevation areas (e.g., the Tehachapi foothills), particularly in more mesic microsites, but this also is speculative (Piemeisel and Lawson 1937, Wester 1981, D'Antonio et al. 2002). The current prevailing perspective is that before European settlement, native perennial grasses likely dominated more mesic areas while annual forbs and shrubs likely dominated drier areas, including large portions of the Sierra Nevada foothills, interior drier portions of the Coast Ranges, and broad terraces around the Central Valley (Hamilton 1997, D'Antonio et al. 2007).

Wildlife communities in the San Joaquin Valley life zone have undergone many changes following European colonization. Large herds of pronghorn and tule elk that once roamed these grasslands were virtually eliminated, and predators such as grizzly bears and gray wolves were completely extirpated. Populations of various vertebrate taxa endemic to this life zone, including San Joaquin kit fox, San Joaquin coachwhip (*Masticophis flagellum ruddocki*), blunt-nosed leopard lizard, San Joaquin antelope squirrel (*Ammospermophilus nelsoni*), and giant kangaroo rat (*Dipodomys ingens*) have been reduced dramatically (USFWS 1998). The San Joaquin life zone provided important foraging habitat for numerous raptors, such as golden eagle (*Aquila chrysaetos*), red-tailed hawk (*Buteo jamaicensis*), ferruginous hawk (*Buteo regalis*), Swainson's hawk (*Buteo swainsoni*), white-tailed kite (*Elanus leucurus*), and northern harrier (*Circus cyaneus*), particularly during winter months. California condor generally occurred historically within the grassland transition zone between the valley and the foothill slopes. Several grassland bird species that were once widespread in the western United States are now species of concern, including burrowing owl, grasshopper sparrow (*Ammodramus savannarum*), western meadowlark (*Sturnella neglecta*), and savannah sparrow (*Passerculus sandwichensis*) (CPIF 2000, Shuford and Gardali 2008).

Species that have a disproportionately high level of influence on ecosystem processes are termed "ecosystem modifiers" or "keystone species" (Mills et al. 1993, Jones et al. 1994). In the uplands of Tejon Ranch's San Joaquin Valley life zone, the California ground squirrel (*Spermophilus beechyi*), pocket gopher (*Thomomys bottae*), Heermann's kangaroo rat (*Dipodomys heermanni*), and possibly the California vole (*Microtus californicus*) may constitute such species (Lidicker 1989). All are widespread and can be abundant. They are fossorial and excavate extensively, and all are herbivorous or granivorous. In the creation and maintenance of burrow systems, huge quantities of earth are loosened and moved to the surface. These burrowing activities increase soil aeration and moisture penetrability, locally affect plant composition and growth through creation and modification of microhabitats, and provide shelter for various invertebrates and other vertebrates. Feeding activities by these species can significantly modify plant community composition and vegetation structure. Furthermore, because these species are widespread and abundant, they constitute the primary prey for numerous reptilian, avian, and mammalian predators. The effects of these species are considered beneficial, as native species have evolved to exploit the micro-niches created by the resulting ground disturbance.

Fire can periodically constitute a significant ecological process in the San Joaquin Valley life zone (Baumgarten et al. 2012). Lightning is the primary natural ignition source and would have occurred rarely in the lower elevation San Joaquin Valley uplands, but adjacent higher elevation areas could have been a source of fire (Baumgarten et al. 2012). Native Americans used fire frequently as a management tool in California grasslands starting between 12,000 and 15,000 years ago (Wills 2006, Anderson 2006, Minnich 2008). Stephens and colleagues (2007) have estimated the pre-European fire rotation interval associated with Native American management practices at between 3 and 8 years. Following European settlement of the San Joaquin Valley, fire may still have been used by ranchers as a management tool, but the frequency and size of fires likely decreased relative to the pre-European period (Wills 2006). The establishment of nonnative annual grasses in the San Joaquin Valley has significantly increased fuel loads and may be increasing the frequency, size, and intensity of burns (Sawyer et al. 2009). Although Wills (2006) suggests that the frequency and size of fires have changed little in the past 50 years, the increasing incidence of anthropogenic ignitions, such as along highways, has been shown to increase the annual number and size of fires in the region around Tejon Ranch (Baumgarten et al. 2012). Depending on topography, weather, and vegetation conditions, the spectrum of impacts from fires can range from light burning or a mosaic of burned and unburned areas to complete removal of all herbaceous vegetation with extensive mortality to perennial plants (e.g., shrubs, cacti) and ground-dwelling animals. Fossorial animals may survive the actual fire, but then must cope with the loss of food and cover resources. Recovery by plant communities depends on burn intensity (e.g., whether seeds in the soil seed bank were killed) and pattern (e.g., proximity to unburned areas within or on the edge of the burn that can serve as sources of propagules).

Beginning in the early 1800s, plant species from the Mediterranean region were introduced via cattle brought into the San Joaquin Valley. Introduced cool-season grasses, in particular, spread rapidly and aggressively (D'Antonio et al. 2007, Minnich 2008), and more than 98% of California grasslands are now dominated by nonnative plant species (Bossard and Randall 2007). The composition, and in some cases the structure and function, of floristic communities in the San Joaquin Valley have in all likelihood been irreversibly altered by the invasion of these nonnative species (Heady 1977, Heady et al. 1991). They compete with native plant species for water, nutrients, and space, and they potentially inhibit or exclude some species, at least locally (Huenneke et al. 1990, D'Antonio et al. 2007). Furthermore, in some settings the nonnative plants have changed the physical structure of the habitat by producing dense stands of standing stems and dense layers of thatch that can persist from one growing season to the next, and these changes have adversely affected native animals that are adapted to a sparse vegetation structure and bare ground (Germano et al. 2012, Rosenberg et al. 2009).

The profusion of certain nonnative plants (i.e., "transformer" species as described in D'Antonio et al. 2007) has resulted in an increased capacity for landscape-scale fires that can reduce or eliminate native perennials (e.g., shrubs and cacti) over large areas (Minnich 2008, Sawyer et al. 2009). In many areas, San Joaquin Valley grasslands commonly occur as a mosaic, with shrub presence ranging from absent to moderately dense. It is not clear whether this variation in shrub abundance is a reflection of local habitat conditions (e.g., soil attributes, aspect) or past disturbance. Shrubs, particularly desert saltbush (*Atriplex polycarpa*), may have been widespread and abundant historically (Twisselmann 1967). However, extensive cattle and sheep grazing in the 1800s coupled with severe droughts in the 1860s may have significantly reduced and locally eliminated shrubs in the San Joaquin Valley (Burcham 1957). Livestock browsing and rubbing can eventually kill adult shrubs and inhibit seedling regeneration. Twisselmann (1967) notes that livestock browsed with "relish" some characteristic shrub species of the southern San Joaquin Valley (e.g., *Atriplex polycarpa*). Also, most shrubs in the San Joaquin Valley are not fire adapted, and "hot" and/or repetitive burning can locally extirpate shrubs (Sawyer et al. 2009). The presence of dense nonnative grasses has increased the frequency, scale, and intensity of fires, which may have further reduced shrub distribution and abundance (Baumgarten et al. 2012, Sawyer et al. 2009). The consequences of both of these processes, grazing and fire, can leave behind what appear to be herbaceous communities (i.e., grass and/or forb dominated). Thus, it is not clear whether present-day grasslands are true grasslands or shrublands in which the shrub component has been reduced or eliminated.

Ecosystem functions of San Joaquin Valley habitats have likely been altered by abundant populations of nonnative species of plants and animals. Among the more important nonnative species, Mediterranean grasses (e.g., *Bromus* spp., *Avena* spp., *Hordeum* spp.), mustards (e.g., *Hirschfeldia incana*, *Brassica tournefortii*), thistles (*Silybum marianum*, *Cirsium vulgare*, *Carduus pycnocephalus*), and salt cedar (*Tamarix* spp.) can dominate plant community composition and biomass, modify vegetation structure and fire regimes, and exclude native species through competition for nutrients, water, and light. Feral pigs (*Sus scrofa*) were first recorded in the Tehachapis in the 1990s. Feeding and rooting by pigs can cause direct mortality to plants and animals, reduce food and cover for other animal species, alter plant species composition, affect soil composition and chemistry, and possibly even limit populations of invertebrates and small ground-dwelling vertebrates through predation (Singer et al. 1984, Sweitzer and Van Vuren 2002, Cushman 2007). Soil disturbance from pig rooting also may encourage invasion of certain nonnative plants (Cushman et al. 2004, Cushman 2007).

Current Conditions at Tejon Ranch

In collaboration with the Conservancy, the University of California (UC) Berkeley Range Ecology Lab (REL) is conducting intensive analyses of the spatial and temporal variation of grasslands, and the drivers of the variation, on Tejon Ranch using permanent plots sampled over multiple years (Spiegal and Bartolome 2012). Using cluster and indicator species analysis, they detected distinct grassland types (i.e., groupings of grassland plant species) referred to as species aggregations. A total of 16 distinct plant species aggregations were defined for Tejon Ranch, with 12 of those aggregations found in the San Joaquin Valley life zone (Table 3-1). Species aggregations are named for the species that emerged as statistically significant indicators of a particular cluster in the indicator species analysis, with the most statistically significant species listed first and others listed in order of declining significance. A species aggregation was classified as "native" if the relative cover of native plant species in the aggregation was 20% or greater and "exotic" if less than 20%. Using this definition, only two of the 12 species aggregations in the San Joaquin Valley life zone qualified as native, with a maximum average native cover of 25%.

Another important characteristic of the species aggregations is the composition of the aggregation with respect to functional groups. As discussed further below, functional group composition can drive ecological structure and function. Two functional groups, forbs and grasses, are relevant for grassland communities. Table 3-1 categorizes the average relative cover over 3 years contributed to each species aggregation by native and exotic, forb, and grass functional groups. Exotic grasses dominate most of the species aggregations in the San Joaquin Valley life zone, with seven of the 12 species aggregations characterized by a relative cover of grasses in excess of 75%. None of the species aggregations has a high cover of native grasses, and the native grassland species found in this life zone are predominantly forbs. If indeed the grasslands of the southern San Joaquin Valley before European contact were dominated by forbs and shrubs, these results document the dramatic shift in composition to nonnative annual grass dominance that has occurred over the last 200 years. Thus, it is important to note the five species aggregations that still support significant forb cover, as we hypothesize that they may function more similarly to the pre-contact grassland condition.

Ecological sites are land units with specific soil and geophysical characteristics that support distinctive vegetation communities and respond similarly to natural disturbances and management actions (NRCS 2003). Ecological sites are being promoted by the U.S. Department of Agriculture (USDA) and others as a means of stratifying landscapes and organizing ecological information for purposes of monitoring, assessment, and adaptive management, particularly in rangeland systems. Spiegal and Bartolome (2012) have classified the areas of Tejon Ranch mapped as grasslands into nine "environmental sites," based on topography and landforms, soil physical and chemical characteristics, and climatic properties. Spiegal and Bartolome have opted to use the term "environmental site" to distinguish their technical approach from that used by the USDA to develop the "ecological site" classification system for the United States, but the two classification systems are conceptually equivalent. Five of the nine environmental sites at Tejon Ranch are located in the San Joaquin Valley life zone (Figure 3-2):

Site 1: *Northern Tehachapi Mountains, steep slopes on varied substrates*. This site is on steeply sloped landforms with silty, high-nutrient soils in the foothills of the Tehachapi Mountains.

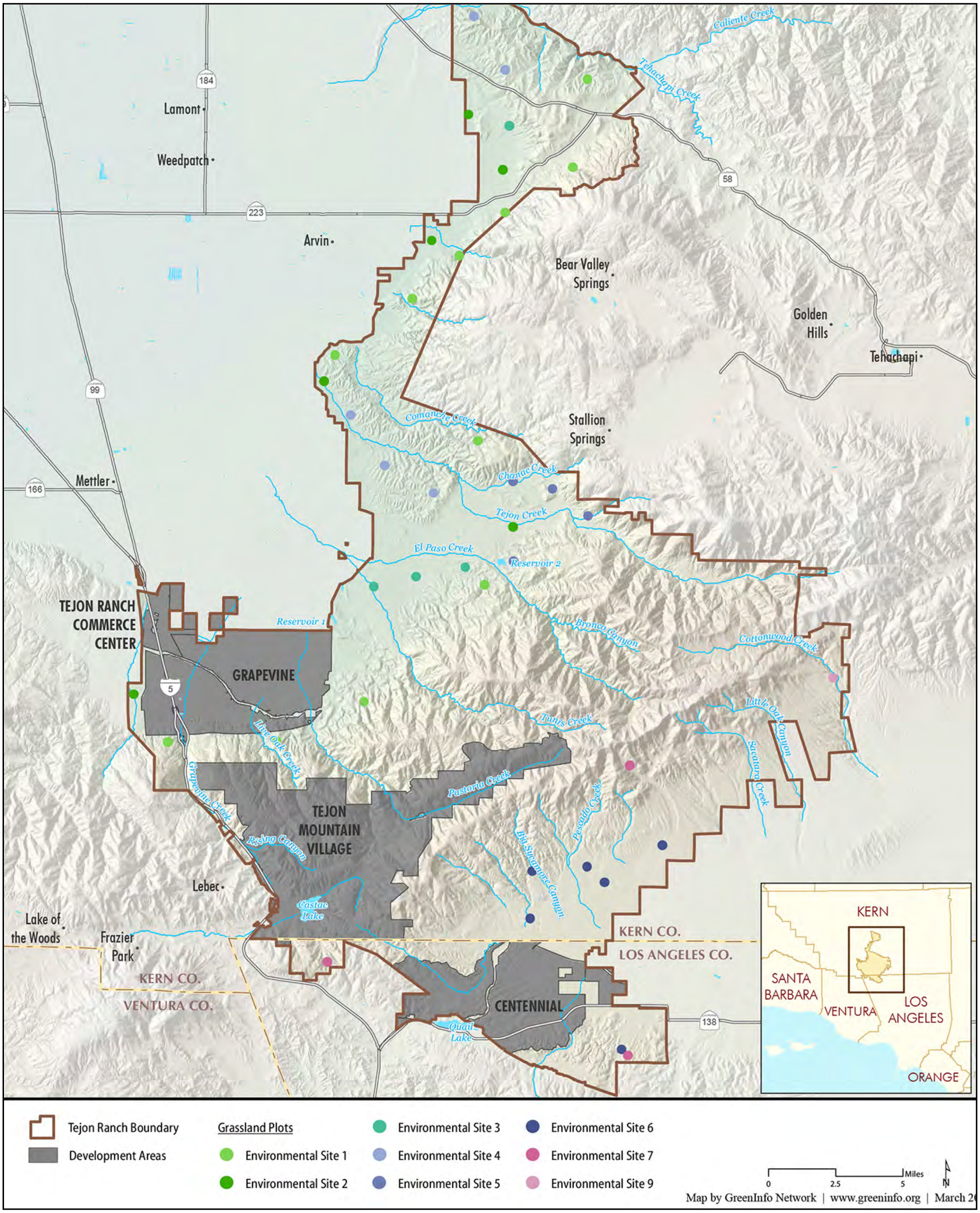
Site 2: *San Joaquin Valley, flat Holocene surficial sediments with low sulfate* (SO_4^{2-}). This environmental site is on flat, recent alluvial deposits that are sandy, with low nutrient and sulfate concentrations. This site is located on low-elevation areas around the northern margins of Tejon Ranch.

Site 3: *San Joaquin Valley, moderate slopes on sandy loams and sandy clay loams with low carbon to nitrogen ratios (C:N)*. This environmental site is on older alluvial terraces at the base of the Tehachapis that support sandy loams and sandy-clay loams, generally with high nutrients.

Table 3-1. Species Aggregations in the San Joaquin Valley Life Zone

Species Aggregation	Native/ exotic	Native cover	Exotic forb	Exotic grass	Native forb	Native grass	Native shrub
Avena barbata	exotic	3%	1%	92%	1%	2%	0%
Avena fatua–Peritoma arborea–Claytonia perfoliata–Bromus madritensis ssp. *madritensis–Amsinckia menziesii* var. *intermedia*	native	23%	1%	75%	17%	0%	6%
Bromus diandrus	exotic	4%	4%	91%	3%	0%	0.3%
Bromus hordeaceus–Plagiobothrys sp.-*Silene gallica–Trifolium microcephalum*	exotic	9%	7%	82%	9%	0%	0%
Bromus madritensis ssp. *rubens–Plantago erecta–Lepidium nitidum*	exotic	13%	28%	58%	13%	0%	0%
Centaurea melitensis–Schismus arabicus–Brassica tournefortii–Eriogonum angulosum	exotic	10%	26%	56%	6%	0%	9%
Clarkia cylindrica–Bromus arenarius–Trifolium ciliolatum–Phacelia cicutaria-Erodium brachycarpum/botrys–Clarkia purpurea–Holocarpha heermannii	exotic	14%	7%	78%	13%	0%	0%
Erodium botrys–Dichelostemma capitatum–Lotus wrangelianus	exotic	10%	45%	45%	10%	0%	0%
Erodium moschatum–Plagiobothrys arizonicus–Cerastium glomeratum–Vulpia myuros–Medicago polymorpha-Amsinckia sp.	exotic	12%	32%	55%	12%	0%	0%
Hordeum murinum	exotic	5%	5%	89%	5%	0%	0%
Mirabilis californica–Avena sp.	exotic	7%	2%	90%	7%	0%	0%
Plagiobothrys nothofulvus–Hypochaeris glabra–Lupinus nanus–Astragalus oxyphysus	native	25%	28%	46%	25%	0%	0%

Notes: Species aggregations are named for species identified as indicators in the species indicator analysis. Percentages are relative cover values averaged across all plots over 3 years. Native species aggregations have a relative cover of native species of 20% or more.
Source: Spiegal and Bartolome 2012



Source: Spiegal and Bartolome 2012

Figure 3-2. Distribution of Grassland Plots Assigned to Their Respective Environmental Sites

Site 4: Southern Sierra Nevada-Tejon Hills, steep slopes on Miocene sediments forming clayey soils with low phosphorus (P), SO_4^{2-}, calcium (Ca^+), and sodium (Na^+). This environmental site is located in the Tejon and Caliente hills, which comprise old alluvial deposits uplifted to form steep landforms with clayey soils consisting of high sulfate, calcium, and sodium concentrations and low phosphorus concentrations.

Site 5: Tejon Hills-Tehachapi Mountain, moderate slopes at approximately 600 m on loamy sands with low Na^+, Ca^+. This is a high-elevation site with moderate slopes and silty, high-nutrient soils that have low sodium and calcium concentrations.

Each environmental site supports a suite of the species aggregations (grassland types) that were discussed in Table 3-1 (Spiegal and Bartolome 2012). The inter-annual variability in plant species composition documented in the first 3 years of the Tejon Ranch grassland study (2010–2012) supports the characterization of these environmental sites as non-equilibrium. In non-equilibrium systems, plant community composition is driven by variations in physical and environmental factors rather than biotic interactions (e.g., competition and herbivory), and the composition of plant species at a particular location can change from year to year (George et al. 2011, Spiegal and Bartolome 2012).

A useful conceptual framework for describing non-equilibrium plant community dynamics is a state-and-transition model (STM) (Westoby et al. 1989, Briske et al. 2005, Bestelmeyer et al. 2009). STMs are descriptions of the dynamics of vegetation communities at ecological sites, organized as sets of community "states" (plant community composition and associated ecological processes) that are determined by the unique characteristics of the site, such as its soils, climate, geomorphic setting, hydrology, and disturbance history. Transitions between states may result from new disturbances (e.g., fire), species invasions (e.g., Mediterranean annual grass invasions), changes in weather or environmental conditions (e.g., soil nutrients from nitrogen deposition, depth to groundwater during drought), and management practices (e.g., grazing, shrub removal, prescribed fire). Some states are more resistant to change (more stable) than others. Human uses can change many characteristics of landscapes and have produced state changes in many ecosystems. Range managers are increasingly using STMs to evaluate the dynamics of ecological sites and to identify and prioritize restoration and management strategies.

While a number of plots in the San Joaquin Valley life zone transitioned from one species aggregation to another (Spiegal and Bartolome 2012), in general, grassland types associated with each plot were remarkably stable. Of 60 possible transitions (30 plots in the San Joaquin Valley life zone x 2 years available to transition), only 19 transitions from one species aggregation to another were documented (32% of possible transitions), and 17 of those transitions were from one exotic species aggregation to another. However, the relative abundance of species within a species aggregation at a given plot varied significantly from year to year; in particular, the relative importance of grasses and forbs changed dramatically. Thus, even plots that were characterized by a stable, native forb species aggregation have significant inter-annual transitions from forb-dominance to grass-dominance.

The establishment of nonnative annual grasses in the life zone has completely altered the composition, structure, and function of these grasslands, and native types remain only in selected environmental sites. Native species aggregations were only supported in Sites 2, 4, and 5 and were most frequent in Site 2. These three environmental sites are believed to have the greatest potential for enhancing native grassland plant species through management prescriptions. In addition, although forb and grass cover fluctuated dramatically over the 3 years of the study, these three sites also generally had higher forb cover than Sites 1 and 3 (Table 3-2). Shrubs were only present in plots in Sites 1 and 4.

Site	Year	Total Native	Native forb	Exotic forb	Native grass	Exotic grass	Native shrub
1	2010	0.16	0.13	0.08	0.01	0.75	0.01
	2011	0.03	0.02	0.04	0.01	0.91	0.01
	2012	0.07	0.06	0.08	0.00	0.81	0.01
	Average	*0.09*	*0.07*	*0.07*	*0.01*	*0.82*	*0.01*
2	2010	0.33	0.33	0.30	0.00	0.36	0.00
	2011	0.04	0.04	0.13	0.00	0.82	0.00
	2012	0.11	0.11	0.26	0.00	0.63	0.00
	Average	*0.16*	*0.16*	*0.23*	*0.00*	*0.60*	*0.00*
3	2010	0.15	0.15	0.36	0.00	0.49	0.00
	2011	0.00	0.00	0.01	0.00	0.98	0.00
	2012	0.01	0.01	0.06	0.00	0.92	0.00
	Average	*0.05*	*0.05*	*0.14*	*0.00*	*0.80*	*0.00*
4	2010	0.17	0.16	0.37	0.00	0.46	0.01
	2011	0.05	0.04	0.09	0.00	0.85	0.00
	2012	0.06	0.03	0.22	0.00	0.67	0.04
	Average	*0.09*	*0.08*	*0.23*	*0.00*	*0.66*	*0.02*
5	2010	0.21	0.21	0.15	0.00	0.63	0.00
	2011	0.03	0.03	0.04	0.00	0.90	0.00
	2012	0.11	0.11	0.23	0.00	0.66	0.00
	Average	*0.12*	*0.12*	*0.14*	*0.00*	*0.73*	*0.00*

Table 3-2. Average Relative Cover of All Plots Within Environmental Sites 1–5

Source: Spiegal and Bartolome 2012

A variety of rare or patchily distributed native plants in the San Joaquin Valley life zone were documented outside of grassland plots, and these often showed an apparent, albeit anecdotal, affinity for specific environmental sites (Kramer Biological 2011). For example, special-status annual plants such as Tejon poppy, Kern mallow (*Eremalche parryi* ssp. *kernensis*), and Comanche Point layia (*Layia leucopappa*) are only known to occur in the Tejon Hills, and Vasek's clarkia (*Clarkia tembloriensis* ssp. *calientensis*) is only known from areas within the Caliente Hills; both of these areas appear to fall within Site 4. Several native bulb species, including the state-listed threatened striped adobe lily (*Fritillaria striata*), appear to show an affinity for Site 1.

The Conservancy has conducted or sponsored several wildlife surveys across the Conserved Lands on Tejon Ranch, often with the support of "citizen scientists" (Cypher et al. 2010, Live Oak Associates 2011, Tejon Ranch Conservancy unpublished data). Common reptiles that can be found in grassland types at all environmental sites include gopher snake (*Pituophis catenifer*), side-blotched lizard (*Uta stansburiana*), Gilbert's skink (*Plestiodon gilberti*), and, in areas with rock outcrops or logs, western fence lizard (*Sceloporus occidentalis*) and Pacific rattlesnake (*Crotalus oreganus*). Common mammals in all grassland types in this life zone include California ground squirrel, pocket gopher, Heermann's kangaroo rat, coyote, and, in areas adjacent to riparian vegetation communities or with higher shrub cover, black-tailed jackrabbit and desert cottontail. Common birds in these grasslands include western meadowlark (*Sturnella neglecta*), common raven (*Corvus corax*), golden eagle, red-tailed hawk, horned lark (*Eremophila alpestris*) in very open habitats or along roads, and, near riparian vegetation communities or areas with higher shrub cover, lark sparrow (*Chondestes grammacus*), northern mockingbird (*Mimus polyglottos*), Savannah sparrow, white-crowned sparrow (*Zonotrichia leucophrys*), and California quail (*Callipepla californica*). Northern harrier (*Circus cyaneus*) is also common in this life zone but is not known to nest there. During the winter and early spring, the numbers of golden eagles and northern harriers increase in the San Joaquin Valley because of the presence of wintering individuals.

Nonnative red fox and feral pig are also present in this life zone. While feral pigs are widespread and abundant at higher elevations and in mesic areas of Tejon Ranch, they are also commonly detected in xeric grasslands. Their rooting can cover extensive areas and can affect plant species composition (Tejon Ranch Conservancy unpublished data). Furthermore, feral pigs apparently feed extensively on the bulbs of some native geophytic plants, although the impacts to these plant populations have not been quantified (Kramer Biological unpublished data, White personal observation). Red foxes may be competitors to native species of concern such as San Joaquin kit foxes, but the magnitude of their effects are not known.

Special-status wildlife species present in this life zone include San Joaquin kit fox, American badger, San Joaquin coachwhip, blunt-nosed leopard lizard, and burrowing owl. While the American badger appears to be a habitat generalist, the other special-status wildlife species appear to be strongly associated with Site 2 (flat, sandy, low-elevation sites). There are also records of San Joaquin kit fox in Site 4 (Tejon Hills). The physical structure of the grasslands is important for these conservation targets and is determined to some degree by dominant functional group. For example, there is a greater potential for low biomass and residual dry matter conditions when forbs dominate, and this structure may be preferred by several wildlife species of concern in this life zone, including San Joaquin kit fox, blunt-nosed leopard lizard, and burrowing owl.

Desired Conditions and Management Approaches

The following sections (and those in subsequent life zones) review published literature concerning desired conditions for specific habitat types and management approaches that have been implemented in other locations to achieve desired conditions. Desired conditions and management approaches to achieve these conditions (Conservation Activities and BMPs) at Tejon Ranch are presented in RWMP Volume 2.

Desired Conditions

Wildlife habitat quality and suitability for native annual plants appear to decline at these sites in years when nonnative annual grasses increase in dominance, producing high biomass conditions with dense thatch. Significant rainfall early in the rainy season (e.g., November) may be associated with conditions favoring grass dominance (Spiegal and Bartolome 2012), but very light grazing intensity may also allow grasses to dominate in some environmental sites. A number of special-status animal species also appear to prefer low-biomass conditions, and habitat quality for these species is low when nonnative annual grasses dominate. No practical strategy has been identified for eliminating invasive nonnative annual grass species on a landscape level (Stromberg et al. 2007). Indeed, because of the extensive and ubiquitous distribution of these species and their aggressively invasive ecology, eradication on any large scale is unrealistic. The most realistic approach for mitigating adverse effects on native plants and animals may be to attempt to maintain habitat structure and functions in the face of annual grass invasion (Germano et al. 2011, Cypher et al. 2010). Desirable conditions for native forbs and the suite of special-status animals are a landscape characterized by a low, sparse vegetation structure with areas of bare ground and periodic shrubs.

Quantifiable metrics for achieving desired conditions have been proposed and are described below. These metrics entail reducing the biomass of herbaceous vegetation, both living and dead (e.g., standing stems, litter, and thatch). Thus, efficacy in achieving these metrics is easily measured. However, a significant caveat is that the relationship between vegetation biomass reduction and the response of species identified as conservation targets, as well as the other species in this ecosystem, is unclear, and this relationship may differ between plant and animal species. The target values proposed for San Joaquin Valley grasslands are based on measurements and observations of habitat conditions in locations where populations of the conservation target species, particularly special-status animals, appear to be robust and persistent. Thus, there is an implicit assumption that manipulating vegetation communities to mimic these conditions will result in favorable habitat conditions for the target species. However, rigorous testing of this assumption has rarely been conducted because of the significant expense and time (i.e., years) required.

A common metric for assessing habitat conditions in San Joaquin Valley grasslands is residual dry matter (RDM). RDM typically is measured in pounds per acre (lbs/ac) of dry plant material, including both standing stems and litter. Generally, RDM is based on plant species considered palatable to livestock. For dry annual grasslands with less than 25% woody plant cover, such as those that occur in this life zone, Bartolome et al. (2006) recommend target RDM values of 300 lbs/ac on 0-10% slopes, 400 lbs/ac on 10–20% slopes, 500 lbs/ac on 20–40% slopes, and 600 lbs/ac on slopes greater than 40%. However, these target values are primarily intended to maintain range health and, in particular, to protect soils. For areas in the San Joaquin Valley where nonnative grasses are dominant in the herbaceous vegetation layer and where conservation of rare native species (e.g., San Joaquin kit fox, blunt-nosed leopard lizard, burrowing owl) is a priority, a typical goal is to manage habitat such that RDM does not exceed 1,000 lbs/ac at the end of the growing season (e.g., U.S. Bureau of Land Management 2010). Preferably, RDM would be kept at 500 lbs/ac or less (U.S. Bureau of Land Management 2010, Germano et al. 2012). The Center for Natural Lands Management also uses 500 lbs/ac as a goal for vegetation management on its preserves in the southern San Joaquin Valley (Center for Natural Lands Management 2000). Blunt-nosed leopard lizard numbers were considerably higher in the Lokern Natural Area on grazed plots (RDM range 127–663 lbs/ac) compared to ungrazed plots (RDM range 894–1,572 lbs/ac; Germano et al. 2012).

Other metrics include vegetation height and percent ground cover. For kit foxes, a maximum herbaceous vegetation height of 20 cm (8 in) has been proposed (U.S. Bureau of Land Management 2010), whereas a height of about 30 cm (12 in) has been suggested as suitable for burrowing owls (Rosenberg et al. 2009). Blunt-nosed leopard lizards prefer areas with bare ground (Montanucci 1965), and Chesmore (1980) suggested that 15–30% ground cover was optimal for blunt-nosed leopard lizards. Similarly, ground cover averaging 45% has been proposed as optimal for burrowing owls (Klute et al. 2003). However, efficacy has not been demonstrated for any of these recommendations.

Management goals for native plants are more equivocal. It is generally assumed that native plant species in San Joaquin Valley grasslands are suppressed by competition from nonnative grasses, and that the abundance of natives will increase when released from this competition. This seems to be the case when the biomass of nonnative grasses is reduced by burning (Parsons and Stohlgren 1989, Zaninovich 1992, York 1997). However, such a clear positive response by native plants to competitive release has not been demonstrated when grazing is used to decrease competition from nonnatives. Although some benefits to natives have been detected when nonnative grasses are reduced (e.g., Bakersfield cactus as described in Cypher and Fiehler 2006), other investigations indicate that native plant cover and diversity have not increased and in some cases have declined under grazing or simulated grazing pressure (e.g., Kimball and Schiffman 2003; Prugh and Brashares 2010; Christian et al., Sonoma State University unpublished data). However, results from these sources have been called into question because of study design limitations (George and McDougald 2010).

Consequently, desired conditions and management goals for a given area may vary depending on whether animals or plants are the designated conservation targets. Reduction of nonnative grasses (and the associated benefits for native animals) may still be possible in areas where native plants are a priority conservation target, but the strategy (particularly the seasonal timing) for achieving this reduction may differ from management in areas where animals are the priority conservation target. For example, in areas where species such as San Joaquin kit fox and blunt-nosed leopard lizard are a priority, vegetation height and density should be controlled (according to the recommendations described above), beginning from the start of the winter growing season. However, in areas where species such as striped adobe lily are a priority, vegetation management entailing biomass removal (e.g., grazing) likely should be restricted during the growing season and limited to the period between seed set/dispersal and seed germination (Cypher 2004).

The San Joaquin Valley grasslands occupy tens of thousands of acres of Tejon Ranch. Thus, management of this system must be conducted on a landscape scale, and this narrows options considerably. Livestock grazing and fire likely constitute the only viable alternatives for modifying or managing the San Joaquin Valley grasslands (Jackson and Bartolome 2007). Both strategies have associated strengths and weaknesses.

Management Approaches

Fire, in the form of controlled burns, could be used to reduce vegetation structure and density. Burning potentially can decrease the cover of nonnative grasses and increase the abundance of forbs and geophytic plants (Reiner 2007). Fire has been used to modify vegetation at several sites with San Joaquin Valley grassland habitat, and in particular to reduce nonnative grasses (e.g., U.S. Bureau of Land Management 2010, Germano et al. 2012). Fire appears to effectively reduce nonnative grass cover for a period of 1–3 years after burning (Parsons and Stohlgren 1989). Zaninovich (1992) reported that wildflower displays were noticeably more intense in springs following summer or fall burns. Prescribed burns have been used on the Carrizo Plain to reduce nonnative grass cover and encourage forbs (U.S. Bureau of Land Management 2010). However, Sawyer et al. (2009) report that fire also can potentially increase the abundance of nonnative grasses in an ecosystem.

Among the strengths of using fire as a management tool are the points that results are achieved rapidly and the beneficial effects can last for more than a single year (although usually not more than 2–3 years, according to Zaninovich 1992). However, this management tool also includes some significant weaknesses that, in many cases, are sufficiently challenging that fire is either not considered as a first choice or even precluded from consideration. First and foremost is the fact that fire can escape control, and when it does so, it can threaten human life, cause property damage, and adversely affect fire-sensitive vegetation communities. Fire also can cause direct mortality to both animals and plants, including sensitive species (e.g., San Joaquin coachwhip, Bakersfield cactus). As mentioned earlier, shrubs in the San Joaquin Valley ecosystem are not fire adapted and therefore are particularly susceptible to burning. Fire can produce a mosaic of burned and unburned patches depending on fuel distribution, topography, soil moisture, and other factors, and controlled burning may not achieve uniformity of desired conditions. However, it also can completely consume all above-ground vegetation over large areas, eliminating food and cover for many species until the next growing season. From an administrative perspective, conducting controlled burns commonly requires a permit from the San Joaquin Valley Air Pollution Control District, and these permits typically include restrictions that severely constrain the availability of prescribed fire in the region. In particular, controlled burns may only be permissible on specific dates based on air quality conditions, which increases the difficulty of planning and implementing prescribed burns. Finally, this management tool potentially can entail considerable financial cost (e.g., preparations such as creating fire breaks and retaining fire-fighting crews on standby).

Grazing can be conducted using various livestock, although cows and sheep are most common. Tejon Ranch lands have been grazed since the mid-1800s; indeed, cattle grazing is a traditional use and a Reserved Right on the Ranch (Tejon Ranch Company 2009). Grazing will continue on the Ranch, and the infrastructure and administrative organization for livestock management is already in place. Therefore, a logical approach is to look for opportunities to manage livestock grazing to achieve conservation goals.

A potential disadvantage of using grazing as a management tool is that results are achieved slowly. Several months may be required before desired management effects are achieved. Also, although grazing can be an effective tool for reducing nonnative grasses, the soil disturbances associated with livestock generally produce more suitable conditions for these same grasses (Heady et al. 1991, Bartolome et al. 2007, Minnich 2008, Sawyer et al. 2009). Furthermore, as alluded to previously, grazing can adversely affect shrubs, even to the point of local extirpation. Thus, as with all tools, grazing has its benefits and detriments.

Grazing, by both cattle and sheep, is pervasive in grasslands throughout the San Joaquin Valley. The efficacy of this tool in promoting species of conservation interest on a landscape scale has been assessed only infrequently and relatively recently. In long-term studies on the Elkhorn Plain in San Luis Obispo County in the 1980s and 1990s, grazing did not appear to affect abundance of giant kangaroo rat (*Dipodomys ingens*) or blunt-nosed leopard lizard, although giant kangaroo rats declined to a lesser extent on grazed areas during periods of high precipitation and vegetation density (California State University, Stanislaus, Endangered Species Recovery Program, unpublished data). In one study on the Carrizo Plain National Monument (Prugh and Brashares 2010), grazing by cattle and giant kangaroo rats (*D. ingens*) reduced RDM down to approximately 305 lbs/ac by fall, but cattle grazing did not appreciably affect the percent cover of either native or nonnative plants. However, giant kangaroo rat abundance tended to be higher in grazed areas during years of high precipitation and primary productivity. Although the focus of the study was on how grazing affected the trajectory of nativeness, Christian (Sonoma State University, unpublished data) reported that abundance of both native plants and giant kangaroo rats was lower in grazed plots on the Carrizo Plain; however, only one grazing strategy (November-to-May grazing) was evaluated. Also, the results may be somewhat biased in that ungrazed areas were not grazed specifically because they had a higher proportion of native species, and grazed areas were grazed specifically because they had a higher proportion of nonnatives.

In the Lokern area of western Kern County, the effect of cattle grazing on a suite of vertebrate species was assessed over a 10-year period (Germano et al. 2012). For this study, treatment areas were winter-grazed annually until a target RDM of 500 lbs/ac or less was achieved. Heermann's kangaroo rat, short-nosed kangaroo rat (*Dipdomys nitratoides nitratoides*), blunt-nosed leopard lizard, and other focal species exhibited a positive response to grazing, based on relative abundance or rate of increase or both. The effect of sheep grazing has been assessed in Lokern since 2001 on sixteen 10-ac plots (eight grazed and eight ungrazed) (Warrick 2011). Native and nonnative plant species cover and small mammal abundance have been similar between grazed and ungrazed plots. Also, RDM has been similar in most years. Also in Lokern, Cypher (1994) determined that light to moderate grazing by sheep may reduce competition from nonnative grasses for endangered Kern mallow (*Eremalche parryi* var. *kernensis*). Finally, based on investigations at the Sand Ridge Preserve in the southeastern San Joaquin Valley, Cypher and Fiehler (2006) reported that removal of nonnative grasses (via clipping) increased the survival and growth rates of Bakersfield cactus.

Conceptual Ecosystem Models: Explanation and Overview

Conceptual ecosystem models are graphical representations of the current understanding of how ecosystems function (Walters 1986). They are intended to help structure thinking about the factors responsible for ecosystem dynamics, the interrelationships between ecosystem elements, and the possible mechanisms of change. Depending on their purpose, these models can range from highly descriptive to fairly abstract. The conceptual models of Tejon Ranch systems provided in this volume do not attempt to comprehensively describe system drivers and processes in detail, although they can be refined over time to add such detail. Rather, they attempt to distill complex information into a simplified representation of relevant assumptions, uncertainties, research or management hypotheses, and potential monitoring measures. The Conservancy's conservation goals, discussed further in RWMP Volume 2, focus on maintaining and enhancing ecosystem functions and the overall conditions of major natural communities to promote diverse, functioning, and resilient ecosystems on Tejon Ranch. However, to focus the Conservancy's management efforts on practical actions that will produce measurable responses, this conceptual modeling relies on conservation targets (specific plant and animal species or groups of species) that are believed to be associated with ecosystem composition, structure, functions, and processes that benefit a wide range of species or have specific habitat requirements that are regionally in decline.

STMs can provide a useful framework for these conceptual models, particularly for non-equilibrium annual systems, in that changes in habitat condition or quality for conservation targets are believed to be associated with changes in state. However, the STM concept is also useful for conceptual models of equilibrium or perennial communities, such as oak woodlands and riparian vegetation communities, where community condition or quality relates more to structural or demographic characteristics of states that transition over long time frames. In this RWMP, conceptual model diagrams represent historical or desired states as green boxes and modified or low condition states as tan boxes. Historical or desired states are referred to as "potential" states to indicate that the specific vegetation composition and structure of the state is a variable but inherent function of the physical, chemical, and biological characteristics of the specific site they occupy in the absence of stressors outside of the natural range of variability. When relevant, different vegetation phases are shown as dashed boxes within particular states and the factors that influence the occurrence of these phases is indicated. While the conceptual models represent system dynamics as discrete states (e.g., native forb-dominated vs. nonnative annual grass-dominated), gradients of conditions between these discrete states are expected to occur in some systems. Potential transitions between states are shown as arrows and the factors that potentially influence those transitions are identified. Many of the transitions back to desired states represent management hypotheses (indicated in the diagrams as H_m). The conceptual models list the Conservancy's conservation targets and show the hypothesized responses of conservation targets to state or condition changes with a simple qualitative "score" for each target using a green triangle with a "+" to indicate a hypothesized positive response and a red triangle with a "–" to indicate a hypothesized negative response. In addition, some conservation targets are affected by ecological interactions or management actions that are independent of the specific state, which for simplicity are shown in the bottom of only the desired state. Hypotheses, assumptions, and uncertainties are indicated with a "?".

Conceptual Model

The San Joaquin Valley life zone on Tejon Ranch essentially forms a portion of the "bathtub ring" of the last remaining undeveloped land around the southern end of the San Joaquin Valley. The landscape extends from the upper portion of the life zone in the Tehachapi foothills, down across moderately old (Pleistocene Era) alluvial fans and terraces to lower elevation areas supporting more recent (Holocene Era) alluvium. Protruding into this landscape are disjunct, uplifted, old (Tertiary Period) alluvial deposits. The current ecological site model can be generally described as follows (Figure 3-2): Site 1 is higher elevations of the Tehachapi foothills. Site 3 is at the base of the foothills on moderately old alluvial fans. Site 4 comprises older terrace formations exposed in isolated areas along the base of the Tehachapi foothills. Site 2 is more recent alluvium below the alluvial fans and terraces in the lowest elevations of the life zone. Site 5 is less well defined but is associated with soils on rocky granitic outcrops of the Sierran Batholith. Portions of this life zone have been disturbed by past human land uses, which can influence individual plot characteristics and may confound our environmental site models. This is particularly true of Site 3, where disturbances from past agricultural uses, oil exploration, and development of ranching infrastructure are apparent. As discussed above, these sites support different vegetation assemblages, vary in their functional group composition, and exhibit different vegetation dynamics. Sites 1 and 3 are dominated by nonnative annual grasses but appear to support native bulb populations. Sites 2, 4, and 5 can support relatively high cover of native forbs in some years and can provide habitat for a group of special-status San Joaquin Valley wildlife species (i.e., San Joaquin kit fox, blunt-nosed leopard lizard, burrowing owl). Native bulbs, native forbs, and the three special-status San Joaquin Valley wildlife species are conservation targets for these sites. For the purposes of the Conservancy's conceptual models, Sites 1 and 3 are grouped together and Sites 2, 4, and 5 are grouped together.

As nonnative plants (particularly Mediterranean annual grasses) have become established, the potential for higher biomass and RDM conditions at all sites has increased, particularly under certain weather conditions (e.g., wet fall and early winter). High biomass conditions may depress forb germination and habitat quality for special-status San Joaquin Valley wildlife species, but the effect on native bulbs is less clear with some bulb species blooming extensively even in years with high nonnative annual grass biomass. Some nonnative forbs (e.g., *Erodium* spp.) may function adequately as habitat for San Joaquin Valley wildlife species, but others would not or would cause other adverse effects such as altering fire regimes (e.g., *Brassica tournefortii*, *Centaurea solstitialis*). In the San Joaquin Valley life zone, greater forb cover is generally believed to provide a more open structure and higher habitat quality for special-status wildlife targets, and the potential for these conditions is thought to be highest in Sites 2, 4, and 5.

The conceptual model for Sites 1 and 3 is summarized below and illustrated graphically in Figure 3-3. The conceptual model for Sites 2, 4, and 5 is summarized further below and illustrated in Figure 3-4.

Grassland Sites 1 and 3 Model Description

The historical states of the grasslands associated with environmental sites 1 and 3 are unknown but can be hypothesized to consist of a mixture of native forbs and shrub species, depending on local site conditions, potentially with native perennial grasses in mesic locations. Invasion of nonnative annual grasses has produced a transition to a new stable state dominated by the nonnative annual grasses, probably representing a novel ecosystem (Hobbs et al. 2006). This new state appears to have multiple phases with greater or lesser amounts of shrubs. Nitrogen deposition from the Central Valley likely encourages nonnative annual grass dominance, and fire frequency and intensity (which can be affected by the biomass of annual grass) and livestock grazing may mediate the amount and distribution of shrubs. Native bulbs are conservation targets in these sites and may successfully compete with annual grasses but the relationship between annual grass cover and the status of native bulb populations is uncertain. Feral pigs may adversely affect native bulb species via herbivory, but this herbivory may be species-specific and its ultimate effects on native bulb populations uncertain. Controlling pigs is hypothesized to reduce herbivory and benefit native bulb populations.

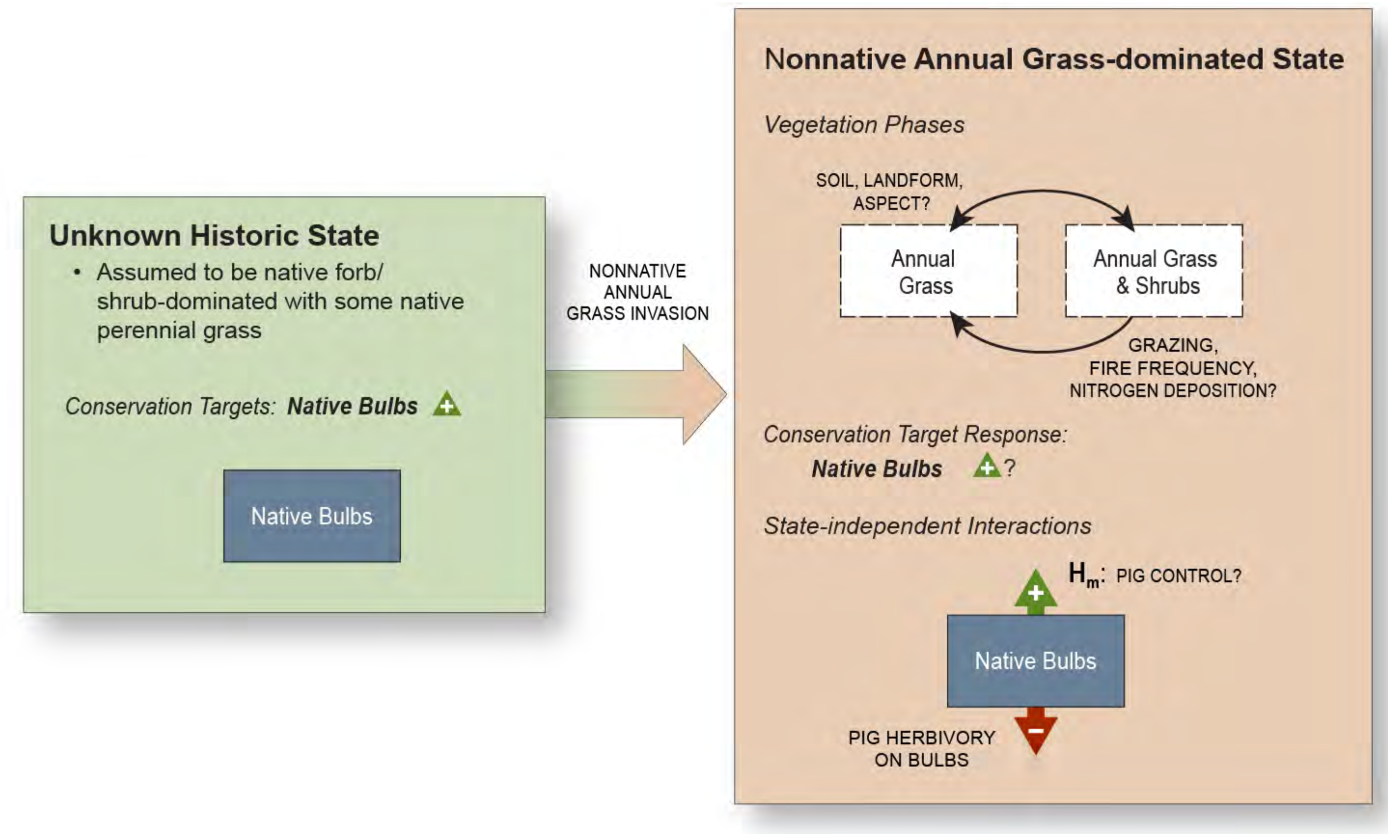


Figure 3-3. Conceptual Model for Grassland Environmental Sites 1 and 3 in the San Joaquin Valley Life Zone

Grassland Sites 2, 4, and 5 Model Description

The potential state and desired condition of the grasslands associated with Sites 2, 4, and 5 is thought to be dominated by native forbs, but potentially had multiple phases with greater or lesser amounts of shrub species. Shrub cover may be driven by edaphic factors (e.g., soils and landforms) and fire and grazing regimes. Invasion of nonnative annual grasses produces a transition to a new (annual grass-dominated) state under certain weather conditions (e.g., high fall precipitation) or livestock management practices (e.g., low grazing pressure) to a state dominated by nonnative annual grasses. Nitrogen deposition from the Central Valley likely encourages nonnative annual grass dominance, and fire frequency and intensity (which can be affected by the biomass of annual grass) and livestock grazing may mediate the amount and distribution of shrubs. Invasive nonnative forbs, such as yellow star-thistle, Saharan mustard, and Russian thistle, have established in some of these sites, producing a new state. Conservation targets in these sites include a suite of special-status San Joaquin Valley wildlife species (e.g., San Joaquin kit fox, blunt-nosed leopard lizard, and burrowing owl), native forbs, and native annual plants that are near-endemic to Tejon Ranch. These conservation targets are hypothesized to be adversely affected by the dense grass cover associated with the annual grass–dominated state and by changes in structure and function of the invasive plant–invaded state. Management, such as increasing grazing pressure to reduce RDM, is hypothesized to facilitate the transition to a forb-dominated state in years when grasses are favored, and all conservation targets are hypothesized to be favored in low biomass conditions. It should be noted that other native species in these sites (e.g., shrubs, invertebrates) may not be favored by low biomass conditions produced by high grazing pressure, and some level of vegetation heterogeneity at these sites is desirable. Controlling invasive nonnative forbs will likely require herbicide treatments, but reducing weed establishment along roads may also reduce invasions. High coyote abundance can adversely affect San Joaquin kit fox, even in the desired vegetation state, but coyote predation is hypothesized to be ameliorated with artificial kit fox burrows or by controlling coyote populations.

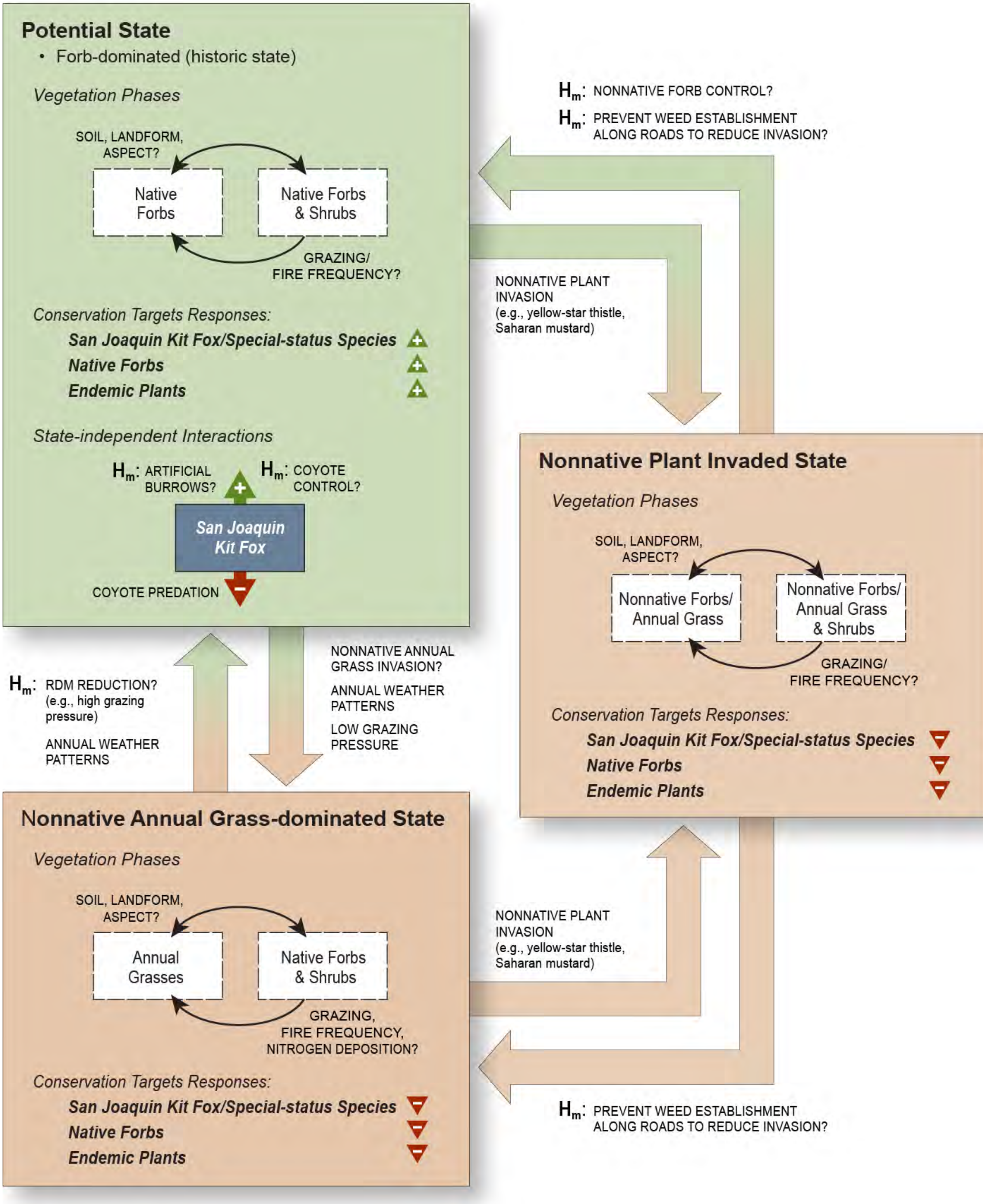


Figure 3-4. Conceptual Model for Grassland Environmental Sites 2, 4, and 5 in the San Joaquin Valley Life Zone

3.1.2 Riparian Vegetation Communities and Wetlands

Riparian systems are those vegetation communities associated with streams and occur in all life zones on Tejon Ranch. Non-riparian wetlands on Tejon Ranch are typically associated with springs or areas with very high groundwater. Consequently, these systems exhibit diverse community composition because of variations in watershed area, elevation, stream gradient, hydrologic regime, soils and channel substrate, adjacent upland communities, and historical and current alterations and impacts from both anthropogenic activities and domestic and feral animals. The extensive ecotones between riparian/wetland systems and adjacent upland vegetation communities enhance biodiversity where they occur (Belsky et al. 1999). Riparian communities vary from relatively narrow corridors or "stringers" to broad alluvial woodlands with water flows that range from ephemeral (e.g., primarily following precipitation events), to intermittent (e.g., seasonal), to perennial (i.e., flowing year-round except possibly during drought years) (Applebaum et al. 2010). Vegetation community structure and composition are often dynamic as a result of frequent disturbance from flooding.

Stream reaches traversing the San Joaquin Valley life zone on Tejon Ranch are high order (i.e., at the lower end of their watersheds) and characterized by low channel gradients. Riparian communities typically have a significant tree species component dominated by western sycamore (*Platanus racemosa*), valley oak (*Quercus lobata*), Fremont cottonwood (*Populus fremontii*), black willow (*Salix gooddingii*), and shining willow (*Salix lucida*), often with lianas of wild grape (*Vitis californica*) reaching into the tree canopy. Common understory species, in addition to those listed above, can include mulefat (*Baccharis salicifolia*), Mexican elderberry (*Sambucus mexicana*), stinging nettle (*Urtica dioica*), wild rose (*Rosa californica*), blackberry (*Rubus ursinus*), poison oak (*Toxicodendron diversilobum*), and red willow (*S. laevigata*) (Sawyer et al. 2009). Before the extensive conversion of the southern San Joaquin Valley to agriculture, San Joaquin streams terminated in "sinks" (e.g., the "Sinks of Tejon") where surface flow ended and infiltrated into the ground. These sinks presumably supported alkali sink vegetation communities or emergent wetlands with species such as tules (*Schoenoplectus acutus*) and California button willow (*Cephalanthus occidentalis*) when sufficient surface water was available. The vegetation composition of San Joaquin wetlands is uncertain, but these systems were likely dominated by sedges (*Cyperus* spp.), spikerushes (*Eleocharis* spp.), rushes (*Scirpus* spp.), seep monkey flower (*Mimulus guttatus*), salt grass (*Distichlis spicata*), Mexican elderberry, and, where there is sufficient water, willows and Fremont cottonwood.

Because of the variation in local environmental attributes, the natural vegetation structure within riparian communities can vary considerably. Canopy cover in the tree-dominated communities can range from continuous to open or intermittent. The shrub layer can range from dense and continuous to sparse or intermittent. The herbaceous layer for all alliances is typically characterized as "variable" and ranges from sparse to grassy, the latter being more common in the more savannah-like sycamore and valley oak alluvial woodlands. Streams entering the San Joaquin Valley life zone from the steep and narrow canyons of the Northern Tehachapi Foothills life zone begin to slow down as their channel gradients decrease. As long as surface water and groundwater (shallow water table) hydrology was sufficient to support them, these lower elevation riparian vegetation communities would be expected to be relatively broad and continuous along the length of the stream with dense understories. Stringers of riparian habitat would also be found in draws in the rolling terrain of the upper portion of the life zone. In stream reaches in which surface discharges decrease (or become more seasonal), a more open habitat would be expected. Currently, the lowest reaches of the major streams that drain from Tejon Ranch into the San Joaquin Valley are largely ephemeral and have very open or no riparian habitat.

Riparian and wetland vegetation communities in the San Joaquin Valley life zone are important to many wildlife species for food, water, and cover. Linear riparian vegetation communities are often important movement corridors for wildlife. They are particularly important to a diversity of avian species for breeding, wintering, and migration habitat. The California Riparian Habitat Joint Venture (RHJV 2004) has identified riparian bird species that require a diversity of riparian habitat characteristics and that have declined from their historical ranges in California, and is using these species as focal species for the group's riparian conservation efforts. The focal species with breeding ranges in the San Joaquin Valley life zone include black-headed grosbeak (*Pheucticus melanocephalus*), Swainson's hawk, yellow warbler (*Setophaga petechia*), song sparrow

(*Melospiza melodia*), least Bell's vireo (*Vireo bellii pusillus*), willow flycatcher (*Empidonax traillii*), warbling vireo (*Vireo gilvus*), and tree swallow (*Tachycineta bicolor*).

Under natural conditions, fluvial (i.e., flooding-related) disturbance can occur regularly, resulting in inundation, soil saturation, and scouring in riparian systems. This disturbance may occur annually, typically in the winter or spring, or even multiple times in a given year, depending on precipitation and runoff patterns. Riparian species are adapted to fluvial processes, and indeed, such disturbance may facilitate regeneration and maintenance of these systems (Vaghti and Greco 2007). Scouring removes accumulated litter and exposes bare wet soil, which is necessary for seed germination and seedling establishment for many woody riparian plants (e.g., sycamore, cottonwood, willow). Many species also readily sprout from broken stems or even pieces of plant (e.g., branches, twigs) that are broken off by the strong flows of flood waters. Flooding and scouring also can thin existing vegetation, thereby preventing the formation of dense stands of aggressive species that can reduce overall plant diversity. The intensity of annual flooding and summer drought can strongly influence species composition in a given location (Ross and Swift 2003). Following disturbances, primary successional or "pioneer" species quickly recolonize, particularly on bare, exposed soils. These species include willows, alders (*Alnus* spp.), cottonwoods, and sycamores. These species generally are fast growing and produce copious litter and debris that facilitate soil development. Secondary successional species, such as valley oak, are more shade tolerant and appear later (Vaghti and Greco 2007). Stream channels were likely very dynamic in these lowest reaches because of periodic flooding, which would have produced a high-disturbance environment and periodically opened up riparian vegetation communities.

Fire was probably only an occasional disturbance factor in regional riparian systems (Potter 2005). The effects of a burn on a given system likely were highly variable, based on variation in patterns of soil moisture and vegetation density (and associated fuel loads). Possibly because of adaptation to frequent fluvial disturbance, many woody riparian plant species crown- or root-sprout after a fire (Sawyer et al. 2009). However, persistent grazing and occasional fires may have also altered species composition and vegetation structure in wetlands and riparian corridors.

Current Conditions at Tejon Ranch

Riparian and wetland vegetation communities in the San Joaquin Valley life zone are some of the most degraded on Tejon Ranch due to the adverse effects of livestock, feral pigs, and nonnative plants. Although impacts of livestock on riparian systems in California have received little attention (Jackson and Bartolome 2007), Belsky and colleagues (1999) provide a detailed review of the impacts that cattle grazing can have in riparian systems. Cattle can reduce or eliminate vegetation, including the complete elimination of rare or palatable species, and can inhibit regeneration by some plant species. Soils bordering riparian areas can be compacted or broken and churned by hoof action, and disturbed areas can then be colonized by nonnative plant species. Morphology of stream banks and beds can be significantly altered by erosion resulting from hoof action or vegetation removal. Watershed runoff can also be altered by changes in vegetation caused by cattle. All of these impacts can adversely affect water quality and reduce habitat quality for wildlife. Because riparian areas offer shade and sometimes the only water available in a pasture, cattle will congregate in some riparian areas, particularly during warmer summer months, substantially degrading the habitat. Kramer Biological (2011) reported that the condition of riparian vegetation communities and wetlands on the ranch decreased in spring as upland forage dried out and livestock and pigs concentrated their activity in these vegetation communities.

The damage to riparian and wetland habitat from feral pigs at Tejon Ranch is potentially more significant than that associated with cattle; although the relative impacts are currently uncertain. Pigs appear to be rooting extensively in wetland and riparian areas in this life zone, causing significant surface disturbance. Pigs are omnivorous and are likely consuming any animal species that they encounter in wetland and riparian areas, including small mammals, ground-nesting birds, lizards, snakes, and possibly salamanders. Pigs appear to be accessing virtually all riparian vegetation communities and wetlands in the life zone. Nonnative bullfrogs (*Rana catesbeiana*) are present in many of the livestock ponds (largely artificial) in this life zone but have not yet been detected in stream systems.

Hydrologic regimes in Tejon Creek and El Paso Creek Ranch have been modified by stream diversions, which reduce discharges in downstream reaches. Groundwater in the southern San Joaquin Valley is pumped for agricultural irrigation and can reduce water tables associated with riparian areas. Some spring systems on Tejon Ranch have been modified as a result of capture and transport of spring flow to livestock water systems or by excavation ("improvement") of the spring into a pond. Watershed hydrology is not well documented on Tejon Ranch, but livestock can alter vegetation composition, compact soils, and destabilization of hillslopes and stream banks. Slopes in the watersheds of Tejon Ranch are often very disturbed and likely exhibit a high amount of sloughing and erosion, and streams appear to have very high loads of fine sediment. The surface water and groundwater hydrology on Tejon Ranch is largely unknown, but watershed and groundwater hydrology in the San Joaquin Valley life zone are hypothesized to have been sufficiently altered relative to historical conditions that riparian vegetation communities have been adversely affected to some degree.

Riparian communities at lower San Joaquin Valley elevations on the Ranch are more structurally diverse and have more species diversity than those in other parts of Tejon Ranch (Applebaum et al. 2010). This diversity may be attributable to the fact that the San Joaquin Valley has a longer growing season, greater flow accumulations (i.e., larger contributory watershed areas), heightened orographic enhancement from northerly low pressure systems, and more persistent stream flows throughout the year than other parts of the Ranch. The riparian vegetation communities in the San Joaquin Valley life zone can typically be characterized as valley oak riparian forest or cottonwood-willow riparian forest, with tree species dominated by Fremont cottonwood, various willow species, valley oak, and western sycamore and extensive lianas of California grape in some reaches. In general, mature trees are present in a structurally complex overstory, but the understory throughout much of the life zone has been reduced or eliminated by cattle grazing or feral pig rooting (Tejon Ranch Conservancy unpublished data). Several nonnative plant species have become established in riparian areas in the San Joaquin Valley life zone, most notably salt cedar (*Tamarix ramosissima*) and various thistles. Stream channels throughout much of the life zone have also been disturbed by cattle and pigs, and many stream reaches and springs appear to have high levels of suspended solids.

Depending on their composition, structure, and condition, riparian vegetation communities can support very diverse wildlife species assemblages. Stream reaches in the San Joaquin Valley life zone support native amphibian species such as California toad (*Bufo boreas halophilus*) and Baja chorus frog (*Pseudacris hypochondriaca*), and have the highest potential to support rare frogs such as foothill yellow-legged frog (*Rana boylii*) and California red-legged frog (*Rana aurora draytonii*) (Live Oak Associates 2011). Bird species are perhaps one of the most diverse groups found in riparian vegetation communities on the Ranch and are important conservation targets in the San Joaquin Valley life zone. Resident bird species characteristic of Tejon Ranch riparian habitats include house wren (*Troglodytes aedon*), barn owl (*Tyto alba*), red-shouldered hawk (*Buteo lineatus*), red-tailed hawk, California quail, and mourning dove (*Zenaida macroura*). Common migratory riparian breeding birds include Bullock's oriole (*Icterus bullockii*), ash-throated flycatcher (*Myiarchus cinerascens*), and western kingbird (*Tyrannus verticalis*), and numerous species utilize riparian vegetation communities for wintering (e.g., yellow-rumped warbler [*Dendroica coronata*]) or during spring migration (e.g., Wilson's warbler [*Cardellina pusilla*], yellow warbler, MacGillivray's warbler [*Oporornis tolmiei*]). The Tehachapi Mountains are considered to be in an important migratory flyway (White et al. 2003), and the canyons and riparian vegetation communities on Tejon Ranch appear to be used extensively by spring migrants in particular (see discussion of the Antelope Valley life zone). Riparian vegetation communities are important for mule deer and carnivores, such as bobcat and mountain lion, as well as other upland grassland species. Given the poor riparian structure in many places on the Ranch, ground-nesting or understory bird species, in particular, are believed to be faring poorly in riparian vegetation communities in this life zone; however, no direct evidence supports this hypothesis. Native songbird diversity has been shown to decline as salt cedar dominance increases (Holmes et al. 2003), and removal of salt cedar and restoration of native habitat can increase bird diversity (Taylor and McDaniel 1998).

Desired Conditions and Management Approaches

Desired Conditions

The Conservancy does not adequately understand the range and drivers of riparian-wetland plant community composition and structure across Tejon Ranch. However, the conditions of riparian and wetland systems in the San Joaquin Valley life zone are believed to be poor because of excessive grazing of understory vegetation and physical disturbance (trampling and rooting) of channels and springs by livestock and feral pigs. Trampling and rooting lead to elevated erosion and geomorphic changes that are observed in numerous wetland and riparian areas in this life zone. The structure of the habitat and the channel or spring head have been significantly altered; in some areas, understory vegetation has been completely eliminated, springs and channel bottoms often churned and trampled, stream banks collapsing in some areas, and head-cutting observed at some springs. Coarse woody debris on channel banks and floodplains, which provide cover for wildlife, are constantly turned and rooted by feral pigs. Water quality appears low in some reaches because of high loads of suspended solids. In addition, invasive nonnative plants such as salt cedar, figs, and various thistles have become established in some stream reaches, sometimes in high abundance. The riparian vegetation communities in the San Joaquin Valley life zone have a good diversity of native tree species, and there is a good cover and structure in higher levels of the canopy, although continued removal of seedlings and saplings by livestock and pigs from understory layers may ultimately reduce recruitment of individuals to overstory layers. In general, the desired conditions are those that would be present without excessive disturbance from livestock and feral pigs, including dense understory vegetation, undisturbed stream channels, and intact spring systems, as well as an absence of invasive nonnative plant species.

Management Approaches

Riparian restoration can be implemented in an active or passive manner (NRC 2000). Active restoration involves practices such as bank stabilization, installation of water control structures, planting or seeding native species, and in some case irrigating plants while they are establishing. Such restoration activities may produce quick responses but may not produce self-sustaining, functioning ecosystems, particularly where extensive grade changes or water control structures are required or where the stressors leading to the degraded condition have not been controlled. Passive restoration removes sources of stress, allowing resilient riparian and wetland systems to recover through natural processes (Kauffman et al. 1997). Passive restoration is considered a logical and necessary first step in any restoration program. For instance, passive restoration of overgrazed stream corridors by excluding or restricting livestock is a common practice (Kauffman et al. 1997, NRC 2000). Numerous examples are available of rapid recovery of riparian vegetation following exclusion of livestock from stream corridors (Schulz and Leininger 1990, Elmore and Kauffman 1994). However, Belsky and colleagues (1999) suggest that initiation of recovery can take as long as 15 years. Fencing to exclude cattle has been proposed to protect sensitive riparian areas within the Carrizo Plain National Monument (U.S. Bureau of Land Management 2010) as well as the Bitter Creek National Wildlife Refuge (NWR) (U.S. Fish and Wildlife Service 2012). It is also important to note that fencing to manage livestock access to riparian areas is quite different than fencing to exclude feral pigs. Pig fencing to protect riparian and wetland areas is much more expensive and difficult to install and maintain than barbed wire for cattle.

Unlike grassland systems, where grazing may confer benefits such as suppression of nonnative plants, few such benefits are associated with grazing in riparian systems. Indeed, Belsky and colleagues (1999) conducted an extensive review of grazing impacts to stream and riparian vegetation communities and identified no positive impacts or ecological benefits that could be attributed to livestock activities. Bock et al. (1993) and Saab et al. (1995) concluded that bird abundance and diversity generally decline in grazed riparian vegetation communities, with ground-nesting species most affected. Bird abundance and diversity have been strongly linked to shrub density and structural diversity in riparian vegetation communities (Taylor 1986). However, Elmore and Kauffman (1994) and Hobbs and Norton (1996) argue that periodic cattle grazing can maintain riparian habitat structure (e.g., maintain a shrubby condition), and Jackson and Allen-Diaz (2003) concluded that light to moderate grazing on spring-fed wetlands and associated creeks can maintain cover and increase plant diversity. Timing and intensity of livestock grazing are the key elements that determine whether the net effects are positive or negative.

Approaches to control of nonnative plant species include mechanical or hand removal, herbicides, controlled burns, controlled flooding, and biological controls (NRC 2000). Control techniques tend to be species specific, but in most cases mechanical and hand removal, in combination with herbicide applications, are believed to be the primary control techniques for most species. For example, cut-stump herbicide applications to salt cedar are believed to be the preferred control method for this species. Concomitant with protection and restoration efforts is the prevention of further invasion by aggressive nonnative plant species. Native songbird diversity declines as tamarisk dominance increases (Holmes et al. 2003). Removal of tamarisk along with the restoration of native species on a 159-acre site on the Bosque del Apache NWR resulted in the number of native bird species almost doubling (Taylor and McDaniel 1998). The Wind Wolves Preserve adjacent to Tejon Ranch has documented nesting least Bell's vireo and other special-status birds following enhancement of riparian condition.

Conceptual Model

Riparian vegetation communities in the San Joaquin Valley life zone are typically associated with low gradient, higher order stream reaches with variable hydrology. Geomorphology of stream channels, floodplains, and the composition of associated vegetation communities were structured by hydrologic regimes, including periodic overbank flooding during the winter and spring. The composition and structure of wetlands associated with spring systems were largely determined by spring hydrology. The Conservancy has done little work to characterize riparian or wetland systems, but historical riparian vegetation communities were likely woodlands with multiple vertical layers and dense understories, and this is the desired condition for these systems. Spring-fed wetlands were more variable but dominated by low-growing herbaceous species with little overstory. High livestock grazing intensity, such as can occur during drier summer and fall months, can reduce the cover of understory riparian vegetation and herbaceous wetland vegetation. The loss of understory cover is hypothesized to adversely affect ground- and understory-nesting bird species in riparian vegetation communities. Feral pig rooting disturbs stream channels and adjacent floodplains; while pigs may not reduce understory vegetation cover, they may increase predation intensity on riparian wildlife such as ground-dwelling reptiles and amphibians (herpetofauna). Invasive nonnative plant species, such as salt cedar, can invade vegetation communities regardless of understory or channel conditions.

Disturbing spring-fed wetlands may affect native plant species diversity and susceptibility to invasion by nonnative plant species.

The conceptual model for riparian vegetation communities is summarized below and illustrated graphically in Figure 3-5.

Riparian Vegetation Communities Model Description

The potential state and desired condition of riparian vegetation communities is one with a vegetation structure appropriate to the site, which in this life zone is assume to include and intact understory community, channel bed, and floodplain. Excessive livestock grazing, particularly in the dry season, is hypothesized to cause a transition to a degraded state with reduced understory cover. Pig rooting and predation cause a transition to another degraded state with a disturbed channel and floodplain, as well as high predation rates on ground-dwelling species in channel and floodplain areas (e.g., certain herpetofauna). Invasion of some nonnative plants, such as salt cedar, produce a third degraded state dominated by these nonnative species. Conservation targets in riparian habitats include ground-nesting birds, understory-nesting birds, and riparian wildlife species such as reptiles and amphibians. Understory- and ground-nesting birds are assumed to be adversely affected in the reduced riparian understory state. Ground-nesting birds and riparian wildlife are assumed to be adversely affected by pigs in the disturbed channel and floodplain state. All conservation targets are assumed to be adversely affected in the nonnative plant invaded state. Managing livestock grazing to reduce grazing pressure (e.g., by rotating livestock out of pastures that support riparian vegetation or excluding them with fences), controlling pigs, and controlling nonnative invasive plants are assumed to facilitate transitions from degraded states to the desired state.

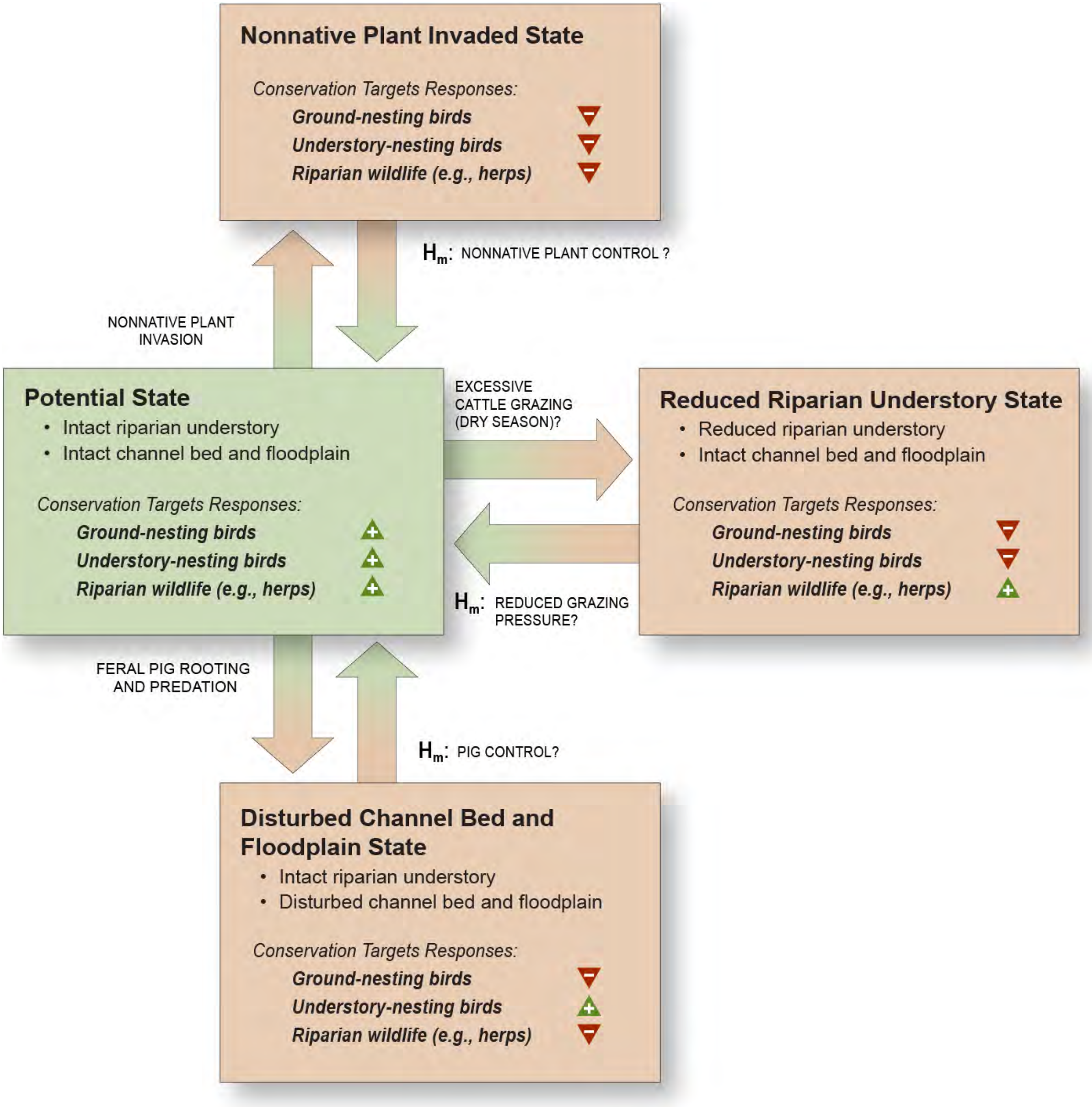


Figure 3-5. Conceptual Model for Riparian Vegetation Communities in the San Joaquin Valley Life Zone

3.2 Antelope Valley

The Antelope Valley life zone on Tejon Ranch, the westernmost portion of the Mojave Desert, is a mosaic of herbaceous communities, shrublands, Joshua tree woodlands, desert riparian vegetation communities, and spring-fed wetlands. The western Antelope Valley is also an area of convergence of multiple ecological regions, namely, the Sierra Nevada, Southwestern California, and the Mojave Desert, with biological elements of all these regions represented (White et al. 2003). Thus these lands encompass considerable biological diversity and a regional community composition that defies easy classification. Indeed, Twisselmann (1967) described these communities as "among the most difficult to define." Climate in the Antelope Valley is largely Mediterranean, with most precipitation falling in the winter as rain but snow is common. The life zone has a diverse geology and terrain, extending from lower elevation alluvial fans and bajadas up to rolling hills underlain by granitic basement rock. Faults associated with the Garlock and San Andreas systems have created numerous spring systems. Diverse riparian vegetation communities are associated with nearly every canyon, and wetland vegetation communities are scattered along higher elevation terraces in this life zone. Edaphic conditions in the Antelope Valley life zone vary spatially with elevation, aspect, landforms, and soil types and underlying geology. Conditions become more mesic with increased elevation, with more northerly or easterly aspects, and apparently at the western end of the life zone. Consequently, natural communities apparently range from arid landscapes dominated by characteristic desert species, such as Joshua tree (*Yucca brevifolia*), California juniper (*Juniperus californica*), and other Mojave Desert shrubs, to more mesic areas that support perennial grasslands or mixed shrublands.

The western Antelope Valley has a long history of human land uses. Lake Elizabeth and Willow Springs just east of the Ranch were stopping points on *El Camino Viejo de Los Angeles*, which connected Los Angeles to northern California through the San Joaquin Valley. Tejon Canyon was a well-used travel route over the Tehachapis between the Antelope and San Joaquin valleys. Vegetation maps of the area prepared in 1935 show extensive areas of the valley floor and alluvial fans under cultivation (Wieslander Vegetation Type Mapping Project 2012), including some areas of Tejon Ranch. Pronghorn (*Antilocapra americana*), for which the Antelope Valley was named, were locally extirpated by the late 1800s. Tejon Ranch supports a significant representation of the extreme western Antelope Valley, although predominantly the higher elevation terraces associated with the foothills of the Tehachapis. This life zone comprises more than 35,000 acres of grasslands and shrublands, which are traversed by numerous desert washes and dotted with springs and seeps. Elevations in the Antelope Valley life zone range from about 3,000 feet to nearly 5,500 feet.

3.2.1 Uplands

The original structure and composition of vegetation communities in the western Antelope Valley are uncertain because, by the time detailed descriptions began, anthropogenic impacts (e.g., livestock grazing) and invasion by nonnative species were extensive and had significantly altered composition (Randall et al. 1998, Minnich 2008). Considerable diversity in plant community composition and structure has persisted in the Antelope Valley life zone on Tejon Ranch, despite extensive anthropogenic impacts in the region and invasion by nonnative species. Twisselmann (1967) characterized vegetation in the "Arid Shrub Association" as being "open" but with a dense cover of xerophytic shrubs and subshrubs, particularly California buckwheat (*Eriogonum fasciculatum* var. *polifolium*), on some of the slopes. Other characteristic species are Joshua trees, bladderpod, golden bush (*Ericameria linearifolia*), and rabbitbrush (*Ericameria nauseosus*). The steeper, sandy slopes generally have little growth in dry years, but in wet years they are covered with colorful desert annuals (forbs). These characterizations may be more appropriate for the more arid, eastern portion of the life zone. Twisselmann intimated that vegetation communities became even less well defined and more intermixed toward the western portion of the Antelope Valley with increased prevalence of bunch grasses, particularly desert needlegrass (*Stipa [Nassella] speciosa*).

As previously discussed, there is a great deal of uncertainty regarding the original composition of grassland in California prior to European settlement, and this includes the western Antelope Valley. Some information is available from the observations of early explorers (e.g., Hamilton 1997, Minnich 2008), and according to Minnich (2008), the most frequent historical accounts of bunch grassland in California were from the Antelope Valley. Drier portions of the Antelope Valley were described by early visitors as having a gravelly surface with occasional “tufts of bunch grass” (Minnich 2008). However, the Antelope Valley also experienced spectacular wildflower displays in some years, and such displays still occur, particularly in years of heavy precipitation following multiple dry years (Minnich 2008). Like other arid-region grasslands, the Antelope Valley grasslands appear to be a non-equilibrium system (Spiegal and Bartolome 2012), and annual species composition can dramatically fluctuate from year to year. Herbaceous vegetation of the western Mojave Desert is similar to that of central and southern California, and the Antelope Valley supports some of the most extensive native perennial grasslands in the Mojave Desert (Keeler-Wolf 2007). These native perennial grasslands are dominated by *Stipa* spp. and one-sided bluegrass (*Poa secunda)*. Keeler-Wolf (2007) suggests that native perennial grasslands may be maintained by disturbances from grazing and fire, and may shift to a shrub-dominated vegetation (e.g., golden bush and California buckwheat alliances) with reduced disturbance. Wells (1961) found that desert needlegrass was dominant in disturbed areas where shrubs were slow to recolonize. However, Rowlands (1995) reports a decline of native perennial grasses in the western Mojave Desert and an increase in Joshua trees that could be associated with disturbance from livestock grazing and an increase in perennial grasses in Joshua Tree National Monument following removal of livestock (Rowlands 1978).

Biological soil crusts are a community of cyanobacteria, green algae, lichens, fungi, liverworts, and mosses that live on the surface of soils, particularly in arid regions. Biological soil crusts are associated with important processes in desert soils, such as soil stabilization, fertility, water relations, organic matter accumulation, and seedling establishment (Belnap et al. 2001). Little is known about biological soil crusts in the Antelope Valley, but they are patchily distributed in other parts of the Mojave Desert and dominated by algae and cyanobacteria (St. Clair et al. 1993, Pietrasiak et al. 2011a). Pietrasiak and colleagues (2011a) found that biological soil crusts at Joshua Tree National Park in the Mojave Desert were associated with coarse, sandy-gravelly soils derived from granitic geology. Physical disturbance from vehicles, foot traffic, and livestock grazing have been shown to reduce the cover of biological soil crusts (Pietrasiak et al. 2001b), which can take decades to recover (Belnap et al. 2001).

The wildlife species of the western Antelope Valley before European settlement have not been well documented; however, the valley was named for herds of pronghorn that formerly roamed the valley. Characteristic wildlife of the Antelope Valley include gopher snake, red racer (*Masticophis flagellum*), side-blotched lizard, Blainville’s horned lizard (*Phrynosoma blainvillii*), desert night lizard (*Xantusia vigilis*), yellow-backed spiny lizard (*Sceloporus uniformus*), Scott’s oriole (*Icterus parisorum*), black-chinned hummingbird (*Archilochus alexandri*), ladder-backed woodpecker (*Picoides scalaris*), greater roadrunner (*Geococcyx californianus*), loggerhead shrike (*Lanius ludovicianus*), California quail, southern grasshopper mouse (*Onychomys torridus*), Panamint kangaroo rat (*Dipodomys panamintinus*), and white-tailed antelope squirrel (*Ammospermophilu leucurus*). Large numbers of horned larks (*Eremophila alpestris*), mountain bluebirds (*Sialia currucoides*), lark sparrows, and white-crowned sparrows winter in Antelope Valley grasslands, as do smaller numbers of ferruginous hawks, rough-legged hawks (*Buteo lagopus*), and prairie falcons (*Falco mexicanus*).

Historically, surface fuel loads have been low in this life zone, and fire spread has been limited by a lack of horizontal fuel continuity (DeFalco et al. 2009, Brooks and Matchett 2006, Brooks and Minnich 2006). In shrub communities, pre-European fire rotation intervals have been estimated to range from 610 to 1,440 years (Safford et al. 2011). This may be an overestimate for the western Mojave, where intervals appear to have been short enough to select for a form of Joshua tree (*Yucca brevifolia* forma *herbertii*) capable of resprouting after fire (Keeler-Wolf 2007). However, it is not clear that the *herbertii* form actually benefits from fire and, given the underlying fuel dynamics, fires are unlikely to have been frequent or severe (Baumgarten et al. 2012). Fire regimes in the Antelope Valley life zone may be altered by the spread of nonnative annual grasses. Elsewhere in the Mojave, species such as cheatgrass (*Bromus tectorum*) are creating a continuous layer of fine fuel cover, thereby facilitating fire spread. Because these species regenerate quickly and are adapted to a high-frequency, high-severity fire regime, their spread can lead to a self-perpetuating cycle of increased fire, followed by more abundant populations of nonnative annual grasses. In parts of the Mojave, this cycle has advanced so far that invasive annual grasses form a majority of plant biomass (Brooks et al. 2011, Cole et al. 2011, DeFalco et al. 2009, Brooks and Matchett 2006, Brooks 2000) that can also adversely affect desert wildlife species (Esque et al. 2003, Vamsted and Rotenberry 2009).

Current Conditions at Tejon Ranch

Of the 16 species aggregations identified for grasslands on Tejon Ranch, four of these aggregations occur in the Antelope Valley life zone (Table 3-3), including two phases of the *Erodium brachycarpum-Calystegia malacophylla-Hirschfeldia incana* aggregation (Spiegal and Bartolome in prep.). All four of the species aggregations in this life zone were defined as native, with native cover averaged over 3 years exceeding 30% for all aggregations. This is in contrast to the San Joaquin Valley, where the maximum average native cover of any species aggregation is 25%. Species aggregations in the Antelope Valley tend to have a higher cover of forbs and native grasses relative to the San Joaquin Valley, and exotic grasses tend to be less prevalent. Also of note was the relatively high abundance of the native annual grass small fescue (*Festuca* [*Vulpia*] *microstachys*) in the Antelope Valley life zone.

Table 3-3. Species Aggregations in the Antelope Valley Life Zone

Species Aggregation	Native/ exotic	Native cover	Exotic forb	Exotic grass	Native forb	Native grass	Native shrub
Bromus tectorum-Coreopsis bigelovii-Eriogonum fasciculatum-Gilia sp.-*Layia glandulosa-Eriogonum* sp.-*Lupinus bicolor-Gilia capitata-Chaenactis xantiana*	native	79%	14%	4%	63%	1%	12%
Erodium brachycarpum-Calystegia malacophylla-Hirschfeldia incana (*Calystegia malacophylla* phase)	native	26%	35%	38%	5%	21%	0%
Erodium brachycarpum-Calystegia malacophylla-Hirschfeldia incana (*Hirschfeldia incana* phase)	native	26%	35%	38%	5%	21%	0%
Festuca microstachys-Erodium cicutarium-Eschscholzia californica-Stipa cernua	native	42%	51%	7%	12%	28%	0.3%
Uropappus lindleyi-Achnatherum speciosum-Heterotheca sessiliflora ssp. *echioides-Poa secunda* ssp. *secunda*	native	32%	27%	37%	22%	7%	0.5%

Notes: Species aggregations are named for species identified as indicators in the species indicator analysis. Percentages are relative cover values averaged across all plots over 3 years. Native species aggregations have a relative cover of native species of 20% or more.

Source: Spiegal and Bartolome 2012

While Spiegal and Bartolome (2012) also characterized the grasslands in the Antelope Valley life zone as non-equilibrium systems, species aggregations in this life zone over the 3 years of the study are very stable. Out of 22 possible transitions (11 plots in the life zone x 2 years available to transition), only a single transition was observed. However, the relative abundance of species within a species aggregation at a given plot can vary substantially from year to year. In particular, functional group composition can vary inter-annually at the plot scale, with annual grass cover increasing in some years (although never reaching the relative cover of annual grass in the San Joaquin Valley).

Spiegal and Bartolome (2012) have classified the areas of Tejon Ranch mapped as grasslands into nine environmental sites, and four of the environmental sites are located in the Antelope Valley life zone (Figure 3-2). These four sites are as follows:

Site 6. *Antelope Valley, flat Holocene surficial sediments.* This site is on flat, sandy, low-elevation soils derived from recent alluvial sediments with low pH.

Site 7. *Southern Tehachapi Mountain-La Liebre Mountain, steep slopes on granitic and dioritic rocks.* This environmental site is on steep, sandy slopes at higher elevations. Soils appear to be derived from decomposing granitic and dioritic rocks.

Site 8. *Antelope Valley, anthropogenically disturbed soils.* This environmental site is represented by a single plot, which may have been disturbed during construction of the California Aqueduct. This site is not considered further at this time.

Site 9. *Antelope Valley, moderate slopes on Pleistocene surficial sediments.* This environmental site is represented by a single plot in the far southeastern portion of the Ranch. It is located on a moderately sloping, older alluvial terrace, with high nutrient and calcium concentrations.

All environmental sites in this life zone support one or more of the native species aggregations discussed above. Native grasses were most abundant at Sites 6 and 9 (each represented by one plot only), and exotic grasses were most abundant in Site 7 (Table 3-4). Total forb cover (native and nonnative) was almost always greater than total grass cover. Shrubs were present in Sites 7 and 9 but not in Site 6. Nonnative mustard (*Hirschfeldia incana*) is distributed extensively through the lower elevation grasslands at the western end of the Antelope Valley life zone and appears to be expanding east (White personal observation).

Table 3-4. Average Relative Cover of All Plots Within Environmental Sites 6–9

Site	Year	Total Native	Native forb	Exotic forb	Native grass	Exotic grass	Native shrub
6	2010	0.34	0.17	0.42	0.14	0.21	0.00
	2011	0.40	0.11	0.23	0.28	0.33	0.00
	2012	0.22	0.06	0.61	0.13	0.16	0.00
	Average	*0.32*	*0.11*	*0.42*	*0.19*	*0.23*	*0.00*
7	2010	0.56	0.48	0.16	0.02	0.25	0.06
	2011	0.48	0.39	0.10	0.05	0.37	0.02
	2012	0.39	0.28	0.29	0.03	0.32	0.05
	Average	*0.48*	*0.38*	*0.18*	*0.03*	*0.31*	*0.04*
9	2010	0.38	0.20	0.56	0.14	0.06	0.00
	2011	0.84	0.25	0.08	0.53	0.07	0.02
	2012	0.39	0.17	0.41	0.13	0.18	0.03
	Average	*0.54*	*0.21*	*0.35*	*0.26*	*0.10*	*0.02*

Note: Site 8 was dropped from the discussion.

Extensive areas of Mojavean shrubland, which can include significant grass and forb components, occur in a mosaic with grasslands in the Antelope Valley life zone. While the factors that control the relative distributions of grasslands and shrublands are unclear, shrubs may tend to be more abundant on older terraces than on lower elevation areas of recent alluvium, which is consistent with the presence of shrubs in environmental sites 7 and 9 but not Site 6 (Table 3-4) (Spiegal and Bartolome in prep.). In a review of grazing effects on Mojave Desert plant communities, Rowlands (1995) stated that heavy livestock grazing favored shrub cover over herbaceous cover. Although characterizations of environmental sites did not extend into shrub communities, the assumption is that shrub-dominated plant communities occupy environmental sites distinct from sites that support grasslands. While quantitative assessments have not been conducted of the composition of these shrub communities, they generally comprise California buckwheat, rabbitbrush, golden bush, Mormon tea (*Ephedra viridis*), desert needlegrass, various annual buckwheat species (*Eriogonum* spp.), Acton encelia (*Encelia actoni*), and California juniper (*Juniperus californica*). Joshua trees occur in a woodland habitat in draws between older alluvial terraces and mixed with shrubs such as manzanita (*Arctostaphylos* spp.), California junipers, cottonthorn (*Tetradymia stenolepis*), desert almond (*Prunus fasciculata*), and antelope bitterbrush (*Purshia tridentata*) in isolated stands on rocky hills. The size structure of Joshua trees, particularly where they occur in woodland settings, is skewed toward smaller, reproductively immature individuals (Tejon Ranch Conservancy unpublished data), and there is evidence that Joshua trees are expanding their distribution on the Ranch (Applebaum et al. 2010). While the fire regimes before European contact are not well understood, the communities in this life zone on Tejon Ranch are believed to be within their desired fire recurrence interval.

The Conservancy has conducted or sponsored several wildlife surveys across the Conserved Lands on Tejon Ranch (Cypher et al. 2010, Live Oak Associates 2011, Kramer Biological 2011). Common reptiles in the grasslands include gopher snake, red racer, side-blotched lizard, and the special-status Blainville's horned lizard. In areas with rock outcrops or logs, western fence lizard (*Sceloporus occidentalis*), Pacific rattlesnake (*Crotalus oreganus*), and Mojave rattlesnake (*Crotalus scutatus*) are common, and desert night lizard (*Xantusia vigilis*) and yellow-backed spiny lizard (*Sceloporus uniformus*) are abundant in Joshua trees. Common mammals in the life zone include antelope ground squirrel (*Ammospermophilus leucurus*), pocket gopher, Panamint kangaroo rat, woodrats (*Neotoma* spp.), coyote (*Canis latrans*), and black-tailed jackrabbit (*Lepus californicus*). Common birds in these grasslands include horned lark, western meadowlark, and common raven, with high numbers of lark sparrows in spring. Where shrub cover is higher, California quail and loggerhead shrike (*Lanius ludovicianus*) increase in abundance, and white-crowned sparrow, savannah sparrow, and lark sparrow can be abundant in these vegetation communities in spring. In Joshua tree vegetation communities, house finch (*Haemorhous mexicanus*) and cactus wren (*Campylorhynchus brunneicapillus*) are common.

Two special-status mammals, Tehachapi pocket mouse and badger, are present in this life zone; the Tehachapi pocket mouse relies on shrublands (Cypher et al. 2010) and the badger is thought to prefer grasslands. The special-status burrowing owl is also present as a winter resident and migrant in scattered locations along the low elevations of the life zone, and the colony adjacent to the mouth of Big Sycamore Canyon consistently supports high numbers of individuals. Burrowing owls prefer a very open vegetative structure, which is present in the Site 6 grasslands that they occupy in this life zone. LeConte's thrasher (*Toxostoma lecontii*), a California Species of Special Concern, occurs in small numbers in areas of sparse shrub cover with a few larger shrubs (PRBO 2012).

The Antelope Valley life zone also supports the southern-most population of pronghorn in California. Between 1985 and 1987, a total of 91 pronghorn from the Modoc Plateau were reintroduced to Tejon Ranch (Kunkel 2013), with an eventual target population size of 150–200 animals on the Ranch. Minimum pronghorn counts on Tejon Ranch since 1995 have been in the range of 28–46, with 37 individuals counted in 2011. Pronghorn life history information and habitat use on Tejon Ranch are not well known, but pronghorn require a significant forb component in their diet and vegetation cover for fawning. Forbs are a significant component of the grassland cover in this life zone, but vegetation cover for pronghorn fawning may be inadequate in some portions of this life zone.

Desired Conditions and Management Approaches

The Antelope Valley life zone supports the most native grassland communities found on Tejon Ranch, which are exemplary from a regional and statewide perspective as well. These grassland communities support high relative cover of native forbs and native grasses (e.g., cheatgrass and red brome) but also exhibit significant increases in cover of nonnative annual grasses in some years. Nonnative mustard has also invaded these grasslands, primarily at the western end of the life zone, and anecdotally appears to be expanding its distribution in wet years. The desired condition for these grasslands is high native cover and, in particular, low cover of nonnative annual grasses and invasive forbs such as shortpod mustard (*Hirschfeldia incana*). The structure of vegetation maybe shorter statured than is ideal for pronghorn, and some ecological sites may have once supported higher shrub cover than exists today.

Desired Conditions

Quantitative metrics of grassland condition have been developed for two species of conservation interest in this life zone. For burrowing owls, RDM levels of less than 1,000 lbs/ac at the end of the growing season have been recommended (U.S. Bureau of Land Management 2010). A maximum herbaceous vegetation height of about 30 cm (12 in) has been suggested as suitable for burrowing owls (Rosenberg et al. 2009), and ground cover averaging 45% has been proposed as optimal (Klute et al. 2003). For pronghorn, RDM levels of more than 1,000 lbs/ac constitute good habitat conditions, while levels of 500–1,000 lbs/ac constitute fair conditions and levels of less than 500 lbs/ac constitute poor conditions (Yoakum 1980). However, the applicability of RDM as a condition metric for native perennial grasslands is unclear. In pronghorn fawning areas, herbaceous vegetation height of 38–64 cm (15–25 in) over 80% of the area has been suggested as optimal (Allen et al. 1984, U.S. Bureau of Land Management 2010). Similarly, Yoakum (1980) suggested that vegetation height throughout pronghorn habitat should not exceed 61 cm (24 in) and that a mean height of 38 cm (15 in) was preferred. Areas where mean annual vegetation height is 76 cm (30 in) or greater generally are avoided. Additionally, patches of shrubs are recommended for fawning areas, with a target of 5–30% shrub cover (U.S. Bureau of Land Management 2010). For foraging, forbs and woody browse (i.e., shrubs) are preferred in all seasons while use of grasses is minimal (O'Gara 1978, Yoakum 1980, U.S. Bureau of Land Management 2010). With regard to vegetation composition and density, habitat conditions may be optimal when the proportion of grass is 40% or less and the proportion of bare ground is approximately 50% (Yoakum 1980).

Management goals for native plants are more equivocal. It is generally assumed that native plant species are suppressed by competition from nonnative grasses, and that the abundance of natives will increase when released from this competition. This seems to be the case when the biomass of nonnative grasses is reduced by burning (Parsons and Stohlgren 1989, Zaninovich 1992, York 1997). However, a clear positive response by native plants to competitive release has not been demonstrated when grazing is used as a management tool.

Ecosystem management over tens of thousands of acres must be conducted on a landscape scale, and this narrows options considerably. Livestock grazing and fire likely constitute the only viable alternatives for modifying or managing vegetation in this region (Jackson and Bartolome 2007), particularly in steeper terrain (Stephens and Ruth 2005). Both strategies have associated strengths and weaknesses.

Management Approaches

Fire

Among the strengths of using fire as a management tool is the fact that results are achieved rapidly and the beneficial effects can last for more than a single year (Reiner 2007). Burning potentially can decrease the cover of nonnative grasses and increase the abundance of forbs and geophytic plants, particularly following repeated fire treatments (Reiner 2007). Fire appears to effectively reduce nonnative grass cover for a period of 1–4 years after burning (Parsons and Stohlgren 1989, D'Antonio et al. 2002), and native annuals can exhibit a positive response to this reduced competition (Reiner 2007, Sawyer et al. 2009). Zaninovich (1992) reported that spring wildflower displays in the San Joaquin Valley were noticeably more intense following burns, as has been noted in many grassland locations as well (Reiner 2007). The effects of burning on perennial bunchgrass are somewhat equivocal. Dyer (2002) found that seeds from burned purple needlegrass plants germinated and survived at a higher rate than seeds from unburned plants. Similarly, Marty and colleagues (2005) found that purple needlegrass seedling density was 100% higher in burned plots; however, adult density still had not recovered to pre-burn density after 4 years.

However, this management tool also includes a number of significant risks. First and foremost is the fact that fire can escape control, and when it does so, it can threaten human life, cause property damage, and adversely affect fire-sensitive vegetation communities. Fire also can cause direct mortality to animals and plants, including sensitive species, and may favor some nonnative species, such as cheatgrass. As mentioned earlier, some woody plant species in the Antelope Valley life zone are not fire adapted and therefore particularly susceptible to burning. Although some native shrubs in Antelope Valley communities can resprout following fire (e.g., rubber rabbitbrush), other species have low (e.g., California buckwheat) or no (e.g., California juniper) fire adaptation, and intense or repeated burning can locally eliminate shrubs (Minnich 2008, Sawyer et al. 2009). Juniper stands in particular once were much more abundant in the Antelope Valley, but stand-replacing fires have converted many to communities dominated by annual grasses or other shrubs (e.g., California buckwheat, rubber rabbitbrush) (Sawyer et al. 2009). Mature Joshua trees can survive most fires but are killed by intense or repeated burning (Gucker 2006, Sawyer et al. 2009). The Joshua tree form (*Y. b.* forma *herbertii*) that occurs in the Antelope Valley region tends to be more of a low growing, rhizomatous form that resprouts well following fire (Webber 1953, Keeler-Wolf 2007). Also, Sawyer et al. (2009) reported that fire can constitute a disturbance that potentially increases the abundance of nonnative grasses (e.g., cheatgrass) in an ecosystem. One of the most significant threats to desert shrub communities is the increase in fire frequency associated with invasions of nonnative annual plants, and increasing fire frequency in these vegetation communities on the Ranch is not a recommended management strategy (Baumgarten et al. 2011).

Grazing

Grazing can be conducted using various types of livestock, although cows and sheep are most common. Several months may be required before desired management effects (e.g., reduction of RDM) are achieved. Also, although grazing can be an effective tool for reducing nonnative grasses, the soil disturbances associated with livestock generally produce more suitable conditions for these same grasses (D'Antonio et al. 2007, Minnich 2008, Sawyer et al. 2009). Furthermore, as alluded to previously, grazing can adversely affect shrubs, even to the point of local extirpation. Cheatgrass is a common and increasing problem in many arid grasslands. To control cheatgrass, Jimerson et al. (2000) recommended using a multifaceted approach: fall burning to expose soil and destroy the seed bank, grazing when seed heads are developing and green, and reseeding with native plants. Grazing in perennial grasslands may benefit forbs but results are unclear, especially in these desert grasslands. Edwards (1992) cites examples where grazing in perennial grasslands presumably promoted spring wildflower displays. Hayes and Holl (2003) examined 25 paired grazed and ungrazed plots in coastal grasslands and found that native annual forb abundance and diversity were higher in grazed plots. However, nonnative grasses and forbs also were more abundant in grazed plots, while abundance of native perennial grasses was similar between treatments, and abundance of native perennial forbs was higher in ungrazed plots. Likewise, Marty et al. (2005) also reported that abundance of perennial grasses did not differ among grazing treatment plots, including ungrazed plots. Grazing also can inhibit recruitment of woody plants, particularly junipers (Sawyer et al. 2009). Young seedlings tend to be vulnerable due to low height and generally high palatability. It is worth noting that pastures in this life zone are large, making targeted grazing regimes for conservation management challenging.

Conceptual Model

The Antelope Valley life zone forms the westernmost extension of the Mojave Desert and supports grassland and desert shrublands and Joshua tree woodlands. In the current model, grassland environmental sites appear to be associated with landforms of distinct geologic origin and soil properties. Site 6 is associated with recent alluvial deposits, Site 9 with older alluvial terraces, and Site 7 with steeper slopes and eroding granitic geology. The states of these grasslands before European settlement are unknown, and additional research is needed to better define potential vegetation states in these environmental sites; however, the grasslands in this life zone still have a substantial native component. Conservation targets include native grasses and forbs and a population of pronghorn. Functional group cover can exhibit significant inter-annual variation that creates less desirable conditions. In particular, nonnative annual grass cover increases in some years, and nonnative forb species, primarily shortpod mustard, are invading this life zone, especially in Site 6. Reducing nonnative plant species and enhancing native plant species is a high priority, but the desired mix of native plant species to be targeted is unknown. Grazing management is hypothesized to have the ability to enhance natives by reducing the cover of nonnative annual grasses, particularly in years with favorable weather conditions.

Grasslands on Sites 6 and 9 also provide important habitat for a herd of pronghorn that use this life zone, but the herd appears to be suffering from low fawn recruitment. Much of Site 7 may be considered unsuitable as habitat for pronghorn because of its steep topography. Pronghorn fawn recruitment may be limited on Sites 6 and 9 by lack of vertical cover or potentially by disturbance from steers stocked at this life zone in the spring. The location of pronghorn fawning areas on Tejon Ranch is unknown, but they likely require grassland vegetation communities with native perennial bunchgrasses and shrubs that provide vertical structure that conceal fawns. Grazing may reduce the vertical structure of these environmental sites and reduce their suitability for fawning. Disturbances to fawning females may occur in years when steers are stocked at these environmental sites during pronghorn fawning season.

The factors that drive the composition, structure, and distribution of Mojave Desert shrublands and Joshua tree woodlands have not been quantified. The distribution and composition of these communities in the Antelope Valley life zone have likely been affected by historical grazing practices and potentially by changes in climate and fire regimes. Conservation targets include the endemic Tehachapi pocket mouse, Joshua tree, and the native shrubs themselves. These communities support varying levels of nonnative annual grass cover, which could increase fire frequency, eventually shifting the community toward a nonnative annual grass–dominated state where conservation targets fare poorly.

Grassland Model Description

The historical or potential state of these grasslands is unknown. The desired condition associated with environmental sites 6, 7, and 9 is thought to be one dominated by native forbs and grasses, but there may have been multiple phases with greater or lesser amounts of shrub species depending on edaphic factors (e.g., soils and landforms) and fire and grazing regimes. Invasion of nonnative annual grasses and nonnative forbs, such as mustard, produces a transition under certain weather conditions or livestock management practices to a state dominated by these nonnative species. Livestock grazing is hypothesized to have the potential to produce a transition to an annual grass-dominated state by reducing cover of native grasses and shrubs. Conservation targets in these sites include native forbs, native grasses (including native perennial bunchgrasses and native annual grasses), and pronghorn. These conservation targets are adversely affected by changes in structure and function of the invasive plant–invaded state. Native grasses and pronghorn may be adversely affected by changes in vegetation composition and structure in the nonnative grass-dominated state. In addition, physical disturbance by livestock is hypothesized to have the potential to adversely affect pronghorn, particularly fawning females, regardless of state. Managed grazing is hypothesized to have the ability to facilitate transitions to the desired state by reducing nonnative annual grass abundance and improving structure for pronghorn fawning. Control of invasive nonnative forbs may be achieved via herbicide treatments.

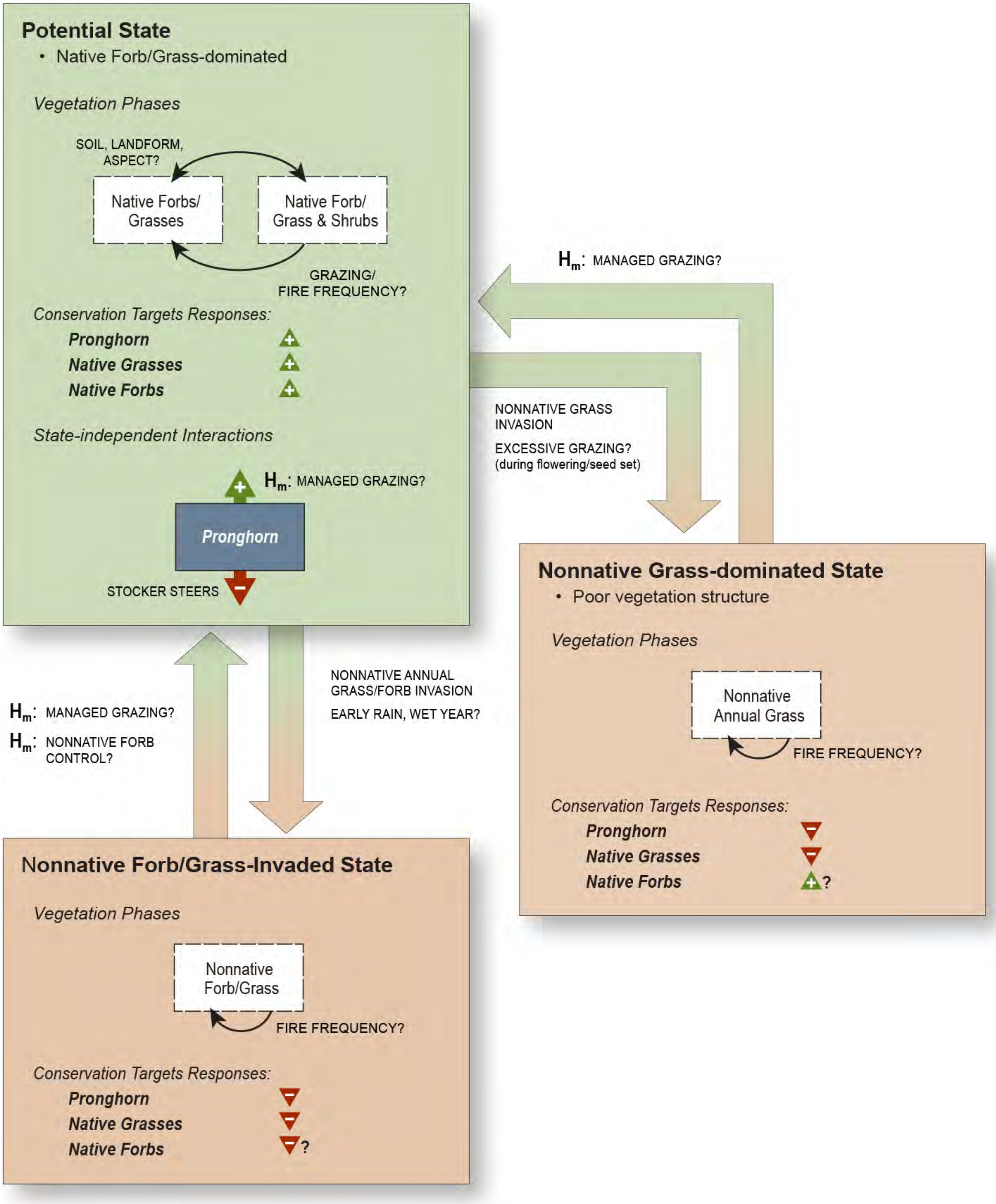


Figure 3-6. Conceptual Model for Grassland Environmental Sites 6, 7, and 9 in the Antelope Valley Life Zone

Mojave Desert Shrublands and Joshua Tree Woodlands Model Description

The historical composition of this system is unknown but is thought to consist of multiple phases with Joshua trees forming a woodland structure in one phase and shrubs dominating in another. The specific composition and distribution of these phases are likely driven by the geophysical setting of the site but potentially also are a product of changing climates and the history of grazing, and fire regimes. The potential or desired state has native forbs and grasses in the herbaceous layer under or around shrubs and Joshua tree stands. Invasion of nonnative annual grasses can modify the composition of the herbaceous layer, increase the fuel load, and potentially increase fire frequency in these communities, creating a transition to a new state where native shrubs and Joshua trees are replaced by nonnative annual grasses that are favored under frequent fire regimes. Conservation targets in these sites include Tehachapi pocket mouse, Joshua trees, and native shrubs. These conservation targets are adversely affected by the shift to nonnative annual–dominated conditions following grass invasion and increased fire frequencies. Management hypotheses to facilitate a transition from the nonnative annual–dominated state to the desired state include managed grazing to reduce annual grass cover and active shrub restoration where shrub cover has been reduced.

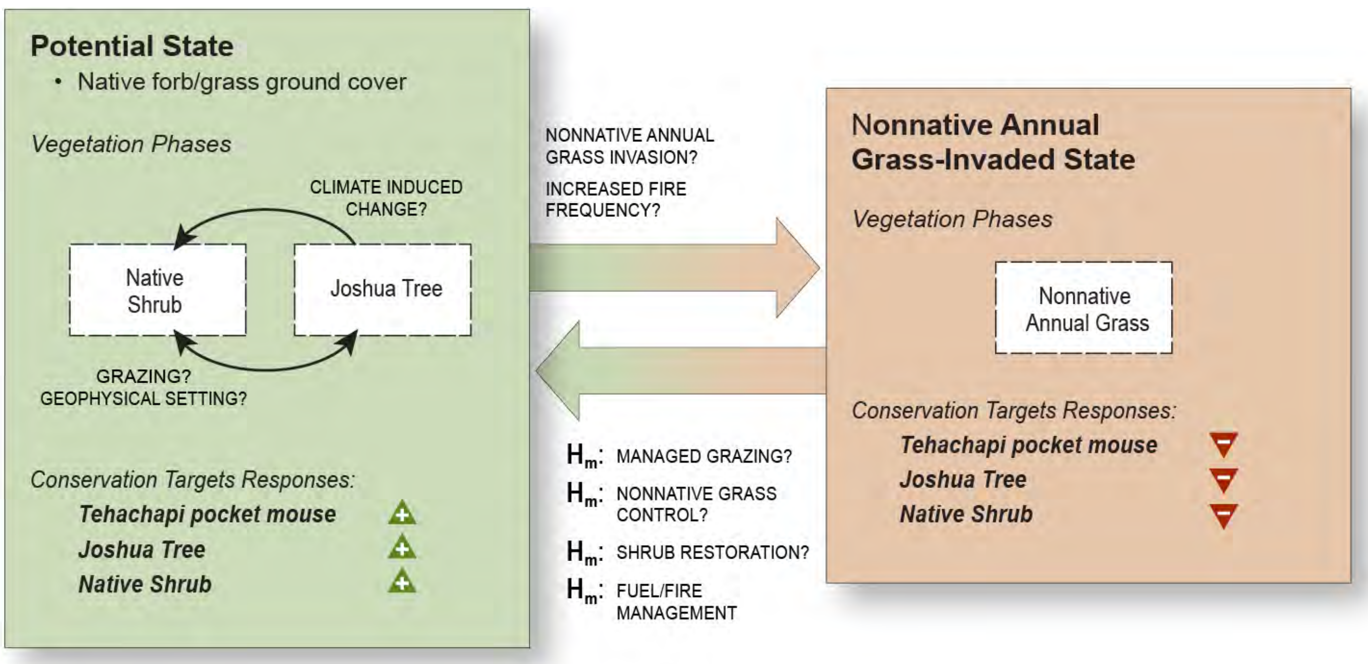


Figure 3-7. Conceptual Model for Mojave Desert Shrublands and Joshua Tree Woodlands in the Antelope Valley Life Zone

3.2.2 Riparian Vegetation Communities and Wetlands

Mojave Desert–draining watersheds on Tejon Ranch are generally smaller than those draining to the San Joaquin Valley. Stream reaches traversing the Antelope Valley life zone are of high order and have low channel gradients. Few perennial stream reaches are present in this life zone, but numerous perennial springs flow varying distances down-gradient from their spring heads. At a small scale, the drainage networks in the Antelope Valley life zone can be complicated because of the extensive amount of rolling terrain controlled by underlying, texturally degraded granitic bedrock. Springs are common in the draws of this rolling terrain as well as at contact zones of the granitic bedrock and overlying meta-sedimentary roof pendants that are common along this side of the Tehachapis. In very wet years, flooding in this life zone can be extensive, particularly across the extensive floodplains and bajadas at its western end (Atkinson pers. comm.). Stream channel geomorphology varies extensively in the Antelope Valley life zone, ranging from the broad alluvial channel of Big Sycamore Canyon to narrow channels in unnamed draws.

Riparian plant communities in the Antelope Valley life zone are extremely diverse, including valley oak riparian woodland, sycamore alluvial woodland, Fremont cottonwood-willow woodland, and willow scrub. While much less common than on the San Joaquin Valley side of the Ranch, valley oaks do occur on the Antelope Valley side of the Ranch and are most often found scattered along draws and canyon bottoms. They can be an important riparian tree in some drainages in this life zone, such as Los Alamos and Cottonwood creeks. Western sycamores are common in broader alluvial valleys such as Big and Little Sycamore canyons, and Fremont cottonwoods and willows are scattered in drainages across the life zone wherever surface water is adequate. Arroyo willow (*S. lasiolepis*) is a common willow species in drainages in the Antelope Valley life zone (Magney 2010), and they form extensive willow scrub vegetation communities in valleys such as Sacatara Canyon. Springs and seeps are dominated by sedges, spikerushes, seep monkey flower, and cattails (*Typha* spp.).

Current Conditions at Tejon Ranch

Riparian and wetland vegetation communities in this life zone have particularly high habitat value because of the arid nature of the landscape. However, the wetlands associated with perennial springs have been severely degraded by livestock and feral pigs. Cattle and feral pigs make extensive use of Antelope Valley wetland vegetation communities, and pigs are commonly seen at springs in summer. Physical disturbance from trampling and rooting, loss of vegetation cover, slumping channel banks, and spring head cutting have been documented in this life zone (Tejon Ranch Conservancy unpublished data). Nonnative plants such as horehound (*Marrubium vulgare*) have become established along some drainages, especially in areas where livestock appear to congregate. However, the relative adverse effects of pigs and cattle on these vegetation communities are uncertain.

No surface water diversions are present in this life zone, but cattle have access to all springs and many springs have been "improved" into ponds for cattle watering. Watershed hydrology is considered relatively natural. There have been few human improvements; the headwaters of many of these drainages support dense vegetation and are fairly inaccessible to livestock. Groundwater hydrology is unknown, but shallow groundwater is clearly an important source of surface discharge in springs and some stream reaches.

Desert riparian and wetland vegetation communities provide important water, food, and cover resources for wildlife species. Bird species are perhaps one of the most diverse groups found in riparian vegetation communities on the Ranch and are an important riparian conservation target in the Antelope Valley life zone. The Tehachapi Mountains are located in an important migratory flyway (White et al. 2003). The Conservancy has noted extensive use of desert riparian vegetation communities by migratory birds in spring. Spring migrants include large numbers of Wilson's warblers, yellow warblers, MacGillivray's warblers, warbling vireos (*Vireo gilvus*), white-crowned sparrows (*Zonotrichia leucophrys*), Bullock's orioles, black-headed grosbeaks, and blue grosbeaks (*Passerina caerula*), and many of these species rely on shrubby riparian vegetation communities and understory vegetation for cover and foraging. Bullock's orioles and black-headed grosbeaks remain on the Ranch and breed in riparian vegetation communities. Other common resident birds include house finches, house wrens, European starlings, oak titmice, and mourning doves. Conservancy biologists have detected several reptile and amphibian species that use riparian (particularly spring-associated) wetlands, including western toad, Baja chorus frog, and two-striped garter snake (*Thamnophis hammondi*). Riparian vegetation communities are also important for mule deer and carnivores such as bobcat and mountain lion, as well as other upland/grassland wildlife species. Springs are likely important water sources for many terrestrial wildlife species, such as pronghorn, although many wildlife guzzlers have been developed by TRC in the Antelope Valley life zone.

Desired Conditions and Management Approaches

The Conservancy does not adequately understand the range and drivers of riparian and wetland plant community composition and structure across this life zone. Given that stream hydrology tends more toward intermittent and ephemeral in this life zone, rather than perennial as in the San Joaquin Valley, riparian vegetation communities in this life zone may not have the ability to support the same density and diversity of understory species as the San Joaquin Valley. However, conditions in many of these vegetation communities in the Antelope Valley are believed to be poor because of excessive grazing and physical disturbance by cattle and pigs. Riparian vegetation communities generally have a good species diversity and overstory cover; understory cover is inadequate in some reaches, however, and channels have been disturbed and degraded and appear to be down-cutting in some reaches. Populations of nonnative plants, most notably horehound, have become established in some drainages. Wetlands associated with springs and meadow systems in this life zone are by far the most degraded, experiencing extreme physical disturbance, removal and rooting of vegetation, and head cutting. The desired condition for these systems is what would occur in the absence of excessive herbivory and disturbance associated with livestock and feral pigs, including increased understory vegetation structure and diversity, intact channel geomorphology, and undisturbed spring systems.

Previously discussed riparian and restoration approaches are also applicable in this life zone. Eliminating or reducing the use of riparian and wetland vegetation communities by livestock and feral pigs is considered a necessary first step to restoring these vegetation communities. Eradication of nonnative invasive plants will likely require active restoration to ensure that native vegetation communities recover once nonnatives are removed.

Conceptual Model

Refer to the riparian conceptual model for the San Joaquin Valley life zone (Figure 3-5).

3.3 Northern Tehachapi Mountains Foothills

The Tehachapi Mountains comprise the major land form on Tejon Ranch, and the foothills of the Tehachapis form an extensive life zone on the Ranch, encompassing more than 60,000 acres. Foothill vegetation communities are mid-elevation, ranging from 2,100 feet to about 5,000 feet. The terrain in this life zone is variable, consisting of rolling hills on the flanks of major ridges but with areas that can be quite steep. Likewise, aspect is extremely variable, setting up strong gradients of soil moisture and insolation across the landscape that can influence ecological processes and vegetation characteristics. Stream systems follow the valleys between major ridges and springs are scattered throughout the foothills. The Tehachapi foothills experience a Mediterranean climate; unlike the San Joaquin Valley, however, this life zone receives regular snowfall during winter months. Radiation fog (tule fog) and hoar frost may be sources of moisture in these vegetation communities.

Vegetation in the Tehachapi Mountains foothills is similar to that found in the foothills of the Sierra Nevada and Coast Ranges. Upland areas are characterized by woodlands comprising several oak species, and the life zone is traversed by numerous stream and riparian systems. Vegetation composition and structure vary considerably depending on elevation and aspect. Oak communities range from open-structured savannahs to dense woodlands and forests. Vegetation composition, except perhaps for herbaceous species, is expected to be annually less dynamic than in the adjacent San Joaquin Valley life zone. One exception is the mast crop (acorns) of oaks, which can fluctuate dramatically from year to year, often driving population responses of mast-dependent wildlife. The oak woodlands in this life zone provide important habitat for various wildlife species, including cavity-nesting birds, game species such as mule deer, and roosting and foraging habitat for California condor.

3.3.1 UPLANDS

The oak woodlands in this life zone are dominated by valley (*Quercus lobata*), blue (*Q. douglasii*), and canyon live (*Q. chrysolepis*) oaks, but include scattered stands of interior live oak (*Q. wislizenii* var. *frutescens*), California buckeye (*Aesculus californica*), and foothill pine (*Pinus sabiniana*). The composition and structure of these communities before the time of significant modern anthropogenic disturbance is unknown. The earliest detailed botanical descriptions were pre-dated by extensive invasion by nonnative grasses (and associated increased fire frequency) and by intensive livestock grazing. Among the earlier community descriptions, Bauer (1930) generally described Tehachapi Mountain foothill woodlands as having an open structure and forming park-like savannahs, but growing in dense stands in more favorable sites. The oak-dominated woodlands were characterized by a diversity of species and "character," including numerous grasses and herbs, and "layered societies," possibly suggesting well-developed canopy, shrub, and herbaceous layers. Herbaceous communities were thought to have consisted of perennial grasses, perennial forbs (e.g., *Brodiaea* spp.), and some native annual forbs (Holmes 1990). Bauer indicated that, in blue and valley oak woodlands, a "characteristic" understory was formed by a diversity of shrubs. Holmes (1990) reported that understory shrub communities were likely absent in many oak woodlands as a result of Native American fire management practices. In canyons and deeper ravines, canyon live oak formed dense stands, sometimes excluding all other species including shrubs and herbaceous plants.

However, Bauer (1930) also noted that most communities were already significantly affected by human land uses by that time. Intensive grazing occurred from valley grasslands up to high-elevation conifer forests. Also, ranchers commonly set fires in the fall to improve forage for livestock. Bauer asserted that these practices were facilitating invasion by nonnative plants and were responsible for the relative lack of shrubs and the openness of the understory. In oak woodlands, only relatively unpalatable species, such as Sierra gooseberry (*Ribes roezelii*), were still common. Biswell (1954) described shrub encroachment into oak woodlands as a result of fire and grazing management practices that occurred after European settlement. Bauer also noted an absence of oak regeneration that he attributed to young oaks being heavily grazed.

Based on more contemporary descriptions (Allen-Diaz et al. 2007, Sawyer et al. 2009), oak woodland communities are characterized by canopies that are open or intermittent to continuous. Blue, valley, and interior live oak communities commonly are "park-like" or form savannahs, whereas canyon live oak stands tend to be dense. Shrub layers can be sparse to intermittent. Herbaceous cover can range from sparse, particularly under dense canyon live oak canopies, to intermittent or grassy with seasonal forbs. Nonnative annual grasses have become a significant component of oak woodland understories (Allen-Diaz et al. 2007).

Oak woodlands provide some of the most important wildlife habitat in California (Pavlik et al. 1991). More than half of the 632 terrestrial vertebrate species in California use oak woodlands for breeding, foraging, or cover (Giusti et al. 2005). Structural diversity, including snags, cavities, and downed wood, provides varied microhabitats. Asynchronous production of acorns by different oak species can provide abundant food resources during fall and early winter when other resources are in short supply (Pavlik et al. 1991, Koenig et al. 2009). Oak woodlands are particularly rich in bird species (Verner 1980), and cavity-nesting birds such as acorn woodpecker, violet green swallow (*Tachycineta thalassina*), ash-throated flycatcher (*Myarchus cinerascens)*, western bluebird (*Sialia mexicana*), white-breasted nuthatch (*Sitta carolinensis*), oak titmouse (*Baeolophus inornatus*), house wren (*Troglodytes aedon*), northern flicker (*Colaptes auratus*), and Nuttall's woodpecker (*Picoides nuttallii*) are among the most common oak woodland birds. The Tehachapi Mountain foothills are among the few parts of California where purple martin (*Progne subis*) nest in natural oak cavities (White et al. 2011). Various raptors and owls, such as golden eagle, red-tailed hawk, Cooper's hawk (*Accipiter cooperii*), American kestrel (*Falco sparverius*), western screech owl (*Megascops kennicottii*), California spotted owl, great horned owl (*Bubo virginianus*), and barn owl (*Tyto alba*) use oaks for nesting. Oak woodlands are also very important roosting and foraging habitat for California condors. Mule deer, mountain lions, and bobcats all rely on oak woodland habitat.

Regeneration of oaks (i.e., replacement of individuals lost to mortality) (Tyler et al. 2006) is considered by some to be too low to sustain the extent of woodlands in California (Allen-Diaz et al. 2007). However, other research suggests that regeneration is not a problem (Tyler et al. 2006). Recruitment for many oak species, particularly blue and valley oaks, is characterized as "naturally low" (Bolsinger 1989, Muick and Bartolome 1987). Blue oak regeneration may be naturally episodic and dependent on various interrelated factors (Mensing 1992, Swiecki et al. 1997b). However, it is not clear whether such characterizations reflect current conditions or whether low regeneration was surmised to be a natural condition. Considerable evidence suggests that low regeneration is a contemporary problem (Muick and Bartolome 1987, Tyler et al. 2006, Allen-Diaz et al. 2007) that is at least partially the result of long-term livestock grazing in oak woodlands (Giusti et al. 2005), although many other factors (e.g., competition with nonnative grasses; herbivory and seed predation by insects, rodents, gophers, and deer) can contribute to lack of regeneration (Tyler et al. 2006). Davis and colleagues (2011), using long-term experimental data, concluded that valley oak population growth was limited more by rodent herbivory and digging and ungulate browsing on established seedlings and saplings than by oak fecundity, acorn survival, or seedling establishment. Low regeneration rates are most problematic for deciduous species at low elevations and on south- and west-facing slopes, and live oaks appear to have generally higher levels of regeneration than deciduous species (Allen-Diaz et al. 2007).

Oak regeneration is dependent on surmounting a variety of ecological challenges. Acorns, and to a lesser extent seedlings, are highly desirable food items for a variety of species. Also, nonnative grasses can reduce suitability for acorn germination and seedling establishment (Gordon et al. 1989). Mensing (1992) surmised that oak regeneration and establishment depends on abundant acorn production, escape from acorn predation, sufficient rainfall, protection from desiccation during germination, limited competition from other plants for light and water, and escape of seedlings and saplings from browsers and burrowing gophers. Acorns are dispersed short distances by gravity and longer distances by birds and mammals (Sawyer et al. 2009). Competition from dense grass can cause complete regeneration failure (Allen-Diaz et al. 2007). Some oaks only produce significant numbers of acorns every 2–3 years, and many species "mast" only every 5–8 years. In masting, trees of a given species in a given location produce large acorn crops that can overwhelm seed predators, thereby increasing the likelihood that some acorns will escape predation to successfully germinate and establish.

Acorns typically germinate in response to fall and winter rains. Seedling mortality from browsing by livestock and wild herbivores tends to be high. Insects, rodents, deer, and livestock have all been identified as agents of seedling mortality (Tyler et al. 2006). In a study of 1,500 plots widely distributed throughout blue oak communities, Swiecki et al. (1997b) found that livestock browsing intensity was negatively associated with the presence of oak saplings. However, removal of livestock does not necessarily result in increases in oak recruitment (White 1966, Callaway 1992a). Stands that have escaped recent major disturbance usually have trees of various sizes and ages (Sawyer et al. 2009).

Seedlings of oak species differ with respect to their shade tolerance and association with shrubs and tree canopies. Valley oak seedlings appear more likely to occur in the open rather than under tree canopy (Muick and Bartolome 1987; Swiecki et al. 1997a, 1997b), and facilitation of valley oak seedling growth by shrubs was not detected (Callaway 1992a, 1992b). In contrast, blue oak seedlings are more likely to be found under shrub or tree canopy (Muick and Bartolome 1987, Swiecki et al. 1990, Callaway and D'Antonio 1991). Swiecki et al. (1997a, 1997b) postulated that this is an adaptive strategy to exploit canopy openings. Seedlings are "released" by overstory mortality and quickly fill the gap. Shrubs may provide shelter from herbivores for blue oak seedlings (Callaway and D'Antonio 1991, Callaway 1992a).

Fire regimes in oak woodland before European settlement are difficult to quantify but were likely regular and of low intensity as a result of Native American land management practices (Baumgarten et al. 2012). In some areas, Native Americans may have set fires annually to remove shrubs, promote herbaceous understory vegetation, or influence development of particular branching structures for basketry or other uses (Anderson 2006). McClaran and Bartolome (1989) estimated pre-contact fire rotation intervals at about 25 years, which were shortened to 7 years after European settlement. Mensing (1992) proposed that many species may have evolved under a regime of low-severity grassland fires with intervals of 8–14 years. The invasion of oak woodland ecosystems by nonnative annual grasses was likely associated with this change in fire regime. Accumulated thatch from these grasses significantly increased fuel loads, resulting in hotter burns that can cause greater mortality among oaks. Seedlings and saplings less than 10 years old are particularly vulnerable (Bartolome et al. 2002, Swiecki and Bernhardt 2002). Mature oak trees survive low-intensity surface fires and young trees readily resprout after burning (Allen-Diaz et al. 2007). Most of the oak species on Tejon Ranch typically sprout prolifically after fire from dormant buds located under tree bark and on root crowns (Sawyer et al. 2009). However, hot burns can kill oaks, including mature trees, particularly if fire reaches the crown. Frequent fires, particularly in combination with annual grazing, can eliminate oak regeneration, convert woodlands to shorter and shrubbier stands, and even eliminate stands completely (White and Sawyer 1995, Bartolome et al. 2002, Swiecki and Bernhardt 2002, Keeley 2006, Sawyer et al. 2009). There is some evidence that oak recruitment may be associated with fire events (McClaran and Bartolome 1989). This evidence indicates that oak recruitment in the Sierran foothills was associated with a period of high fire frequency, but the apparent increase in oaks following fires may actually represent resprouting of top-killed individuals. However, fire may facilitate oak recruitment by removing annual grasses that compete with seedlings for resources and reducing herbivore populations.

Feral pigs constitute another novel, contemporary disturbance for oak woodlands. Pigs have multiple ecosystem impacts but affect oaks most directly through predation on acorns and uprooting of seedlings (Sweitzer and Van Vuren 2002, Sweitzer and Van Vuren 2009). Pigs also can affect sensitive plant and animal species through habitat disturbance caused by rooting and direct predation (Jolley et al. 2010). The actual effects of such activities on oak regeneration warrant further investigation to determine the level of severity and long-term impacts. For example, pigs definitely consume considerable quantities of acorns (Loggins et al. 2002, McCreary 2012). However, McCreary (2012) found that pig rooting was not related to acorn or oak seedling abundance, and oak seedlings were found in the bare ground created by rooting. Also, food habit studies indicate significant predation by pigs on gophers, voles, and California ground squirrels, all of which are predators on acorns and oak seedlings (Loggins et al. 2002, Wilcox and Van Vuren 2009). Singer and colleagues (1984) also noted that understory plants in hardwood stands were absent where wild pigs root regularly.

Current Conditions at Tejon Ranch

In partnership with the Bren School of Environmental Sciences and Management at the University of California, Santa Barbara, the Conservancy investigated the composition, structure, and condition of three oak woodland types on Tejon Ranch. Using data collected from permanent plots, Hoagland and colleagues (2011) characterized the oak size structure, seedling and sapling density, and understory composition of blue, valley, and black oak (*Q. kelloggii*) woodlands on Tejon Ranch. Black oak results are discussed below for the Montane life zone (Section 3.5).

Consistent with the distribution of oaks in other parts of California (Allen-Diaz et al. 2007), the distribution of oaks on Tejon Ranch is associated with elevation and slope orientation (or amount of insolation). Blue oaks are most abundant at elevations between about 1,300 and 4,000 feet. They tend to occur on north-facing slopes at lower, drier elevations and on south-facing slopes at higher, wetter elevations. Valley oaks exhibit a bimodal elevational distribution; they are more abundant in valley bottoms between 1,300 and 2,600 feet and on ridges between 4,000 and 5,700 feet. Thus, the upper range of valley oaks on Tejon Ranch extends into the Montane life zone.

On average, blue and valley oak woodlands on Tejon Ranch appear to be better stocked (total basal area [ft^2] of trees per acre of land area) and generally support larger diameter individuals when compared to these woodland types statewide (Hoagland et al. 2011). Both seedlings and saplings of blue and valley oaks were detected in the Tejon Ranch plots (Table 3-5). Although the density of blue oak seedlings was very low compared to valley oak seedling density, the sapling density was higher for blue oaks. The average density of blue oaks was nearly twice that of valley oaks, but given the larger size of valley oaks, the average stocking of valley oaks was nearly twice that of blue oaks (Table 3-5). Hoagland and colleagues (2011) also noted that understory composition in blue and valley oak plots was dominated by grasses and forbs; valley oak woodlands had an average shrub cover of 1.6%, while blue oak woodlands had an average shrub cover of only 0.1%.

Table 3-5. Average Stocking Rate and Densities of Blue and Valley Oak Woodlands				
Woodland Type	**Stocking (ft^2/ac)**	**Seedling Density (No./acre)**	**Sapling Density (No./acre)**	**Tree Density (No./acre)**
Blue oak	31.4	1.4	3.1	23.1
Valley oak	57.5	20.1	1.7	12.4
Source: Hoagland et al. 2011				

Using historical (1952) and recent (2009) aerial photographs, Hoagland and colleagues (2011) estimated oak recruitment and mortality rates, and from these demographic parameters they calculated population growth rates. Although mortality rates were generally estimated to be low, the population growth rates calculated for both species were slightly declining. Over long time frames, these slow population declines can lead to significant population losses. For example, using the population growth rate calculated by Hoagland and colleagues, the blue oak population on the Ranch was estimated to decline by 9.3% over 50 years (Hoagland et al. 2011). However, the photographic analysis required tracking the fate of trees in low-density stands (as opposed to denser woodlands), and these rates may not be representative of population growth rates across Tejon Ranch.

Conservancy biologists have observed areas of Tejon Ranch that exhibit high levels of valley oak recruitment, often associated with a dense rabbitbrush shrub community. Stunted saplings in these areas show obvious signs of heavy, repeated browsing by herbivores, but some individuals eventually release and grow above browse heights. Hoagland and colleagues (2011) established four plots in one of these areas and found valley oak sapling density to be an order of magnitude higher than in an average valley oak plot. The association of valley oak saplings with high shrub cover was suggested to be a result of protection from herbivores (Hoagland et al. 2011); however, there is little evidence for this relationship in valley oaks in the literature. In one relevant study, Williams and colleagues (2006) found that "cropped" valley oak saplings were protected from herbivory in nonnative blackberry thickets and allowed to grow into taller saplings. However, Williams and colleagues (2006) also noted that oaks often form stands of cropped and stunted individuals and that these individuals may be able to quickly increase in height when browsing pressure is reduced. Thus, while the stunted valley oaks seen in parts of Tejon Ranch may receive some protection from the rabbitbrush, this association is uncertain. The area sampled by Hoagland and colleagues is within the Garlock Fault zone, and high groundwater elevations may be partially responsible for the high density of saplings in that area but oak regeneration is also evident on Tejon Ranch outside of fault zones.

Oak woodlands are important habitats for a wide variety of wildlife in California (Pavlik et al. 1991). Three lungless salamander species occur under rocks and woody debris in this life zone: black-bellied salamander (*Bactrachoseps nigriventris*), Tehachapi slender salamander (*B. stebbinsi*), and yellow-blotched ensatina (*Ensatina eschscholtzii*). The latter two are considered special-status species. Reptiles common in the Northern Tehachapi Mountain Foothills life zone include gopher snake, striped racer (*Masticophis lateralis*), and, when rocks or logs are present, western fence lizard and Pacific rattlesnake. Many of these species may be subject to predation by feral pigs.

Bird surveys conducted in oak woodlands by the Conservancy suggest that the avian community varies somewhat by oak woodland type. In blue oak woodlands, house finch, house wren (*Troglodytes aedon*), mourning dove (*Zenaida macroura*), oak titmouse, western bluebird, lazuli bunting (*Passerina amoena*), and western scrub jay (*Aphelocoma californica*) are common residents, as is the nonnative European starling (*Sturnus vulgaris*). Valley oak woodlands tend to support similar bird species as blue oaks with the addition of acorn woodpecker and white-breasted nuthatch, particularly at higher elevations, and also support western wood-pewee (*Contopus sordidulus*) and ash-throated flycatcher in the breeding season. Golden eagles are abundant in this life zone; since the inception of the Tejon Ranch Christmas Bird Count, Tejon Ranch has had among the highest counts of wintering golden eagles in the United States (Audubon 2012). Oak woodlands in this life zone support a high diversity of cavity-nesting bird species, including the special-status purple martin. White and colleagues (2011) documented 17 species of cavity-nesting birds, with acorn woodpecker being the most frequently encountered and abundant species. Large trees in this life zone, generally valley oaks, are used for roosting by California condors, which forage throughout this and adjacent life zones on Tejon Ranch.

The Tehachapi Mountains are considered the last area of California supporting a significant population of purple martins nesting in natural oak cavities (Williams 2002). The Conservancy has documented about two dozen purple martin nests in 2010 and 2011 located in large valley oaks on the tops of ridges (White et al. 2011). Purple martin is a special-status species in California primarily because of concerns over its decline in the face of increasing numbers of European starlings in the state. While European starlings are common in oak woodlands on Tejon Ranch, they appear not to be abundant in areas used for nesting by purple martins (White et al. 2011), although the distribution and potential adverse effects of European starlings on Tejon Ranch bird species requires more research.

Common mammals include pocket gopher, woodrat, western gray squirrel (*Sciurus griseus*), mule deer (*Odocoileus hemionus*), gray fox (*Urocyon cinereoargenteus*), bobcat (*Felis rufus*), and mountain lion. A population of nonnative Rocky Mountain elk became established on Tejon Ranch after escaping from a Tehachapi-area ranch in the 1960s. Mule deer are an important game species on Tejon Ranch; although population data are not available, they are considered to be in decline. Mule deer harvests on the Ranch have fallen from more than 150 animals per year in the late 1990s and early 2000s to an average of 125 per year since 2003 (Kunkel and White 2013).

Feral pigs are abundant in the oak woodlands of Tejon Ranch and are considered to be the most significant threat to resource condition in this life zone. Pig rooting, particularly under individual oaks, is extensive. Shrubs are not abundant in this life zone, and feral pig herbivory and rooting may be partially responsible for this condition. Shrubs provide important cover for species such as California quail and other ground-nesting birds, and the nests of these species are likely being preyed upon by pigs. Rocks and woody debris that provide cover for other ground-dwelling species, such as Tehachapi slender salamander, are continually turned over by pigs as part of their foraging activities. Animals are known to be a significant component of feral pig diets (Wilcox and Van Vuren 2009), and pigs may be important predators on these ground-dwelling species on Tejon Ranch.

Desired Conditions and Management Approaches

Desired Conditions

As previously discussed, conditions in oak woodlands in the Northern Tehachapi Mountains Foothills life zone prior to significant modern anthropogenic disturbance are unknown. The composition of canopy species in these communities probably has not changed appreciably, although stand structures and population demographic parameters have likely changed. Research by Swiecki et al. (1997a, 1997b) suggests that, at least for blue oak woodlands, optimal conditions for oak regeneration may consist of a moderate overstory, shrubs present in the understory, and as little grass as possible in the herbaceous layer. Shrub understories in woodland communities on Tejon Ranch are variable, particularly in valley oak woodlands, and shrubs are virtually absent in most blue oak stands. Low shrub cover may actually be similar to conditions in oak woodlands under Native American land management regimes, but this cover likely limits habitat quality for some species (e.g., ground-nesting birds). The herbaceous layer of these woodlands also is variable, but Smith (1985) suggested that herbaceous diversity, especially the diversity of native species, is higher with less intensive livestock use. The understories of blue and valley oak woodlands on Tejon Ranch are strongly dominated by nonnative annual grasses. Trees of various sizes and ages generally are present in stands that have not experienced recent major disturbance (Sawyer et al. 2009), denoting a desirable habitat condition. Diverse structural composition, from both a mix of oak age and size classes and a well-developed shrub layer, also promotes an abundant and diverse avian community. Verner and colleagues (1997) found lower abundance and diversity of native birds in grazed areas, as well as increased abundance of cowbirds, a nest parasite, and European starlings, which are aggressive competitors with native birds for nesting cavities.

Management Approaches

In many areas oak woodland management efforts appear to have been focused primarily on enhancing regeneration of oaks, particularly blue and valley oaks. Nonnative grasses now dominate the herbaceous layer in many oak woodlands, including those not subjected to human uses such as livestock grazing. Despite much research, the effects of nonnative grasses on oak regeneration are not completely clear, but they are generally thought to be detrimental. Adverse effects on oak regeneration from grazing can occur, but livestock grazing is unlikely to limit regeneration in the long term (Davis et al. 2011) and grazing also is a potential tool for managing nonnative grasses. Swiecki and colleagues (1997b) proposed that successful recruitment of blue oaks may be a multistep process requiring years or even decades to complete. This process may have been quite complex, actually consisting of a series of processes in which a disruption of any single process resulted in regeneration failure. Blue oaks on Tejon Ranch were shown to exhibit pulses of recruitment over decadal time frames (Mensing 1992). Thus, oak recruitment appears to have been cyclic or episodic. Given this natural complexity and the anthropogenic alteration of many ecosystem processes, creating the appropriate conditions for oak regeneration may be difficult. Feral pigs also may adversely affect oak regeneration.

Grazing

Although livestock grazing can help reduce nonnative grass abundance, it also can inhibit oak regeneration through consumption of acorns, browsing of seedlings, and increased soil compaction. Heavy grazing also may eliminate shrubs, the presence of which seems to facilitate regeneration, at least for blue oaks (Swiecki et al. 1997b). Shrubs may facilitate oak regeneration either by providing shade or protecting seedlings from browsers or both (Muick 1997). Based on various research results, light to moderate grazing may be the best strategy (Tyler et al. 2006). Jansen and colleagues (1997) found that early spring grazing resulted in less damage to blue oak saplings compared to late spring grazing, probably because more green forage may be available to cattle in early spring. Similarly, Hall and colleagues (1992) found that winter grazing was less damaging than spring or summer grazing. For grazing in oak woodlands, Bartolome and colleagues (2006) recommended target RDM levels of 100–800 lbs/acre, depending on actual canopy cover and percent slope (RDM target values increase with decreasing woody cover and increasing slope). However, these target values are primarily intended to maintain “range health” and, in particular, to protect soils. The utility of these RDM targets for oak regeneration, wildlife habitat value, and other aspects of oak woodland condition are unclear.

Fire

Available data are equivocal regarding the potential benefits and detriments associated with the use of fire as a management tool in oak woodland communities. McClaran and Bartolome (1989) reported that blue oak regeneration may be associated with fire, but this is likely a result of resprouting of new stems after oaks were top-killed. Allen-Diaz and Bartolome (1992) examined blue oak seedling establishment and survival under grazing and prescribed burning treatments, and found that seedling density and mortality in those areas were not significantly different from unburned and ungrazed areas. However, fire might provide other benefits beyond oak regeneration. Fire may help reduce diseases and pests, such as filbert weevil (*Cucurlio occidentalis*) and filbert worms (*Melissopus latiferreanus*), that can infest acorns (Lewis 1991). Low-intensity prescribed burns might be beneficial in reducing fuels that could lead to more intense, mortality-inducing crown fires, and also can reduce dense understory that might inhibit seedling establishment (Sawyer et al. 2009). Baumgarten and colleagues (2012) found that blue oak woodlands on Tejon Ranch are an average of 7.4 fire return intervals away from the estimated rotation intervals before European contact. However, they recommended continued fire suppression in oak woodlands because of the risk of tree mortality and further recommended reducing and controlling fuel loads via livestock grazing.

Reduced Competition and Protection from Herbivory

Restoration efforts for native oaks have been somewhat successful with the aid of weed control and irrigation (Alpert et al. 1999). Studies and trials have demonstrated that seedling survival and growth are significantly greater when seedlings are protected from herbivory and competition from other plants is reduced. Protection could be applied to large areas from which herbivores are excluded, or to individual trees. Strategies for achieving these protections are diverse, including cages, “tree shelters,” fencing, herbicide applications, weed-blocking mats, and hand clearing of vegetation around seedlings (Griffin 1971, Adams et al. 1997, Bernhardt and Swiecki 1997, McCreary and Tecklin 1997). These strategies all were successful on small-scale study plots, but application on a landscape scale may be difficult as well as cost-prohibitive. Another strategy may be to "rest" areas from grazing to allow oak seedlings time to establish and grow large enough to escape browsing by cattle. However, this might require excluding cattle from an area for a minimum of 5–10 years (Hoagland et al. 2011), and buildup of nonnative annual grasses in the absence of grazing can also cause regeneration failure (Allen-Diaz et al. 2007), whereas cattle removal has not been an effective strategy elsewhere (White 1966, Callaway 1992a).

Reducing impacts from feral pigs has produced limited success. Acorn survival and seedling number and survival were increased in plots from which pigs were excluded (Sweitzer and Van Vuren 2002, Sweitzer and Van Vuren 2009). Excluding pigs from under oak canopies increased survival of coast live oak (*Q. agrifolia*) seedlings on Santa Cruz Island, California (Peart et al. 1994). Complete eradication of livestock, feral sheep, and feral pigs from Santa Cruz Island has facilitated passive restoration of native plant communities (Morrison pers. comm.). However, cattle fencing (generally made of barbed wire) does not restrict movement of pigs. Pig fencing (which must be buried in the ground) is expensive to install and still does not entirely exclude determined individuals. Furthermore, fencing that effectively excludes pigs may disrupt ecological processes by also excluding native animals (e.g., ungulates, medium and large carnivores) or by trapping debris that could inhibit water flows. Eradication of pigs is unlikely to be a viable approach on Tejon Ranch, given that pigs are also established on public and privately owned land surrounding the Ranch. Reducing population size is considered a more feasible approach, but research from Australia and New Zealand suggests it may be necessary to annually remove as many as 70% of individuals to stabilize or reduce pig populations (Kunkel and White 2013), and the relationship between feral pig population size and the extent of specific types of environmental damage has not been quantified.

Conceptual Model

Although blue and valley oaks tend to be distributed differently across Tejon Ranch, the conceptual model groups these two communities together. They tend to vary in structure from open savannahs to denser woodlands, and both have understories dominated by nonnative annual grasses. The factors that drive the structure and distribution of these oak communities have not been explicitly documented by the Conservancy, but it is appears that physical factors such as elevation, aspect, slope, and soil moisture are responsible (Hoagland et al. 2011). The conceptual model for blue and valley oaks is shown in Figure 3-8. Conceptual models have not been developed for live oak communities.

Blue and Valley Oak Woodlands Model Description

The historical or potential state of these oak woodlands is unknown but likely had multiple phases of oak overstory cover (i.e., savannah or woodland structures) driven by terrain and physical factors (e.g., soils, landforms, aspect) with variable but diverse understory communities. The desired conditions consist of adequate oak sapling recruitment to maintain the cover of oaks appropriate to the site, intact understory communities (herbs and shrubs), and available acorns for seedling establishment and a food source for wildlife. Rooting and foraging by pigs and grazing by livestock, as well as climate changes, may decrease survival of seedling and sapling oaks, modifying the demography of oak populations, which can result in a transition to a new state with reduced oak cover. The consumption of acorns by feral pigs may decrease the availability of this food resource for deer and other wildlife. Foraging by livestock and feral pigs is hypothesized to produce a new state with low understory diversity even in areas supporting a stable oak population. Conservation targets in these sites include cavity-nesting birds, mule deer, blue and valley oaks, and the oak understory community. These conservation targets respond positively to the desired oak woodland state. All conservation targets are hypothesized to have a negative response to the modified demographic state. Mule deer and the oak understory community are hypothesized to respond negatively to the modified understory state. Starlings can compete with cavity-nesting birds in any state. Managed livestock grazing and pig control are management actions hypothesized to facilitate transition from the modified understory state to the desired potential state. Physical protection of seedlings and saplings is a management action hypothesized to facilitate a transition from the modified demographic state to the desired state. In appropriate sites, shrub restoration may be a required management action to increase shrub cover. Starling control efforts are hypothesized to positively affect cavity-nesting bird species where competition for nest cavities is a problem.

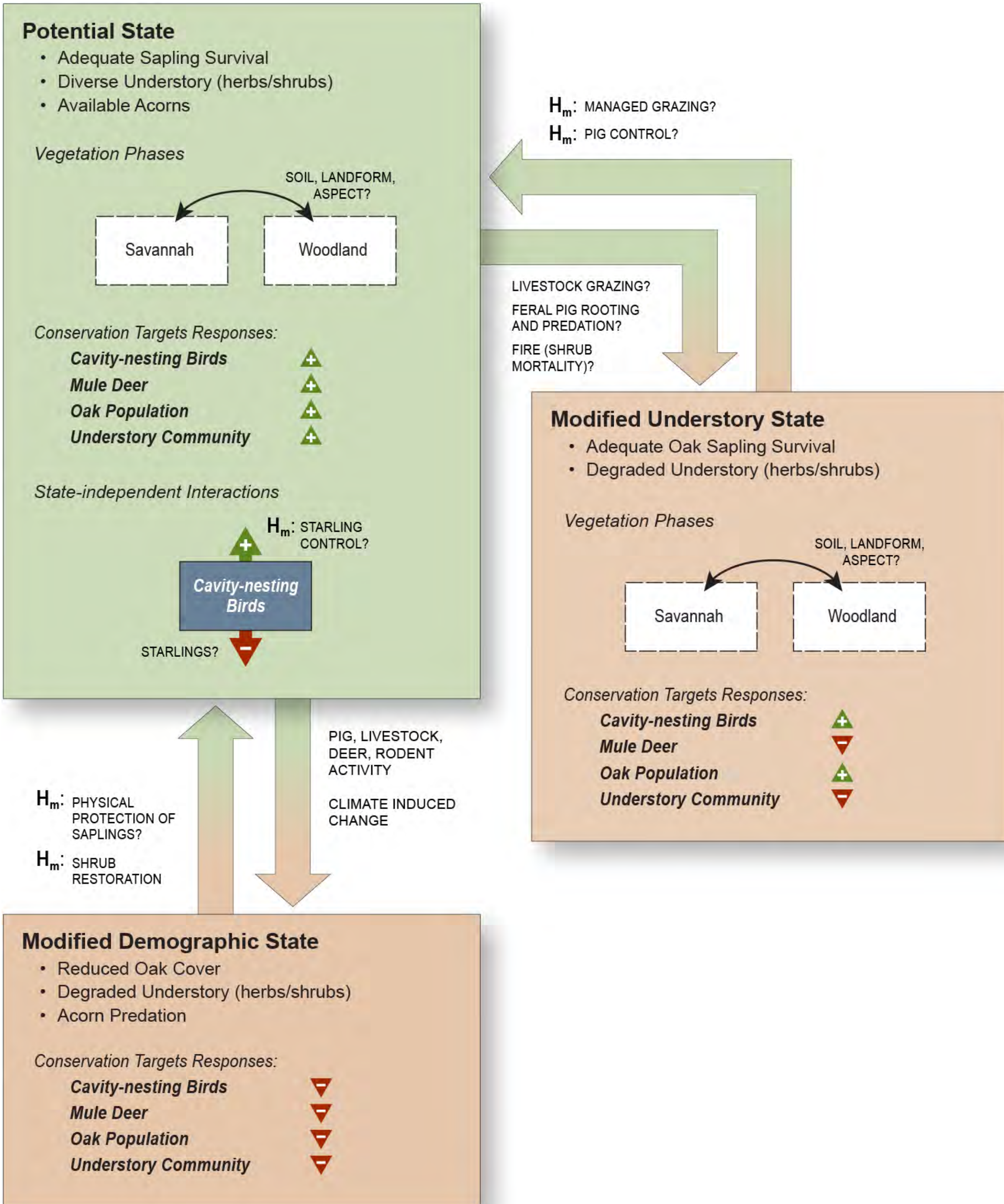


Figure 3-8. Conceptual Model for Blue and Valley Oak Woodlands in the Northern Tehachapi Mountain Foothills Life Zone

3.3.2 Riparian Vegetation Communities and Wetlands

The Northern Tehachapi Mountains Foothills life zone supports stream reaches in the middle of the foothill watersheds. Most stream reaches in this life zone are within relatively narrow canyons and tend to have moderate gradients. Mainstem stream reaches are largely perennial, and tributary streams generally have an intermittent hydrologic regime. Springs in this life zone are often found on the slopes of canyon walls.

Current Conditions at Tejon Ranch

Riparian vegetation composition in the Northern Tehachapi Mountains Foothills life zone is similar to that in the San Joaquin Valley life zone, dominated by western sycamore, valley oak, Fremont cottonwood, box elder (*Acer negundo*), and various willow species in the overstory layer. The understory comprises mulefat, wild rose, Mexican elderberry, and various herbaceous species. This life zone, however, also includes big-leaf maple (*Acer macrophyllum*) and incense cedar (*Calocedrus decurrens*) along stream margins. Vegetation condition is somewhat better than in the San Joaquin Valley life zone, but many reaches have experienced degradation from livestock grazing and feral pig rooting. Most stream channels in this life zone have sections of collapsed or unstable banks, and channel bottoms can be extensively rooted. Overstory vegetation structure is considered in good condition, but understory vegetation is virtually absent in many reaches. Various nonnative thistle species and scattered salt cedar can be found along most riparian corridors, and Himalayan blackberry (*Rubus armeniacus*) has been documented along El Paso Creek. The Conservancy has virtually no information on spring systems in this life zone.

Except for a portion of Tejon Creek, stream reaches within this life zone are free of surface water diversions. Thus, except for the influence of livestock and feral pigs in their watersheds (e.g., soil disturbance or compaction, vegetation modifications), these stream reaches support a natural hydrograph. Little information is available on water quality, but suspended solids are believed to be elevated as a result of soil disturbance by cattle and pigs.

Bird species are an important conservation target in riparian vegetation communities in this life zone. Resident bird species in these riparian vegetation communities include California quail, house finch, purple finch (*Carpodacus purpureus*), house wren, and oak titmouse. Numerous species use riparian vegetation communities in this life zone during migration, and Bullock's oriole and lazuli bunting (*Passerina amoena*) are common migratory breeders on the Ranch. European starlings occur commonly in riparian vegetation communities in this life zone. Streams and riparian vegetation communities are also important to many other wildlife species, such as mule deer and small and large carnivore species. Species that rely on understory cover for habitat, such as ground-nesting birds, may be adversely affected by the poor condition of riparian vegetation communities. Two special-status amphibians, Tehachapi slender salamander and yellow-blotched ensatina, use rocks and coarse woody debris in floodplains for cover. Common reptiles in this life zone include gopher snake, Sierra garter snake (*Thamnophis couchii*), and striped racer, which also rely on rocks and logs for cover. Cover objects in floodplain areas and adjacent uplands often appear to have been overturned by pigs looking for animal prey, and many of these reptile and amphibian species may be subject to predation by feral pigs.

Desired Conditions and Management Approaches

With regard to other riparian and wetland systems on Tejon Ranch, little information is available on the range and drivers of community composition and structure of these vegetation communities in the Northern Tehachapi Mountain Foothills life zone. However, as has been discussed for other life zones, the condition of riparian and wetland vegetation communities in this life zone is believed to be poor because of excessive grazing and physical disturbance (trampling and rooting) of stream channels and springs by livestock and feral pigs. Several invasive nonnative plant species are established in this life zone (e.g., various thistles, scattered salt cedar, and Himalayan blackberry), and these species may exclude other plant species, alter ecological process, or otherwise reduce habitat quality. European starlings are also common in this life zone, but the magnitude of any adverse effects of this nonnative cavity-nesting species on native cavity-nesters is not well understood.

Potential management and restoration approaches discussed for other life zones are applicable to these systems as well. Reducing livestock and feral pig use of riparian and wetlands in this life zone will likely promote passive restoration of these vegetation communities. Eradication of nonnative plants will likely require active restoration to ensure that native plant communities reestablish following removal of nonnatives.

Conceptual Model

Refer to the riparian conceptual model for the San Joaquin Valley life zone (Figure 3-5).

3.4 Southern Tehachapi Mountains Foothills

The Southern Tehachapi Mountains Foothills is a complex life zone extending from near the crest of the Tehachapi Mountains (approximately 6,000 feet in elevation), down its steep southern face, and through rolling foothill terrain and canyons to its lowest elevation of about 3,000 feet. This life zone comprises approximately 25,000 acres on Tejon Ranch. The Southern Tehachapi Mountains foothills support extensive live oak woodlands, limited areas of deciduous oak woodlands, single-leaf pinyon pine (*Pinus monophylla*) forest, California juniper woodlands, and a variety of shrub and chaparral vegetation communities. Vegetation in this life zone shows Coast, Sierra Nevadan, and Mojavean influences. Most canyons support riparian vegetation communities, often wetlands associated with spring discharge, and wet meadows when groundwater is high. Like the Northern Tehachapi Mountains Foothills, the extensive oak and pine forests in the southern foothills provide an important seasonal mast crop for a variety of wildlife species.

The topography of the Southern Tehachapi Mountains Foothills is rugged and generally has a southeastern orientation but, at smaller spatial scales, supports a wide variety of slopes and aspects. The geology of this life zone is also variable, with outcroppings of granitic basement rock and meta-sedimentary roof pendants exposed along the front of the foothills. Geology and soils appear to control the distribution of some types of vegetation, and stark boundaries between vegetation communities are apparent in some places. These foothills receive a relatively high amount of precipitation relative to the Antelope Valley life zone, and snow falls regularly throughout the foothills. A gradient of mean annual precipitation is suspected to divide this life zone, with wetter conditions present at the west end.

3.4.1 Uplands

Upland vegetation communities in the Southern Tehachapi Mountains Foothills life zone are quite varied. Blue oaks, often mixed with California juniper, are common at the west end of the life zone, and scattered stands of valley oak occur in the bottoms of many canyons and draws. Extensive stands of dense canyon live oak woodland are present on the upper-elevation southern slopes of the Tehachapis and at lower elevations on the slopes of narrow canyons. Interior live oaks form dense woodlands, typically in canyon bottoms and adjacent slopes. These oak communities are discussed for the Northern Tehachapi Mountains Foothills life zone in Section 3.3 and are not treated again here.

Pinyon pine woodlands are characterized by a canopy that ranges from open to intermittent; a shrub layer that is intermittent to continuous; and an herbaceous ground layer that historically was probably sparse, especially in denser stands (Minnich 2007, Sawyer et al. 2009). Associated shrubs include California juniper, manzanita (*Arctostaphylos* spp.), flannel bush (*Fremontodendron californicum*), ceanothus (*Ceanothus* spp.), Mormon tea (*Ephedra* spp.), and Great Basin sagebrush (*Artemisia tridentata*). California juniper is often more abundant at the lower end of the pinyon belt. Pinyon pines recruit continuously and stands are typically multi-aged. Shrub cover is high in young stands and decreases as canopies close in older stands. These woodlands are not adapted for frequent disturbance. Pinyon pines are long-lived (reaching more than 200 years) and do not reach reproductive maturity until 50 or more years of age (Minnich 2007). Seed production is cyclic, likely as a strategy to escape the numerous animals that feed on the seeds. Heavy crops are produced approximately every 5–7 years. Fires were not historically frequent in these communities, and indeed, fire rotation may have averaged as much as 480 years (Wangler and Minnich 1996). Pinyon pines are often found on steep slopes and areas with dissected topography, as these sites may function as fire refugia (West 1988). Pinyon pines are obligate seeders and do not resprout after fire. Furthermore, partial shade from shrubs may be necessary to facilitate seedling establishment, and post-fire recruitment may be delayed 20–30 years until shrubs recover sufficiently to act as nurse plants for seedlings (Minnich 2007). Fires often result in high mortality rates (Minnich 2007). Hot fires are stand-replacing, and recovery may require decades. Contemporary invasion of woodlands by nonnative grasses, particularly cheatgrass, has increased fuel loads resulting in hot, stand-replacing fires in many areas (Brooks and Minnich 2007, Thorne et al. 2007). Furthermore, recent epidemics of the pinyon ips beetle (*Ips confuses*) are destroying stands and creating dangerous fuel loads (Thorne et al. 2007), although the Conservancy has not observed significant pinyon mortality on Tejon Ranch.

Chaparral and shrub communities in the life zone are diverse and discontinuous, primarily occurring on sites too arid for woodlands and too mesic for grasslands. Shrub communities range from stands of rabbitbrush and Great Basin sagebrush in canyon bottoms to diverse chaparral communities on slopes, particularly at the west end of the life zone. These communities are characterized by a canopy of large shrubs such as manzanita, chamise (*Adenostoma fasciculatum*), coffeeberry (*Rhamnus californica*), birch-leaved mountain mahogany (*Cercocarpus betuloides*), and silk-tassle bush (*Garrya flavescens*); subshrubs and vines such as coyote melon (*Cucurbita palmata*), golden yarrow (*Eriophyllum confertiflorum*), deerweed (*Acmispon* [*Lotus*] *scoparius*), honeysuckle (*Lonicera* spp.), and keckiella (*Keckiella* spp.); and occasionally small trees (e.g., canyon live oaks, interior live oaks, and pinyon pines). Stands generally have continuous cover, but composition varies substantially from place to place. The herbaceous layer is sparse, especially in dense, closed-canopy stands. These communities tend to be fire-adapted, and chaparral fires are classically stand-replacing (Keeley and Davis 2007). Regeneration of many chaparral species occurs immediately following fires, with some species being obligate reseeders (e.g., *Arctostaphylos* spp. and *Ceanothus* spp.) and some resprouters (e.g., *Prunus* spp., *Rhamnus* spp., and some *Quercus* spp.). It is unclear how fire frequency has changed over time in this life zone, but in many parts of Southern California fire frequencies in chaparral have increased due to more human-caused ignitions (Baumgarten et al. 2012). Excessively frequent fires can lead to nonnative grasses and forbs replacing native flora, and can convert chaparral communities into nonnative annual grasslands (Keeley and Davis 2007).

Current Conditions at Tejon Ranch

The Conservancy has spent little time assessing the composition and condition in this life zone. The lower elevational limit of chaparral and pinyon pine woodland is often a stark boundary that appears to be associated with a change in the underlying geology, likely the presence of granitic and meta-sedimentary rocks covered by shallow soils. Chaparral is most extensive at the west end of the life zone and appears to transition to pinyon pine woodland to the east with increasing elevation. The fire regime in these vegetation communities appears to be within the desired fire rotation intervals (Baumgarten et al. 2012). No specific information is available on conditions in this life zone and no management hypotheses have been identified. Minimizing the abundance of nonnative annual grasses that could alter the fire regimes in this life zone is a desired condition.

Little information is available on wildlife species in this life zone. Common bird species in pinyon forests include oak titmouse, California quail, white-breasted nuthatch, western scrub jay, and California towhee. In chaparral and shrub communities, spotted towhee, mountain quail, wrentit, and California thrasher are common.

3.4.2 Riparian Vegetation Communities and Wetlands

The Southern Tehachapi Mountains Foothills life zone supports stream reaches in the middle of the foothill watersheds. Most stream reaches in this life zone are within relatively narrow canyons and tend to have moderate to steep gradients. Stream hydrology is intermittent to ephemeral, but reaches can be perennial when fed by springs. Fewer springs are present in this life zone than in the Northern Tehachapi Mountains Foothills.

Current Conditions at Tejon Ranch

Riparian vegetation composition in the Southern Tehachapi Mountains Foothills life zone is dominated by western sycamore, valley oak, and Fremont cottonwood; various willow species are present in the overstory layer, and various herbaceous species in the understory, along with mulefat and Mexican elderberry. Vegetation condition is often poor in perennial reaches because of degradation from livestock grazing and feral pig rooting. Overstory vegetation structure is generally considered in good condition, but understory vegetation is virtually absent in many reaches. Stream reaches within this life zone are free of surface water diversions. Thus, except for the influence of livestock and feral pigs in their watersheds (e.g., soil disturbance or compaction, vegetation modifications), streams in this life zone support a natural hydrograph. The Conservancy has virtually no information on spring systems in this life zone.

Little information is available on wildlife species in this life zone. House finches, house wrens, European starlings, oak titmice, and mourning doves are common residents in foothill riparian vegetation communities. Riparian vegetation communities can support high numbers of migrants, such as western tanager, *Empidonax* flycatchers, yellow warbler, and Wilson's warbler, while Bullock's oriole and black-headed grosbeak remain to breed.

The Conservancy does not adequately understand the range and drivers of riparian and wetland community structure and function. However, it is believed that these systems, like other riparian and wetland systems on Tejon Ranch, are being adversely affected by livestock and feral pigs. No specific management hypotheses have been proposed for these systems as this time.

3.5 MONTANE

The Tehachapi Mountains lie at the southern tip of the Sierra Nevada range. The Montane life zone on Tejon Ranch supports species and vegetation communities found at higher elevations of the Sierra Nevada ecoregion. This life zone, covering approximately 20,000 acres, extends from about 5,000 feet in elevation to the top of the Tehachapi Mountains on Tejon Ranch at 6,803 feet on Blue Ridge. However, the Tehachapi Mountains are a lower elevation range between higher elevation mountains immediately adjacent to the Ranch to the west and east. Blue Ridge, essentially the spine of the Tehachapis, is narrow and steep, but major ridges extend perpendicularly in a northwest orientation. The terrain in the life zone largely comprises steep ridges and high-elevation valleys, and the Garlock Fault zone runs through it. The geology of the life zone is variable but largely comprises intrusive (mafic and granitic) and metamorphic (gneiss, schist, meta-sedimentary roof pendants) rocks. The Montane life zone supports the headwaters of all major watersheds on Tejon Ranch. This life zone receives the highest amounts of precipitation on the Ranch, much of it falling as snow in winter, but regularly receives small amounts of summer rain. Low temperatures are commonly below freezing during winter.

Upper elevation plant communities are diverse and vary extensively with respect to slope, aspect, and soils. These plant communities include black oak woodlands, valley oak woodlands, conifer forests, mixed hardwood-conifer stands, mixed shrublands and chaparral, and montane riparian habitat. Forest, woodland, and shrub communities in this life zone generally have dense, closed canopies. Some slopes with southern exposures are dominated by herbaceous communities. The only significant riparian habitat in the life zone is associated with upper Cottonwood Creek.

3.5.1 UPLANDS

The structure and composition of vegetation communities in the Montane life zone prior to European contact is not known. Among the earliest community descriptions, Bauer (1930) generally described conifer forests in the Tehachapi Mountains as having a closed structure with comparatively large trees, occasional shrub understory, and sparse ground cover. He stated that ponderosa pine (*Pinus ponderosa*) was the most important tree, although Jeffrey pine (*Pinus jeffreyi*) was abundant in places, white fir (*Abies concolor*) was most abundant on higher ridges and ravines, and black oak was most abundant at the lower portion of the life zone (Bauer 1930). Bauer also noted that most communities were already degraded, particularly by intensive summer grazing. During the summer, cattle were moved to high-elevation conifer forests as forage at lower elevations became "scanty."

Given the lower elevation of the Tehachapis relative to other parts of the Sierra Nevada, the lower montane forests of the Sierra Nevada are probably most ecologically similar to the Montane life zone on Tejon Ranch. Based on more contemporary descriptions (Fites-Kaufman et al. 2007), lower montane conifer forests fall into three categories: ponderosa pine and Douglas-fir–mixed conifer, white fir–mixed conifer, and giant sequoia. Giant sequoias and Douglas-fir do not occur in the Tehachapis. In the drier portions of the southern Sierra Nevada, such as the Tehachapis, Douglas-fir may be replaced by ponderosa pine. Evidence also indicates that populations of white fir and incense cedar (*Calocedrus decurrens*) may be increasing in the ponderosa pine and Douglas-fir–mixed conifer type as a result of contemporary land management practices. White fir becomes increasingly dominant at higher elevations and with deeper soils in the life zone. White fir is often associated with incense cedar and sugar pine (*Pinus lambertiana*) in the Sierra Nevada. Understory trees and shrubs can be an important component of white fir–dominated forests, with bitter cherry (*Prunus emarginata*), snowberry (*Symphoricarpos mollis*), and gooseberry (*Ribes* spp.) most prevalent. Some research has suggested that white fir may be expanding its distribution at the expense of stands of montane chaparral. Herbaceous cover is generally low in white fir forests, and thick layers of litter can accumulate. Herbaceous cover appears to be associated with soil moisture more than light (North et al. 2005a).

Chaparral and shrub communities are variable in composition. Dominant shrubs in montane shrub and chaparral communities include rabbitbrush, bitter cherry, chokecherry (*Prunus virginiana*), mountain mahogany, whitethorn (*Ceanothus cordulatus*), Parry manzanita (*Arctostaphylos parryana*), service-berry (*Amelanchier utahensis*), interior live oak, and Brewer's oak (*Quercus garryana* var. *breweri*). Brewer's oak can occur in dense, nearly pure stands, often classified as shrub oak chaparral. This species reproduces readily from both acorns and sprouts from crowns and rhizomes; thus, it can regenerate rapidly after burning. Canyon live oaks can also be found scattered through shrub-dominated vegetation communities, often near rock outcrops or in mesic draws.

Wildlife species in the Montane life zone include many of the species present in the two adjacent foothill life zone. Bird species more common in the Montane life zone include dark-eyed junco (*Junco hyemalis*), Brewer's sparrow (*Spizella breweri*), mountain chickadee (*Parus gambeli*), purple finch (*Haemorhous purpureus*), white-headed woodpecker (*Picoides albolarvatus*), mountain quail (*Oreortyx pictus*), Steller's jay (*Cyanositta stelleri*), and black-headed grosbeak. Two snakes, rubber boa (*Charina bottae*) and mountain king snake (*Lampropeltis zonata*), are restricted to rock outcrops in the Montane life zone. Western grey squirrel (*Sciurus griseus*) and Merriam's chipmunk (*Tamias merriami*) are mammals common in this life zone.

Historically, disturbances in montane communities included periodic fire, landslides, and mass wasting events, which are important processes in the Tehachapis (Saleeby pers. comm.). Baumgarten and colleagues (2012) concluded that mixed conifer and white fir stands on Tejon Ranch experienced a mixed-severity fire regime before European settlement. Fire return intervals were estimated to average 14–17 years in white fir stands (Kilgore and Taylor 1979), 1–30 years in mixed conifer stands (Habeck 1992), and 7 years in black oak woodlands (Safford et al. 2011). Fires were assumed to have been caused by lightning strikes and Native American land management practices. These fires may have thinned understory and created a "park-like" appearance (Belsky and Blumenthal 1997). Low-intensity ground fires may be necessary for conifer regeneration. Typical of black oak woodlands elsewhere, fires may have been predominantly of low or mixed severity, with surface fires occurring frequently in summer and fall, although the frequency is unknown (van Wagtendonk and Fites-Kaufman 2006). Resprouting has been observed among black oaks that survive fires (Plumb 1979, Stephens and Finney 2002), but seedling germination and establishment are not enhanced by burning (Collins et al. 2007). Occasional high-intensity fires may have occurred in both conifer and mixed conifer-oak forests, and these may have been stand-replacing and may have shifted communities toward montane chaparral (van Wagtendonk and Fites-Kaufman 2006). The current policy of fire suppression in the Montane life zone may favor conifers such as white fir over black oaks or chaparral species (Baumgarten et al. 2012, Fites-Kaufman et al. 2007). Also, surviving white firs damaged by fire are highly susceptible to insect and disease invasion (Zouhar 2001). Much of the ridgeline of the Tehachapis on Tejon Ranch is dominated by shrubs rather than trees, potentially as a result of disturbances from mass wasting or fires rather than merely edaphic conditions.

Regeneration generally is not an issue in conifer forests, particularly in white fir stands. White fir is very shade tolerant and seedlings tend to be abundant under shrub or canopy cover (Belsky and Blumenthal 1997, Sawyer et al. 2009, Baumgarten et al. 2012). There is evidence that fire suppression has increased the density of white fir and incense cedar in the Sierra Nevada (North et al. 2005b). Jeffrey and ponderosa pines appear to require wet conditions to successfully recruit, for example following El Nino events (North et al. 2005b), and thus they may be less important in the drier parts of the Tehachapis than in other parts of the Sierra Nevada. Black oaks may live for 500 years and may not begin reproducing until they reach 30 years (Sawyer et al. 2009). After that, they produce mast sporadically. The acorns are a favored food for many birds and animals, and unconsumed acorns readily germinate and persist in shade until released by canopy openings. Black oaks appear to be regenerating well on Tejon Ranch, although population growth rates are slightly less than replacement rates (Hoagland et al. 2011).

Other contemporary stressors include feral pigs, climate change, and air pollution. Air pollution can increase susceptibility to disease and pests, such as bark beetle invasion in conifers (Applebaum et al. 2010). The Conservancy has documented a stand of dead ponderosa and Jeffrey pines (collectively "yellow pines") on Tejon Ranch, but tree mortality does not appear widespread in this part of the Tehachapis. However, given the limited distribution of yellow pines on Tejon Ranch, this mortality may represent a relatively large fraction of the Ranch-wide population. The observed Ponderosa pine mortality on Tejon Ranch is consistent with conifer mortality observed in the Sierra Nevada and attributed to temperature-driven drought stress associated with warmer climates (van Mantgem and Stephenson 2007). The extent of pig effects on these vegetation communities on Tejon Ranch, particularly in oak and mixed oak vegetation communities, has not been quantified, but extensive rooting can be observed in virtually all montane vegetation communities. Pigs can cause a variety of ecosystem impacts but affect oaks most directly through predation on acorns and uprooting of seedlings (Sweitzer and Van Vuren 2002, 2009). Pigs may also affect sensitive plant and animal species through habitat disturbance caused by rooting and direct predation (Jolley et al. 2010). The actual effects of such activities on black oak regeneration and other species populations warrant further investigation.

Current Conditions at Tejon Ranch

Within Tejon Ranch, montane vegetation communities are generally patchily distributed based on terrain, orientation, and presumably past disturbances. Conifer vegetation communities are dominated by white fir, with small numbers of sugar pine and incense cedar, which increase in abundance in more mesic microclimates such as canyons and ravines. Conifer-dominated vegetation communities are generally found on more mesic north- and east-facing slopes, resulting in a patchy or "sky island" distribution across the landscape. Ponderosa- and Jeffrey pine-dominated forests are confined to relatively small stands in the Tejon and Cottonwood creek watersheds. Black oaks are extensively distributed and can be found in oak-dominated stands or mixed with conifers. Valley oak woodlands occur on ridges and particularly within the valley bottom of the Cottonwood Creek watershed within this life zone. Canyon live oaks form dense forests on steep north-facing slopes, but are also scattered through other vegetation communities such as chaparral. The fire regime in this life zone has been significantly altered relative to pre–European contact conditions, and Baumgarten and colleagues (2012) estimate that more than half of the Ranch's conifer stands are at least 10 fire recurrence intervals from pre-contact intervals. Prescribed burns were conducted on portions of the Blue Ridge in the 1980s and a fire burned portions of Middle Ridge in the 1990s.

No quantitative information is available on the structure and composition of conifer and mixed conifer forests on Tejon Ranch. Although no records have been found, harvest of conifers on the Ranch occurred historically. Only one small portion of Blue Ridge shows evidence of the extensive, almost clear-cutting of white fire that occurred in the early 1980s, but numerous stumps can be found throughout most conifer stands on the Ranch. Many larger trees appear to have been removed by historical timber harvesting (Bland pers. comm.). Understories of conifer-dominated forests are largely herbaceous with very little shrub cover. Soil disturbance from cattle and feral pig rooting is extensive in conifer forests.

Black oak woodlands on Tejon Ranch appear to be in relatively good condition (Hoagland et al. 2011). Black oaks on Tejon Ranch, on average, have a larger diameter at breast height and appear to be better stocked than black oak woodlands in California in general, and are denser than either blue or valley oak woodlands (Table 3-6). Black oak woodlands have more shrub cover than other oak woodlands on Tejon Ranch. Black oak seedlings were much more abundant than either blue or valley oaks in 2010, but sapling density was comparable among the species (Table 3-6). However, high numbers of valley oak saplings are present in the Cottonwood Creek valley within an extensive rabbitbrush shrubland (Hoagland et al. 2011). Based on a demographic analysis using aerial photography from 1952–2009 (Hoagland et al. 2011), black oak woodlands on Tejon Ranch exhibited a population growth rate just below replacement. The researchers concluded that black oaks, like other deciduous oaks on the Ranch, were undergoing a slow but significant decline and could decrease by about 9% over the next 50 years without management intervention. Feral pig rooting is extensive in oak-dominated vegetation communities.

Table 3-6. Average Stocking Rate and Densities of Black Oak Woodlands

Woodland Type	Stocking (ft^2/ac)	Seedling Density (No./acre)	Sapling Density (No./acre)	Tree Density (No./acre)
Black oak	137.8	40.7	3.6	52.5

Source: Hoagland et al. 2011

Black oak woodlands on Tejon Ranch have considerably more understory compared to conifer-dominated forests. Shrub cover averages approximately 25% and consists primarily of snowberry and gooseberry (Hoagland et al. 2011). The species composition of the herbaceous layer is not known, but Conservancy biologists suspect that there may have been changes in this community because of the history of livestock grazing and, more recently, feral pig rooting. In addition, annual Mediterranean grasses have invaded these herbaceous communities and have likely altered their composition and structure. Based on literature reviews and field investigation, Applebaum and colleagues (2010) concluded that, in general, montane forests on the Ranch appear to be healthy. It is possible that significant management changes may not be necessary at this time, although monitoring clearly is warranted.

Vegetation communities in this life zone are important for various wildlife species. Characteristic bird species include white-breasted nuthatch (*Sitta canadensis*), Steller's jay (*Cyanocitta stelleri*), mountain chickadee (*Poecile gambeli*), band-tailed pigeon (*Patagioenas fasciata*), western tanager (*Piranga ludoviciana*), black-headed grosbeak, lazuli bunting, and mountain quail (*Oreortyx pictus*). A high number of California quail have also been found in black oak woodlands; the shrubby understory may afford these ground-nesters some protection from predators such as feral pigs. Important habitat for mule deer and Rocky Mountain elk is located in the Montane life zone. Feral pigs appear to use this life zone extensively. The Montane life zone supports a number of species unique to the life zone, including several special-status species. Two high-elevation snake species, rubber boa (*Charina bottae*) and mountain king snake (*Lampropeltis zonata*), have been documented in rock outcrops in this life zone. White and colleagues (2003) showed that the distributions of several closely related taxa may come into contact on Tejon Ranch, including subspecies of these two snakes. Conservancy biologists do not yet know which subspecies are found on Tejon Ranch. Two special-status amphibians, yellow-blotched salamander and Tehachapi slender salamander, have been documented in oak and mixed-oak vegetation communities. Yellow-blotched salamanders are regularly encountered under canyon live oaks, even isolated oaks within a chaparral matrix, and Tehachapi slender salamanders have been found as high as 6,000 feet in a mixed oak-conifer forest. Conservancy biologists conducted a focused survey for, but did not detect, Mt. Pinos sooty grouse (*Dendragapus fuliginosus howardi*), a subspecies of blue grouse endemic to the southern Sierra Nevada and Tehachapi Mountains on Tejon Ranch. In the opinion of the expert who conducted the survey, many of the old, large fir trees that Mt. Pinos sooty grouse require for breeding have been harvested on Tejon Ranch and the habitat may no longer be suitable (Bland pers. comm.).

Desired Conditions and Management Approaches

As mentioned previously, natural conditions in vegetation communities in the Montane life zone before significant modern anthropogenic disturbance are unknown. The composition of canopy species in these communities probably has not changed appreciably, although tree densities and relative composition are likely to have changed as land management practices have changed since the mid-1800s. Understories of conifer forest appear to have been dominated by herbaceous species with low shrub cover. However, no quantitative information is available on the existing or desired species richness of the herbaceous understory community.

Many white fir stands may actually be denser currently than they were before European settlement. Potential causes for this increase include fire suppression (Fites-Kaufman et al. 2007) and climatic shifts (Millar and Woolfenden 1999). This has resulted in forests with a more uniform and higher density of stems. A more natural condition in the lower montane zone of the Sierra Nevada is a mosaic of trees and shrubs of varying densities with predominant combinations, including (1) dense forest with absent or poorly developed understory, (2) open to moderately dense forest with a sparse to well-developed understory, (3) openings dominated by shrubs or herbs and grasses, and (4) open forests with sparse understory on rocky sites (North et al. 2002, Fites-Kaufman et al. 2007). Tree cover can vary from 30% to 95%, shrub cover can vary from absent to 95%, and herbaceous ground cover tends to be low and can vary from 1% to 5% (Fites-Kaufman et al. 2007).

Baumgarten and colleagues (2012) recommended continued fire suppression in oak woodlands, including black oak woodlands, because of the danger of stand-replacing burns. Fuel reduction and management through moderate grazing in winter was recommended to help prevent fires. Livestock grazing might help to reduce competition from nonnative grasses, but it also could inhibit oak regeneration through consumption of acorns, browsing of seedlings, and increased soil compaction. As described above, Bartolome and colleagues (2006) recommended target values are primarily intended to maintain “range health” and, in particular, to protect soils. Restoration efforts for native oaks have been somewhat successful with the aid of weed control and irrigation (Alpert et al. 1999). Several studies and trials (also described above for the Northern Tehachapi Mountains Foothills) have demonstrated that seedling survival and growth are significantly greater when seedlings are protected from herbivory and competition from other plants is reduced.

Baumgarten and colleagues (2012) surmised that livestock grazing can actually increase the density of seedlings in conifer forests, and livestock grazing was not recommended for conifer forests. The number of seedlings on grazed plots was significantly higher, presumably because livestock browsed down shrubs and grasses, which reduced competition for conifer seedlings (Belsky and Blumenthal 1997, Miller and Urban 2000). Young trees can act as fuel ladders, increasing the threat of high-intensity crown fires (Belsky and Blumenthal 1997). Following fires, livestock can facilitate colonization by invasive plants by transporting seeds into burned areas (Keeley et al. 2003, Keeley 2005). Therefore, Baumgarten and colleagues (2012) recommended the exclusion of grazing in conifer forests using fencing. They also recommended a thorough assessment of stand structure to determine whether thinning might be warranted. If forest stands are determined to be overly dense, then active thinning treatments might be considered to reduce the probability of stand-replacing crown fires. Such thinning could be achieved using chain saws or heavy equipment, depending on terrain and the stem size classes being targeted. Prescribed burning might be employed following thinning to further remove fuels and to open understories.

Reducing overall pig numbers in the Montane life zone is ecologically desirable but would necessitate a significant alteration in feral pig harvest and management strategies on the Ranch. Protecting habitats in this life zone from pigs would be difficult. Barbed wire fencing used to manage cattle will not exclude pigs. Pig fencing is expensive and requires a high level of maintenance to be effective. Furthermore, fencing that effectively excludes pigs may disrupt ecological processes by also excluding native animals (e.g., ungulates, medium and large carnivores) or by trapping debris that could inhibit water flows. Nevertheless, such tradeoffs may still result in a net improvement in biodiversity and ecological function; such exclusion may be particularly desirable in locations constituting important habitat for sensitive plant and animal species. Acorn survival and seedling number and survival have been shown to increase in plots from which pigs were excluded (Sweitzer and Van Vuren 2002, 2009).

Conceptual Model

Montane forest vegetation communities include areas dominated by black oaks and areas supporting mixed black oak–conifer habitat. Black oaks exhibit higher seedling densities, and their understories are more diverse with a higher cover of shrubs than other deciduous oak species on Tejon Ranch. They provide important habitat for a variety of wildlife, including feed resources for mule deer. The conceptual model for montane forest is shown in Figure 3-9.

Montane Forest Model Description

The historical or potential state of these forests is unknown but likely had multiple phases of overstory composition varying from oak-dominated to mixed oak and conifer with diverse understories of shrubs and herbaceous plants. The desired state consists of adequate oak and conifer recruitment to maintain forest cover appropriate to the site, an intact understory community, and available acorns for germination and a food source for wildlife. Rooting and foraging by pigs and grazing by livestock, as well as climate changes, may decrease survival of seedling and sapling oaks, modifying the demography of tree species populations, which can result in a transition to a new state with reduced tree cover. The consumption of acorns by feral pigs may decrease the availability of this food resource for deer and other wildlife. Foraging by livestock and feral pigs is hypothesized to produce a new state with low understory diversity even in areas supporting stable tree populations. Conservation targets in these sites include mule deer, black oaks, and the understory community. All conservation targets are assumed to respond negatively to the transition to the modified demographic state. Mule deer and the understory community are assumed to respond negatively to the modified understory state. Physical protection of seedlings and saplings is a management action hypothesized to facilitate a transition from the modified demographic state to the desired state. Managed livestock grazing and pig control are management actions hypothesized to facilitate transition from the modified understory state to the desired potential state.

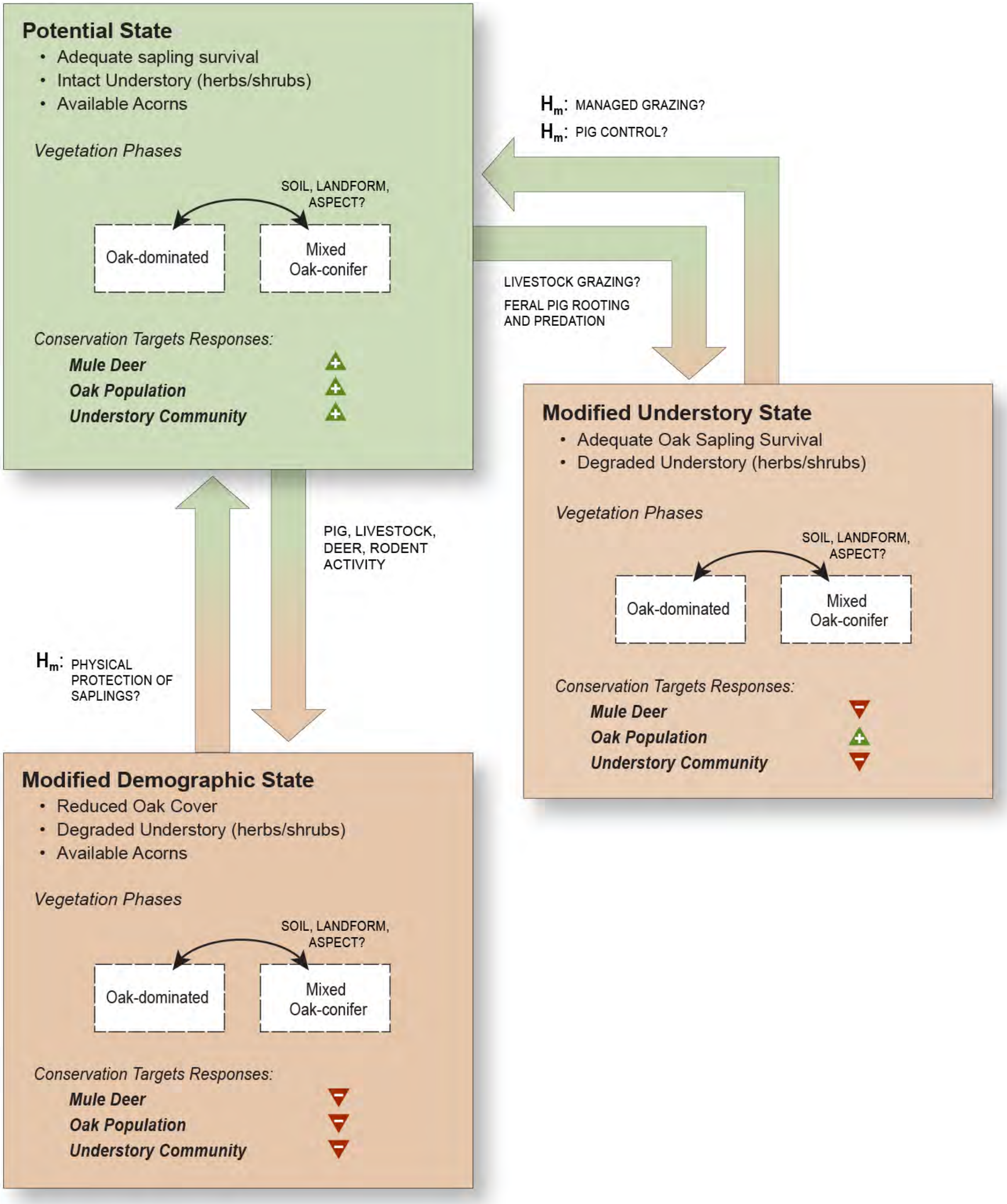


Figure 3-9. Conceptual Model for Black Oak and Mixed Conifer Woodlands in the Montane Life Zone

3.5.2 Riparian Vegetation Communities and Wetlands

The Montane life zone supports the headwaters of streams on Tejon Ranch. Most stream reaches in this life zone are within relatively narrow canyons and tend to have steep gradients. Stream reaches in this life zone generally have variable flow regimes: perennial flow when fed by spring flow, or intermittent when hydrology is driven by precipitation. Springs in this life zone are often found on the slopes of canyon walls or valley bottoms, particularly when they occur in fault zones.

Current Conditions at Tejon Ranch

The Conservancy has little quantitative information on the composition and condition of riparian and wetland vegetation communities in this life zone, or on the wildlife species that rely on these vegetation communities. Vegetation community composition and structure appear to be related to stream gradients and hydrologic regime. Riparian vegetation composition in perennial reaches is often dominated by big-leaf maple (*Acer macrophyllum*), willows, and Mexican elderberry, with incense cedar occasionally found along stream margins. There is generally little herbaceous or shrub understory. No surface water diversions or groundwater wells are present in this life zone.

Cottonwood Creek is a somewhat unique system in the Montane life zone. It is a low-gradient stream that lies within the Garlock Fault zone; as a result, it appears to be associated with relatively high groundwater elevations and has many perennial reaches. Riparian vegetation along the creek is dominated by shrubby arroyo willow (*Salix lasiolepis*) with pockets of herbaceous meadow vegetation in adjacent floodplain areas. These meadows have poor condition as a result of grazing by livestock and rooting by feral pigs.

Desired Conditions and Management Approaches

The Conservancy has little information on the range and drivers of community composition and structure of these vegetation communities in the Montane life zone. However, as has been discussed for other life zones, the condition of riparian and wetland vegetation communities in the Montane life zone is likely poor because of excessive grazing and physical disturbance (trampling and rooting) of stream channels and springs by livestock and feral pigs, particularly where perennial water is present. Desired conditions are those that would occur in the absence of excessive disturbances, including higher cover and diversity of understory vegetation, undisturbed stream channels, and intact meadows and springs.

Management and restoration approaches proposed for other life zones are applicable to these systems as well. Reducing livestock and feral pig use of riparian and wetlands in this life zone may promote passive restoration of these vegetation communities. Nonnative plant eradication will likely require active restoration to ensure that native plant communities reestablish following removal of nonnatives.

Conceptual Model

Refer to the riparian conceptual model for the San Joaquin Valley life zone (Figure 3-5).

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APPENDICES

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Appendix A

Summary of the Tejon Ranch Conservation and Land Use Agreement

Executive Summary

The Tejon Ranch Company (TRC) and Audubon California, the Endangered Habitats League, Natural Resources Defense Council, Planning and Conservation League and Sierra Club (the Resource Groups) reached agreement on June 17, 2008 to preserve permanently up to 240,000 acres of the 270,000-acre Tejon Ranch – approximately 90% of the entire Ranch. Without regard to the timing of any development on the remainder of the Ranch, the conserved lands were to be managed to preserve natural resource values by the newly formed, independent Tejon Ranch Conservancy. The key provisions of the Agreement are as follows:

- The Resource Groups are assured, as of the date of execution of the Agreement, and at no cost to taxpayers, of the permanent preservation of approximately 178,000 acres of the Ranch through the phased recordation of conservation easements.

- The Resource Groups were granted options, which have been exercised, to acquire the development rights over five parcels comprising an additional 62,000 acres of the Ranch. Once these options were exercised, the total amount of conserved lands became approximately 240,000 acres.

- The Agreement did not authorize development. For any development project TRC wishes to pursue on the approximately 30,000 acres not subject to conservation under the Agreement, TRC is required to seek applicable approvals, including the completion of all environmental review and permitting processes to develop the Centennial, Tejon Mountain Village and Grapevine projects in compliance with all laws, regulations and standards. The entitlement process consists of extensive public review and public hearing processes, including Environmental Impact Reports and numerous agency approvals for each project. Frequent opportunities for public involvement, review, comment and testimony on the three planned projects will be available.

- The Agreement requires that TRC propose a suite of environmental protection and sustainability requirements as part of each project to address traffic, air quality, climate change and other important issues.

- The protection and stewardship of the conserved lands was assured, from the date of execution of the Agreement, by the creation and funding of the independent Tejon Ranch Conservancy, a nonprofit public benefit corporation that has been qualified as tax-exempt under Section 501(c)(3) of the Internal Revenue Code.

- To ensure that the public will be able to use and enjoy the conserved lands, the Agreement guarantees significant public access to Tejon Ranch, to be defined in a public access plan (Volume 3 of the RWMP) developed and implemented by the Conservancy. Public access also includes realignment of approximately 37 miles of the Pacific Crest Trail within an approximately 10,000 acre viewshed through the heart of the Ranch and docent-led tours to Bear Trap Canyon.

- The Agreement was reached after two years of careful scientific analysis and intense negotiations between TRC, its partners and the Resource Groups. All parties believe that the Agreement provides for a far better conservation outcome than the typical project-specific permitting and protracted litigation methods most often used in development and conservation disputes.

A more detailed description of the key provisions of the Agreement follows:

Conserved Lands

- **Management Plan.** Under the Agreement, all conserved lands will be managed pursuant to a Ranch-Wide Management Plan that will be developed by TRC (the Interim RWMP, adopted in September of 2009) and the Conservancy (the Initial RWMP, due for adoption June 21, 2013).
- **Dedicated Conservation Areas.** TRC will permanently protect approximately 178,000 acres through a combination of dedicated conservation easements and designated project open spaces.
    - A conservation easement of up to 10,000 acres will be dedicated to allow for realignment of 37 miles of the Pacific Crest Trail through the Ranch.
    - An additional 33,000 acres of open space areas within the permitted project areas will be designated as part of the project development process.
    - Conservation easements over the remaining 135,000 acres will be dedicated in six phases as TRC receives development approvals, with all dedications to occur within 30 years from final approval of the first project.
    - Prior to these dedications, no unauthorized development is permitted in the conservation areas. Grazing, game management and other existing ranch activities continue in accordance with the Ranch-Wide Management Plan.
- **Acquired Conservation Areas.** TRC provided separate options for the Resource Groups to purchase development rights, through acquisition of conservation easements, for five separate Acquisition Areas, totaling an additional 62,000 acres. The Conservancy exercised these options with the support of the California Wildlife Conservation Board and recorded conservation easements March 2011.
- **Public Access.** The parties are committed to providing opportunities for significant public access and community education programs on the conserved lands. To date, the Conservancy, in close collaboration with the Tejon Ranch Company, has introduced about 4,000 visitors to Tejon Ranch through its access programs.
    - **State Park.** The Resource Groups and TRC will work with the Conservancy and the California State Parks Department towards creation of a State Park within the conserved lands.
    - **Pacific Crest Trail.** TRC will work with the Conservancy, the US Forest Service and the Pacific Crest Trail Association to provide an easement on conserved lands to realign a 37-mile segment of the Pacific Crest Trail through the Ranch.

- University of California Natural Reserve. The Conservancy will work with the University of California Natural Reserve System to determine whether certain conserved lands may be viable for a future UC Natural Reserve.

TEJON RANCH CONSERVANCY

- The Conservancy was created as an independent nonprofit public benefit corporation and was qualified as tax-exempt under Section 501(c)(3) of the Internal Revenue Code.
- The Conservancy is governed by a twelve member board consisting of four members appointed by the Resource Groups, four members appointed by TRC and four independent members appointed by the Conservancy Board.
  - Four independent directors: Emmy Cattani, Cattani Farming; Al Wright, Retired Wildlife Conservation Board; Frank Davis, UCSB, Bren School; Soapy Mulholland, Sequoia Riverlands Trust;
  - Four appointed by the Resource Groups: Joel Reynolds, NRDC; Dan Silver, Endangered Habitats League; Dan Taylor, Audubon CA; Jim Dodson, Sierra Club; and,
  - Four by TRC: Brian Grant, TRC; Roberta Marshall, DMB Pacific Ventures; Gary Hunt, California Strategies; Randall Lewis, Lewis Operating Corp.
- The Conservancy has an experienced staff with expertise in land trust administration, conservation biology, environmental education, outdoor recreation and open space land management.
- The Conservancy is in the 2014 round for Accreditation under the Land Trust Alliance Standards and Practices.
- **Ranch-Wide Stewardship.** The Conservancy has brought together the expertise of leading experts in conservation, natural resource management and business interests to develop the framework for stewardship of the conserved lands.
  - The Conservancy's mission is to preserve, enhance and restore the native biodiversity and ecosystem values of the Tejon Ranch and Tehachapi Range for the benefit of California's future generations. The Conservancy will work collaboratively with TRC to promote long-term, science-based stewardship of this historic 270,000-acre property to provide for public enjoyment through educational programs and public access.
  - The Conservancy will adopt, update, monitor and enforce implementation of the Ranch-Wide Management Plan, which will be applicable to all conserved lands.
  - As necessary the Conservancy will manage and monitor natural resource mitigation activities on conserved lands and will hold conservation easements, subject to regulatory agency approval.
  - The Conservancy will receive and allocate conservation fees and other sources of funding.
  - The Conservancy, in close collaboration with the Tejon Ranch Company, manages public access to conserved lands and provides interpretive and environmental education programs for the local communities, focusing in particular on underserved populations.

- **Conservancy Funding**. Funding for the Conservancy is assured through a combination of advances from TRC and payment of conservation fees collected at the time of initial sales and resales of residential units within current development areas.

  - ~ A conservation fee covenant will be recorded encumbering the development projects of Centennial, Tejon Mountain Village and Grapevine. The covenant shall provide for a fee, payable in perpetuity, equal to one quarter percent (.25%) of the retail sales price of each covered transaction, which generally includes initial sales and resales of custom lots and single family attached and detached homes and excludes units designated as affordable.

  - ~ Prior to the receipt of conservation fees by the Conservancy, TRC will advance amounts necessary to adequately fund the Conservancy, as described below.

  - ~ For the 2008 calendar year, TRC advances will total $820,000 and for 2009 and 2010, TRC annual advances will be $1,070,000. The advances for these first three years include a total of $1,100,000 for costs of Conservancy formation and for costs associated with securing funding for acquisition of the conservation easements for the five Acquisition Areas.

  - ~ For calendar years 2011 through 2014, which was extended to 2021 since conservation easements for the Acquisition Areas were purchased, TRC annual advances will be $800,000.

  - ~ Three years after Final Approval of a development that requires mitigation in the conserved lands or two years before the Conservancy first takes responsibility to manage and monitor natural resource mitigation activities on the conserved lands, the TRC annual advance will be increased to $1,500,000.

  - ~ In the year the Conservancy first takes responsibility to monitor and maintain natural resource mitigation, the TRC annual advance will be adjusted to $1,500,000 plus the actual mitigation costs for each year.

  - ~ In future years, conservation fees in excess of amounts required to meet the Conservancy's core obligations will be used to repay TRC advances without interest.

MANAGEMENT OF CONSERVED LANDS

- **Public Access.** Public enjoyment of the conserved lands is a high priority to Tejon Ranch Company, the Resource Groups and the Conservancy. Tejon Ranch Company works closely with the Conservancy to establish and implement a public access plan to conserved lands that encourages and facilitates public access, including public access opportunities for underserved populations. The public access plan also provides for docent-led tours to Bear Trap Canyon.

- **Ranch-Wide Management Plan (RWMP).** The RWMP identifies and assesses natural resource and conservation attributes of the conserved lands in order to develop sustainable stewardship management strategies that provide for protection and enhancement of natural resource values and appropriately managed existing ranch uses.

  - ~ **Development and Implementation.** TRC worked with the Conservancy to draft and implement an interim RWMP that was adopted by the Conservancy Board in September of 2009. The Initial RWMP is targeted for adoption by the Conservancy board on June 21, 2013.

  - ~ **Identification of Conservation Values and Existing Ranch Uses.** The RWMP identifies natural resources and conservation values of the conserved lands as well as opportunities to protect, enhance and restore identified resources and values. In addition, the RWMP establishes best management practices for existing ranch uses on the conserved lands.

- **Current Stewardship.** During an initial 5-year period, the RWMP focused on preservation of existing conservation values by maintaining baseline conditions.

- **Restoration and Enhancement.** After the 5-year initial period, the RWMP will include Conservation Activities, funded by the Conservancy, for restoring and enhancing the natural values of the conserved lands.

- **Core Activities.** TRC will be permitted to continue certain core activities on conserved lands (e.g. comply with obligations pursuant to existing leases and easements, perform natural resource mitigation, comply with applicable laws) without regard to Conservancy developed BMPs.

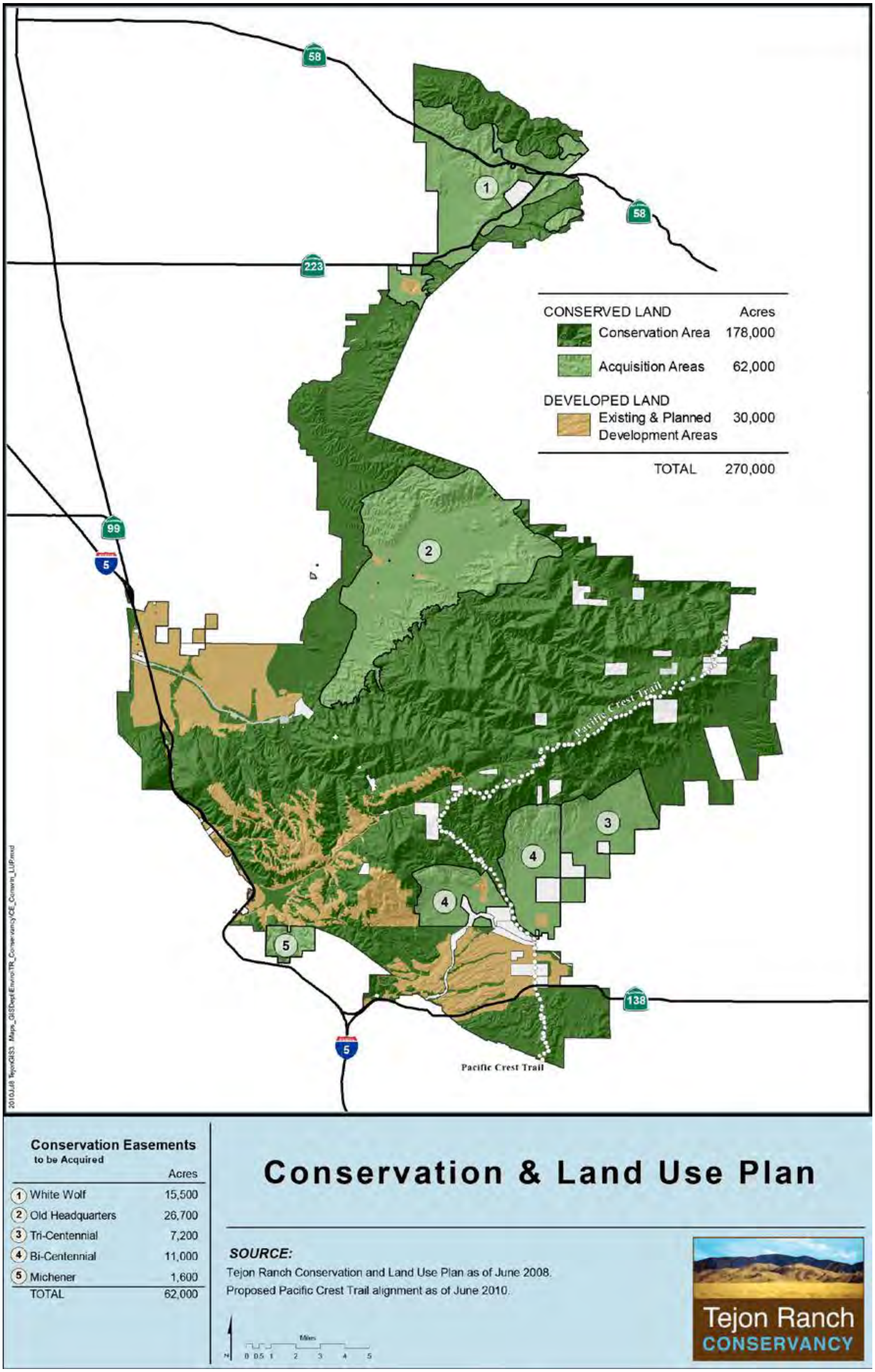
- **Existing Ranch Uses.** TRC will be permitted to continue certain existing uses on conserved lands, subject to the stewardship and adaptive management standards in the RWMP.
  - Grazing, game management and filming activities are generally permitted ranch-wide and will be subject to BMPs in the RWMP.
  - Farming, sand and gravel mining and oil and gas extraction activities are permitted within existing areas and defined expansion areas and will be subject to BMPs under the applicable management standard.

Permitted Development

- **Permitted Developments.** TRC is proceeding through the process to entitle and develop the three new projects of Centennial, Tejon Mountain Village and Grapevine within designated development envelopes and subject to local, state and federal approvals.

- **Project Design Measures.** Centennial, Tejon Mountain Village and Grapevine will be required to incorporate specific design measures in its entitlement applications to minimize impacts on the environment (e.g. energy reduction requirements in excess of Title 24 standards, construction waste recycling, onsite shuttle bus systems connecting to regional routes, environmental education outreach programs).

- **Non-Opposition.** The Resource Groups will refrain from opposing the entitlements, approvals and agency applications for the proposed development projects and for other permitted uses.


58
223
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Pacific Crest Trail
CONSERVED LAND Acres
Conservation Area 178,000
Acquisition Areas 62,000
DEVELOPED LAND
Existing & Planned Development Areas 30,000
TOTAL 270,000
Conservation Easements to be Acquired
Acres
1 White Wolf 15,500
2 Old Headquarters 26,700
3 Tri-Centennial 7,200
4 Bi-Centennial 11,000
5 Michener 1,600
TOTAL 62,000
Conservation & Land Use Plan
SOURCE:
Tejon Ranch Conservation and Land Use Plan as of June 2008.
Proposed Pacific Crest Trail alignment as of June 2010.
Tejon Ranch CONSERVANCY

Appendix B

Special-status Species Occurring or Potentially Occurring on Tejon Ranch

Plants		
Common Name	***Scientific Name***	**Status Federal/State/CRPR**
Bakersfield cactus	*Opuntia basilaris* var. *treleasei*	FE/CE/List 1B.1
Striped adobe lily	*Fritillaria striata*	CT/–/List 1B.1
Fort Tejon woolly sunflower	*Eriophyllum lanatum* var. *hallii*	–/–/List 1B.1
Tehachapi buckwheat	*Eriogonum callistum*	–/–/List 1B.1
Tejon poppy	*Eschscholzia lemmonii* ssp. *kernensis*	–/–/List 1B.1
Vasek's clarkia	*Clarkia tembloriensis* ssp. *calientensis*	–/–/List 1B.1
Comanche Point layia	*Layia leucopappa*	–/–/List 1B.1
Pale yellow layia	*Layia heterotricha*	–/–/List 1B.1
Piute Mountain navarretia	*Navarretia setiloba*	–/–/List 1B.1
Gypsum-loving larkspur	*Delphinium gypsophilum* ssp. *gypsophilum*	–/–/CBR
Cottony buckwheat	*Eriogonum gossypinum*	–/–/List 4.2
Alkali Mariposa lily	*Calochortus striatus*	–/–/List 1B.2
Aromatic canyon gooseberry	*Ribes menziesii* var. *ixoderme*	–/–/List 1B.2
Golden violet	*Viola purpurea* ssp. *aurea*	–/–/List 2.2
Calico monkeyflower	*Mimulus pictus*	–/–/List 1B.2
Palmer's mariposa lily	*Calochortus palmeri* var. *palmeri*	–/–/List 1B.2
San Bernardino aster	*Symphyotrichum defoliatum*	–/–/List 1B.2
California androsace	*Androsace elongata* ssp. *acuta*	–/–/List 4.2
Adobe yampah	*Perideridia pringlei*	–/–/List 4.3
Sylvan microseris	*Microseris sylvatica*	–/–/List 4.2

Plants		
Common Name	***Scientific Name***	**Status Federal/State/CRPR**
Hoover's eriastrum	*Eriastrum hooveri*	DL 2003/–/List 4.2
Mt. Pinos larkspur	*Delphinium parryi* ssp. *purpureum*	–/–/List 4.3
Flax-like monardella	*Monardella linoides* ssp. *oblonga*	–/–/List 1B.3
Small-flowered monkey flower	*Mimulus inconspicuous*	–/–/List 4.3
Silvery false lupine	*Thermopsis californica* var. *argentata*	–/–/List 4.3
Tehachapi ragwort	*Packera ionophylla*	–/–/List 4.3
Oak-leaved nemophila	*Nemophila parviflora var. quercifolia*	–/–/List 4.3
Round-leaved filaree	*California macrophyllum*	–/–/List 1B.1
Kusche's sandwort	*Eremogone macradenia var. arcuifolia*	–/–/CBR

Invertebrates		
Common Name	***Scientific Name***	**Status Federal/State**
Valley elderberry longhorn beetle	*Desmocerus californicus dimorphus*	FT/–

Reptiles and Amphibians		
Common Name	***Scientific Name***	**Status Federal/State**
Blunt-nosed leopard lizard	*Gambelia sila*	FE/CE, FP
Tehachapi slender salamander	*Batrachoseps stebbinsi*	–/CT
Yellow-blotched salamander	*Ensatina eschscholtzii croceator*	–/SSC
Western spadefoot	*Spea hammondii*	–/SSC
Coast horned-lizard	*Phrynosoma blainvillii*	–/SSC
San Joaquin whipsnake	*Masticophis flagellum ruddocki*	–/SSC
Silvery legless lizard	*Anniella pulchra pulchra*	–/SSC
Two-striped garter snake	*Thamnophis hammondii*	–/SSC

Birds		
Common Name	***Scientific Name***	**Status Federal/State**
Golden eagle	*Aquila chrysaetos*	FP/WL (wintering and nesting)
Bald eagle	*Haliaeetus leucocephalus*	FP/CE (wintering and nesting)
Short-eared owl	*Asio flammeus*	–/SSC (nesting)
Burrowing owl	*Athene cunicularia*	–/SSC (burrow sites and some wintering sites)
California spotted owl	*Strix occidentalis occidentalis*	–/SSC
Swainson's hawk	*Buteo swainsoni*	–/CT (nesting)
Cooper's hawk	*Accipiter cooperii*	–/WL (nesting)
Prairie falcon	*Falco mexicanus*	–/WL (nesting)
Ferruginous hawk	*Buteo regalis*	–/WL (wintering)
Northern harrier	*Circus cyaneus*	–/SSC (nesting)
American peregrine falcon	*Falco peregrinus anatum*	FP (nesting)/–
Loggerhead shrike	*Lanius ludovicianus*	–/SSC (nesting)
California horned lark	*Eremophila alpestris actia*	–/WL
Mountain plover	*Charadrius montanus*	PT/SSC (wintering)
Long-billed curlew	*Numenius americanus*	–/WL (nesting)
Olive-sided flycatcher	*Contopus cooperi*	–/SSC (nesting)
Purple martin	*Progne subis*	–/SSC (nesting)
Little willow flycatcher	*Empidonax traillii brewsteri*	–/CE (nesting)
Yellow warbler	*Dendroica petechia brewsteri*	–/SSC (nesting)
Tricolored blackbird	*Agelaius tricolor*	–/SSC (nesting colony)
White-tailed kite	*Elanus leucurus*	FP (nesting)/–

Mammals		
Common Name	***Scientific Name***	**Status Federal/State**
San Joaquin kit fox	*Vulpes macrotis mutica*	FE/CT
Tehachapi pocket mouse	*Perognathus alticolus inexpectatus*	–/SSC
American badger	*Taxidea taxus*	–/SSC
Ringtail	*Bassariscus astutus*	–/FP

Status codes:

Bold = Tehachapi Uplands Multiple Species Conservation Program Covered Species
Dash = No listing status

Federal

FE = Federal endangered
FC = Federal Candidate
PT = Federal Proposed Threatened
DL = Delisted

California

CE = California Endangered
CT = California Threatened
SSC = California Species of Special Concern
FP = California Fully Protected
WL = California Watch List

California Rare Plant Rank

List 1B.1 = Plants Rare, Threatened, or Endangered in California and Elsewhere (Threat = seriously endangered in California)

List 1B.2 = Plants Rare, Threatened, or Endangered in California and Elsewhere (Threat = fairly endangered in California)

List 1B.3 = Plants Rare, Threatened, or Endangered in California and Elsewhere (Threat = not very endangered in California)

List 2.2 = Plants Rare, Threatened, or Endangered in California, but More Common Elsewhere (Threat = fairly endangered in California)

List 4.2 = Plants of Limited Distribution - A Watch list (Threat = fairly endangered in California)

List 4.3 = Plants of Limited Distribution - A Watch list (Threat = not very endangered in California)

CBR = Considered but Rejected