California Essential Habitat Connectivity Project:

A Strategy for Conserving a Connected California

February 2010

Prepared for:

California Department of Transportation
California Department of Fish and Game

With Funding From:
Federal Highways Administration

California Essential Habitat Connectivity Project
"A Strategy for Conserving a Connected California"

Funding for this project was provided by the California Department of Transportation, State Planning and Research program (80% Federal Highway Administration and 20% State transportation funds). In-kind services were provided by the California Department of Fish and Game.

Disclaimer

The statements and conclusions in this report are those of the authors and advisory committees and not necessarily those of the Federal Highways Administration, California Department of Transportation or Department of Fish and Game. The mention of commercial products, their source or their use in connection with material reported herein is not to be construed as either an actual or implied endorsement of such products.

The user accepts sole responsibility for the correct interpretation of this report and the correct use of its accompanying data sets in environmental documents. No statement or data set shall by itself be considered an official response from a state agency regarding impacts to wildlife resulting from a management action subject to the California Environmental Quality Act (CEQA).

Copyright Information

Cover image: Left-side photo by SC Wildlands (Rocky Peak Rd.).

Preferred Citation

Spencer, W.D., P. Beier, K. Penrod, K. Winters, C. Paulman, H. Rustigian-Romsos, J. Strittholt, M. Parisi, and A. Pettler. 2010. California Essential Habitat Connectivity Project: A Strategy for Conserving a Connected California. Prepared for California Department of Transportation, California Department of Fish and Game, and Federal Highways Administration.

Document Availability

This document and companion data files are available online at:

http://www.dot.ca.gov/hq/env/bio/program_efforts.htm
http://www.dfg.ca.gov/habcon
http://www.scwildlands.org

For individuals with sensory disabilities, this document is available in Braille, large print, on audiocassette, or computer disk. To obtain a copy in one of these alternate formats, please call or write to Caltrans, Attn: Amy Pettler, Senior Planner, 1120 N. Street MS 27, Sacramento, CA 95814; telephone number: (916)651-8166.

Members of the Steering Committee

California Department of Transportation
Amy Pettler, AICP
Senior Endangered Species Coordinator and Wildlife Biologist
Division of Environmental Analysis

Gregg Erickson
Chief, Office of Biological and Technical Assistance
Division of Environmental Analysis

Marilee Mortenson
Senior Environmental Planner
Division of Transportation Planning

Katie Benoaur
Senior Environmental Planner
Collaborative Planning Branch
Division of Transportation Planning

Robert Cervantes
Associate Transportation Planner
Division of Transportation Planning

California Department of Fish and Game
Monica Parisi
Staff Environmental Scientist
Conservation Planning Program
Habitat Conservation Planning Branch

Tina Bartlett
Chief
Habitat Conservation Planning Branch

California Department of Parks and Recreation
Rick Rayburn
Chief, Natural Resources Division

California Department of Water Resources
Marc Hoshovsky
Environmental Program Manager
Floodway Ecosystem Sustainability Branch

United States Fish and Wildlife Service
Roberta Gerson
Regional Transportation Coordinator - Region 8

Consultant Team

The Dangermond Group
Karin Winters, Project Manager
Pete Dangermond

SC Wildlands
Kristeen Penrod
Candace Paulman

Conservation Biology Institute
Wayne Spencer, PhD
James Strittholt, PhD
Heather Rustigian-Romsos

Paul Beier, PhD

Members of the Technical Advisory Group

Amador County
Keith Johnson

Association of Monterey Bay Area Governments
David Johnston

California Department of Fish and Game
Armand Gonzales
David Johnston
Tom Lupo
Ray McDowell
Kent Smith
Chris Stermer

California Department of Transportation
Bruce April
Kelly Eagan

California Tahoe Conservancy
Adam Lewandowski

California Department of Water Resources
Ted Frink

East Bay Regional Parks
Steve Bobzien

Enterprise Rancheria
Ren Reynolds

Federal Highway Administration
Michael Morris
Larry Vinzant

National Park Service
David Graber
Ray Sauvajot

Sacramento Area Council of Governments
Joe Concannon

San Gabriel and Lower Los Angeles Rivers and Mountains Conservancy
Luz Torres

San Joaquin Council of Governments
Steve Mayo

Santa Clara Valley Habitat Plan
Ken Schreiber

Sierra Nevada Conservancy
Steve Beckwitt
Jim Branham
Liz VanWagtendonk

State Coastal Conservancy
Nadine Hitchcock

United States Bureau of Land Management
Amy Fesnock
Russell Scofield

United States Bureau of Reclamation
David Hansen
Barbara Simpson
John Thomson

United States Fish and Wildlife Service
Sally Brown
Cat Darst
Laura Finley
Cheryl Hickam
Steve Kirkland
Rocky Montgomery
Jerry Roe

United States Forest Service
Don Yasuda
Peter Stine
Diana Craig

United States Geological Survey
Robert Fisher

Washoe Environmental Protection Department
John Warpeha

Multi-Disciplinary Team Participating Agencies

Agua Caliente Band of Cahuilla Indians
Alpine County
Amador County
Arizona Game and Fish Department
Association of Bay Area Governments
Association of Monterey Bay Area Governments
Butte County Association of Governments
Calaveras Council of Governments
California Department of Conservation
California Department of Fish and Game
California Department of Parks and Recreation
California Department of Transportation
California Department of Water Resources
California Energy Commission
California Tahoe Conservancy
Coachella Valley Association of Gov
Coachella Valley Mountains Conservancy
Colusa County Transportation Commission
Contra Costa County
Contra Costa Transportation Authority
Council of Fresno County Governments
County of San Diego
East Bay Regional Parks
Enterprise Rancheria
Federal Highway Administration
Fresno Flood Control
Lake County/City Area Planning
Mono County
National Park Service
Nevada County Transportation Commission
Office of Planning and Research
Orange County Transportation Authority
Placer County
Rancho Palos Verdes
Riverside County Regional Conservation Authority
Robinson Rancheria
Sacramento Area Council of Governments
Sacramento County Planning Department
San Diego Association of Governments
San Diego River Conservancy
San Gabriel and Lower Los Angeles Rivers and Mountains Conservancy
San Joaquin Council of Governments
San Joaquin River Conservancy
Santa Clara Valley Habitat Plan
Sierra Nevada Conservancy
Southern California Association of Governments
Sutter County
Tahoe Regional Planning Agency
Transportation Agency Monterey County
Tuolumne County Transportation Council
United States Air Force Western Regional Environmental Office
United States Bureau of Land Management
United States Bureau of Reclamation
United States Department of Defense - Marines
United States Environmental Protection Agency
United States Fish and Wildlife Service
United States Forest Service
United States Geological Survey
Ventura County Transportation Commission
Washoe Tribe of Nevada and California
Western Riverside Council of Governments
Yolo Habitat Joint Powers Authority
Yurok Tribe

Peer Reviewers

Kevin Crooks, Ph.D.
Colorado State University

Patrick Huber, Ph.D.
University of California, Davis

Brad McRae, Ph.D.
The Nature Conservancy

Reed Noss, Ph.D.
University of Central Florida

John Wiens, Ph.D.
PRBO Conservation Science

Table of Contents

Figures

Tables

Appendices

Executive Summary

The California Department of Transportation (Caltrans) and California Department of Fish and Game (CDFG) commissioned the California Essential Habitat Connectivity Project because a functional network of connected wildlands is essential to the continued support of California's diverse natural communities in the face of human development and climate change. This Report is also intended to make transportation and land-use planning more efficient and less costly, while helping reduce dangerous wildlife-vehicle collisions.

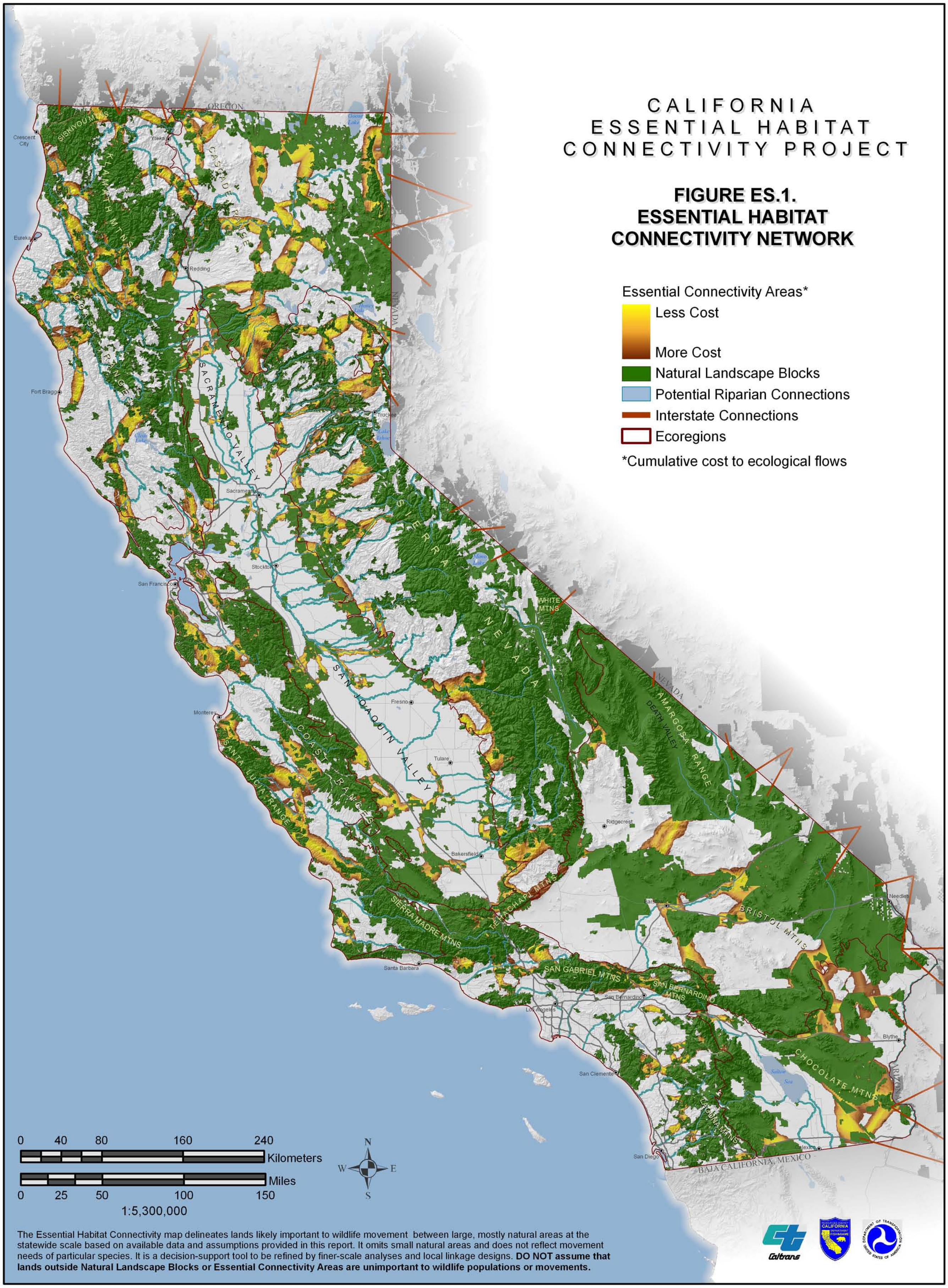
This Report was produced by a highly collaborative, transparent, and repeatable process that can be emulated by other states. The work was guided by input and review of a Multidisciplinary Team of agency representatives, a Technical Advisory Group, and a Steering Committee. The Multidisciplinary Team (~200 people from 62 agencies) provided broad representation across Federal, State, Tribal, regional, and local agencies that are involved in biodiversity conservation, land-use planning, or land management—and that could therefore both contribute to and benefit from efforts to improve habitat connectivity at various scales. The Technical Advisory Group (44 people from 23 agencies) was a subset of the Multidisciplinary Team. It provided technical expertise to help guide such decisions as selection of data sources, models, and mapping criteria. The Steering Committee (ten people from four partner agencies) guided key decisions about work flow, meeting agendas, and document contents. In addition to review by these agency representatives, the work plan and this final report were subject to peer review by five outside experts in conservation biology and conservation planning.

This Essential Habitat Connectivity Report includes three primary products: (1) a statewide Essential Habitat Connectivity Map, (2) data characterizing areas delineated on the map, and (3) guidance for mitigating the fragmenting effects of roads and for developing and implementing local and regional connectivity plans. These products will be made available for public use on two websites—BIOS, managed by the California Department of Fish and Game (http://bios.dfg.ca.gov), and Data Basin, managed by the Conservation Biology Institute (http://databasin.org). Both are interactive web-based systems that allow users to download, print, combine, comment on, or otherwise use the maps, data layers, and other information.

Essential Connectivity Map (Figure ES-1)

The Essential Connectivity Map depicts large, relatively natural habitat blocks that support native biodiversity (Natural Landscape Blocks) and areas essential for ecological connectivity between them (Essential Connectivity Areas). This coarse-scale map was based primarily on the concept of ecological integrity[1], rather than the needs of particular species.

[1] Natural Landscape Blocks were delineated based primarily on an Ecological Condition Index devised by Davis et al. (2003, 2006) using degree of land conversion, residential housing impacts, road impacts, and status of forest structure (for forested areas) as inputs. This index was modified by also considering degree of conservation protection and areas known to support high biological values, such as mapped Critical Habitat and hotspots of species endemism. Essential Connectivity Areas were delineated using least-cost corridor models


CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
FIGURE ES.1.
ESSENTIAL HABITAT
CONNECTIVITY NETWORK
Essential Connectivity Areas*
Less Cost
More Cost
Natural Landscape Blocks
Potential Riparian Connections
Interstate Connections
Ecoregions
*Cumulative cost to ecological flows
OREGON
NEVADA
ARIZONA
BAJA CALIFORNIA, MEXICO
Crescent City
Eureka
Redding
Fort Bragg
Sacramento
Stockton
San Francisco
Monterey
Fresno
Tulare
Bakersfield
Ridgecrest
Santa Barbara
Los Angeles
San Bernardino
San Clemente
San Diego
Blythe
Needles
SISKIYOU MTNS
CASCADE RANGE
SACRAMENTO VALLEY
SIERRA NEVADA
WHITE MTNS
SAN JOAQUIN VALLEY
COAST RANGES
SANTA LUCIA RANGE
AMARGOSA RANGE
DEATH VALLEY
BRISTOL MTNS
SIERRA MADRE MTNS
TEHACHAPI MTNS
SAN GABRIEL MTNS
SAN BERNARDINO MTNS
CHOCOLATE MTNS
0 40 80 160 240
Kilometers
Miles
0 25 50 100 150
1:5,300,000
N
W
E
S
The Essential Habitat Connectivity map delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale based on available data and assumptions provided in this report. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.
Caltrans

Essential Connectivity Areas are placeholder polygons that can inform land-planning efforts, but that should eventually be replaced by more detailed Linkage Designs, developed at finer resolution based on the needs of particular species and ecological processes. It is important to recognize that even areas outside of Natural Landscape Blocks and Essential Connectivity Areas support important ecological values that should not be "written off" as lacking conservation value. Furthermore, because the Essential Habitat Connectivity Map was created at the statewide scale, based on available statewide data layers, and ignored Natural Landscape Blocks smaller than 2,000 acres[2], it has errors of omission that should be addressed at regional and local scales, as discussed in Chapters 4-6.

The statewide essential connectivity network consists of 850 relatively intact and well-conserved Natural Landscape Blocks (ranging from 2,000 to about 3.7 million acres each) with over 1,000 potential connections among them. The 192 Essential Connectivity Areas represent principle connections between the Natural Landscape Blocks within which land conservation and management actions should be prioritized to maintain and enhance ecological connectivity. Each Essential Connectivity Area connects from 2 to 15 (on average 4.3) Natural Landscape Blocks across distances averaging roughly 10 to 20 km. In addition to these Essential Connectivity Areas, there are 522 instances where Natural Landscape Blocks were separated only by a road—in which case there was no need to delineate a connecting polygon, because sustaining and enhancing functional connectivity across roads is the primary or only conservation action needed (Chapter 6). In addition, the map illustrates that numerous riparian corridors contribute to ecological connectivity throughout the state; and sustaining and enhancing riparian and riverine corridors should remain a high conservation priority whether they are inside or outside of Essential Connectivity Areas and Natural Landscape Blocks.

Characterizing Natural Landscape Blocks and Essential Connectivity Areas

Data characterizing the Natural Landscape Blocks and Essential Connectivity Areas—including their size, physical characteristics, biological characteristics, ownerships, and the roads that cross them—are summarized in Chapter 3 and provided in detail in Appendices B and C. These data are also available in electronic databases so that users can select, sort, or weight the various attributes to help prioritize and plan conservation, mitigation, or other actions in or near the Essential Connectivity Areas and Natural Landscape Blocks.

Across the state, Natural Landscape Blocks average about 40% in private ownership and 44% in conservation reserves, with over 90% of their area in natural landcovers. Essential Connectivity Areas average about 15 km long, are about 61% in private ownership, have about 13% of their area in conservation reserves, and are over 80% natural landcovers. However, there is tremendous variability in attributes among California's eight diverse

---

run on a data layer that represents the relative permeability of the landscape to wildlife movements, based on land cover naturalness, modified slightly to reflect conservation status.

[2] Only areas > 2,000 acres in size that met ecoregion-specific rules for Ecological Condition Index, degree of conservation protection, and support of known high-biological resource values were considered Natural Landscape Blocks. Only Natural Landscape Blocks > 10,000 acres were connected by Essential Connectivity Areas in most regions, and those > 2,000 acres were connected in more developed ecoregions (San Francisco Bay Area, Great Central Valley, South Coast, and Northern Sierra Nevada).

ecoregions and individual connectivity areas. Within each ecoregion, Essential Connectivity Areas tend to connect the most ecologically intact and well-conserved lands across generally less intact and protected land. However, optimal approaches to sustaining and enhancing functional connectivity will vary between ecoregions and individual Essential Connectivity Areas to reflect different contexts. For example, in the relatively undeveloped forest and desert ecoregions—such as the Sierra Nevada and Mojave Desert—many Essential Connectivity Areas connect highly intact wilderness and park lands across private or federally managed multiple-use lands, which support mostly natural landcovers and are relatively permeable to wildlife movements. In these "low-contrast" situations, managing to sustain wildlife movements between existing protected areas may be the primary conservation approach. In other, more human-altered ecoregions—such as the San Francisco Bay Area, Great Central Valley, and South Coast Ecoregion—Essential Connectivity Areas tend to connect existing reserves across lands with more roads, agriculture, and urbanization, which can constrain wildlife movements. In such "high-contrast" situations, there may be greater focus on restoration and enhancement actions to improve ecological connectivity.

The California Essential Habitat Connectivity network overlaps considerably with other conservation maps, and it should be seen as complementary to rather than replacing existing conservation maps and plans. For example, the network includes 76% of the protected lands in California, including 99.6% of National Parks, 91% of conservation lands administered by non-governmental organizations, 80% of California Department of Parks and Recreation lands, and 80% of various County conservation lands. The network also overlaps with 41% of the area covered by Habitat Conservation Plans and Natural Community Conservation Plans, and 80% of habitat considered essential to recovery of federally Threatened or Endangered species. Essential Connectivity Areas also support high biodiversity, with an average of 26 special status plant and animal taxa per Essential Connectivity Area. On average, 12% of the land area in Essential Connectivity Areas is Critical Habitat for species listed under the Endangered Species Act.

Although the Essential Connectivity Areas were mapped based on coarse ecological condition indicators, rather than the needs of particular species, Essential Connectivity Areas are expected to serve the majority of species in each region. For example, Essential Connectivity Areas in California's South Coast Ecoregion included on average 81% of the area in each of 11 detailed Linkage Designs prepared by the South Coast Missing Linkages project based on the needs of 14 to 34 focal species each. Nevertheless, how well the Essential Connectivity Network actually accommodates wildlife movements is uncertain and will vary tremendously among species and locations. Consequently, future work should focus on assessing functionality of the network for diverse wildlife species and refining the Essential Habitat Connectivity Map and the following recommendations based on the results.

Framework for Regional Analysis

Given the coarse nature of the Essential Habitat Connectivity Map and the difficulties inherent to prioritizing conservation across such a diverse landscape, this Report provides guidance for mapping connectivity networks at regional and local scales. Regional analyses (Chapter 4) are useful to (1) help planners comprehensively consider regional needs for connectivity, including for natural areas smaller than those mapped in this statewide project; (2) prioritize Essential Connectivity Areas for more detailed planning; and (3) take advantage of spatial datasets not used in this Report because they did not cover the entire state. A regional analysis produces a map of all Natural Landscape Blocks (including small blocks), detailed and implementable conservation plans for the most important connectivity areas, and placeholder polygons for the remaining connectivity areas.

A good existing example of a regional analysis is South Coast Missing Linkages and the accompanying 11 individual Linkage Designs for the South Coast Ecoregion (available at www.scwildlands.org). The Linkage Designs were developed based on the habitat and movement needs of multiple focal species, and 10 of the 11 designs are being actively implemented.

In developing a regional connectivity analysis, it is important to involve end-users early in the design process to collectively agree on what types of areas they want to connect, which areas need connectivity, and which areas merit the highest priority for detailed Linkage Design. The entire process should be transparent and repeatable to build trust and allow updating as new or better data become available.

We recommend that regional connectivity analyses identify Natural Landscape Blocks by considering ecological integrity, protection status, biodiversity, and highways, and map Essential Connectivity Areas by least-cost modeling for a broad suite of focal species. In Chapter 4 we describe the advantages and disadvantages of alternative approaches, so that planners can choose the most appropriate methods for their region. If time and budget allow, we recommend conducting detailed Linkage Designs for all potential linkages in a region. More commonly, limited resources will compel planners to develop a few priority Linkage Designs at a time. Nonetheless every regional plan should replace the most crucial placeholder polygons with detailed Linkage Designs using methods described in Chapter 5.

Framework for Local-scale Analyses

The goal of local-scale analyses is to replace the relatively coarse Essential Connectivity Areas with detailed Linkage Designs—that is, maps delineating the specific lands needed to maintain or restore functional connections between two Natural Landscape Blocks and detailed descriptions of the necessary conservation and management actions. Chapter 5 provides a "cookbook" of step-wise procedures for each major step listed below. Except for the new procedures related to climate change, each set of instructions has a well-established history of use for local-scale analysis in California and elsewhere. Each step should involve collaboration among stakeholders, end-users, implementers, and scientific experts.

1. *Delineate Natural Landscape Blocks:* Connectivity is meaningful only with reference to the areas to be connected—whether they are existing protected areas, suitable habitat for select focal species, or other alternatives.
2. *Select focal species:* Choose focal species to represent a diversity of habitat requirements and movement needs. Focal species should include *area-sensitive species* (those with large area requirements, which are often the first to disappear when connectivity is lost),

barrier-sensitive species (those least likely to traverse roads, urban areas, canals, agricultural fields, or other features), and *less mobile species* (habitat specialists and those with limited movements).

3. *Map corridors for focal species:* Conduct least-cost corridor analyses for each focal species to identify one or more swaths of habitat that support movement and gene flow. Consult experts on each focal species to parameterize the model and review the results.

4. *Map corridors for climate change:* Add additional swaths of habitat to increase the utility of the linkage under an uncertain future climate. We offer an approach that identifies corridors based on *land facets*—or areas of relatively uniform physical conditions that represent the arenas of biological activity, rather than the temporary occupants of those arenas.

5. *Evaluate and refine the preliminary Linkage Design.* Even the most permeable landscape identified in the previous two steps may not be very permeable for some species. Therefore, assess the spatial distribution of habitat patches for each species and add habitat as needed to the Linkage Design to ensure each species is accommodated. Where possible, impose a minimum width of 2 km to allow occupancy by medium-sized animals and support networks of linked populations for less-mobile species that require multiple generations to move their genes between Natural Landscape Blocks.

6. *Assess the Linkage Design in the field:* Conduct fieldwork to ground-truth existing habitat conditions, document barriers and passageways, identify restoration opportunities, and consider management options.

7. *Develop a Linkage Design Action Plan:* Compile results of analyses and fieldwork into a comprehensive report detailing what is required to conserve and improve linkage function, including priority lands for conservation and specific management.

Each Linkage Design should be based on existing baseline conditions or (for highly altered areas such as the Central Valley) on context and restorability of habitats, rather than on potential future build-out scenarios. Basing the analysis on future development scenarios may obscure what could be optimal alternatives. Although compromises will occur during implementation, the biological optimum provides a useful reference condition, so that decision-makers can evaluate trade-offs and make good compromises.

Guidelines for Addressing Road Impacts

The ecological footprint of a road network extends far beyond its physical footprint due to road mortality, habitat fragmentation, and numerous indirect impacts. The Essential Habitat Connectivity analysis identified 552 pairs of Natural Landscape Blocks separated only by a road, and numerous roads cross Essential Connectivity Areas. Chapter 6 therefore provides guidelines for assessing where mitigating road impacts to wildlife movement and ecological connectivity will be most effective, along with guidelines for how best to enhance functional connectivity while reducing the hazards of vehicle-wildlife collisions. In locations where a road crosses a Natural Landscape Block in protected status, the strongest enhancement and mitigation measures should be used. Protected status represents a significant public investment and commitment to ecological integrity, and roads should not compromise that investment.

Wildlife crossing structures—such as wildlife overpasses, underpasses, bridges, and culverts—can facilitate wildlife movement across roads, especially when integrated with appropriate roadside fencing. Because species vary tremendously in their reactions to roads, fences, and different types of crossing structures, multiple types of crossing structures should be constructed and maintained to provide connectivity for all species. The structures should be spaced close enough to allow free movement by species with different spatial requirements, and fencing should keep animals off the road and direct them towards crossing structures.

Strategies for Integrating and Institutionalizing the California Essential Habitat Connectivity Project

Maintaining and enhancing functional ecological connectivity across California's landscape in the face of human development and climate change is no easy task, and no single agency or small group of agencies can tackle it alone: The 200 members of the Multidisciplinary Team for this Project volunteered to serve as ambassadors for connectivity within and outside their agencies. As described in Chapter 7, each agency has a unique role to play in conserving ecological connectivity while also pursuing its own mission—whether it involves improving transportation, delivering water and power, providing recreational opportunities, or conserving biological diversity. Connectivity conservation fits all missions to some degree.

The Essential Habitat Connectivity Project was designed to be adopted and used to support planning at multiple scales. At the broadest scale, the products of this Project can serve new or emerging collaborations larger than the state of California, such as the 14-state Western Governors' Wildlife Council. At the statewide scale, the Project was intended to support conservation plans like California's Wildlife Action Plan and the California Climate Adaptation Strategy, and to integrate with infrastructure plans such as California Transportation Plan 2035. At regional and local scales, the products can be used to inform a wide array of planning efforts, such as Natural Community Conservation Plans and Habitat Conservation Plans, transportation Blueprint Plans, city and county General Plans, and land acquisition, management or restoration plans by conservancies, land trusts, and other non-governmental organizations. Private landowners may want to use this information to understand how they can be a part of a regional conservation goal or engage in the discussion. Legislation both supports and assures the conservation of connectivity in California.

Chapter 1. Introduction

1.1. Project Goals

The California Department of Transportation (Caltrans) and California Department of Fish and Game (CDFG) commissioned the California Essential Habitat Connectivity Project because a functional network of connected wildlands is essential to the continued support of California's diverse natural communities in the face of human development and climate change. This Essential Habitat Connectivity Report includes a statewide map of Essential Connectivity Areas and an assessment of these areas and the lands they connect. It also describes strategies for maintaining and enhancing functional ecological connectivity through local and regional land-use and management plans. These tools and strategies are provided to assist all agencies and organizations involved in land-use planning, transportation planning, land management, and conservation in California with maintaining a connected California, while simultaneously making land-use and infrastructure planning projects more cost efficient.

Contents of this Report are specifically intended to help Caltrans comply with Section 6001 of SAFETEA-LU[3] by avoiding, minimizing, and mitigating impacts to habitat connectivity during the transportation planning process. The information is also intended to help the California Department of Fish and Game update the State Wildlife Action Plan (Bunn et al. 2007) and comply with AB2785[4], which requires the Department of Fish and Game to map essential wildlife corridors and habitat linkages. The California Department of Fish and Game and the United States Fish and Wildlife Service (USFWS) also intend to use the plan to help during development and assessment of Natural Communities Conservation Plans (NCCPs), Habitat Conservation Plans (HCPs), and Habitat Management Plans (HMPs). Finally, the information in this Report is intended to help other land-planning and land-management agencies or non-governmental organizations to improve how natural open space, wildlife movement, and habitat connectivity are addressed in land-use, conservation, and transportation plans—including, for example, through local or regional General Planning and Transportation Planning processes, or via the operations of state, regional, or local conservancies and land trusts.

This document presents the methods used to prepare and assess the statewide Essential Connectivity Map, the maps and other information resulting from these analyses, and approaches and decision support tools for future work by implementing agencies. It includes three primary products:

1. The statewide Essential Connectivity Map, which broadly depicts large, relatively natural habitat blocks that support native biodiversity (Natural Landscape Blocks) and areas essential for ecological connectivity between them (Essential Connectivity Areas). The resulting network of Natural Landscape Blocks and Essential Connectivity Areas is considered important for maintaining native species, natural communities, and ecological

[3] Safe Accountable Flexible Efficient Transportation Equity Act of 2005
[4] California Assembly Bill 2785 (Ruskin)

processes throughout California. The map is very broad in scale, is not based on the needs of any particular species, and necessarily focuses on a finite number of approximate areas likely important for maintaining ecological connectivity. The map therefore excludes numerous areas that may be important to wildlife movement and ecological connectivity at more local scales. As outlined later in this Report, finer-scale analyses should be performed to identify and delineate these more local connectivity areas, as well as to refine the broad-brush Essential Connectivity Areas and Natural Landscape Blocks identified by this project using additional analytical tools, such as focal-species analyses.

2. Matrices summarizing characteristics of the Essential Connectivity Areas and the Natural Landscape Blocks they connect. These characteristics include data on the size, physical condition, and biological resources supported by these areas, as well as such characteristics as roads, topography, and existing degree of conservation that may influence land planning and management. The matrices are intended as decision-support tools for land-planning, land-management, and conservation agencies and organizations. Users of the matrices can select, sort by, or differentially weight the various attributes to help them prioritize and plan conservation, mitigation, or other actions in or near Essential Connectivity Areas and Natural Landscape Blocks.

3. Strategies for implementing habitat connectivity plans throughout the state, including guidance for developing finer-scale analyses and implementable connectivity plans at regional and local scales, standards and guidelines for addressing impacts of roads to ecological connectivity, and strategies for how various agencies and non-governmental organizations can integrate and institutionalize connectivity conservation in their planning processes and actions (Chapters 4 – 8). Given the broad-scale nature of the Essential Connectivity Map, completing finer-scale analyses, including refined delineation of the Essential Connectivity Areas and Natural Landscape Blocks, is considered a high priority for future analyses.

1.2. Project Approach

The approach used in this interagency project was highly collaborative, transparent, and repeatable. The work of the consulting team was guided by input and review of a Steering Committee, Multidisciplinary Team, and Technical Advisory Group via three in-person meetings and multiple web-based meetings, e-mail exchanges, and conference calls.

The Steering Committee was composed of staff members from California Department of Transportation, California Department of Fish and Game, U.S. Fish and Wildlife Service, California Department of Parks and Recreation (DPR), and California Department of Water Resources (DWR). The Steering Committee worked closely with the Consultant Team on work flow, decision points, meeting structure and content, document editing, and overall project concerns. The team held regular web-based meetings with the Steering Committee to obtain input and review of interim products.

The Multidisciplinary Team was comprised of Federal, State, Tribal, regional, and local agencies that could potentially have interest in the project, including transportation planning agencies, regional planning agencies, regulatory agencies, and natural resources agencies. An initial project meeting was held on October 7, 2008, with invitations sent to over 250 members of the Multidisciplinary Team. At this meeting, an overview of the project goals was presented, with some background on connectivity planning. Members of the Multidisciplinary Team then broke out into groups and provided input to the Consultant Team regarding their goals and needs for the proposed project. Also at this meeting, Multidisciplinary Team members identified potential Technical Advisory Group members.

The Technical Advisory Group represents a subset of the Multidisciplinary Team with specific technical skills in geographic information systems (GIS), biology, land management, and other relevant expertise. Technical Advisory Group members were identified and selected to work more closely with the Steering Committee and Consultant Team. Key decisions on all technical matters, such as data sources and models to use to delineate Natural Landscape Blocks and Essential Connectivity Areas, were guided by the Technical Advisory Group. A second project meeting was held on January 29, 2009, with members of the Technical Advisory Group. At this meeting, the Technical Advisory Group provided input on the Draft Work Plan, the proposed modeling approach and criteria for defining Natural Landscape Blocks and Essential Connectivity Areas, and characteristics for describing the Essential Connectivity Areas.

After the second project meeting, the Consultant Team produced a Work Plan to guide the remainder of the project. Most of the methods described in this Report and used to develop the Essential Connectivity Map were originally detailed in multiple drafts of the Work Plan, which were reviewed by the Technical Advisory Group as well as several outside peer reviewers[5]. The Work Plan (attached as Appendix A) also served as a vehicle for keeping members of the Technical Advisory Group and Multidisciplinary Team apprised of revisions to methods and how their technical input was being addressed. Members of the Technical Advisory Group reviewed draft Natural

[5] Kevin Crooks, Colorado State University; Reed Noss, University of Central Florida; and John Wiens, PRBO Conservation Science.

Landscape Block and Essential Connectivity Area maps via web-based meetings. The Consultant Team also used Data Basin[6] and Google Docs as methods for sharing, receiving input, and refining maps, models, and other work products throughout the project.

A third project team meeting was held on October 15, 2009, to solicit input from the Technical Advisory Group on draft products, including maps of the Natural Landscape Blocks and Essential Connectivity Areas, comparisons with other conservation maps, criteria used to characterize the Essential Connectivity Areas and Natural Landscape Blocks, and the desired contents of this Report. The final project meeting, scheduled for February 10, 2010, was designed to release the final results and to review the recommendations and other contents of this Report with the Multidisciplinary Team.

1.3. Report Goals and Organization

This Report summarizes the methods and results of the California Essential Habitat Connectivity Project and provides a framework for local and regional analyses, as well as strategies for implementation. Chapter 2 details the Methods used in constructing the products for this project, including steps for delineating Natural Landscape Blocks and Essential Connectivity Areas. Chapter 3 showcases the results from this Project, including statewide and ecoregional Essential Connectivity maps, comparisons to other conservation maps, and characteristics of the Natural Landscape Blocks and Essential Connectivity Areas. Frameworks for moving forward with future, finer-resolution actions, including regional analyses, local-scale analyses and approaches to improving connectivity across roads are detailed in Chapters 4 through 6, respectively. Strategies for integrating and institutionalizing the results of this analysis are presented in Chapter 7. Chapter 8 presents a framework for data distribution and updating. Details concerning background technical information, data, detailed characteristics of Natural Landscape Blocks and Essential Connectivity Areas, and other supporting information are presented in the Appendices.

The work represented by this project is broad scale by nature. In order to accommodate the diversity and size of the State of California, detailed analyses were not possible, and thus this report and the Essential Habitat Connectivity Map represent only a first step toward maintaining and protecting essential habitat connectivity throughout the State. Much more work is needed to meet the project's ultimate goals.

[6] Data Basin (http://databasin.org/about_data_basin) is an innovative web tool that connects users with conservation datasets, tools, and expertise. Individuals and organizations can explore and download a vast library of conservation datasets, upload their own data, comment on or add to other's data, and produce customized maps and charts that can be easily shared.

Chapter 2. Methods

Constructing and assessing the statewide Essential Habitat Connectivity Map required five principle analytical steps:

1. Delineating the lands to connect (Natural Landscape Blocks).
2. Identifying which pairs of Natural Landscape Blocks to connect (by drawing "sticks" connecting neighboring blocks).
3. Delineating Essential Connectivity Areas (polygons) connecting the Natural Landscape Blocks using least-cost corridor models.
4. Characterizing the biological and physical attributes of the resulting network of Natural Landscape Blocks and Essential Connectivity Areas.
5. Comparing the Essential Habitat Connectivity Map to other conservation priority maps.

Decisions concerning the data and methods used at each step were guided by input and review from the Steering Committee and Technical Advisory Group, in an iterative fashion. The Consultant Team produced numerous draft maps and pilot tests using various data sources and modeling approaches, based on suggestions from the Steering Committee and Technical Advisory Group, which then reviewed the results and suggested revisions. The team strove to make the methods as transparent and repeatable as possible, generally guided by formal decision rules derived for each step; however fully automated and quantitative methods were not possible at every step, and implementation of decision rules sometimes required professional judgment. The methods, data sources, and rule sets used at each analytical step are detailed below.

2.1. Delineating Natural Landscape Blocks

The first step in any connectivity analysis is deciding what needs to be connected—whether these are existing reserves, suitable or occupied habitat for particular species, or large areas of relatively natural landcover (Beier et al. 2008). Intense discussions with the Multidisciplinary Team and Technical Advisory Group suggested that no single approach would satisfy all partners in all parts of the state, due to differing agency goals and mandates, as well as California's extreme biogeographic and geopolitical variability. In some regions and for some agencies, existing protected areas seemed the logical units to connect, whereas in others, large natural areas, whether conserved or not, seemed better. Nearly all parties favored focal-species, habitat-based approaches, but recognized that these would not be possible given schedule, data, and budgetary constraints—and again, the extreme biogeographic variability of the State (i.e., no species or set of species would provide an adequate and unbiased representation of areas needing connectivity). Ultimately, there was consensus that the Project should use an objective, state-wide index of ecological integrity or "naturalness" as the primary basis for defining Natural Landscape Blocks, supplemented or modified with some consideration of existing protected areas (especially in large, relatively unaltered regions like the deserts) as well as some consideration of areas known to support high-value biological resources, such as concentrations of endemic species or habitat considered essential to supporting Threatened or Endangered species.

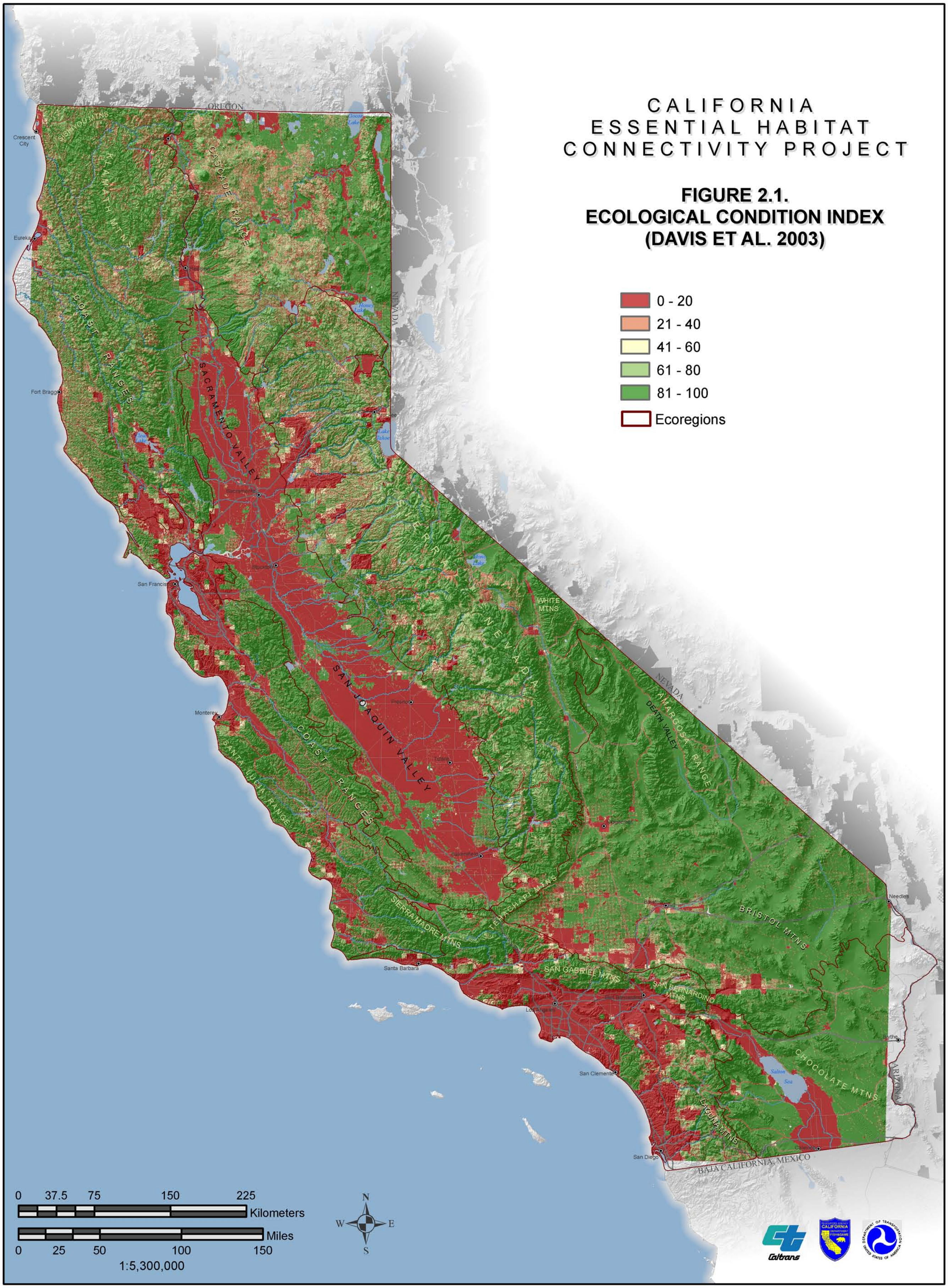
2.1.1. Ecological Condition Index

After investigating various approaches for defining Natural Landscape Blocks based on indices of ecological integrity, it was decided that the best approach was to modify an existing published model of Ecological Condition Index (ECI) developed by Davis et al. (2003, 2006) for the California Legacy Project (http://legacy.ca.gov/). The Ecological Condition Index characterizes site resource quality statewide, at 100-m resolution, using the following components (see Davis et al. 2003 and 2006 for equations and further details):

- *Land Conversion.* This component rates each 100-m pixel based on whether or not it has been converted from relatively natural landcover by human land uses. A score of zero was applied to converted areas (urban, cropland, orchard, vineyard, improved pastures, and exotic tree plantations) and all other areas were scored 1.0 (data source: California Department of Forestry and Fire Protection [FRAP] 2003).
- *Residential Housing Impact.* The score of suburban and rural residential areas declined linearly with increasing housing density (FRAP 2003) to a score of zero at ≥ 1 house/2 ha (5 ac), at which point the cell was classified as urban.
- *Road Effects.* The score for road effects varied as a function of road class, cell distance from the road, and predicted traffic volume (data sources: Caltrans 2001, TIGER 2000 in U.S. Census Bureau 2002). Value increased according to a quadratic equation from 0 at the road midline to 1.0 at distances > 500 m from major roads or > 300 m from minor roads (local streets and unpaved rural roads).
- *Forest Structure.* The score for forest structure applied only within areas mapped as forest types (FRAP 2003) where trees can attain large, commercially harvestable size—such as Sierran mixed conifer or eastside pine—and not to such woodland types as pinyon-juniper woodland or oak woodland. The score is intended to represent the degree of modification in forest canopy structure by logging, silvicultural practices, or fire. Thus, the structure score declines from dense, late-seral, large-tree conditions, to more open, early seral, smaller-tree conditions. Scores were 0.33 for early seral forests (tree crowns less than 12-ft diameter for conifers and 30 ft for hardwoods) and 1.0 for mid-to-late seral forests (tree crown cover > 40% and tree crowns > 24-ft diameter for conifers and 45 ft for hardwoods). Intermediate forest structures were assigned a value of 0.66.

The four scores were combined using Boolean logic, such that an area in good condition for supporting native terrestrial biodiversity must be not converted AND must have low impact from residential development AND must not be affected by roads AND must have good forest structure in the event it is forested (Davis et al. 2003). Figure 2.1[7] is the Davis et al. (2003) Ecological Condition Index map, rescaled from 0 to 100.

[7].Note that small slivers near the corners of the state and it's western most point south of Eureka were not scored by Davis et al. (2003) (Figure 2.1), apparently an artifact of using a rectangular analysis envelope. Also, because Davis et al. (2003) extrapolated housing density over census blocks that can extend into areas with little or no housing from higher-density areas, some wild areas near cities scored lower than might be expected in ecological condition. Although these issues may lead to errors of omission in delineating Natural Landscape Blocks, they are at least partly compensated for by further modifications and rules described below.


CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
FIGURE 2.1.
ECOLOGICAL CONDITION INDEX
(DAVIS ET AL. 2003)
0 - 20
21 - 40
41 - 60
61 - 80
81 - 100
Ecoregions
OREGON
NEVADA
ARIZONA
BAJA CALIFORNIA, MEXICO
Crescent City
Eureka
Fort Bragg
San Francisco
Monterey
Santa Barbara
Los Angeles
San Clemente
San Diego
Needles
Blythe
SACRAMENTO VALLEY
SAN JOAQUIN VALLEY
COAST RANGES
SIERRA NEVADA
WHITE MTNS
AMARGOSA RANGE
DEATH VALLEY
BRISTOL MTNS
CHOCOLATE MTNS
SAN GABRIEL MTNS
SAN BERNARDINO MTNS
SIERRA MADRE MTNS
TEHACHAPI MTNS
SANTA LUCIA RANGE
Salton Sea
0 37.5 75 150 225
Kilometers
Miles
0 25 50 100 150
1:5,300,000
N
S
E
W
Caltrans

2.1.2. Modifications to Ecological Condition Map

The Davis et al. (2003) Ecological Condition Index output was next modified for purposes of defining Natural Landscape Blocks by considering conservation protection status (GAP status) and areas known to have High Biological Value (HBV), as follows.

- *GAP Conservation Status*[8]. Lands conserved for wilderness or wildlife habitat values were considered likely to maintain high ecological integrity relative to, for example, multiple-use or unprotected lands. Moreover, these lands represent existing investments in conservation that need to be connected to preserve their continued functionality in supporting ecological values. Therefore, all lands having GAP status 1 or 2 (excluding Wild and Scenic Rivers) were delineated as preliminary Natural Landscape Blocks, regardless of Ecological Condition Index (Source: California Protected Area Database 2009, Conservation Biology Institute Protected Areas Database 2009, and SC Wildlands Protected Lands 2008).
- *High Biological Value.* Areas known to support important biological values, such as rare communities, endemic species, or essential habitat for Threatened or Endangered species, received heightened consideration for inclusion in Natural Landscape Blocks. Numerous data layers indicative of such High Biological Value areas were nominated by the Technical Advisory Group and reviewed for potential consideration in defining Natural Landscape Blocks. Only data layers resulting from systematic statewide assessments of resources and that would be useful for assessing terrestrial (not aquatic) connectivity qualified for inclusion, to avoid biasing against poorly studied regions[9]. Ultimately, an area was considered to have High Biological Value if any one or more of the following conditions were met:
    - Mapped as essential habitat or legally designated Critical Habitat for Threatened or Endangered species (Source: USFWS 2008). Essential habitat includes areas that support habitat features essential to survival and recovery of a species, as determined by U.S. Fish and Wildlife Service prior to consideration of economic impacts and land ownership issues that are also considered in designating Critical Habitat. Unlike Critical Habitat, essential habitat has no legal or regulatory implications, but is based purely on biological and physical considerations.
    - Wetlands or vernal pools (Sources: CDFG 1997, Holland et al. 1998, North Fork Associates 2000, Holland and USFWS 2003).

---

[8] GAP protection status (Crist 2000). Status 1: permanent protection from conversion of natural landcover and a mandated management plan to maintain a natural state and disturbance events, e.g., designated wilderness, national parks. Status 2: permanent protection from conversion of natural landcover and a mandated management plan to maintain a primarily natural state, but may receive uses that degrade the quality of existing natural communities, including suppression of natural disturbance. Status 3: permanent protection from conversion of natural landcover for most of the area, but subject to extractive uses of either a broad, low-intensity type (e.g., logging) or localized intense type (e.g., mining); protection to federally listed species throughout the area. Status 4: no public or private mandates or easements prevent conversion of natural habitat types to anthropogenic habitat types.

[9] Some biological values that were offered but could not be utilized due to lack of appropriate data layers included such factors as successional stage of the vegetation, susceptibility to disturbance, and presence of invasive species.

- Hotspots for amphibians, reptiles, mammals, or plants as mapped by California Department of Fish and Game using a rarity-weighted richness index on California Natural Diversity Database records. This index can be used as one measure of endemism or irreplaceability (CDFG 2003a).
- BLM Areas of Critical Environmental Concern (ACEC) that were designated based on biological values, rather than archaeological or other values (Source: U.S. BLM, 2000).

2.1.3. Block Designation Rules

The maps of Ecological Condition Index (Figure 2.1), Gap Conservation Status (Figure 2.2), and High Biological Value (Figure 2.3) were used to delineate Natural Landscape Blocks according to specific rules that varied among the State's diverse ecoregions (Hickman 1993). Ecoregion-specific rules (e.g., using different Ecological Condition Index thresholds to distinguish Natural Landscape Blocks) were necessary to account for great inter-regional variation in degrees of habitat loss, habitat fragmentation, and land protection throughout the State. They allowed for more appropriate discrimination of those areas important to supporting biological diversity in need of connectivity in and between regions. For example, a single, state-wide Ecological Condition Index threshold that would adequately discriminate areas to be connected in the Sierra Nevada or Mojave Desert would eliminate almost all land in the Great Central Valley or San Francisco Bay Area from consideration, including important habitat areas that deserve connectivity. On the other hand, a statewide threshold that adequately discriminated Natural Landscape Blocks in the Central Valley and Bay Area would coalesce the entire Sierra Nevada and Desert regions into a single, huge block. To further account for within-ecoregion variability in degree of habitat degradation and fragmentation, we also differentiated the Bay Area[10] from the Southern Central Coast Ecoregion, and the Northern Sierra Nevada from the Southern Sierra Nevada Ecoregion[11].

Ultimately, all GAP status 1 or 2 lands were included as potential Natural Landscape Blocks, along with any areas meeting the following criteria (arranged from most inclusive to least inclusive by ecoregion, Figure 2.4)[12]:

- *South Coast, Bay Area, Great Central Valley, Northern Sierra Nevada:*
  - ECI > 70 *OR*
  - ECI > 51 AND High Biological Value
- *Modoc Plateau:*
  - ECI > 95 OR
  - ECI > 71 AND High Biological Value
- *North Coast, Southern Central Coast:*

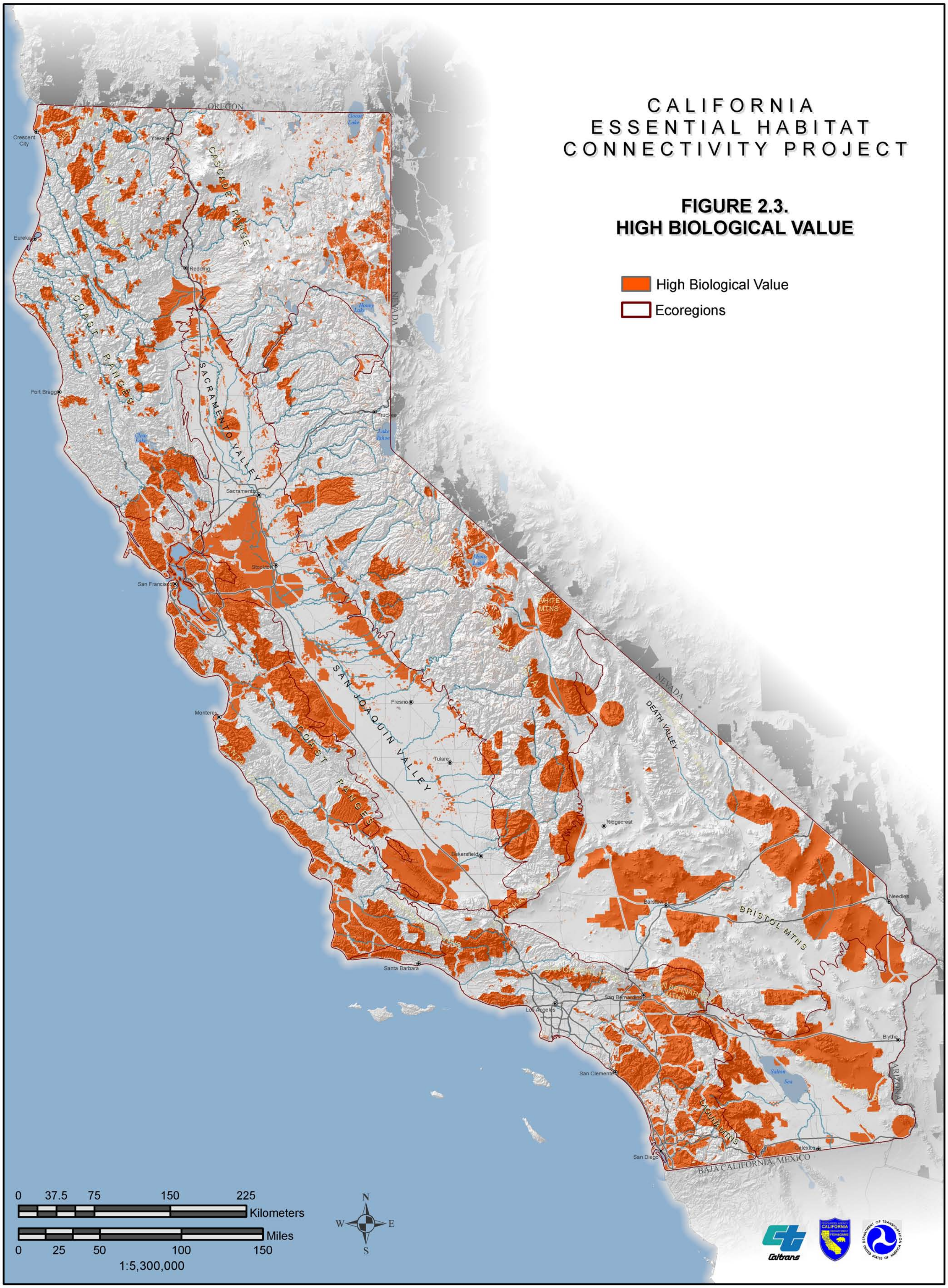
---

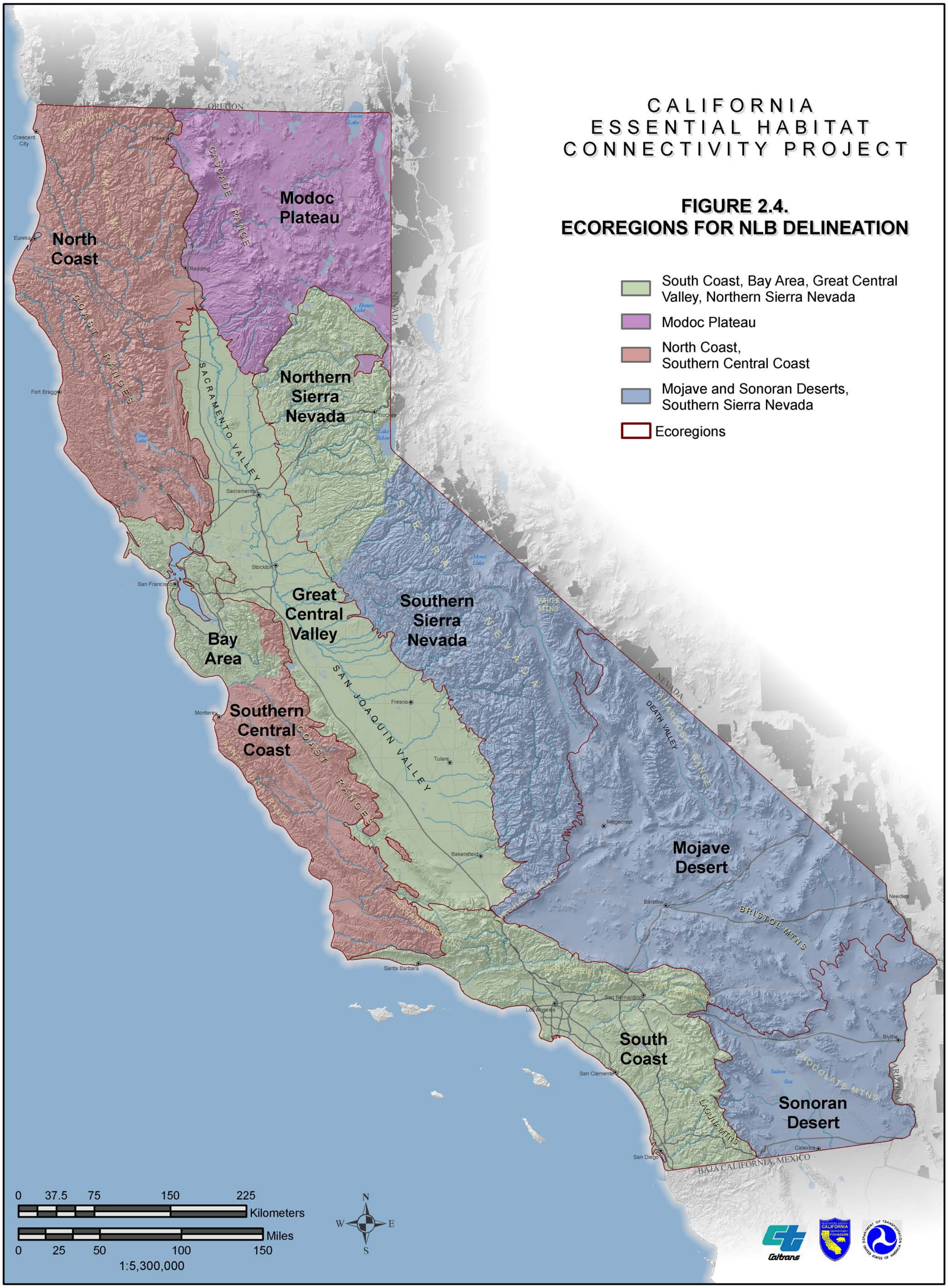
[10] The Bay Area includes those portions of the following counties falling within the greater Central Coast Ecoregion: Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Santa Cruz, and Solano.

[11] The Northern Sierra Nevada included portions of all Counties from Calavera north falling within the greater Sierra Nevada Ecoregion.

[12] These thresholds were established by visual evaluation of mapped results produced using alternative criteria, applied iteratively, to each ecoregion. The team strived to balance inclusiveness versus discrimination ability of the resulting maps, based on expert opinion of team members familiar with the ecoregions.


CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
FIGURE 2.2.
GAP CONSERVATION STATUS
GAP Category 1 or 2
Ecoregions
OREGON
NEVADA
ARIZONA
BAJA CALIFORNIA, MEXICO
CASCADE RANGE
COAST RANGES
SACRAMENTO VALLEY
SAN JOAQUIN VALLEY
SIERRA NEVADA
WHITE MTNS.
AMARGOSA RANGE
DEATH VALLEY
BRISTOL MTNS
CHOCOLATE MTS
Crescent City
Eureka
Redding
Fort Bragg
Sacramento
Stockton
San Francisco
Monterey
Fresno
Tulare
Bakersfield
Ridgecrest
Barstow
Needles
Santa Barbara
Los Angeles
San Bernardino
San Clemente
Blythe
San Diego
Calexico
0 37.5 75 150 225
Kilometers
Miles
0 25 50 100 150
1:5,300,000
N
W
E
S


CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
FIGURE 2.3.
HIGH BIOLOGICAL VALUE
High Biological Value
Ecoregions
OREGON
NEVADA
ARIZONA
BAJA CALIFORNIA, MEXICO
Crescent City
Yreka
Eureka
Redding
Fort Bragg
Truckee
Sacramento
Stockton
San Francisco
Monterey
Fresno
Tulare
Bakersfield
Ridgecrest
Barstow
Needles
Santa Barbara
Los Angeles
San Bernardino
San Clemente
San Diego
Calexico
Blythe
CASCADE RANGE
COAST RANGES
SACRAMENTO VALLEY
SAN JOAQUIN VALLEY
DEATH VALLEY
BRISTOL MTNS
WHITE MTNS
0 37.5 75 150 225
Kilometers
Miles
0 25 50 100 150
1:5,300,000
N
W
E
S
Caltrans


CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
FIGURE 2.4.
ECOREGIONS FOR NLB DELINEATION
South Coast, Bay Area, Great Central Valley, Northern Sierra Nevada
Modoc Plateau
North Coast,
Southern Central Coast
Mojave and Sonoran Deserts,
Southern Sierra Nevada
Ecoregions
Modoc Plateau
North Coast
Northern Sierra Nevada
Great Central Valley
Southern Sierra Nevada
Bay Area
Southern Central Coast
Mojave Desert
South Coast
Sonoran Desert
OREGON
NEVADA
ARIZONA
BAJA CALIFORNIA, MEXICO
CASCADE RANGE
COAST RANGES
SACRAMENTO VALLEY
SAN JOAQUIN VALLEY
SIERRA NEVADA
DEATH VALLEY
BRISTOL MTNS
CHOCOLATE MTNS
LAGUNA MTNS
Crescent City
Eureka
Redding
Fort Bragg
Sacramento
Stockton
San Francisco
Monterey
Fresno
Tulare
Bakersfield
Ridgecrest
Barstow
Needles
Santa Barbara
Los Angeles
San Bernardino
San Clemente
San Diego
Blythe
Calexico
Salton Sea
0 37.5 75 150 225
Kilometers
Miles
0 25 50 100 150
1:5,300,000
N
W E
S
Caltrans

  - ECI > 95
- *Mojave and Sonoran Deserts and Southern Sierra Nevada:*
  - ECI > 95 AND High Biological Value

Application of these rules resulted in thousands of potential Natural Landscape Blocks, many of which were too small to be reasonably assessed at the statewide level. Consequently, preliminary blocks < 2,000 acres in size were eliminated as potential Natural Landscape Blocks statewide. Remaining blocks were aggregated if within one kilometer of each other by subsuming the intervening gap using the ArcGIS Aggregate Polygons tool (ESRI 2008). Portions of blocks within 50 m of major and secondary roads were removed to recognize the potential for highways to fragment habitat. This action split many large Natural Landscape Blocks into multiple smaller ones. Any resulting blocks ≥ 2,000 acres formed the final set of 850 Natural Landscape Blocks (Figure 2.5). Of these 850 Natural Landscape Blocks, 458 were 2,000 to 10,000 acres, and 392 were > 10,000 acres.

2.2. Determining Which Natural Landscape Blocks To Connect

Once the Natural Landscape Blocks were delineated, the following rules were used to select pairs or constellations of Natural Landscape Blocks that should be connected. These rules distinguish between Essential Connectivity Areas that were subsequently delineated using least-cost corridor analysis (see Section 2.3.2.) and Road Fragmentation Areas, which involve Natural Landscape Blocks separated only by a road, for which least-cost modeling is neither necessary nor appropriate (see Section 2.2.3). Regardless of the nature of the areas being connected, pairs of blocks to be connected were first represented on maps as line segments, referred to below as "sticks." Sticks were placeholders showing which Natural Landscape Blocks needed to be connected using least-cost corridor models or where road fragmentation measures need to be developed (in the event the Natural Landscape Blocks are separated only by a road).

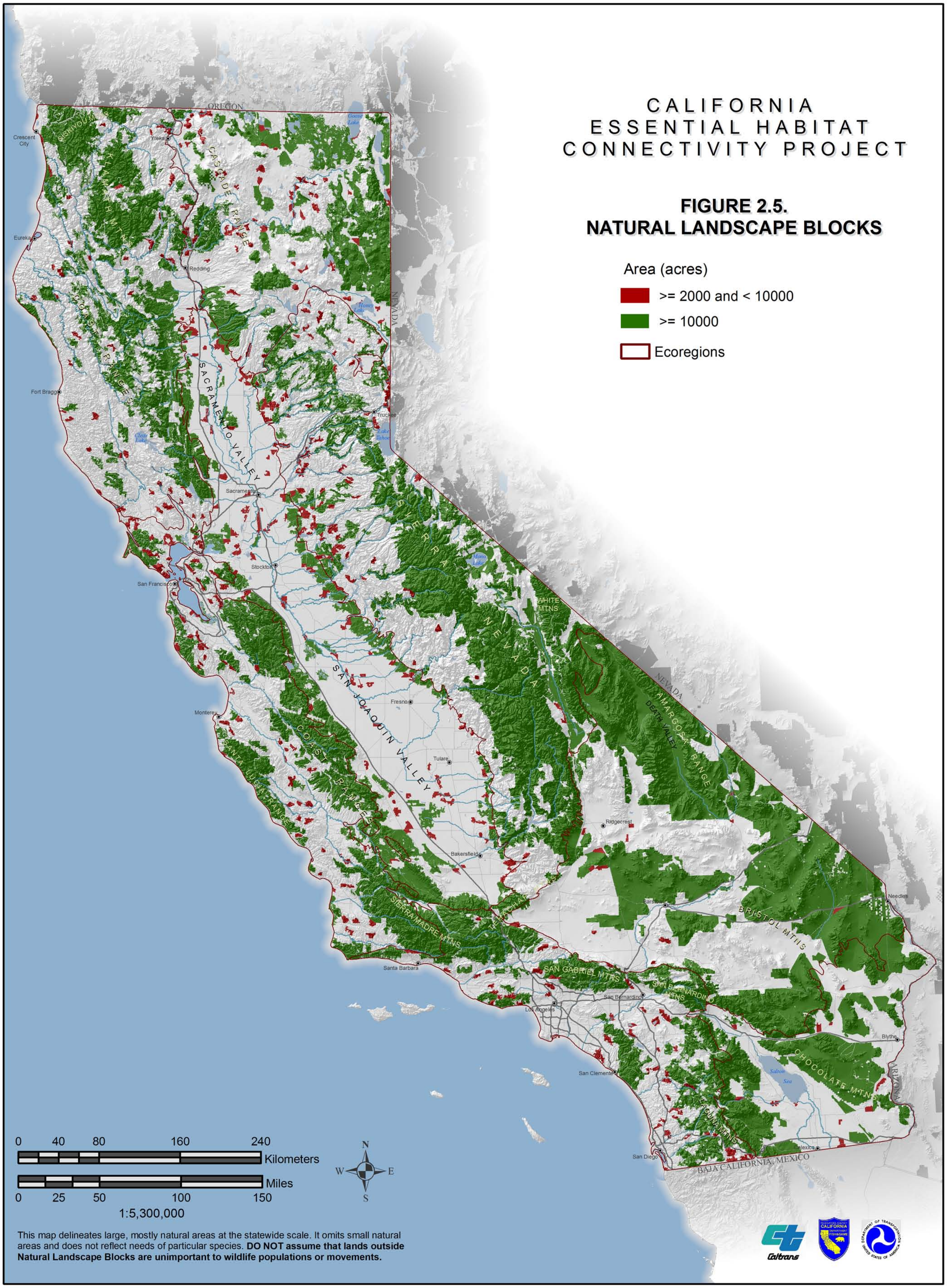
2.2.1. Rules for Drawing Sticks for Essential Connectivity Areas

Sticks represent the need to connect two or more Natural Landscape Blocks with an Essential Connectivity Area. The location of a stick did not indicate the location of the Essential Connectivity Area; sticks were placeholders indicating which Natural Landscape Blocks needed to be connected using least-cost corridor modeling.

1. Sticks were drawn to connect the centroids[13] of Natural Landscape Blocks that were ≥ 10,000 acres in size and that were not entirely edge-affected (entirely edge-affected blocks are those where all portions are < 1 km from the block's edge)[14]. In the

[13] We use centroids of the Natural Landscape Blocks as the termini for least-cost corridor modeling because (1) this is repeatable and (2) it provides the least-cost corridor model sufficient room to roam between landscape blocks. Using block edges can constrain the least-cost corridor such that it may simply identify the shortest route between the facing Natural Landscape Block edges, potentially omitting more functional (lower -cost) routes.

[14] This procedure eliminated long, semi-linear areas < 2 km wide as Natural Landscape Blocks. Many of these were later incorporated into least-cost corridors between larger, less edge-effected blocks.


CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
FIGURE 2.5.
NATURAL LANDSCAPE BLOCKS
Area (acres)
>= 2000 and < 10000
>= 10000
Ecoregions
OREGON
NEVADA
ARIZONA
BAJA CALIFORNIA, MEXICO
Crescent City
Eureka
Redding
Fort Bragg
Sacramento
Stockton
San Francisco
Monterey
Fresno
Tulare
Bakersfield
Ridgecrest
Barstow
Needles
Santa Barbara
Los Angeles
San Bernardino
San Clemente
San Diego
Blythe
CASCADE RANGE
SACRAMENTO VALLEY
SAN JOAQUIN VALLEY
SIERRA NEVADA
WHITE MTNS
AMARGOSA RANGE
DEATH VALLEY
COAST RANGES
SIERRA MADRE MTNS
SAN GABRIEL MTNS
SAN BERNARDINO MTNS
BRISTOL MTNS
CHOCOLATE MTNS
0 40 80 160 240
Kilometers
Miles
0 25 50 100 150
1:5,300,000
N
W
E
S
This map delineates large, mostly natural areas at the statewide scale. It omits small natural areas and does not reflect needs of particular species. **DO NOT assume that lands outside Natural Landscape Blocks are unimportant to wildlife populations or movements.**
Caltrans

Central Valley, Bay Area, Northern Sierra Nevada, and South Coast ecoregions, sticks were also drawn to Natural Landscape Blocks 2,000 to 10,000 acres or entirely edge-affected, if the blocks met all other criteria for drawing sticks.

2. No stick could represent an Essential Connectivity Area that would have to cross > 1 km of open water or > 1.5 km of urban land. (Note that a *stick* may cross open water or urban land if it is feasible for the modeled Essential Connectivity Area to avoid crossing such areas.)
3. Each Natural Landscape Block was connected to its nearest neighbor (where nearness was defined edge to edge). Where the nearest neighbor was > 15 km away, the resistance surface (see Section 2.3.1) between the Natural Landscape Blocks had to be dominated by values < 15 (on a scale of 1 to 25, as described in Section 2.3.1) [15].
4. Each Natural Landscape Block was also connected to its second nearest neighbor if the second neighbor was < 15 km away (edge to edge) or < 5 km across high-resistance (resistance > 15) areas, such as urban or agricultural landscapes.
5. A group of two or more Natural Landscape Blocks connected by sticks is called a *constellation*. Once all constellations were created by the above rules, each constellation was connected to its nearest neighboring constellation, if it was not already connected, starting with the smallest constellation.

2.2.2. Rules for Removing and Consolidating Sticks[16]

Application of the preceding rules resulted in many hundreds of Essential Habitat Connectivity Areas that would need to be modeled using least-cost corridor methods, which was prohibitive given project constraints. We therefore derived and applied (manually, using expert judgment) the following rules to reduce the total number of model runs by eliminating some redundant sticks and consolidating chains of sticks into a single spanning stick.

1. When a Natural Landscape Block was connected to two or more Natural Landscape Blocks by sticks or chains of sticks, redundant sticks that were markedly inferior were removed. “Inferior” was defined as a potential connectivity area that would have to cross at least twice as much high-resistance (> 15) land as the better alternative, or that would be constrained by existing land uses to be less than half the width of the better alternative. We retained redundant connections where they were of roughly equal quality.

---

[15] This determination was done by visual inspection and was generally quite straightforward: In most cases, intervening lands were either mostly natural landcovers (low resistance) or mostly non-natural land covers (high resistance).

[16] The following rules for removing or consolidating sticks are specifically intended to limit least-cost corridor modeling to meaningful and non-redundant locations. Many sticks “removed” by these rules were later captured within least-cost corridors for other sticks.

2. Where multiple sticks connected three or more Natural Landscape Blocks in a fairly linear configuration ("stepping stones"), they were consolidated by user judgment as one stick spanning the entire group between the centroids of the two farthest blocks (Figure 2.6), unless a least-cost corridor model between the two farthest blocks would be unlikely to connect all blocks in the group (in which case sticks were still drawn independently between the nearest-neighbor pairs as described above).

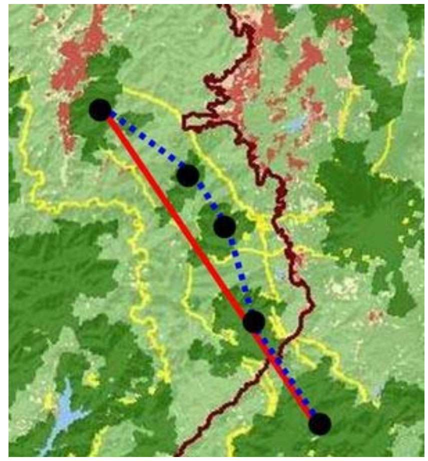


Figure 2.6. Use of a spanning stick (red) to consolidate a chain of sticks (blue) connecting multiple Natural Landscape Blocks (dark green). A single least-cost corridor (yellow) between the centroids (black) of the end blocks captures the intervening blocks.

2.2.3. Designating Road Fragmentation and Adjacent State Connectivity Areas

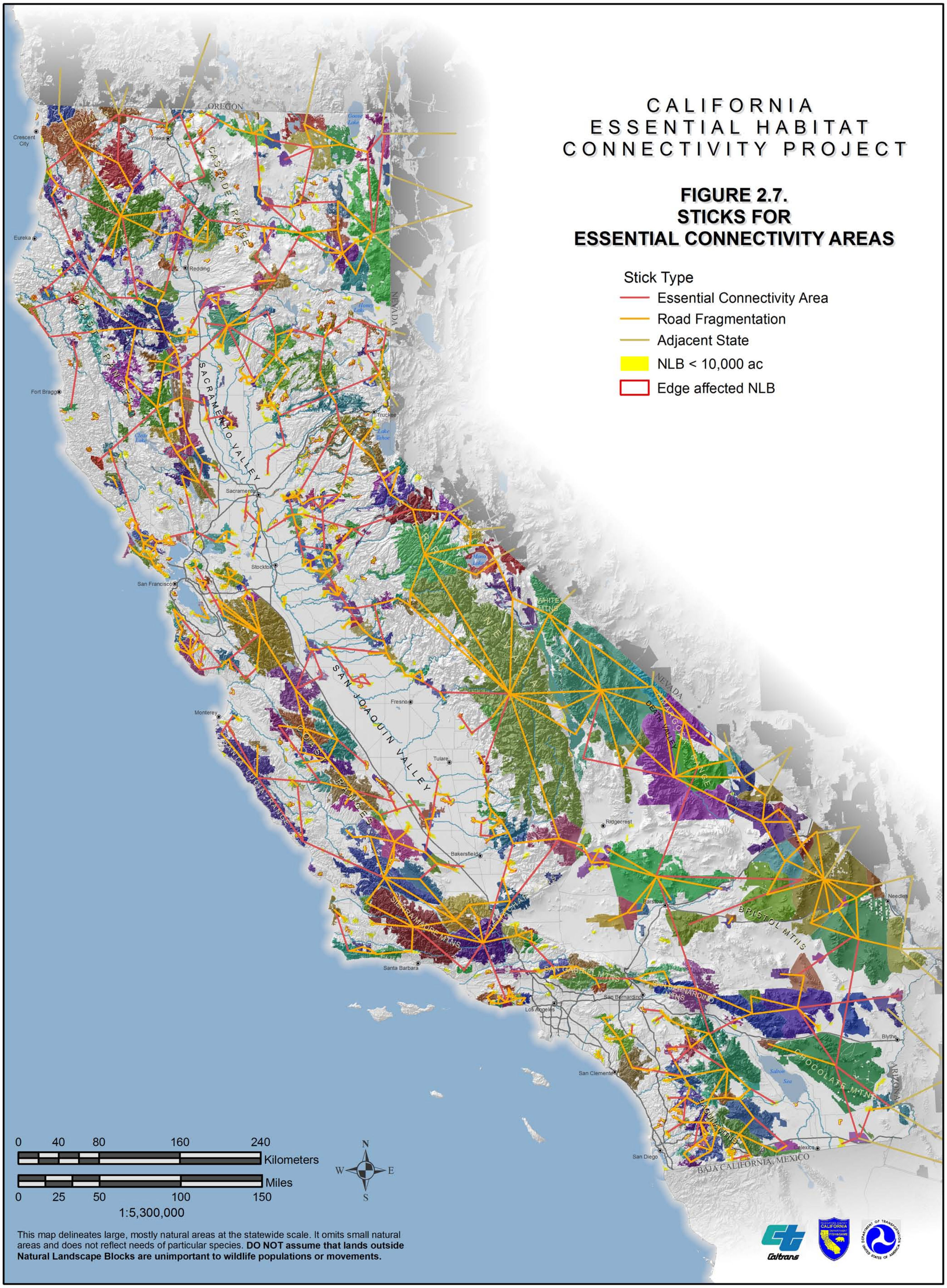
Road fragmentation sticks were used where the facing edges of two Natural Landscape Blocks were separated only by a road, railroad, or similar linear feature that may represent a barrier to wildlife movement. In these cases, there was no need for least-cost corridor modeling. Road fragmentation is addressed in Chapter 6 with approaches for identifying where road-crossing structures or other mitigation actions may be recommended based on future, more local-scale analyses, and design criteria for such mitigation actions.

Interstate connections were also indicated using sticks to recognize the need for connectivity into neighboring states (Arizona, Nevada, and Oregon). Interstate sticks connect centroids of California Natural Landscape Blocks to the centroids of GAP 1 or 2 lands within 100 km of the border in neighboring states. However, no least-cost corridor modeling or other attempts to delineate interstate Essential Connectivity Areas were performed for interstate sticks. Rather, interstate sticks were depicted as placeholders for future efforts, ideally in collaboration with those states.

Figure 2.7 illustrates the sticks resulting from the above rules, with Essential Connectivity Area sticks, Road fragmentation sticks, and Interstate sticks shown in different colors.

2.3. Delineating Essential Connectivity Areas

Essential Connectivity Area polygons were created between pairs of Natural Landscape Blocks using least-cost corridor models (Singleton et al. 2002) run on a resistance surface


CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
FIGURE 2.7.
STICKS FOR
ESSENTIAL CONNECTIVITY AREAS
Stick Type
Essential Connectivity Area
Road Fragmentation
Adjacent State
NLB < 10,000 ac
Edge affected NLB
0 40 80 160 240
Kilometers
Miles
0 25 50 100 150
1:5,300,000
N
W
E
S
This map delineates large, mostly natural areas at the statewide scale. It omits small natural areas and does not reflect needs of particular species. **DO NOT assume that lands outside Natural Landscape Blocks are unimportant to wildlife populations or movements.**
OREGON
NEVADA
ARIZONA
BAJA CALIFORNIA, MEXICO
Crescent City
Eureka
Redding
Fort Bragg
Sacramento
Stockton
San Francisco
Monterey
Fresno
Tulare
Bakersfield
Ridgecrest
Barstow
Needles
Santa Barbara
Los Angeles
San Bernardino
San Clemente
San Diego
Blythe
Calexico
Truckee
SACRAMENTO VALLEY
SAN JOAQUIN VALLEY
CASCADE RANGE
BRISTOL MTNS
CHOCOLATE MTNS
Salton Sea
Caltrans

that represents the relative resistance of the landscape to ecological movements. These steps are detailed below.

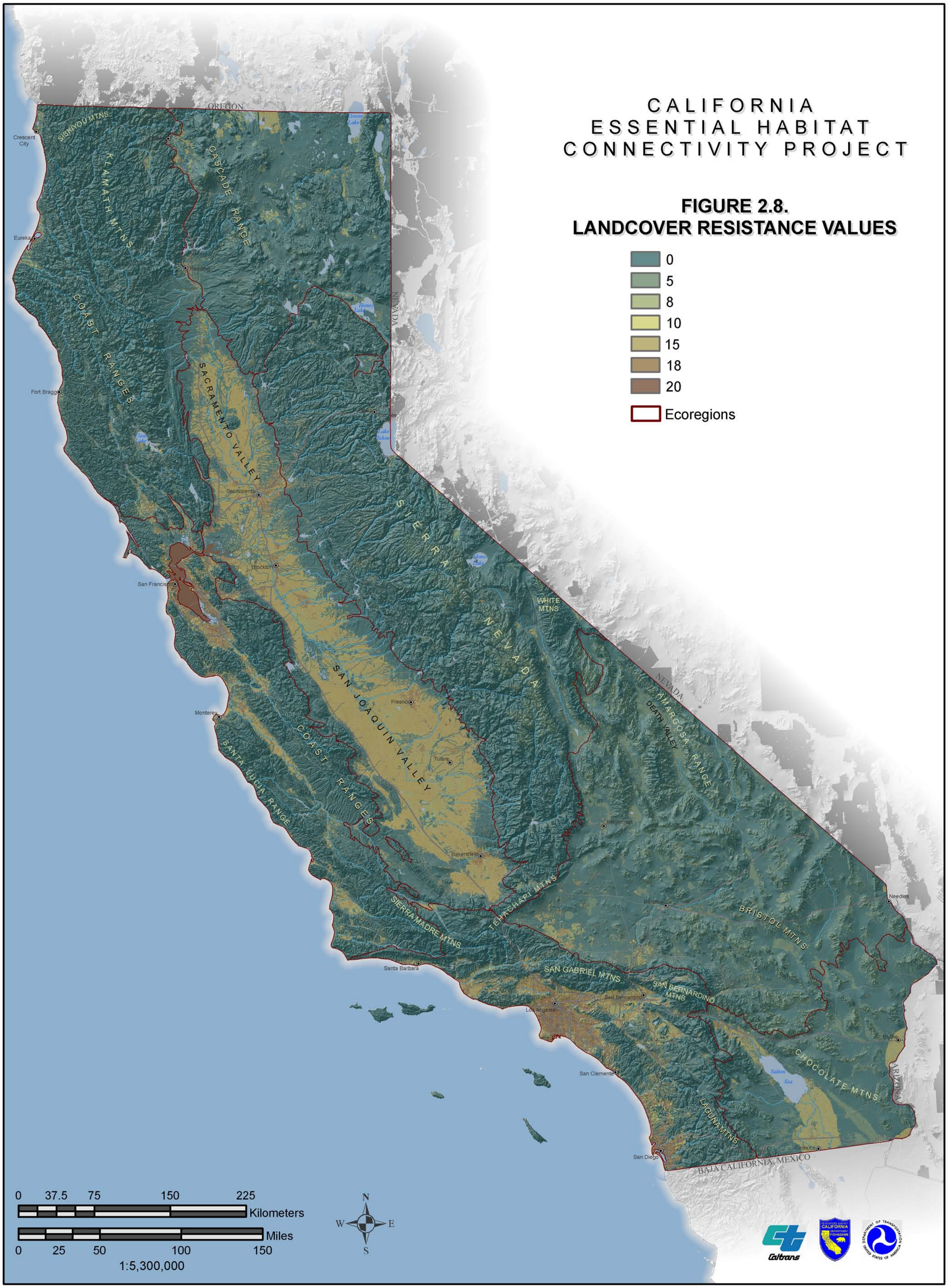
2.3.1. Creating the Resistance Surface

Least-cost corridor models (Singleton et al. 2002) use a "resistance surface" as the primary input. The resistance surface represents the per-pixel cost of movement across the landscape for an ecological movement of interest (e.g., species migration or gene flow)[17]. However, for this statewide modeling effort, it was not possible to model movements of particular focal species or genes across the landscape. Therefore, we used a resistance layer based primarily on land-cover naturalness—as a proxy representing, very broadly, overall resistance of the landscape to ecological flows—under the assumption that less human-modified areas are less resistant to most ecological movements of interest. The resistance layer therefore emphasizes landscape naturalness, modified to assign slightly lower resistance to lands that are protected against habitat conversion and managed for ecological values.

Resistance values for landcover type were assigned based on expert opinion of landcover permeability to ecological flows and ranged from 0 (for natural landcover types) to 20 (for completely urbanized landcover types) (Table 2.1, Figure 2.8). Land protection status was given a separate score from 0 for GAP 1 lands (e.g., Wilderness Areas and Ecological Reserves, which are managed for ecological values and have the highest protection from conversion) increasing linearly to 4 for GAP 4 lands (which generally have no protection from conversion) (Table 2.2, Figure 2.9). Thus, the landcover score was weighted four times as much as the land protection score in determining total resistance. The final resistance surface was a 30-m grid with pixel scores ranging from 1 to 25 (Resistance = Landcover Score + Protection Score +1)[18]. Because this scaling ranges only from 1 to 25, it does not allow the flexibility to model situations with extremely high resistance to ecological flows. For example, Shirk (2009) used circuit theory to investigate resistance to gene flow for mountain goats (*Oreamnos americanus*) in Washington State and found resistance across a major highway to be on the order of one thousand times greater than resistance elsewhere. Our conservative scaling may therefore overestimate permeability for focal species and ecological flows that are highly sensitive to highways, urban areas, or other potential impediments to movement. Finer-resolution analyses at local and regional scales (see Chapters 4-6) should select resistance scales appropriate to the ecological flows of interest, and should consider empirical evidence, such as measured movement rates or gene-flow rates, if available.

[17] Unfortunately, resistance has no simple biological interpretation. For instance, a resistance of 10 does not necessarily indicate that the energetic costs or mortality risks of travel are 10 times than those for a resistance of 1. Beier et al. (2008) name this the "subjective translation problem," and explained that it would be resolved only when resistance estimates are derived from data on animal movement or gene flow.

[18] The lowest possible resistance (or cost of movement) score must be 1, not 0, to avoid the untenable assumption of zero cost of movement and to avoid arithmetic artifacts, such as multiplying distance by zero when calculating cumulative costs within the least-cost corridor.


CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
FIGURE 2.8.
LANDCOVER RESISTANCE VALUES
0
5
8
10
15
18
20
Ecoregions
OREGON
NEVADA
ARIZONA
BAJA CALIFORNIA, MEXICO
SISKIYOU MTNS
KLAMATH MTNS
CASCADE RANGE
COAST RANGES
SACRAMENTO VALLEY
SIERRA NEVADA
WHITE MTNS
SAN JOAQUIN VALLEY
SANTA LUCIA RANGE
AMARGOSA RANGE
DEATH VALLEY
TEHACHAPI MTNS
SIERRA MADRE MTNS
BRISTOL MTNS
SAN GABRIEL MTNS
SAN BERNARDINO MTNS
CHOCOLATE MTNS
LAGUNA MTNS
Crescent City
Eureka
Fort Bragg
San Francisco
Monterey
Fresno
Tulare
Bakersfield
Santa Barbara
Los Angeles
San Clemente
San Diego
Barstow
Needles
0 37.5 75 150 225
Kilometers
Miles
0 25 50 100 150
1:5,300,000
N
W
E
S

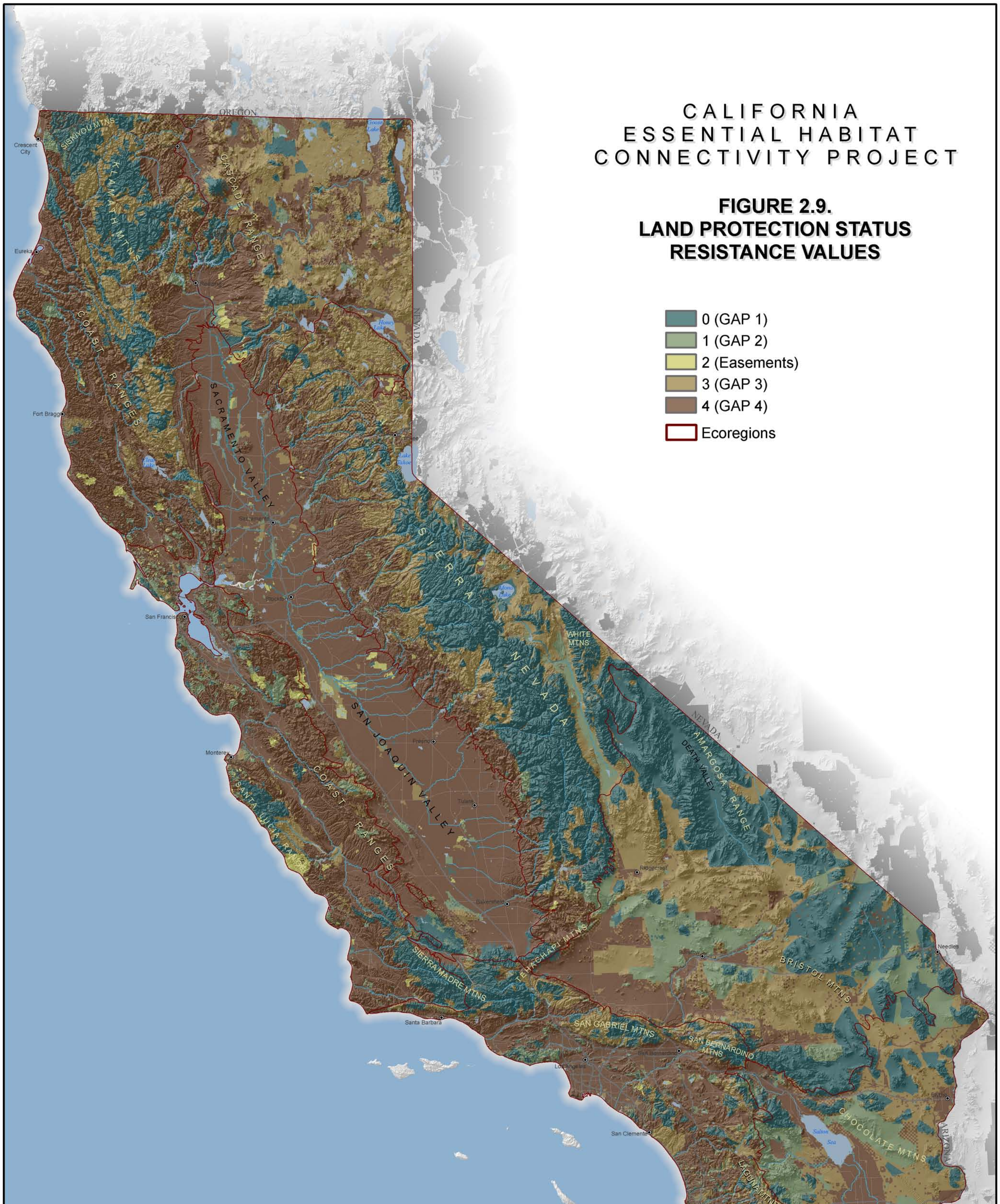

CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
FIGURE 2.9.
LAND PROTECTION STATUS
RESISTANCE VALUES
0 (GAP 1)
1 (GAP 2)
2 (Easements)
3 (GAP 3)
4 (GAP 4)
Ecoregions
OREGON
NEVADA
ARIZONA
BAJA CALIFORNIA, MEXICO
SISKIYOU MTNS
KLAMATH MTNS
CASCADE RANGE
COAST RANGES
SACRAMENTO VALLEY
SIERRA NEVADA
WHITE MTNS
AMARGOSA RANGE
DEATH VALLEY
SAN JOAQUIN VALLEY
SANTA LUCIA MTNS
COAST RANGES
TEHACHAPI MTNS
SIERRA MADRE MTNS
SAN GABRIEL MTNS
SAN BERNARDINO MTNS
BRISTOL MTNS
CHOCOLATE MTNS
LAGUNA MTNS
Crescent City
Eureka
Fort Bragg
San Francisco
Monterey
Santa Barbara
Los Angeles
San Clemente
San Diego
Needles
Salton Sea
0 37.5 75 150 225
Kilometers
Miles
0 25 50 100 150
1:5,300,000
N
W
E
S
Caltrans

Table 2.1. Land Cover Costs

Cost	Class	Land Cover
20	Developed, High Intensity	Developed, High Intensity
20	Open Water	Open Water
20	Primary/Secondary Roads	Primary Roads (TIGER 2007), Secondary Roads/Ramps (TIGER 2007)
18	Developed, Medium Intensity	Developed, Medium Intensity
18	Local Roads and Railroads	Local Roads (TIGER 2007), Railroads (TIGER 2007)
15	Row Crops	Cropland (1998 GAP), Cultivated Crops, Irrigated Row and Field Crops (1998 GAP)
15	Vineyard	Orchard and Vineyard (1998 GAP), Vineyard (1998 GAP)
10	Developed, Low Intensity	Developed, Low Intensity
10	Developed, Open Space	Developed, Open Space
10	Orchard	Deciduous Orchard (1998 GAP), Evergreen Orchard (1998 GAP)
8	Grain/Hay/Pasture	Dryland Grain Crops (1998 GAP), Hay/Pasture, Irrigated Hayfield (1998 GAP), Pasture (1998 GAP)
5	Barren	Central California Coast Ranges Cliff and Canyon, Coulmbia Plateau Ash and Tuff Badland, Inter-Mountain Basins Active and Stabilized Dune, Inter-Mountain Basins Cliff and Canyon, Inter-Mountain Basins Playa, Inter-Mountain Basins Shale Badland, Inter-Mountain Basins Volcanic Rock and Cinder Land, Inter-Mountain Basins Wash, Klamath-Siskiyou Cliff and Outcrop, Mediterranean California Alpine Bedrock and Scree, Mediterranean California Coastal Bluff, Mediterranean California Northern Coastal Dune, Mediterranean California Serpentine Barrens, Mediterranean California Southern Coastal Dune, North American Alpine Ice Field, North American Warm Desert Active and Stabilized Dune, North American Warm Desert Bedrock Cliff and Outcrop, North American Warm Desert Pavement, North American Warm Desert Playa, North American Warm Desert Volcanic Rockland, North Pacific Volcanic Rock and Cinder Land, Sierra Nevada Cliff and Canyon, Southern California Coast Ranges Cliff and Canyon, Temperate Pacific Freshwater Mudflat
5	Harvested Forests	Harvest Forest- Tree Regenerated, Harvested Forest- Shrub Regenerated, Harvested Forest-grass regeneration
5	Introduced Vegetation	Introduced Annual and Biennial Forbland, Introduced Upland Vegetation - Annual and Perennial Grassland, Introduced Upland Vegetation – Treed, Introduced Upland Vegetation -Perennial Grassland
5	Quarries/Strip Mines/Gravel Pits	Quarries/Strip Mines/Gravel Pits
5	Recently Burned	Recently Burned- Forest, Recently Burned- Grassland, Recently Burned- Shrubland
0	Forest and Woodland	California Coastal Closed-Cone Conifer Forested and Woodland, California Coastal Redwood Forest, California Montane Jeffrey Pine-(Ponderosa Pine) Woodland, Central and Southern California Mixed Evergreen Woodland, Columbia Plateau Western Juniper Woodland and Savanna, East Cascades Oak-Ponderosa Pine Forest and Woodland, Great Basin Pinyon-Juniper Woodland, Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland, Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland, Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland, Klamath-Siskiyou Lower Montane Serpentine Mixed Conifer Woodland, Klamath-Siskiyou Upper Montane Serpentine Mixed Conifer Woodland, Mediterranean California Dry-Mesic Mixed Conifer Forest and Woodland, Mediterranean California Lower Montane Black Oak-Conifer Forest and Woodland, Mediterranean California Mesic Mixed Conifer Forest and Woodland, Mediterranean California Mesic Serpentine Woodland and Chaparral, Mediterranean California Mixed Evergreen Forest, Mediterranean California Mixed Oak Woodland, Mediterranean California Red Fir Forest, Mediterranean California Subalpine Woodland, North Pacific Broadleaf Landslide Forest and Shrubland, North Pacific Dry Douglas-fir-(Madrone) Forest and Woodland, North Pacific Hypermaritime Sitka Spruce Forest, North Pacific Lowland Mixed Hardwood Conifer Forest and Woodland, North Pacific Maritime Dry-Mesic Douglas-fir-Western Hemlock Forest, North Pacific Maritime Mesic-Wet Douglas-fir-Western Hemlock Forest, North Pacific Mountain Hemlock Forest, North Pacific Oak Woodland, North Pacific Wooded Volcanic Flowage, Northern California Mesic Subalpine Woodland, Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest, Northern

		Rocky Mountain Ponderosa Pine Woodland and Savanna, Rocky Mountain Aspen Forest and Woodland, Rocky Mountain Lodgepole Pine Forest, Rocky Mountain Montane Dry-Mesic Mixed Conifer Forest and Woodland, Rocky Mountain Montane Mesic Mixed Conifer Forest and Woodland, Rocky Mountain Poor Site Lodgepole Pine Forest and Woodland, Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland, Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland, Sierra Nevada Subalpine Lodgepole Pine Forest and Woodland, Sierran-Intermontane Desert Western White Pine-White Fir Woodland
0	Herbaceous	California Central Valley and Southern Coastal Grassland, California Mesic Serpentine Grassland, California Northern Coastal Grassland, Inter-Mountain Basins Semi-Desert Grassland, Mediterranean California Alpine Dry Tundra, Mediterranean California Subalpine Meadow, North Pacific Alpine and Subalpine Dry Grassland, North Pacific Montane Grassland, Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland, Rocky Mountain Subalpine-Montane Mesic Meadow
0	Shrubland	Apacherian-Chihuahuan Mesquite Upland Scrub, California Maritime Chaparral, California Mesic Chaparral, California Montane Woodland and Chaparral, California Xeric Serpentine Chaparral, Columbia Plateau Scabland Shrubland, Great Basin Semi-Desert Chaparral, Great Basin Xeric Mixed Sagebrush Shrubland, Inter-Mountain Basins Big Sagebrush Shrubland, Inter-Mountain Basins Mixed Salt Desert Scrub, Mediterranean California Alpine Fell-Field, Mogollon Chaparral, Mojave Mid-Elevation Mixed Desert Scrub, North Pacific Avalanche Chute Shrubland, North Pacific Dry and Mesic Alpine Dwarf-Shrubland, Fell-field and Meadow, North Pacific Montane Shrubland, Northern and Central California Dry-Mesic Chaparral, Northern California Coastal Scrub, Northern Rocky Mountain Montane-Foothill Deciduous Shrubland, Sonora-Mojave Creosotebush-White Bursage Desert Scrub, Sonora-Mojave Mixed Salt Desert Scrub, Sonora-Mojave Semi-Desert Chaparral, Southern California Coastal Scrub, Southern California Dry-Mesic Chaparral
0	Steppe and Savanna	California Central Valley Mixed Oak Savanna, California Coastal Live Oak Woodland and Savanna, California Lower Montane Blue Oak-Foothill Pine Woodland and Savanna, Columbia Plateau Low Sagebrush Steppe, Columbia Plateau Steppe and Grassland, Inter-Mountain Basins Big Sagebrush Steppe, Inter-Mountain Basins Juniper Savanna, Inter-Mountain Basins Montane Sagebrush Steppe, Inter-Mountain Basins Semi-Desert Shrub-Steppe, Klamath-Siskiyou Xeromorphic Serpentine Savanna and Chaparral, Southern California Oak Woodland and Savanna, Willamette Valley Upland Prairie and Savanna
0	Wetland/Riparian	California Central Valley Riparian Woodland and Shrubland, Columbia Basin Foothill Riparian Woodland and Shrubland, Columbia Plateau Silver Sagebrush Seasonally Flooded Shrub-Steppe, Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland, Inter-Mountain Basins Alkaline Closed Depression, Inter-Mountain Basins Greasewood Flat, Mediterranean California Eelgrass Bed, Mediterranean California Foothill and Lower Montane Riparian Woodland, Mediterranean California Serpentine Foothill and Lower Montane Riparian Woodland, Mediterranean California Subalpine-Montane Fen, North American Arid West Emergent Marsh, North American Warm Desert Riparian Mesquite Bosque, North American Warm Desert Riparian Woodland and Shrubland, North American Warm Desert Wash, North Pacific Lowland Riparian Forest and Shrubland, North Pacific Montane Riparian Woodland and Shrubland, Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland, Rocky Mountain Alpine-Montane Wet Meadow, Rocky Mountain Lower Montane-Foothill Riparian Woodland and Shrubland, Rocky Mountain Subalpine-Montane Riparian Shrubland, Rocky Mountain Subalpine-Montane Riparian Woodland, Temperate Pacific Freshwater Emergent Marsh, Temperate Pacific Subalpine-Montane Wet Meadow, Temperate Pacific Tidal Salt and Brackish Marsh

Table 2.2. Protection Status Resistances

Resistance	GAP Protection Status
0	GAP1
1	GAP2
2	Conservation Easements
3	GAP3
4	GAP4

The basis for the landcover layer was the 2008 California landcover (California GAP Analysis 2008, 30-m resolution) modified by transportation features. Because the GAP 2008 layer lacks the detail for agricultural classes of the old California GAP layer (1998), we used the more detailed agricultural classes (irrigated row and field crops, dryland grain crops, irrigated hayfield, deciduous orchard, evergreen orchard, orchard and vineyard, vineyard) from the older GAP layer instead of the "cultivated crops" class in the new layer (Figure 2.10). Transportation features representing secondary roads and ramps, local roads, and railroads (from 2007 TIGER data, U.S. Census Bureau) were converted separately to 30-m grids. Primary roads were buffered by 25 m before conversion to a 30-m grid. The grids of the four road types were combined into one, giving priority to roads in this order if they overlapped: primary, secondary/ramps, local, and rails. The resulting transportation grid was merged into the landcover grid, overriding all landcovers except developed, medium intensity, and developed, high intensity (Figure 2.11).

2.3.2. Least-cost Corridor Modeling

Once the resistance layer was derived, a least-cost corridor analysis was conducted between the centroids of each pair of Natural Landscape Blocks to be connected. The analysis extent was defined by creating a 5-km buffer around the feature envelope[19] of both Natural Landscape Blocks in a pair. The cost-weighted distance was calculated from each of the two centroids for each pixel in the analysis extent. The two centroid-specific outputs were then summed to define the least-cost surface. The continuous surface output was then sliced into equal-interval percentages to define the least-cost corridor.

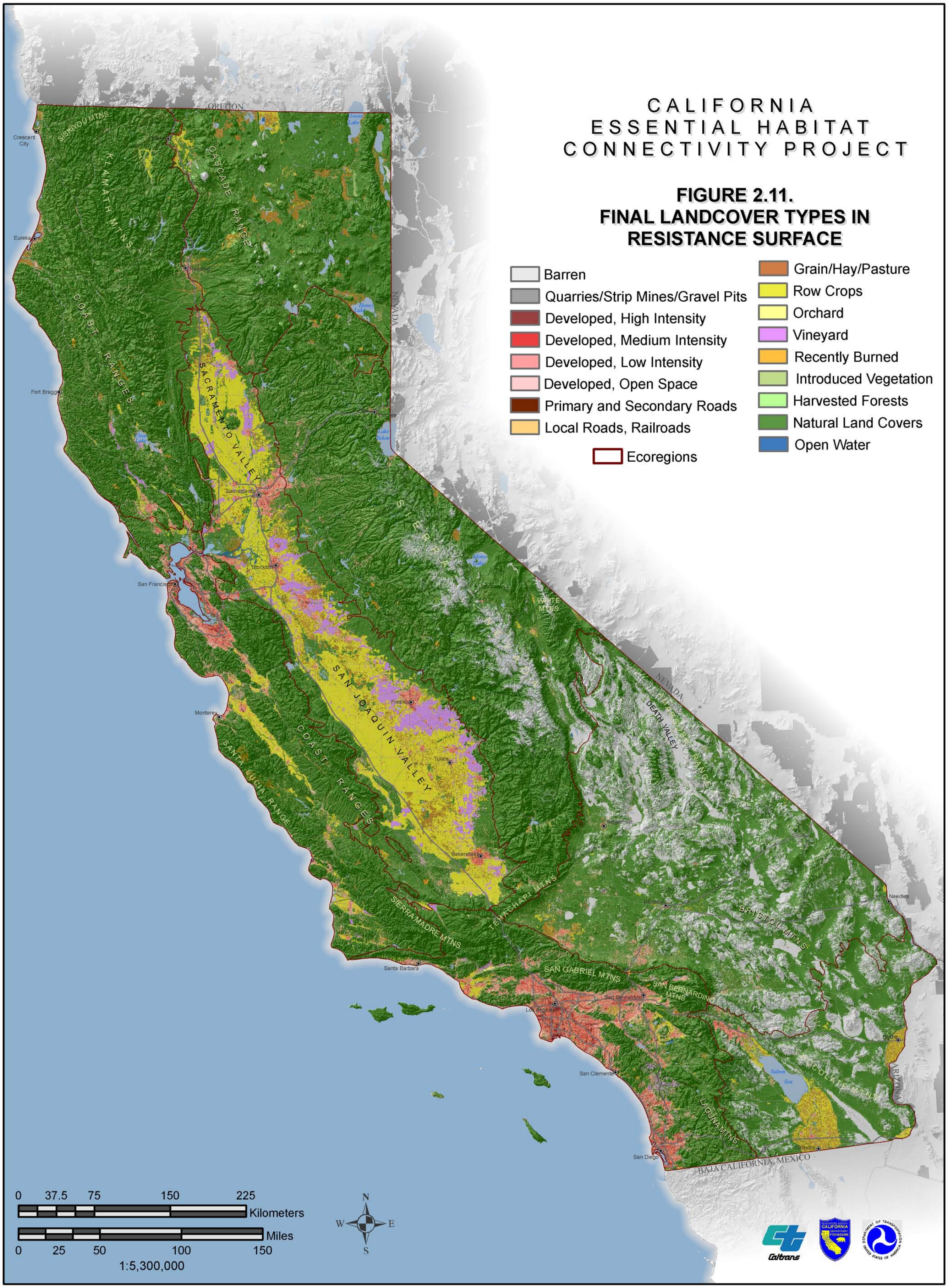
The top 5% least-cost corridor (i.e., the lowest-cost 5% of pixel values in the analysis window) was used to define the Essential Connectivity Areas. This 5% least-cost corridor appeared to reasonably approximate the size and shape of linkage design polygons delineated by focal species methods for the South Coast Missing Linkages project (Beier et al. 2006), and appeared to represent a fairly inclusive, but biogeographically justifiable polygon for most Essential Connectivity Areas at this state-wide scale.

2.3.3. Refining the Least-cost Polygons

Due to the close proximity of some Natural Landscape Blocks, overlap of analysis extents that shared one Natural Landscape Block, and the variable sizes of the analysis extents, there were some Essential Connectivity Areas that were completely subsumed by others. In these few cases, the smaller Essential Connectivity Area that was completely included within a larger one was removed from the final output.

[19] A feature envelope is a rectangular area determined by the maximum and minimum x and y coordinates enclosing a feature of interest, in this case the pair of Natural Landscape Blocks.


CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
FIGURE 2.10.
LANDCOVER TYPES IN
RESISTANCE SURFACE
Barren
Quarries/Strip Mines/Gravel Pits
Developed, High Intensity
Developed, Medium Intensity
Developed, Low Intensity
Developed, Open Space
Grain/Hay/Pasture
Ecoregions
Row Crops
Orchard
Vineyard
Recently Burned
Introduced Vegetation
Harvested Forests
Natural Land Covers
Open Water
OREGON
NEVADA
ARIZONA
BAJA CALIFORNIA, MEXICO
SISKIYOU MTNS
KLAMATH MTNS
CASCADE RANGE
COAST RANGES
SACRAMENTO VALLEY
SIERRA NEVADA
SAN JOAQUIN VALLEY
SANTA LUCIA RANGE
TEHACHAPI MTNS
SIERRA MADRE MTNS
SAN GABRIEL MTNS
SAN BERNARDINO MTNS
DEATH VALLEY
BRISTOL MTNS
LAGUNA MTNS
Crescent City
Eureka
Fort Bragg
San Francisco
Monterey
Santa Barbara
San Clemente
San Diego
Needles
0 37.5 75 150 225
Kilometers
Miles
0 25 50 100 150
1:5,300,000
N
W E
S
Caltrans


CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
FIGURE 2.11.
FINAL LANDCOVER TYPES IN
RESISTANCE SURFACE
Barren
Quarries/Strip Mines/Gravel Pits
Developed, High Intensity
Developed, Medium Intensity
Developed, Low Intensity
Developed, Open Space
Primary and Secondary Roads
Local Roads, Railroads
Ecoregions
Grain/Hay/Pasture
Row Crops
Orchard
Vineyard
Recently Burned
Introduced Vegetation
Harvested Forests
Natural Land Covers
Open Water
SACRAMENTO VALLEY
SAN JOAQUIN VALLEY
COAST RANGES
KLAMATH MTNS
CASCADE RANGE
SIERRA MADRE MTNS
TEHACHAPI MTNS
SAN GABRIEL MTNS
SAN BERNARDINO MTNS
SANTA LUCIA RANGE
BRISTOL MTNS
DEATH VALLEY
OREGON
NEVADA
ARIZONA
BAJA CALIFORNIA, MEXICO
Crescent City
Eureka
Fort Bragg
San Francisco
Monterey
Santa Barbara
San Clemente
San Diego
Needles
0 37.5 75 150 225
Kilometers
Miles
0 25 50 100 150
1:5,300,000
N
W
E
S
Caltrans

For cases where least-cost corridor analyses were run on “spanning sticks” across three or more Natural Landscape Blocks (see Section 2.2.2) and an internal landscape block completely spanned the 5% least-cost corridor, the least-cost polygon was segmented into two Essential Connectivity Areas at the centroid of the spanning Natural Landscape Block, which then became a terminal block.

Because each analysis was run from centroid to centroid, instead of from edge to edge of the Natural Landscape Block pair, a portion of the least-cost corridor output occurred within each Natural Landscape Block. To display the Essential Connectivity Areas on a map and describe its characteristics in a meaningful way (Chapter 3), the final boundaries were defined by subtracting the portions of the least-cost corridor output that fell within terminal Natural Landscape Blocks.

2.3.4. Potential Riparian Connection Additions

Potential riparian connections were added using the Statewide 1:100k Routed Hydrography for California dataset (CDFG, Pacific States Marine Fisheries Commission 2003). This data file is a 1:100,000 scale, stream-based routed hydrography covering the entire State of California. Named rivers and streams that were at least 50 miles long were extracted from the dataset and added to Essential Connectivity Maps. These potential riparian connections were added to illustrate the contribution that streams, rivers, and adjacent vegetation can make to both terrestrial and aquatic connectivity. In many parts of the state, such riparian corridors represent the best remaining options for sustaining or improving ecological connectivity.

2.4. Characterizing Natural Landscape Blocks and Essential Connectivity Areas

Each Natural Landscape Block and Essential Connectivity Area is a polygon—that is, a two-dimensional area in map space. Users of this report need data on polygon attributes to describe the biological and physical traits of each polygon, or to make decisions on conservation investments and conservation strategies.

The Essential Habitat Connectivity Maps depict the spatial location and shape of each polygon. To provide users with additional quantitative information on each polygon, we selected 36 biological and physical characteristics (Tables 2.3 and 2.4). Some of these characteristics, such as Ecological Condition Index, protection status, occurrence of wetlands, and occurrence of Critical or essential habitat, were used to define the Natural Landscape Blocks. Other traits, such as landcover, were used to define the resistance-surface layer. Yet other variables, such as length of the Essential Connectivity Area, emerged from our analyses.

We used ArcGIS queries to generate summary statistics (e.g., sum, mean, proportion) for each trait. The statistic used for each characteristic is indicated in Table 2.3. Quantitative metrics, such as area and length, were rounded in recognition of the coarse scale of the analysis and to avoid false appearances of precision. The Natural Landscape Blocks and

Essential Connectivity Areas should be viewed as rough approximations that should be refined by future, finer-scale assessments.

Table 2.4 lists and defines the physical and biological characteristics of Essential Connectivity Areas and Natural Landscape Blocks and lists the data sources for each descriptor. Some of these metrics (such as Ecological Condition Index, protection status, wetlands, and Critical or essential habitat) were used to help define Natural Landscape Blocks, and others (such as landcover, road density, and protection status) were used to define the resistance-surface layer and Essential Connectivity Areas. All of the metrics are potentially useful to describe the polygons, but we urge readers to consider information in the *Limitations* column of the table to avoid over-interpreting the data. Some users and stakeholders may wish to use some of these descriptors to prioritize Essential Connectivity Areas according to their organization's mandates and priorities.

Table 2.3. Statistics used to describe polygons (Natural Landscape Blocks, Essential Habitat Connectivity Areas). The characteristics are defined in Table 2.4.

Statistic	**Characteristics for which this statistic was used**
Sum across all pixels in the polygon	Area of polygon
Proportion (%) of all pixels in the polygon belonging to a certain class of pixel	Landcover classes (9 broad classes) Land protection classes (4 GAP classes) Rarity-weighed richness hotspots Vernal pool or wetlands Critical or essential habitat BLM Area of Critical Environmental Concern
Mean, range, and standard deviation across all pixels in the polygon	Ecological Condition Index Number of terrestrial vertebrate species whose range overlaps 10-mi^2 (25.9-km^2) hexagons within the NLB or ECA Elevation Elevation range
Line length	Shortest straight line between edges of NLBs within an ECA Length of least cost path within ECA
Count and List	Ecoregions Ecoregion subsections Counties Watershed
Count only	Number of CNDDB special status animal or plant taxa ESA-listed species with Critical Habitat in the polygon ESA-listed species with essential habitat in the polygon Number of times the polygon is intersected by major or secondary roads
Density (km per km^2)	Major roads Secondary roads
Elevation profile	A plot of elevation against distance along the least-cost path between the centroids of the two NLBs

Table 2.4. Definitions, data sources, limitations, and suggested interpretations of metrics related to Natural Landscape Blocks and Essential Connectivity Areas. The final column lists the acronym used in the accompanying appendices to this Report.

	Descriptor	Data Source	Limitations and Suggested Interpretation	Acronym
Identifier	Unique Number for the NLB or ECA			ID
	Name for the NLB or ECA		NLB names	ECA_Name NLB_Name
Landform	Elevation profile (plot of elevation versus distance) along the least-cost path between NLB centroids	Digital Elevation Model	A visual representation of landform (e.g. high plateau, steep mountains, low plains) in the two NLBs (right and left ends of graph) and ECA (center of graph).	Not applicable
	Mean, Min, Max, and Standard Deviation of Elevation	Digital Elevation Model		elev_MEAN elev_MIN elev_MAX elev_STD
	Elevation Range: difference between minimum and maximum elevation	Digital Elevation Model		elev_range
Ecological Condition	Mean Ecological Condition Index, re-scaled to 0-100; see *Section 2.1.1* for details	Davis et al. (2003, 2006)	Some polygons in urban areas have false values of zero, usually because housing density was calculated for Census 2000 Blocks. When a heavily populated Census Block extended into unpopulated natural areas, all pixels were assigned a value exceeding the threshold mean value of 1 house/2 hectares (ha). We advise users to disregard any ECI value < 51 for NLBs adjacent to urban areas.	Mn_integ
	Standard deviation of Ecological Condition Index	Based on variation among pixels within an NLB or ECA		Std_integ

Polygon Area	Area in acres	Calculated in GIS based on number of 1-ha (2.49-acre) pixels in ECA or NLB	Multiply acres by 0.4047 to determine area in ha; divide ha by 100 to determine area in km^2	AREA_acres
Essential Connectivity Area	Identifying numbers of NLBs connected by the ECA			pointA pointB
	List of NLBs (other than the ECA termini) that partially intersect the ECA but do not span ECA width		These NLBs are also served by the ECA	NLB_ln
	Length of shortest straight line within the ECA between edges of NLBs (m)	Measured in GIS		Min_lgth
	Length of least cost path within Essential Connectivity Area (m)	Measured in GIS, based on least-cost model		LCP_lgth
Protection Status	Percent protected as GAP 1, GAP2, GAP3 or easements	CPAD (2009) CBI PAD (2009) SCW Protected Lands (2008) Easements: GreenInfo Network (2009b)	GAP1: permanent protection of natural landcover and mandated plan to maintain disturbance events. GAP2: permanent protection of natural landcover, but uses may degrade quality or suppress natural disturbance. GAP3: permanent protection of most natural landcover, but logging or mining permitted. GAP4: no protection of natural habitat.	Pc_protect
	Percent protected as GAP1, GAP2, or easements			Pc_gap12e
	Percent protected as GAP3			Pc_gap3
	Percent in private, unprotected status			Pc_privunp

Species diversity	Mean number of amphibians, reptiles, mammals, and birds whose range overlaps each 10-mi^2 (25.9-km^2) hexagon	CDFG (2008) http://www.dfg.ca.gov/biogeodata/cwhr/ California Wildlife Habitat Relationships hexagon range maps	Suitable habitat may not be present in every hexagon throughout a species' range. This probably overestimates the number of species in each hexagon.	Mn_sprich
	Standard deviation of number of species per CWHR hexagon			Std_sprich
	Number of special status plant taxa (species or subspecies or varieties) occurring in polygon according to the California Natural Diversity Database (CNDDB) point data	http://www.dfg.ca.gov/biogeodata/cnddb/	CNDDB includes only positive occurrences; absence of records in a polygon does not mean taxon is absent. All records presumed extant, regardless of date, unless otherwise noted in CNDDB.	CNDDB_plant_count
	Number of special status animal taxa (species or subspecies) in polygon according to CNDDB point data		As for plants.	CNDDB_animal_count
	Percent in amphibian, reptile, mammal, or plant rarity hotspot	Derived by CDFG from Rarity-Weighted Richness Index (CDFG 2003a,b)	These are areas with the highest concentrations of special status range-restricted taxa. (See CDFG 2003a for discussion on the limitations of this index.)	Pc_hotspt

Habitat for listed species	Percent in USFWS-designated Critical Habitat for federally listed species	GIS coverages provided by USFWS	Designation is influenced by economic considerations and land ownership.	pc_crithab
	Number of species with Critical Habitat in the polygon			CritHab_Sp_Count
	Percent essential habitat (% with habitat features essential to survival and recovery of the species, as determined by USFWS prior to consideration of economic impact and land ownership)	GIS coverages provided by USFWS	Habitat considered essential to conservation of a species but not designated as Critical due to economic, legal, or other reasons. Unlike Critical Habitat, essential habitat has no regulatory consequences.	pc_essenthab
	Number of species with essential habitat in the polygon			EssHab_Sp_Count
Wetlands	Percent in wetland or vernal pool	CDFG (1998) CDFG (1997) CDFG (2000) CDFG (2003b) USFWS (2006)		Pc_wtvp
Paved roads	Number of times the ECA is intersected by major roads (primary limited access or interstate, primary US and state highways)	ESRI (2008) was used for all road data	Roads within ECAs may require mitigation actions, to be determined by finer-resolution analyses.	Mjrd_cross
	Density of major roads (km/km^2)	Total length divided by polygon area		Mjrd_dens
	Density of secondary state and county highways (km/km^2)	Total length divided by polygon area	Roads within ECAs may require mitigation actions, to be determined by finer-resolution analyses.	Secrd_dens

Ecoregions	Number of Jepson ecoregions (Calif. has 8 ecoregions)	Hickman (1993)		N_Ecoregs
	List of ecoregions			Ecroregs
	Number of ecoregion subsections (Calif. has 190 subsections)	Miles and Goudey (1998)		N_Subsect
	List of ecoregion subsections		If more than 8 occur in a polygon, the 8 largest are listed.	Subsect
Watersheds	Number of watersheds	California Resources Agency 2004	Any portion of the Hydrological Unit intersects the ECA or NLB.	HU_num
	List of watersheds			HU_name
ACEC	Percent in BLM Areas of Critical Environmental Concern based on the area's biological values (rather than archeological or other values)		ACECs can be designated only on federal land; most are on BLM land.	Pc_blmacec
County	Number of counties			N_Counties
	List of counties			Counties
Landcover	Percent classed as forest and woodland	GAP 2008		PC_FOREST
	Percent classed as shrubland, steppe, or savanna	GAP 2008		PC_SHRUB
	Percent classed as herbaceous	GAP 2008		PC_HERB
	Percent classed as wetland/riparian	GAP 2008	"% wetland or vernal pool" (above) was derived from different data sources and is typically (though not always) larger than the area mapped as wetland in GAP (2008).	PC_WETRIP
	Percent classed as open water	GAP 2008		PC_WATER

	Percent classed as developed (high, medium, and low intensity, and open space such as ball fields, cemeteries, and golf courses)	GAP 2008		PC_DEV
	Percent classed as cultivated crops	GAP 2008		PC_CROP
	Percent classed as hay/pasture	GAP 2008		PC_PASTURE
	Percent classed as barren, harvested forest, introduced vegetation, recently burned, or quarries/strip mines/gravel pits	GAP 2008		PC_OTHER

2.5. Comparing the Essential Connectivity Map to Other Conservation Maps

We compared the Essential Connectivity Map to other applicable conservation data and maps, including various conservation priority map layers provided by members of the Multidisciplinary Team. Once data sets were acquired, they were converted to the appropriate coordinate system and clipped to mainland California as necessary. We calculated area included in polygons of the comparison dataset, calculated areas of overlap with Natural Landscape Blocks and Essential Connectivity Areas, and derived statistics for appropriate attributes within GIS. The following specific data layers were compared to the Essential Habitat Connectivity Map:

- *Habitat Conservation and Natural Community Conservation Plans* (CDFG 2009). Due to tremendous variation among Habitat Conservation Plans and Natural Community Conservation Plans in the nature of mapped polygons, and lack of information on what each polygon means in many plans, only planning area boundaries were overlaid on the Essential Habitat Connectivity Map.
- *USFWS designated Critical Habitat* and *essential habitat* (USFWS 2009). For each species, overlap with the Natural Landscape Blocks and Essential Connectivity Areas was calculated. Critical Habitat includes Final Critical Habitat and Final Critical Habitat (Preliminary); essential habitat includes Excluded Essential Habitat, Excluded Habitat, Exempt from Critical Habitat, Proposed Critical Habitat, Under Review, and Vacated Critical Habitat.
- *Existing California Conservation Network and Other Major Landholders.* Existing conservation areas (California Protected Areas Database version 1.3; CPAD 2009) and Department of Defense Lands and Tribal lands (National Atlas 2005) were

overlaid on the Essential Habitat Connectivity Map. The "Symbology Layer" field in CPAD was used to delineate areas by ownership (e.g. City, County, and NGO) to generate a summary table.

- *California Missing Linkages Project* (Penrod et al. 2001) was compared by overlaying the Missing Linkages arrows over the Essential Habitat Connectivity Map for visual comparison.
- *Functional Habitat Connectivity of the American Marten in Northeastern California* (Kirk and Zielinski in preparation). The marten *(Martes americana)* connectivity map was prepared by the USDA Forest Service for this species of concern that relies on dense, late-seral coniferous forests. The map consists of six least-cost corridor polygons that connect between protected lands that support marten populations or high-value marten habitat, from the central Sierra Nevada to the Oregon border. It represents an interesting opportunity to compare how well our coarse Natural Landscape Blocks and Essential Connectivity Areas, which are not based on particular focal species, may capture habitat blocks and least-cost corridors for a focal species at an ecoregional scale.
- *Wildlands Conservation in the Central Coast Region of California* (Thorne et al. 2002). Overlap with this regional conservation network design was calculated for cores, linkages, and the total network as presented in Thorne et al. (2002).
- *A Potential Regional Conservation Network for the Central Valley Ecoregion* (Huber et al. 2010). "Conservation opportunity areas" and least-cost corridors from this focal-species-based plan (Huber et al. 2010) were compared with the Essential Habitat Connectivity Map.
- *South Coast Missing Linkages Project* (Penrod et al. 2003, Luke et al. 2004, Penrod et al. 2004 a,b, Penrod et al. 2005 a,b,c, and Penrod et al. 2006 a,b,c,d). Local-scale linkage design outlines from this focal-species-based regional plan were compared with the Essential Habitat Connectivity Map.
- *Dispersal and Corridor Models for Desert Bighorn Sheep* (Epps et al. 2007). We overlaid the following features from Epps et al. (2007): population areas; most likely corridors, severed by barriers; and most likely corridors, highest predicted use. For the most likely corridors, the length of each path and the segment length that intersected the Essential Habitat Connectivity Map were calculated. For population areas, area was calculated.
- *California Desert Connectivity Project* (Penrod et al. in preparation). Wildland blocks and targeted linkages for this ongoing regional linkage plan were displayed on a map with the Essential Habitat Connectivity Map for visual comparison.
- *Bay Area Open Space Council's Upland Habitat Goals Project.* MARXAN results from the Bay Area Open Space Council (SF Bay Area Upland Habitat Goals GIS 2009) were used to define Essential and Important areas for conservation in this regional upland network plan. Essential, Important, and total areas overlapping the Essential Habitat Connectivity Map were calculated in order to generate comparison statistics.

- *The Nature Conservancy's Ecoregional Priorities.* Two datasets—mainland California and Cascade Region—were merged and used to calculate overlap of The Nature Conservancy's ecoregional priority sites with the Essential Habitat Connectivity Map, differentiating by Terrestrial, Aquatic, and Marine sites.
- *California Rangeland Conservation Coalition Focus Area Prioritization Map* (Cameron 2007) differentiates Critical and Important Rangelands. Overlap with the Essential Habitat Connectivity Map was calculated for Critical, Important, and total area.
- *Audubon's Important Bird Areas* (National Audubon Society 2008). Important Bird Areas were clipped to mainland. Water bodies were removed using Teale Hydrology (CalAtlas 2003) water polygons (lakes, ponds, bays, estuaries, gulfs, oceans, and seas). Overlap statistics were further delineated by summarizing on geographic region using the "Region" field in the attribute table.

Chapter 3. Results: The Essential Habitat Connectivity Map

Figure 3.1 presents the statewide Essential Habitat Connectivity Map, which illustrates the Natural Landscape Blocks and Essential Connectivity Areas along with placeholder "sticks" for potential interstate connections that should be assessed in the future, in collaboration with neighboring states. Figures 3.2 through 3.9 show each ecoregion in more detail.

3.1. Statewide Summary

The Essential Connectivity Map shows a statewide network of 850 relatively intact Natural Landscape Blocks (ranging in size from 2,000 to about 3.7 million acres) connected by 192 Essential Connectivity Areas (Table 3.1)[20]. There are fewer Essential Connectivity Areas than Natural Landscape Blocks, because each Essential Connectivity Area serves to connect at least two, and as many as 15 Natural Landscape Blocks[21]. Due to the broad, statewide nature of this map, and its focus on connecting very large blocks of mostly protected natural lands, the network omits many areas that are important to biological conservation. The purpose of the map is to focus attention on large areas important to maintaining ecological integrity at the broadest scale. Natural areas excluded from this broad-brush Essential Connectivity Network can therefore not be "written off" as unimportant to connectivity conservation or to sustaining California's natural heritage. Chapters 4 through 6 recommend regional and local analyses to refine the Essential Connectivity Map and identify additional areas important to sustaining ecological connectivity.

Essential Connectivity Area polygons tend to be wide when they connect larger Natural Landscape Blocks (e.g., in the deserts), and narrow where they connect smaller landscape blocks (e.g., in more urbanized regions). This is an artifact of the consistent use of the 5% least-cost corridor to define Essential Connectivity Areas. Because the 5% slice represents the 5% lowest-cost area within the analysis extent comprising each pair of blocks, it is naturally larger when the Natural Landscape Blocks are larger or farther apart. This is reasonable: connections between larger, more distant landscape blocks should be relatively wide. Conversely, smaller Natural Landscape Blocks tend to occur in more developed and highly constrained landscapes (e.g., through narrow bands of undeveloped lands between urbanized areas in the Bay Area or South Coast Ecoregion), and connections between close blocks may not need to be overly wide to accommodate the ecological flows of interest.

---

[20] Table 3.1 summarizes the average, minimum, and maximum for each metric across Natural Landscape Blocks and Essential Connectivity Areas. Because of the large number of variables, tables listing all characteristics of the Essential Connectivity Areas and Natural Landscape Blocks are too large to include here. The full results are provided in Appendix B (for Essential Connectivity Areas) and Appendix C (for Natural Landscape Blocks). The data are also available in Excel spreadsheets at http://www.dfg.ca.gov/habcon or http://www.dot.ca.gov/hq/env/bio/program_efforts.htm or GIS tables at http://bios.dfg.ca.gov .

[21] An Essential Connectivity Area can serve numerous landscape blocks as a result of (1) running the least-cost corridor model across a series of Natural Landscape Blocks arrayed more-or-less linearly (using the "spanning stick" rules described in Section 2.2.2) and (2) a least-cost corridor may touch, and therefore serve to connect, a block that was too small (2,000 to 10,000 ac) or edge-effected (< 2 km across) to serve as a terminus for least-cost modeling (see Section 2.2.1).

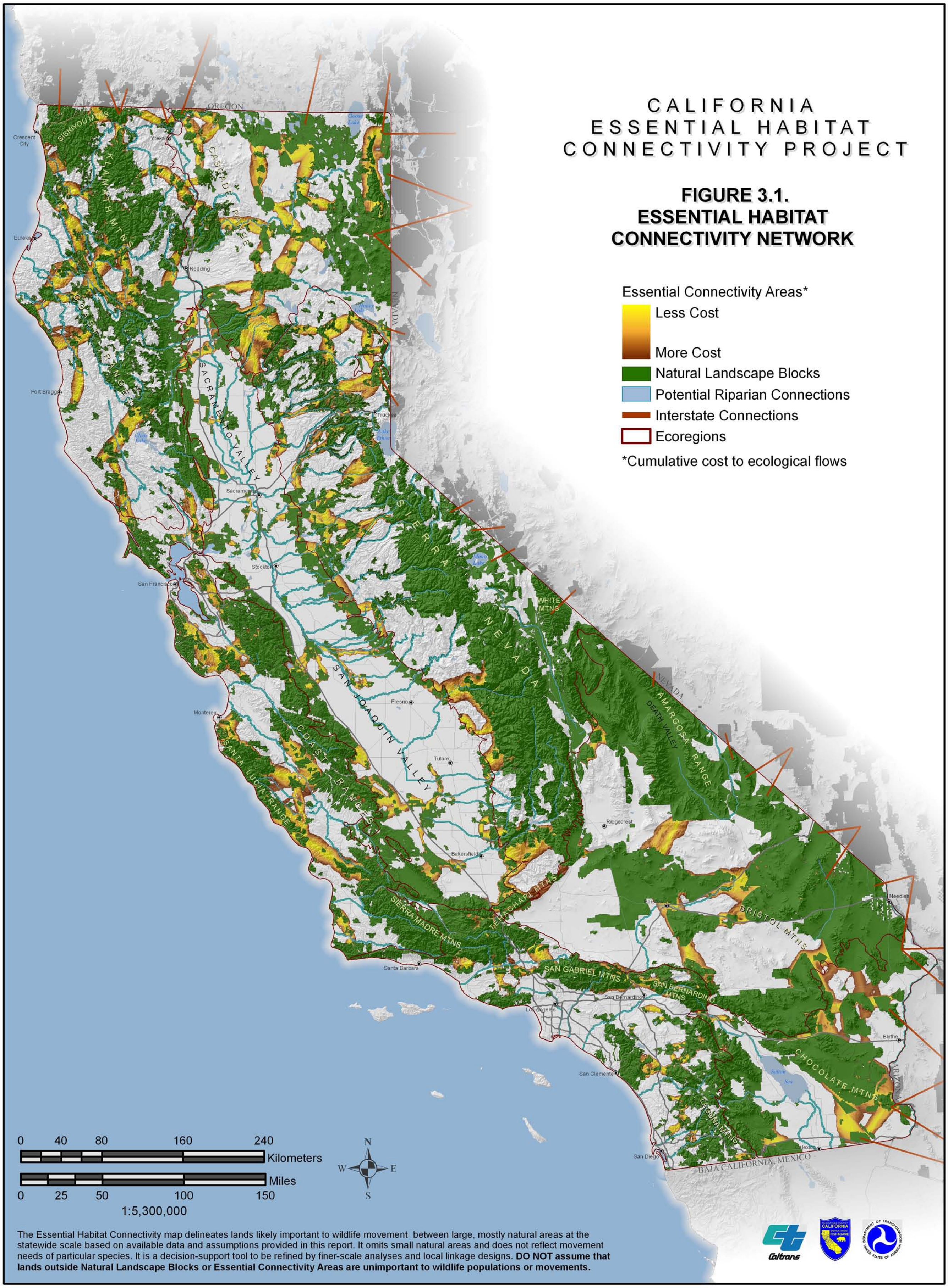

CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
FIGURE 3.1.
ESSENTIAL HABITAT
CONNECTIVITY NETWORK
Essential Connectivity Areas*
Less Cost
More Cost
Natural Landscape Blocks
Potential Riparian Connections
Interstate Connections
Ecoregions
*Cumulative cost to ecological flows
OREGON
NEVADA
ARIZONA
BAJA CALIFORNIA, MEXICO
Crescent City
Eureka
Redding
Fort Bragg
Sacramento
Stockton
San Francisco
Monterey
Fresno
Tulare
Bakersfield
Ridgecrest
Barstow
Needles
Santa Barbara
Los Angeles
San Bernardino
San Clemente
San Diego
Blythe
SISKIYOU MTNS
KLAMATH MTNS
CASCADE RANGE
COAST RANGE
SACRAMENTO VALLEY
SIERRA NEVADA
WHITE MTNS
SAN JOAQUIN VALLEY
COAST RANGES
SANTA LUCIA RANGE
AMARGOSA RANGE
DEATH VALLEY
TEHACHAPI MTNS
SIERRA MADRE MTNS
SAN GABRIEL MTNS
SAN BERNARDINO MTNS
BRISTOL MTNS
CHOCOLATE MTNS
Salton Sea
0 40 80 160 240
Kilometers
Miles
0 25 50 100 150
1:5,300,000
N
W
E
S
The Essential Habitat Connectivity map delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale based on available data and assumptions provided in this report. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.
Caltrans

Table 3.1. Mean, minimum, and maximum for metrics in 850 Natural Landscape Blocks (NLBs) and 192 Essential Connectivity Areas (ECAs). See Table 2.4 for data sources and definitions.

	Descriptor	Mean (Min-Max) for 850 Natural Landscape Blocks	Mean (Min-Max) for 192 Landscape Essential Connectivity Areas
Landform	Elevation (m)	664 (-65 to 2,570; 589 SD)	661 (-1 to 2,006, 565 SD)
	Elevation range (difference between maximum and minimum)	614 (1 to 4,100; 598 SD)	967 (6 to 3,440; 716 SD)
	Mean Ecological Condition Index	75 (0 to 100; 25 SD)	53 (3 to 100; 22 SD)
Area	Area in acres	51,000 (2,000 to 3,676,000; 181,000 SD)	97,500 (1,400 to 1,461,000; 160,000 SD)
Essential Connectivity Area	Shortest straight line within ECA between edges of NLBs (km)	Not applicable	15 (0.1 to 75; 16 SD)
	Length of least-cost path within ECA (km)	Not applicable	21 (0.1 to 130; 21 SD)
Protection Status	Percent GAP 1, GAP2, GAP3 or easements	60 (0 to 100; 40 SD)	39 (0 to 100; 33 SD)
	Percent GAP1, GAP2, or easements	44 (0 to 100; 41 SD)	13 (0 to 92; 18 SD)
	Percent GAP3	16 (0 to 100; 40 SD)	26 (0 to 100; 29 SD)
	Percent in private, unprotected status	40 (0 to 100; 40 SD)	61 (0 to 100; 33 SD)
Species diversity	Mean number of amphibians, reptiles, mammals, and birds whose modeled habitat overlaps each CWHR hexagon	237 (128 to 320; 33 SD)	233 (142 to 280; 30 SD)
	Standard deviation of number of species per CWHR hexagon	7	9
	Number of CNDDB special status plant taxa	6 (0 to 162; 11 SD)	13 (0 to 72; 14 SD)
	Number of CNDDB special status animal taxa	6 (0 to 85; 7 SD)	13 (0 to 53; 10 SD)
	Percent of polygon in amphibian, reptile, mammal, or plant rarity hotspot	11 (0 to 100; 29 SD)	7 (0 to 100; 20 SD)
Habitat for listed species	Percent in USFWS-designated Critical Habitat	16 (0 to 100; 29 SD)	12 (0 to 100; 19 SD)
	Number of species with Critical Habitat	0.8 (0 to 11;1.4 SD)	1.6 (0 to 11; 2.1 SD)
	Percent in USFWS-mapped essential habitat	23 (0 to 100; 37 SD)	13 (0 to 100; 23 SD)
	Number of species with essential habitat	0.6 (0 to 9; 0.9 SD)	0.9 (0 to 9;1.3 SD)

Wet-lands	Percent in wetland or vernal pool	9 (0 to 100; 22 SD)	6 (0 to 76; 13 SD)
Paved roads	Number of intersections by major roads	Not applicable	1 (0 to 6; 1 SD)
	Density of major roads (km/km^2)	0 (0 to 0)	0.1 (0 to -1.2; 0.1 SD)
	Density of secondary state and county highways (km/km^2)	0 (0 to 0)	0.2 (0 to 2.8; 0.2 SD)
Eco-regions	Number of Jepson ecoregions	1.2 (1 to 4;0.4 SD)	1 (1 to 4; 0.6 SD)
	Number of ecoregion subsections	2.1 (1 to 14; 1.3 SD)	3 (1 to 11; 1.8 SD)
	Number of watersheds	2.7 (1 to 12; 1.7 SD)	1.8 (1 to 10; 1.1 SD)
ACEC	Percent in BLM Areas of Critical Environmental Concern based on the area's biological values	6 (0 to 100; 21 SD)	2 (0 to 84; 7 SD)
	Number of counties	1.3 (1 to 8; 0.7 SD)	2 (1 to 4; 0.9 SD)
Landcover	Percent forest and woodland	24 (0 to 97; 32 SD)	29 (0 to 93; 34 SD)
	Percent shrubland, steppe, or savanna	38 (0 to 100; 32 SD)	28 (0 to 96;27 SD)
	Percent herbaceous	20 (0 to 99;30 SD)	17 (0 to 98; 23 SD)
	Percent wetland/riparian	5 (0 to 82; 10 SD)	4 (0 to 63; 8 SD)
	Percent open water	1 (0 to 65; 5 SD)	1 (0 to 20;2 SD)
	Percent developed	2 (0 to 32; 3 SD)	5 (0 to 25; 5 SD)
	Percent cultivated crops	3 (0 to 93; 11 SD)	7 (0 to 69; 15 SD)
	Percent hay/pasture	2 (0 to 81; 8 SD)	3 (0 to 45; 8 SD)
	Percent barren or other	5 (0 to 99; 13 SD)	5 (0 to 98; 12 SD)

Major rivers are also shown on the Essential Habitat Connectivity Map to represent where aquatic and riparian corridors may further contribute to ecological connectivity. Riparian areas, although generally narrower than Essential Connectivity Areas, are very important to maintaining ecological connectivity throughout much of the state. Many long riparian corridors connect Natural Landscape Blocks and Essential Connectivity Areas through otherwise inhospitable matrix lands (e.g., urban and agricultural areas), while also maintaining aquatic habitats and flows for numerous species and important ecological processes. In many places, like the Great Central Valley, riparian corridors may be the primary avenues for wildlife movement and other ecological flows between remaining habitat areas. Although aquatic connectivity and riparian restoration are not a focus of this report, maintaining and enhancing riparian corridors and aquatic systems will also greatly enhance overall ecological connectivity throughout the state, and should be a focus of regional and local connectivity plans (Chapters 4 – 6).

Although most Natural Landscape Blocks and Essential Connectivity Areas comprise relatively natural landcovers with high ecological integrity, they vary greatly in their ecological condition, biological values, resistance to ecological flows, and degree of conservation protection. Compared to Essential Connectivity Areas, Natural Landscape Blocks tend to score higher in Ecological Condition Index, have more protected land, and contain less agriculture and development. These differences reflect the stringent, ecoregion-specific rules used to define Natural Landscape Blocks, which delineated Natural Landscape Blocks as the largest, most natural, and best-conserved portions of each ecoregion. Essential Connectivity Areas tend to include more developed and agricultural landcovers (Table 3.1) than Natural Landscape Blocks.

In all ecoregions, Essential Connectivity Areas generally connect areas of both High Biological Value and high conservation status across mostly natural habitats that have relatively low resistance to ecological flows, but that tend not to enjoy high levels of protection of biological resource values. For instance, many Essential Connectivity Areas in forested ecoregions comprise National Forest or private timber lands lying between large National Parks, wilderness areas, or other highly protected lands. These multiple-use areas may be managed primarily for timber harvest, recreation, or other land uses, but may nevertheless support diverse and valuable biological resources and be highly permeable to ecological flows. Inclusion of such lands within Essential Connectivity Areas highlights opportunities to manage them in ways that promote functional ecological connectivity between the highly protected parks, wildlife reserves, and wilderness areas.

Similarly, large areas of natural desert habitats on multiple-use BLM lands and military training lands were excluded from Natural Landscape Blocks, because they didn't meet the stringent criteria of being both highly conserved (GAP1 or 2 lands) AND being mapped as having High Biological Value. Nevertheless, extensive desert areas outside of Natural Landscape Blocks do support valuable biological resources and tend to be highly permeable to ecological flows. Including some such lands in Essential Connectivity Areas highlights the need to maintain functional ecological connectivity between existing protected areas across the desert landscape. Lands within Essential Connectivity Areas should be targets for additional conservation protection and management to ensure that wildlife movements, ecological range shifts, and other ecological flows are maintained in the future. However, it is important to recognize that even areas outside of Natural Landscape Blocks and Essential Connectivity Areas support important ecological values that should not be treated as lacking conservation value. In relatively intact, "low-contrast" landscapes, such as California's deserts, managing the entire landscape to sustain ecological permeability is a worthy conservation goal.

In contrast to the relatively intact mountain and desert ecoregions, many landcovers in Essential Connectivity Areas in other regions are of lower ecological condition and less permeable to ecological flows, such as the extensive agricultural areas of the Great Central Valley and urban and suburban development in the Bay Area, Central Coast, and South Coast Ecoregions. In these relatively "high-contrast" landscapes, maintaining or enhancing permeability to wildlife movement and ecological flows may be quite challenging, and will likely require greater focus on ecological restoration to sustain or enhance habitat values and permeability. Maintaining and enhancing riparian corridors in such regions should be a high conservation priority, as these corridors often represent the only remaining, relatively natural connections between remnant habitat areas, in addition to having intrinsic habitat value for diverse species.

Limitations of the Maps—Although objective, repeatable rules are necessary for a transparent science-based product, no single set of rules can produce a perfect map of Natural Landscape Blocks and Essential Connectivity Areas for California, given the state's extreme biogeographic diversity and the limited number and quality of available statewide data layers. The map probably does not depict any Natural Landscape Block or Essential Connectivity Area that should not have been recognized, but may depict a few non-functional Essential Connectivity Areas[22]. In addition, the map probably excludes a few areas that should have been recognized. Such omissions should be addressed by future regional and local analyses (see Chapters 4-6). For example, large expanses of the western slope of the Sierra Nevada contain no Natural Landscape Blocks or Essential Connectivity Areas, such that the map shows a lack of north-south connectivity through the region, primarily on National Forests downslope of the high-elevation National Parks and Wilderness Areas. These large expanses of forests, woodlands, and chaparral nevertheless support diverse and important biological resources, and there is a need for north-south connectivity along the western slope of the Sierra Nevada to accommodate connectivity for such species as the fisher (*Martes pennanti*) and California spotted owl (*Strix occidentalis occidentalis*).

A second example of potential errors of omission in the Essential Habitat Connectivity Map is the lack of east-west Essential Connectivity Areas across the Great Central Valley, or connecting foothill habitats on either side to Natural Landscape Blocks on the Valley floor. This is due to low average Ecological Condition Index values and the paucity of protected areas in the Valley, coupled with the stringent rules for determining which Natural Landscape Blocks to connect (Section 2.2). However, connectivity of remaining habitat areas in the Great Central Valley is of considerable conservation concern. Regional and local connectivity plans for the Valley need to address these omissions with a focus on ecological restoration and enhancement (see, for example, Huber 2008 and Huber et al. 2010).

One final example of apparent "errors of omission" concerns large portions of the Mojave Desert Ecoregion that were excluded from the Essential Connectivity Network because they are on military bases. The stringent rules used in the deserts to delineate Natural Landscape Blocks excluded Department of Defense lands as not having GAP 1 or 2 protection status, despite that large portions of these bases are actually well protected from human influences and are quite pristine, ecologically intact, and have high biological resource values. Ongoing regional and local planning is addressing connectivity needs in the deserts, with Department of Defense as an active partner. Results of those finer-scale analyses should be used to improve the Essential Habitat Connectivity Map (see Section 3.3.10).

[22] Several Essential Connectivity Areas in highly developed areas may not currently support animal movement and ecological processes, and a few of these may not be fully, or even partially, restorable. We mapped these as Essential Connectivity Areas to avoid portraying some Natural Landscape Blocks as "hopelessly isolated" before more detailed analyses have been conducted to justify such a conclusion.

3.2. Ecoregional Summaries

The following sections provide more detailed ecoregion-by-ecoregion overviews (working from north to south) of the Essential Connectivity Map, with general descriptions of the Natural Landscape Blocks, Essential Connectivity Areas, and surrounding matrix lands. These are intended primarily to highlight limitations to the maps and provide guidance for future analyses and connectivity plans, as described in Chapters 4 through 7.

3.2.1. North Coast

The North Coast Ecoregion is characterized by large expanses of rugged, forested mountains. It is California's wettest ecoregion, especially coastward of the major mountain ranges (Klamath, Siskiyou, Marble, Trinity, and North Coast). Consequently, the ecoregion is crossed by numerous large rivers and is capable of supporting large, fast-growing trees, such as California's massive coastal redwoods. Forestry is the most widespread land use in the region, and historical forest management practices have severely altered and fragmented its natural communities, resulting in generally younger, more even-aged, less structurally diverse forests. The few remaining late-seral forests are scattered in relative isolation of one another.

The North Coast Ecoregion contains 96 Natural Landscape Blocks from 2,000 to 732,500 acres each, which are interconnected by 24 Essential Connectivity Areas that are wholly within the ecoregion (totaling about 78,300 acres) (Figure 3.2, Table 3.2). In addition to these, there are 22 Natural Landscape Blocks and 16 Essential Connectivity Areas that are shared between the North Coast and other ecoregions. Most Natural Landscape Blocks in the North Coast Ecoregion are associated with parks (e.g., Redwood National Park) and wilderness areas (e.g., Marble Mountains Wilderness) in heavily forested mountains and rugged coastal regions. They are mostly forested (63%) and average relatively high on the Ecological Condition Index (82). The Essential Connectivity Areas are also primarily in forest landcovers (74%). They are mostly on privately owned lands (56%), which have traditionally been managed for timber harvest, and National Forests (about 40%), which are managed for multiple uses (e.g., wood, water, livestock forage, wildlife, and recreation), with an historic focus on timber harvest. As a result these forests have been significantly altered and fragmented, and average a moderate Ecological Condition Index of 64. Many of the Essential Connectivity Areas are quite long (up to about 70 km), but these generally span multiple smaller "stepping-stone" blocks between the larger Natural Landscape Blocks they serve to connect. Numerous roads cross the Essential Connectivity Areas (with an average of over 50 km of major and secondary roads in each), but many of these are small and lightly traveled rural roads. Extremely rugged terrain in the ecoregion constrains most highways to following major river canyons over much of their length. The ecoregion also has five placeholder "sticks" to reserve areas in neighboring Oregon, indicating where future connectivity planning, in collaboration with agencies in Oregon, is recommended.

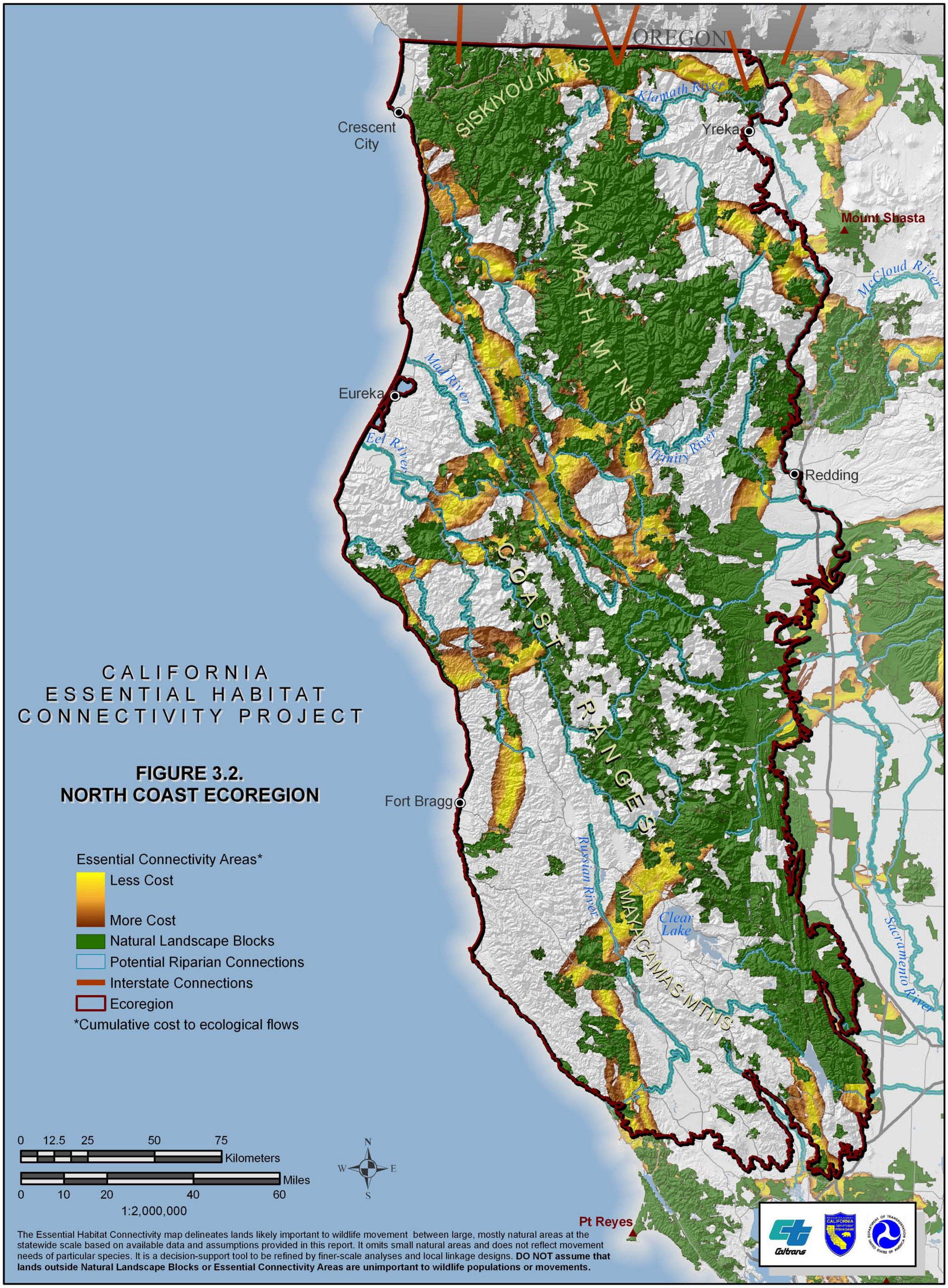

OREGON
SISKIYOU MTNS
Klamath River
Crescent City
Yreka
KLAMATH MTNS
Mount Shasta
McCloud River
Mad River
Eureka
Eel River
Trinity River
Redding
COAST RANGES
CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
FIGURE 3.2.
NORTH COAST ECOREGION
Fort Bragg
Russian River
Clear Lake
MAYACAMAS MTNS
Sacramento River
Essential Connectivity Areas*
Less Cost
More Cost
Natural Landscape Blocks
Potential Riparian Connections
Interstate Connections
Ecoregion
*Cumulative cost to ecological flows
0 12.5 25 50 75
Kilometers
Miles
0 10 20 40 60
1:2,000,000
N
W
E
S
Pt Reyes
The Essential Habitat Connectivity map delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale based on available data and assumptions provided in this report. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.
Caltrans

Table 3.2. Mean and standard deviation for metrics in 96 Natural Landscape Blocks and 24 Essential Connectivity Areas wholly within the North Coast Ecoregion. See Table 2.4 for data sources and definitions.

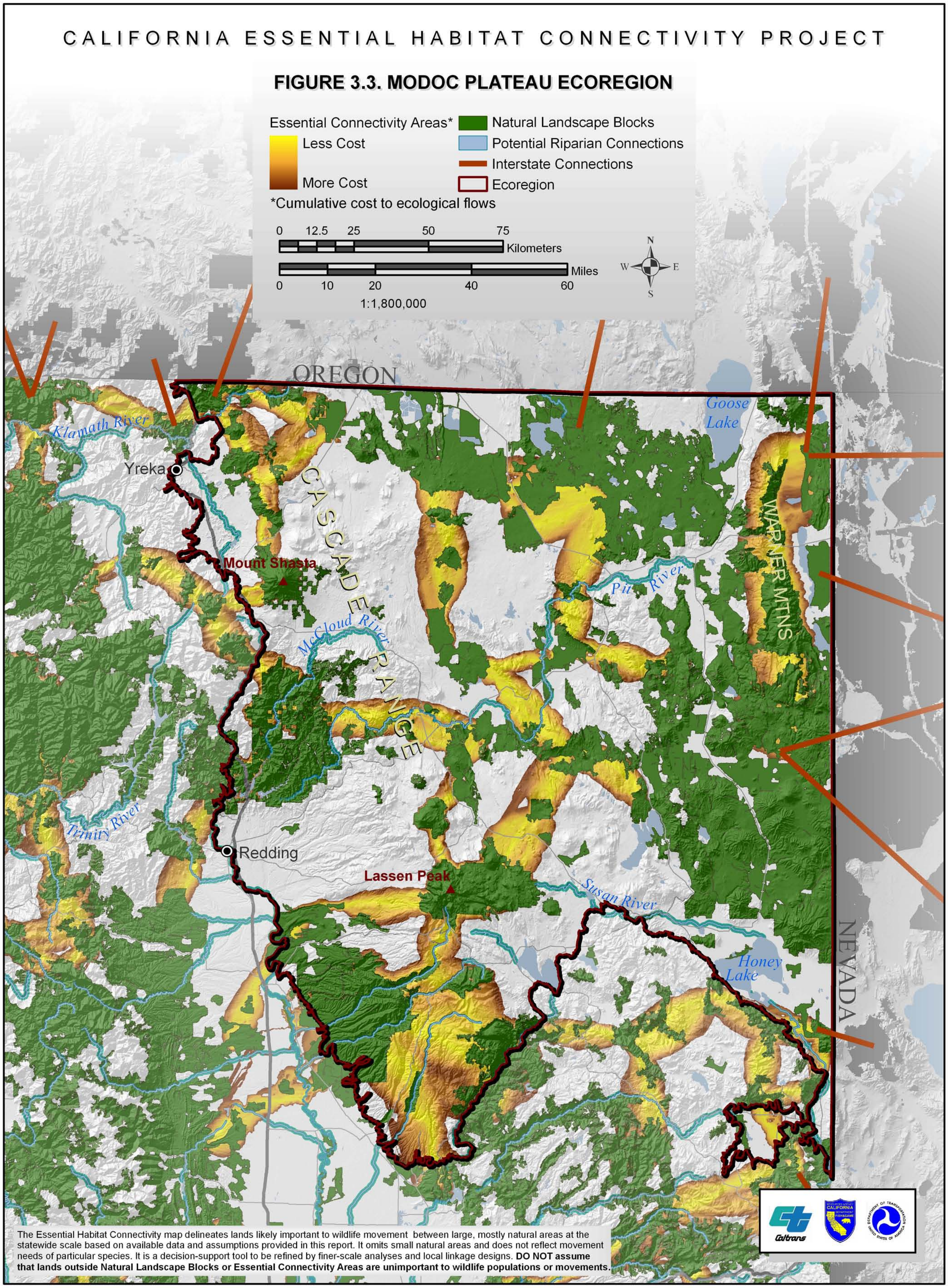
	Descriptor	Mean for 96 Natural Landscape Blocks	Mean for 24 Essential Connectivity Areas
Landform	Elevation (m)	669 (8 to 2,196; 404 SD)	761 (330 to 1,360; 344 SD)
	Elevation range	897 (25 to 2,630; 497 SD)	1,377 (732 to 1,872; 373 SD)
	Mean Ecological Condition Index	82 (0 to 97; 16 SD)	64 (50 to 72; 5 SD)
	Area in acres	41,700 (2,000 to 732,500; 100,800 SD)	87,400 (6,100 to 326,500; 78,300 SD)
ECA	Shortest straight line within ECA between edges of NLBs (km)	Not applicable	14 (0.1 to 45; 15 SD)
	Length of least cost path within ECA (km)	Not applicable	17 (0.1 to 59; 18 SD)
Protection Status	Percent GAP 1, GAP2, GAP3 or easements	66 (0 to 100; 37 SD)	44 (0 to 96; 30 SD)
	Percent GAP1, GAP2, or easements	48 (0 to 100; 41 SD)	8 (0 to 31; 9 SD)
	Percent in private, unprotected status	34 (0 to 100; 37 SD)	56 (4 to 100; 30 SD)
	Percent of polygon in amphibian, reptile, mammal, or plant rarity hotspot	4 (0 to 100; 18 SD)	1 (0 to 29; 6 SD)
Listed species	Percent in USFWS-designated Critical Habitat	21 (0 to 98; 29 SD)	20 (0 to 63; 18 SD)
	Percent in USFWS-mapped essential habitat	4 (0 to 99; 15 SD)	0 (0 to 12; 2 SD)
	Percent in wetland or vernal pool	1 (0 to 28; 3 SD)	0 (0 to 2; 1 SD)
Land Cover	Percent forest and woodland	63 (0 to 97; 30 SD)	74 (19 to 93; 22 SD)
	Percent shrubland, steppe, or savanna	24 (0 to 88; 24 SD)	14 (1 to 57; 16 SD)
	Percent herbaceous	6 (0 to 75; 10 SD)	4 (0 to 18; 6 SD)
	Percent wetland/riparian	1 (0 to 5; 1 SD)	0 (0 to 2; 1 SD)
	Percent open water	1 (0 to 59; 6 SD)	0 (0 to 1; 0 SD)
	Percent developed	1 (0 to 7; 1 SD)	4 (1 to 9; 2 SD)
	Percent cultivated crops	0 (0 to 5; 1 SD)	0 (0 to 3; 1 SD)
	Percent hay/pasture	0 (0 to 5; 1 SD)	0 (0 to 0; 0 SD)
	Percent barren or other	3 (0 to 38; 6 SD)	4 (0 to 10; 3 SD)

A major focus of regional and local connectivity planning in the North Coast Ecoregion should be to sustain and enhance connectivity of high-integrity forest habitats within Natural Landscape Blocks and Essential Connectivity Areas. Essential Connectivity Areas should be assessed for opportunities to increase the size and continuity of dense, late-seral forests for the diverse focal species that depend on them, such as the rare Humboldt marten (*Martes americana humboldtensis*), fisher (*Martes pennanti*), northern spotted owl (*Strix occidentalis*), and marbled murrelet (*Brachyramphus marmoratus*). Increasing the amount of late-seral coniferous forests in this rainy and highly productive forest region would also increase carbon sequestration to help mitigate against global climate change. Consult the California Wildlife Action Plan (Bunn et al. 2007) for a more thorough description of the ecoregion's resources, threats, and conservation priorities.

3.2.2. Modoc Plateau

The Modoc Plateau Ecoregion comprises the northeastern portion of the state, stretching from the North Coast Ecoregion east to the Nevada border, and includes the Cascade Mountain Range as well as the Modoc Plateau proper. The region is topographically and climatically diverse, with numerous volcanic peaks (e.g., Mount Shasta and Mount Lassen), broad lava-formed plateaus, and steep river canyons. The Modoc Plateau lies east of the Cascades, on the western edge of the Great Basin, and supports high-desert ecosystems, including shrub-steppe, perennial grasslands, and juniper woodlands. Conifer forests dominate the higher mountains, such as the Cascade and Warner Ranges. Diverse aquatic ecosystems, including large freshwater and saline lakes, important trout streams, and several managed wetland refuges, are found throughout the region. Although there are a number of large parks and wilderness areas in the Cascades (e.g., Lassen Volcanic National Park, Lava Beds National Monument, Mount Shasta Wilderness, Ishi Wilderness) and several large wildlife refuges in the region (e.g., Lower Klamath, Tule Lake, and Clear Lake National Wildlife Refuges and Tehama and Ashe Creek State Wildlife Areas), the Modoc Plateau region is among the lowest in the state in the proportion conserved for biological resources. Most of the region is managed for multiple uses by the US Forest Service and Bureau of Land Management, with about a third of the area in private ownership. Natural communities on both federal and private lands have been widely degraded by overgrazing (by livestock as well as feral horses), invasive annual grasses, altered fire regimes, timber management, and other stressors (Bunn et al. 2007).

The Modoc Plateau Ecoregion has 124 Natural Landscape Blocks (100 totally within the region and 24 extending into other regions) ranging from 2,000 to 790,000 acres each. They are interconnected by 19 Essential Connectivity Areas wholly within the ecoregion (Figure 3.3, Table 3.3) plus about 17 connecting into other ecoregions. Most Natural Landscape Blocks are associated with the various national parks and wilderness areas (especially at higher elevations) or wildlife refuges (especially at lower elevations) and have generally very high ecological integrity (ECI scores average 88). The Essential Connectivity Areas lie primarily on National Forest, Bureau of Land Management, and privately owned lands, with only 9% protected as Gap 1 or 2 conservation lands and a modest average Ecological Condition Index of 60. The Essential Connectivity Areas average nearly 24 km long, but there are numerous smaller stepping-stone blocks along the longer ones. Major landcovers within Essential Connectivity Areas are forests and woodlands (66%) and shrublands (22%). Numerous roads cross the Essential Connectivity Areas (averaging about 47 km of road in each), but many of these are small and lightly traveled rural roads.


CALIFORNIA ESSENTIAL HABITAT CONNECTIVITY PROJECT
FIGURE 3.3. MODOC PLATEAU ECOREGION
Essential Connectivity Areas*
Less Cost
More Cost
*Cumulative cost to ecological flows
Natural Landscape Blocks
Potential Riparian Connections
Interstate Connections
Ecoregion
0 12.5 25 50 75 Kilometers
0 10 20 40 60 Miles
1:1,800,000
N
W
E
S
OREGON
NEVADA
Goose Lake
Honey Lake
Klamath River
Pit River
McCloud River
Trinity River
Susan River
Yreka
Redding
Mount Shasta
Lassen Peak
CASCADE RANGE
WARNER MTNS
The Essential Habitat Connectivity map delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale based on available data and assumptions provided in this report. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.
Caltrans

The ecoregion also has eight placeholder "sticks" to reserve areas in Oregon and Nevada, indicating where future connectivity planning, in collaboration with agencies in these states, is recommended.

Table 3.3. Mean and standard deviation for metrics in 100 Natural Landscape Blocks and 19 Essential Connectivity Areas wholly within the Modoc Plateau Ecoregion. See Table 2.4 for data sources and definitions.

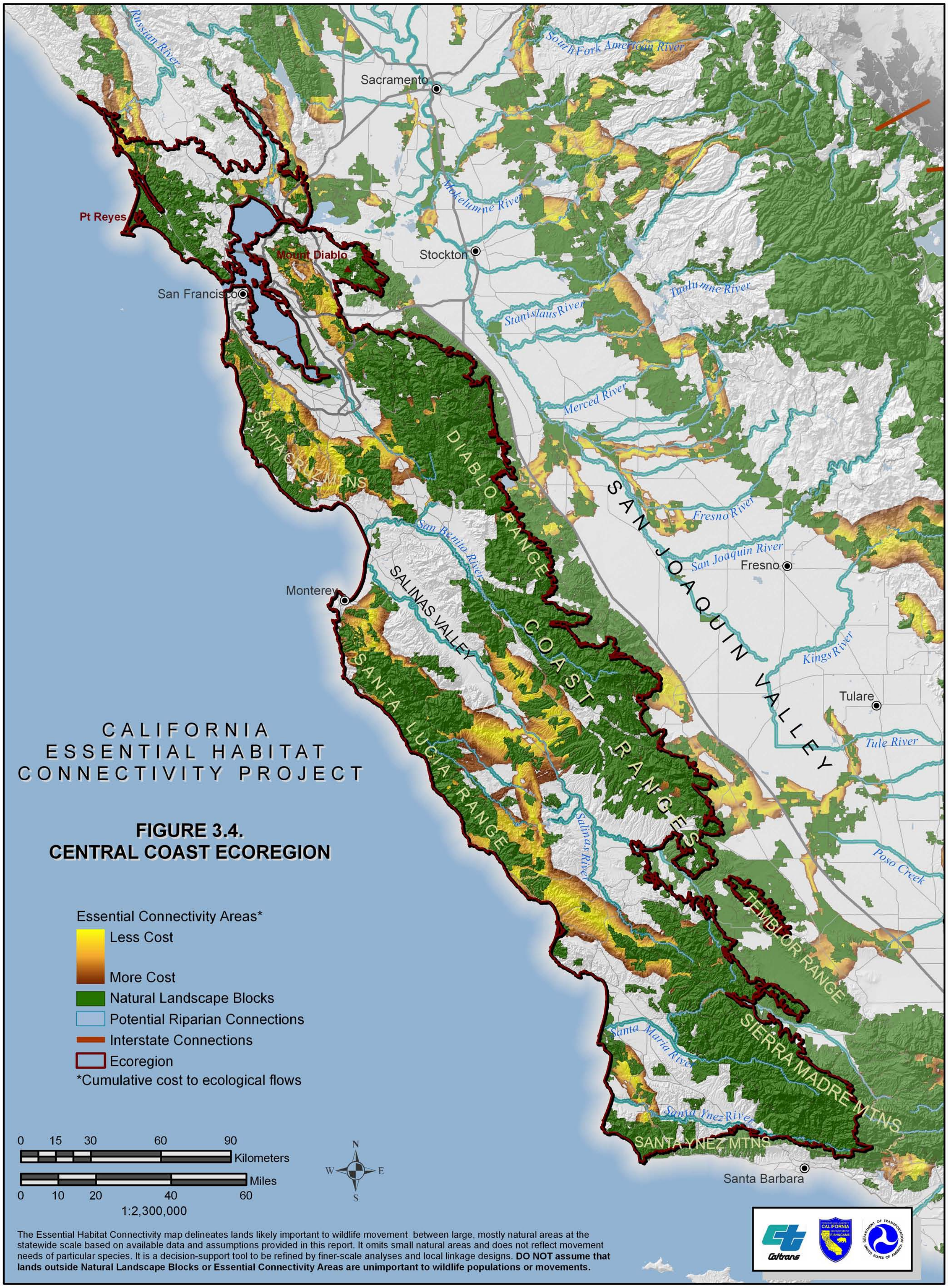
	Descriptor	Mean for 100 Natural Landscape Blocks	Mean for 19 Essential Connectivity Areas
Landform	Elevation (m)	1,330 (276 to 2,189; 405 SD)	1,484 (998 to 1,934; 269 SD)
Landform	Elevation range	539 (5 to 3,247; 487 SD)	1,200 (336 to 2,874; 643 SD)
	Mean Ecological Condition Index	88 (1 to 99; 17 SD)	60 (50 to 76; 7 SD)
	Area in acres	34,800 (2,000 to 790,000; 88,000 SD)	100,200 (15,000 to 300,100; 70,700 SD)
ECA	Shortest straight line within ECA between edges of NLBs (km)	Not applicable	17 (1 to 49; 14 SD)
ECA	Length of least cost path within ECA (km)	Not applicable	24 (2 to 51; 15 SD)
Protection Status	Percent GAP 1, GAP2, GAP3 or easements	67 (0 to 100; 34 SD)	61 (21 to 100; 27 SD)
Protection Status	Percent GAP1, GAP2, or easements	29 (0 to 100; 38 SD)	9 (0 to 48; 13 SD)
Protection Status	Percent in private, unprotected status	33 (0 to 100; 34 SD)	39 (0 to 79; 27 SD)
	Percent of polygon in amphibian, reptile, mammal, or plant rarity hotspot	0 (0 to 15; 2 SD)	0 (0 to 0; 0 SD)
Listed species	Percent in USFWS-designated Critical Habitat	4 (0 to 100; 16 SD)	4 (0 to 39; 10 SD)
Listed species	Percent in USFWS-mapped essential habitat	5 (0 to 100; 17 SD)	2 (0 to 8; 3 SD)
	Percent in wetland or vernal pool	8 (0 to 99; 18 SD)	3 (0 to 8; 2 SD)
Land Cover	Percent forest and woodland	39 (0 to 96; 33 SD)	66 (24 to 86; 18 SD)
Land Cover	Percent shrubland, steppe, or savanna	39 (0 to 98; 32 SD)	22 (2 to 72; 18 SD)
Land Cover	Percent herbaceous	2 (0 to 40; 5 SD)	1 (0 to 6; 2 SD)
Land Cover	Percent wetland/riparian	5 (0 to 36; 6 SD)	3 (0 to 7; 2 SD)
Land Cover	Percent open water	2 (0 to 63; 7 SD)	0 (0 to 1; 0 SD)
Land Cover	Percent developed	0 (0 to 4; 1 SD)	1 (0 to 2; 1 SD)
Land Cover	Percent cultivated crops	3 (0 to 65; 10 SD)	2 (0 to 8; 3 SD)
Land Cover	Percent hay/pasture	5 (0 to 68; 13 SD)	1 (0 to 5; 2 SD)
Land Cover	Percent barren or other	6 (0 to 84; 14 SD)	3 (0 to 10; 3 SD)

A major focus of regional and local connectivity planning in the Modoc Plateau Ecoregion should be working to sustain and enhance connectivity of high-integrity forest habitats in the mountains, and restoring ecological integrity to degraded Great Basin communities (e.g., shrub steppe and perennial grass communities). Essential Connectivity Areas should be assessed for opportunities to increase the size and continuity of higher canopy closure, late-seral forests for such species as pine marten and northern goshawk (*Accipiter gentilis*) as well as shrub-steppe and perennial grassland habitats that support such species as greater sage grouse (*Centrocercus urophasianus*) and pronghorn (*Antilocapra americana*). Consult the California Wildlife Action Plan (Bunn et al. 2007) for a more thorough description of the ecoregion's resources, threats, and conservation priorities.

3.2.3. Central Coast

The Central Coast Ecoregion includes coastal mountains, valleys, and plains along the Pacific Ocean from about the Russian River and Sonoma Valley on the north to Point Conception on the south. The region is characterized by a rugged coastline and many mountain ranges roughly paralleling the Pacific coast and the hills surrounding San Francisco Bay. The mountain ranges are separated by fertile, alluvial river valleys near the coast, with more arid valleys and hills further inland. The region's topographic, climatic, and edaphic complexities result in diverse coastal, montane, and desert-like ecological communities—ranging from coastal wetlands and maritime chaparral, to redwood forests, to arid grasslands and shrublands. Large portions of the region are highly urbanized, especially in the San Francisco Bay Area and near Monterey and San Luis Obispo Bays. The broad, fertile river valleys, such as Salinas Valley, as well as some broad coastal terraces, have been largely converted to agriculture. Most remaining natural vegetation is therefore restricted to the more rugged coastal mountains and arid inland valleys and hills. In addition to expanding agricultural areas and urban and exurban development, excessive livestock grazing is a major stressor on the region's natural communities (Bunn et al. 2007). Numerous large and heavily traveled highways also fragment and isolate natural areas from one another and impede wildlife movements.

The highly fragmented Central Coast Ecoregion has 129 total Natural Landscape Blocks (including 103 totally within the region and 26 shared with neighboring regions) which are served by 24 Essential Connectivity Areas (12 wholly within the ecoregion and 12 shared with adjacent regions) (Figure 3.4 and Table 3.4). The Natural Landscape blocks are mostly in rugged areas, with generally smaller, more fragmented blocks on the region's gentler slopes, terraces, and valleys due to the widespread conversion to urban and agricultural land uses. Landcover composition of the Natural Landscape Blocks is diverse, reflecting this ecoregion's tremendous ecological diversity, with various shrubland (44%), grassland/herbaceous (25%), forest/woodland (19%), and wetland/riparian (4%) types well represented. The average Ecological Integrity Condition is moderate but highly variable among blocks (61 $\pm$ 30 SD). The Essential Connectivity Areas are likewise diverse in landcover composition. Because they tend to connect the more rugged areas across the region's valleys and plains, the Essential Connectivity Areas have a higher proportion of landcover in urban (11%) and agriculture (6%) than the Natural Landscape Blocks, and they have a relatively low average Ecological Condition Index (44). They also are crossed by



CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
FIGURE 3.4.
CENTRAL COAST ECOREGION
Essential Connectivity Areas*
Less Cost
More Cost
Natural Landscape Blocks
Potential Riparian Connections
Interstate Connections
Ecoregion
*Cumulative cost to ecological flows
0 15 30 60 90
Kilometers
Miles
0 10 20 40 60
1:2,300,000
N
W
E
S
Russian River
South Fork American River
Sacramento
Mokelumne River
Pt Reyes
Mount Diablo
Stockton
San Francisco
Tuolumne River
Stanislaus River
Merced River
SANTA CRUZ MTNS
DIABLO RANGE
SAN JOAQUIN VALLEY
Fresno River
San Joaquin River
Fresno
San Benito River
Monterey
SALINAS VALLEY
COAST RANGES
Kings River
Tulare
Tule River
SANTA LUCIA RANGE
Salinas River
Poso Creek
TEMBLOR RANGE
SIERRA MADRE MTNS
Santa Maria River
Santa Ynez River
SANTA YNEZ MTNS
Santa Barbara
The Essential Habitat Connectivity map delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale based on available data and assumptions provided in this report. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.

numerous major and secondary roads, with an average of 149 km of roads per Essential Connectivity Area.

Table 3.4. Mean and standard deviation for metrics in 103 Natural Landscape Blocks and 12 Essential Connectivity Areas wholly within the Central Coast Ecoregion. See Table 2.4 for data sources and definitions.

	Descriptor	Mean for 103 Natural Landscape Blocks	Mean for 12 Essential Connectivity Areas
Landform	Elevation (m)	266 (1 to 816; 170 SD)	303 (108 to 407; 104 SD)
Landform	Elevation range	431 (3 to 1,782; 258 SD)	871 (412 to 1,524; 356 SD)
	Mean Ecological Condition Index	61 (0 to 98; 30 SD)	44 (9 to 75; 22 SD)
	Area in acres	15,900 (2,000 to 475,000; 48,200 SD)	123,000 (6,300 to 345,700; 101,300 SD)
ECA	Shortest straight line within ECA between edges of NLBs (km)	Not applicable	23 (2 to 61; 19 SD)
ECA	Length of least cost path within ECA (km)	Not applicable	28 (5 to 74; 21 SD)
Protection Status	Percent GAP 1, GAP2, GAP3 or easements	59 (0 to 100; 37 SD)	23 (1 to 47; 14 SD)
Protection Status	Percent GAP1, GAP2, or easements	53 (0 to 100; 38 SD)	15 (0 to 33; 10 SD)
Protection Status	Percent in private, unprotected status	41 (0 to 100; 37 SD)	77 (53 to 99; 14 SD)
	Percent of polygon in amphibian, reptile, mammal, or plant rarity hotspot	33 (0 to 100; 44 SD)	7 (0 to 45; 15 SD)
Listed species	Percent in USFWS-designated Critical Habitat	17 (0 to 100; 28 SD)	12 (0 to 35; 12 SD)
Listed species	Percent in USFWS-mapped essential habitat	48 (0 to 100; 44 SD)	30 (0 to 85; 27 SD)
	Percent in wetland or vernal pool	4 (0 to 62; 10 SD)	0 (0 to 3; 1 SD)
Land Cover	Percent forest and woodland	19 (0 to 92; 23 SD)	22 (1 to 68; 20 SD)
Land Cover	Percent shrubland, steppe, or savanna	44 (0 to 93; 25 SD)	44 (19 to 71; 17 SD)
Land Cover	Percent herbaceous	25 (0 to 93; 27 SD)	15 (1 to 44; 13 SD)
Land Cover	Percent wetland/riparian	4 (0 to 71; 11 SD)	2 (0 to 4; 1 SD)
Land Cover	Percent open water	2 (0 to 65; 9 SD)	1 (0 to 5; 1 SD)
Land Cover	Percent developed	4 (0 to 19; 4 SD)	11 (5 to 23; 7 SD)
Land Cover	Percent cultivated crops	1 (0 to 61; 6 SD)	5 (0 to 34; 10 SD)
Land Cover	Percent hay/pasture	0 (0 to 3; 0 SD)	1 (0 to 2; 1 SD)
Land Cover	Percent barren or other	1 (0 to 45; 5 SD)	0 (0 to 1; 0 SD)

Major foci of regional and local connectivity planning in the Central Coast Ecoregion must be maintaining and enhancing functional connectivity across numerous roads, agricultural areas, and urbanizing areas. This challenge is already being tackled by existing connectivity planners in portions of the region. For example, Thorne et al. (2002) used a focal species approach to develop a guide to wildlands conservation in the Central Coast region. T. Diamond (2010) has analyzed movement of badgers and other species in the Essential Connectivity Area connecting the Diablo Range to the Santa Cruz Mountains across Coyote Valley, and there is an ongoing effort by university scientists and Caltrans to assess and enhance wildlife connectivity across Highway 101 in the Essential Connectivity Area between the Sierra Madre and Santa Lucia Range (P. Huber, personal communication). Developing Natural Community Conservation Plans in this ecoregion are also addressing connectivity conservation in this ecoregion—including the Santa Clara Valley Conservation Plan, which has been in development for several years, and a recently initiated North San Luis Obispo County Conservation Program. Finally, a recently initiated regional effort intends to develop local Linkage Designs around the San Francisco Bay area (see Section 3.3.12).

Other documented connectivity issues in the region include (1) maintaining potential for Endangered San Joaquin kit fox (*Vulpes macrotis mutica)* movement corridors from Camp Roberts Military Reservation in the central part of this ecoregion southeast into the Carrizo Plain and the San Joaquin Valley and northeast toward the Cholame Hills area, and (2) preserving a corridor along the Pajaro River and adjacent lands from the Santa Cruz Mountains to the Diablo Range and Santa Lucia Mountains for wide-ranging species (Bunn et al. 2007).

3.2.4. Great Central Valley

The Great Central Valley Ecoregion comprises the Sacramento Valley in the north, the San Joaquin Valley in the south, and the Sacramento-San Joaquin Delta in between, where the waters from California's two great central watersheds come together before flowing to the Pacific—or, via pipes and canals, to agricultural and urban areas throughout much of the state. This ecoregion comprises most of the low-lying lands of Central California, bounded between the Coast Ranges on the west, Sierra Nevada and Cascade Ranges on the east, and the Tehachapi Range on the south. The Sutter Buttes, a circular set of volcanic hills, rises about 2,000 feet from the floor of the Sacramento Valley. The vast majority of the valley is in private ownership, but there are a large number of wildlife refuges and other preserves scattered throughout, including many important wetland refuges and grassland reserves.

The Great Central Valley is largely converted to agricultural and urban landcovers, with remaining natural communities severely reduced. For example, 99.9% of the region's historic native grasslands, 99% of valley oak savannah, 95% of wetlands, and 89% of riparian woodlands have been converted (Bunn et al. 2007). Nevertheless, the Valley still supports diverse native and endemic species and has numerous important wildlife reserves, especially in wetland areas along the many waterways. There are also some important grassland and shrubland areas, especially around the margins of the Valley and adjacent foothills, which support a variety of rare and Endangered species, such as the San Joaquin kit fox, blunt-nosed leopard lizard (*Gambelia sila*), and several endemic kangaroo rats

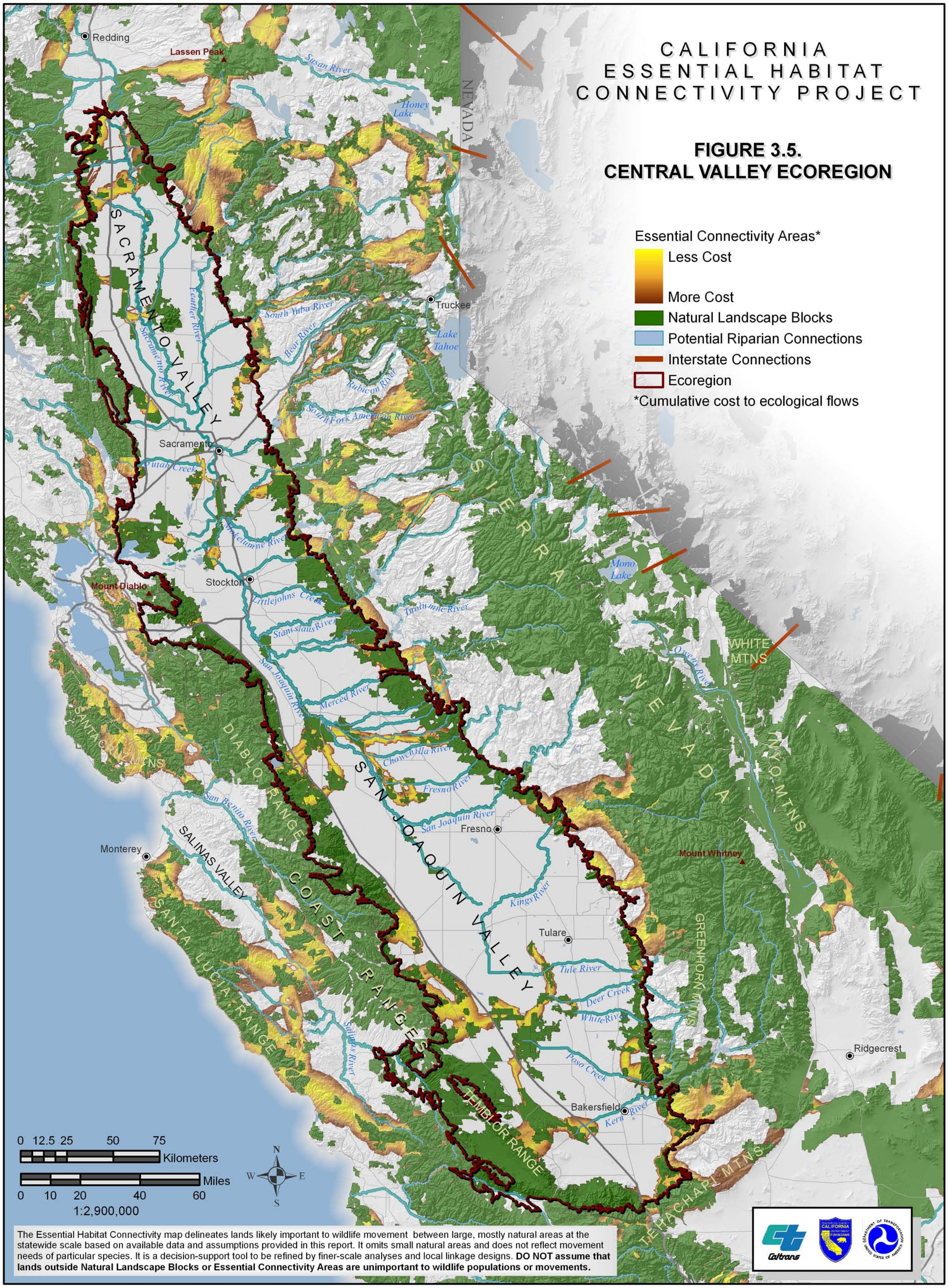
(*Dipodomys* spp.). There are also numerous vernal pools on remaining grasslands in the region, including large vernal pool complexes that are an important source of regional biodiversity and support numerous imperiled species. Tule elk (*Cervus elaphus nannodes*), which were once common and widespread throughout the region, were nearly extirpated, but have been reintroduced to several wildlife reserves over recent decades, with one free-roaming population in the Carrizo Plain. Restoring and enhancing connectivity for such species, as well as for aquatic and riparian species, is a high conservation priority in the region.

Due to the highest level of habitat conversion and fragmentation of any ecoregion, the Great Central Valley has a large number of very small Natural Landscape Blocks (Figure 3.5, Table 3.5). The 114 blocks entirely within the ecoregion tend to be very small and isolated, with the smallest average block size of any ecoregion, at <9,000 acres. The largest Natural Landscape Blocks (those > 20,000 acres) are largely restricted to the foothill margins of the Valley proper. These foothill margins are dominated by annual grasslands (55% of Natural Landscape Blocks are mapped as grassland/herbland). The Natural Landscape Blocks in this ecoregion also average a modest Ecological Condition Index of 68, which partly reflects the high proportion of land in nonnative landcovers (28% of Natural Landscape blocks are mapped as urban or agricultural landcovers).

The Natural Landscape blocks are connected by 29 Essential Connectivity Areas (not including 35 Essential Connectivity Areas connecting to other ecoregions), most of which primarily cross agricultural lands. Less than half of the land within Essential Connectivity Areas is in natural landcovers, with 46% in agricultural uses and 5% developed. The balance of the land is in annual grasslands (31%; mostly in the foothills around the Valley) or wetlands and open water (11%; mostly on the Valley floor). The Essential Connectivity Areas consequently average the second lowest Ecological Condition Index of any ecoregion, at only 35. Large expanses of the Great Central Valley lack any significant natural blocks or Essential Connectivity Areas, and there are very few opportunities for maintaining or enhancing cross-Valley connectivity using natural upland vegetation. Consequently, in addition to Essential Connectivity Areas, the remaining riparian corridors play a critical role in helping connect remaining natural areas in the Great Central Valley, a function that can and should be greatly enhanced by riparian and riverine restoration projects.

Some local and regional connectivity planning and implementation has already been done, or is currently being done in the region. For example, the Recovery Plan for Upland Species of the San Joaquin Valley (USFWS 1998) addressed the need to sustain and enhance functional connectivity for various upland species, such as the kit fox, with landscape and “stepping-stone” linkages proposed both on the Valley floor and in the foothills on the Valley’s margins. Because few Valley-floor linkages currently exist, the plan also emphasized the need for restoration of continuous corridors, or islands of suitable vegetation to serve as stepping stones for wildlife movements.

Huber (2008) and Huber et al. (2010) developed a conceptual reserve network design for the Central Valley based on least-cost corridor models for a variety of focal species, which focused on the need to restore and enhance suitable habitat in core areas as well as potential


CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
FIGURE 3.5.
CENTRAL VALLEY ECOREGION
Essential Connectivity Areas*
Less Cost
More Cost
Natural Landscape Blocks
Potential Riparian Connections
Interstate Connections
Ecoregion
*Cumulative cost to ecological flows
Redding
Lassen Peak
Susan River
Honey Lake
NEVADA
SACRAMENTO VALLEY
Feather River
Sacramento River
South Yuba River
Bear River
Truckee
Lake Tahoe
Rubicon River
South Fork American River
Sacramento
Putah Creek
Mokelumne River
Stockton
Mount Diablo
Littlejohns Creek
Stanislaus River
Tuolumne River
Mono Lake
SIERRA NEVADA
WHITE MTNS
Owens River
San Joaquin River
Merced River
Chowchilla River
Fresno River
SANTA CRUZ MTNS
DIABLO RANGE
San Benito River
SAN JOAQUIN VALLEY
Fresno
Monterey
SALINAS VALLEY
COAST RANGES
INYO MTNS
Mount Whitney
Kings River
Tulare
SANTA LUCIA RANGE
Tule River
Deer Creek
White River
GREENHORN MTNS
Salinas River
Poso Creek
Ridgecrest
TEMBLOR RANGE
Bakersfield
Kern River
TEHACHAPI MTNS
0 12.5 25 50 75
Kilometers
Miles
0 10 20 40 60
1:2,900,000
N
S
E
W
The Essential Habitat Connectivity map delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale based on available data and assumptions provided in this report. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.
Caltrans

linkages between them. This finer-scale conceptual reserve network includes numerous areas that were excluded from our coarse, statewide Essential Habitat Connectivity Map (see Section 3.3.7), once again emphasizing the need for regional and local analyses.

Table 3.5. Mean and standard deviation for metrics in 114 Natural Landscape Blocks and 29 Essential Connectivity Areas wholly within the Great Central Valley Ecoregion. See Table 2.4 for data sources and definitions.

	Descriptor	Mean for 114 Natural Landscape Blocks	Mean for 29 Essential Connectivity Areas
Landform	Elevation (m)	96 (-1 to 627; 108 SD)	79 (-1 to 380; 96 SD)
	Elevation range	86 (1 to 645; 136 SD)	97 (6 to 1,010; 199 SD)
	Mean Ecological Condition Index	68 (0 to 96; 27 SD)	35 (3 to 80; 23 SD)
	Area in acres	8,900 (2,000 to 63,700; 10,700 SD)	22,600 (4,800 to 86,700; 18,300 SD)
ECA	Shortest straight line within ECA between edges of NLBs (km)	Not applicable	9 (1 to 35; 8 SD)
	Length of least cost path within ECA (km)	Not applicable	13 (2 to 49; 10 SD)
Protection Status	Percent GAP 1, GAP2, GAP3 or easements	41 (0 to 100; 42 SD)	20 (0 to 99; 29 SD)
	Percent GAP1, GAP2, or easements	37 (0 to 100; 39 SD)	12 (0 to 72; 19 SD)
	Percent in private, unprotected status	59 (0 to 100; 42 SD)	80 (1 to 100; 29 SD)
	Percent of polygon in amphibian, reptile, mammal, or plant rarity hotspot	5 (0 to 100; 20 SD)	3 (0 to 71; 14 SD)
Listed species	Percent in USFWS-designated Critical Habitat	25 (0 to 100; 38 SD)	17 (0 to 100; 33 SD)
	Percent in USFWS-mapped essential habitat	32 (0 to 100; 41 SD)	16 (0 to 100; 29 SD)
	Percent in wetland or vernal pool	38 (0 to 100; 37 SD)	21 (0 to 76; 22 SD)
Land Cover	Percent forest and woodland	0 (0 to 1; 0 SD)	0 (0 to 1; 0 SD)
	Percent shrubland, steppe, or savanna	4 (0 to 59; 10 SD)	3 (0 to 49; 9 SD)
	Percent herbaceous	55 (1 to 99; 36 SD)	34 (1 to 98; 30 SD)
	Percent wetland/riparian	11 (0 to 82; 20 SD)	9 (0 to 63; 15 SD)
	Percent open water	1 (0 to 15; 3 SD)	2 (0 to 20; 4 SD)
	Percent developed	3 (0 to 20; 3 SD)	5 (1 to 16; 3 SD)
	Percent cultivated crops	17 (0 to 93; 23 SD)	31 (0 to 69; 22 SD)
	Percent hay/pasture	8 (0 to 81; 16 SD)	15 (0 to 45; 16 SD)
	Percent barren or other	0 (0 to 8; 1 SD)	0 (0 to 4; 1 SD)

A number of extensive restoration projects are planned or underway to improve aquatic flows, remove in-stream barriers, and increase the extent and continuity of riparian vegetation communities along major rivers and tributaries in the Central Valley. For example, the San Joaquin National Wildlife Refuge includes one of California's largest riparian forest restoration projects, creating the largest block of contiguous riparian woodland in the San Joaquin Valley; and conservation and restoration efforts are underway along the Tuolumne, San Joaquin, Cosumnes and other rivers in the region. The focus on restoring ecological functionality in the San Joaquin-Sacramento Bay Delta and the rivers that feed it has also spawned numerous restoration and enhancement projects under the CALFED Ecological Restoration Program and the Bay-Delta Conservation Plan. Finally, various other Natural Community Conservation Plans in the Great Central Valley have focused on, or are currently focusing on, approaches for sustaining, restoring, and enhancing functional connectivity for diverse species and communities (e.g., NCCP/HCP plans in the Counties of Butte, Yolo, Yuba, Sutter, Contra Costa, and Placer).

3.2.5. Sierra Nevada

The Sierra Nevada Ecoregion extends up from the Great Central Valley to the high-elevation peaks of the Sierra Nevada, then plunges abruptly down to Great Basin and desert communities in the great rain shadow that the Sierra Nevada Range casts to the east. The extreme elevation range, long north-south extent, and topographic diversity of the ecoregion makes its natural communities extremely diverse, ranging from grasslands and shrublands on the lower western slopes, up through oak woodlands and highly productive mixed coniferous forests, to subalpine and barren alpine communities at the highest elevations, and then back down through coniferous forests and pinion-juniper woodlands to various desert scrub types to the east. Large areas of the Sierra Nevada are protected as National Parks and wilderness areas, mostly at higher elevations in the southern two-thirds of the range. The more productive timberlands lower down on the western slopes and in the northern Sierra Nevada are a mixture of mostly US Forest Service and private lands that have been historically subject to intensive timber harvest. Outside of the few protected old-growth groves, such as in Yosemite and Sequoia-Kings Canyon National Parks, the ecoregion's forests are generally younger, more even-aged, and less structurally complex than before. This history, coupled with 100 years of intensive fire suppression, has greatly altered fuels conditions and fire regimes—resulting in larger, more frequent, and more severe crown fires than historically occurred. The range is crossed by numerous highways and secondary roads that fragment habitats and represent crossing hazards for wildlife and vehicles alike. Effects of climate change are also evident in the range, with strong upward shifts and expansions in geographic ranges of various species documented over the past century (Moritz et al. 2008).

This large ecoregion has 197 total Natural Landscape blocks, including 118 totally contained within the ecoregion and 79 shared with adjoining ecoregions (Figure 3.6, Table 3.6). The blocks average about 34,000 acres each, with the largest approaching 800,000 acres. Natural Landscape blocks wholly within the ecoregion average a moderately high Ecological Condition Index of 75, are predominantly in shrub (42%) and forest (45%) landcovers, and include a significant amount of riparian and wetland types (6%). The blocks are moderately well protected, with 46% in unprotected private lands, 32% in reserves, and the balance in mostly multiple use federal ownerships, especially National Forests. Many of the Natural


CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
FIGURE 3.6.
SIERRA NEVADA ECOREGION
Essential Connectivity Areas*
Less Cost
More Cost
Natural Landscape Blocks
Potential Riparian Connections
Interstate Connections
Ecoregion
*Cumulative cost to ecological flows
Redding
Lassen Peak
Susan River
Honey Lake
NEVADA
SACRAMENTO VALLEY
Feather River
Sacramento River
South Yuba River
Bear River
Truckee
Lake Tahoe
Rubicon River
South Fork American River
Sacramento
Mokelumne River
Stockton
Mount Diablo
SIERRA
Mono Lake
YOSEMITE NATIONAL PARK
Tuolumne River
Stanislaus River
WHITE MTNS
Owens River
Merced River
NEVADA
INYO MTNS
DIABLO RANGE
SANTA CRUZ MTNS
SAN JOAQUIN VALLEY
Fresno River
San Joaquin River
Fresno
San Benito River
Monterey
SALINAS VALLEY
COAST RANGES
SEQUOIA-KINGS CANYON NATIONAL PARK
Mount Whitney
DEATH VALLEY
PANAMINT RANGE
Kings River
Tulare
GREENHORN MTNS
SANTA LUCIA RANGE
Tule River
Deer Creek
Salinas River
Poso Creek
Ridgecrest
TEMBLOR RANGE
Bakersfield
Kern River
TEHACHAPI MTNS
Barstow
Santa Clara River
0 12.5 25 50 75
Kilometers
Miles
0 10 20 40 60
1:3,000,000
N
W
E
S
The Essential Habitat Connectivity map delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale based on available data and assumptions provided in this report. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.
Caltrans
CALIFORNIA

Landscape Blocks are separated from neighbors only by a road (the ecoregion has 101 road fragmentation “sticks”), such that there are only 45 total Essential Connectivity Areas connecting Natural Landscape Blocks—16 wholly within the ecoregion and 29 connecting into adjacent ecoregions. The Essential Connectivity Areas wholly within the region are mostly in forest and woodland (57%) or shrub (31%) landcovers. They are generally not well protected, with 59% in private, unprotected status, only 3% in reserves, and most of the balance in multiple-use Forest Service and Bureau of Land Management lands. The Ecological Condition Index in Essential Connectivity Areas is low to moderate, averaging only 51.

Most Essential Connectivity Areas connect between the high-elevation parks and wilderness areas, across multiple-use Forest Service and private lands to Natural Landscape Blocks at lower elevations. Large expanses of the western slope of the Sierra Nevada contain no Natural Landscape Blocks or Essential Connectivity Areas, such that the map shows a lack of north-south connectivity through this region, primarily on National Forests downslope of the large, high-elevation National Parks and Wilderness Areas. These large expanses of forests, woodlands, and chaparral nevertheless support diverse and important biological resources, and there is a need for north-south connectivity along the western slope of the Sierra Nevada to accommodate connectivity for a wide array of species. For example, an isolated population of less than 400 fishers is concentrated within large, old forests at mid elevations, south from Yosemite National Park; and sustaining and enhancing north-south connectivity through this area and expanding suitable habitat to the north of Yosemite is a high conservation priority for sustaining and expanding the population (Spencer et al. 2008). Moreover, Figure 3.6 does not include an Essential Connectivity Area crossing north-south over Interstate 80 in the vicinity of Bear River, an area that is considered an imperiled wildlife linkage (P. Huber, personal communication). Because the Natural Landscape Blocks and Essential Connectivity Areas were delineated based on repeatable rules that could not consider the needs of particular focal species, such omissions must be dealt with in future regional and local connectivity plans (Chapters 4 and 5). Finally, improved road crossings for wildlife (Chapter 6) are a key conservation priority in this ecoregion, not only where roads cross the delineated Natural Landscape Blocks and Essential Connectivity Areas, but also elsewhere.

Table 3.6. Mean and standard deviation for metrics in 118 Natural Landscape Blocks and 16 Essential Connectivity Areas wholly within the Sierra Nevada Ecoregion. See Table 2.4 for data sources and definitions.

	Descriptor	Mean for 118 Natural Landscape Blocks	Mean for 16 Essential Connectivity Areas
Landform	Elevation (m)	1,089 (95 to 2,569; 756 SD)	1,131 (395 to 1,968; 578 SD)
	Elevation range	757 (28 to 3,561; 655 SD)	1,196 (448 to 2,045; 566 SD)
	Mean Ecological Condition Index	75 (0 to 100; 18 SD)	51 (33 to 67; 9 SD)
	Area in acres	33,800 (2,000 to 793,000; 92,800 SD)	73,000 (8,600 to 217,200; 60,800 SD)
ECA	Shortest straight line within ECA between edges of NLBs (km)	Not applicable	16 (1 to 64; 17 SD)
	Length of least cost path within ECA (km)	Not applicable	21 (3 to 84; 20 SD)
Protection Status	Percent GAP 1, GAP2, GAP3 or easements	57 (0 to 100; 40 SD)	41 (0 to 95; 33 SD)
	Percent GAP1, GAP2, or easements	32 (0 to 100; 39 SD)	3 (0 to 21; 6 SD)
	Percent in private, unprotected status	43 (0 to 100; 40 SD)	59 (5 to 100; 33 SD)
	Percent of polygon in amphibian, reptile, mammal, or plant rarity hotspot	7 (0 to 100; 24 SD)	0 (0 to 0; 0 SD)
Listed species	Percent in USFWS-designated Critical Habitat	1 (0 to 100; 9 SD)	0 (0 to 3; 1 SD)
	Percent in USFWS-mapped essential habitat	21 (0 to 100; 38 SD)	27 (0 to 100; 39 SD)
	Percent in wetland or vernal pool	2 (0 to 95; 10 SD)	1 (0 to 2; 1 SD)
Land Cover	Percent forest and woodland	42 (0 to 97; 38 SD)	57 (1 to 93; 34 SD)
	Percent shrubland, steppe, or savanna	45 (0 to 97; 35 SD)	31 (1 to 80; 32 SD)
	Percent herbaceous	4 (0 to 92; 13 SD)	1 (0 to 12; 3 SD)
	Percent wetland/riparian	6 (0 to 37; 5 SD)	5 (4 to 7; 1 SD)
	Percent open water	0 (0 to 5; 1 SD)	1 (0 to 2; 1 SD)
	Percent developed	0 (0 to 6; 1 SD)	3 (0 to 10; 2 SD)
	Percent cultivated crops	0 (0 to 2; 0 SD)	0 (0 to 2; 1 SD)
	Percent hay/pasture	0 (0 to 2; 0 SD)	1 (0 to 5; 2 SD)
	Percent barren or other	3 (0 to 33; 7 SD)	1 (0 to 5; 1 SD)

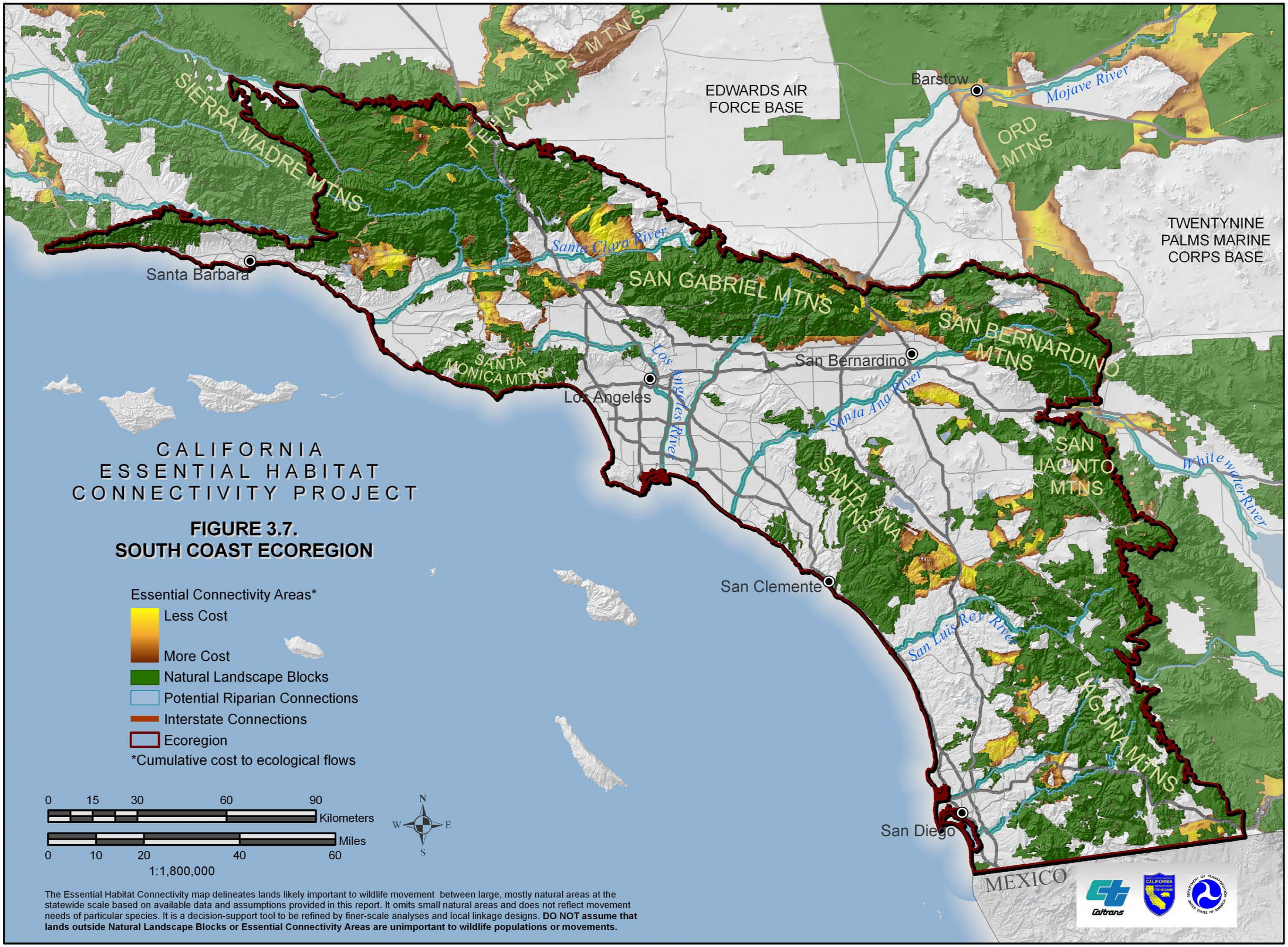
3.2.6. South Coast

The South Coast Ecoregion encompasses roughly 8% of California west of the Sonoran and Mohave deserts and south of the Santa Ynez and Transverse Ranges to the Mexican border. California's most populated ecoregion; it has the dubious distinction of being the most threatened hotspot of biodiversity in the continental United States, with over 400 species of plants and animals considered at risk by government agencies and conservation groups. Despite a human population of over 19 million, the South Coast Ecoregion has many remaining wildland areas, mostly in more rugged mountainous habitats within the Los Padres, Angeles, San Bernardino, and Cleveland National Forests, Santa Monica Mountains National Recreation Area, US Marine Corps Base Camp Pendleton, and several State Parks. It is also one of the most biodiverse regions in the country, with numerous endemic species living in its diverse natural communities, which range from coastal sage scrub and chaparral, to oak and pine woodlands, to desert scrub. These upland communities are punctuated by diverse wetland communities, including vernal pools, estuaries, and riparian scrub and woodlands. In terms of connectivity planning, the South Coast Ecoregion represents a very high-contrast landscape—with most of the conserved blocks in rugged mountainous areas separated by often densely urbanized and agricultural lands on the gentler terrain between them.

The South Coast Ecoregion has 116 Natural Landscape Blocks, including 90 wholly within the ecoregion and 26 shared with adjoining ecoregions. They average only about 23,000 acres and have the lowest average Ecological Integrity Index of any ecoregion, at 52. About 51% of the area within Natural Landscape Blocks is conserved; about 30% is in private, unprotected status; and the balance is mostly in multiple-use federal lands (National Forests and Bureau of Land Management) or military training areas (the largest being US Marine Corps Base Camp Pendleton). About 6% of the area within Natural Landscape Blocks is developed, and about 1% is agriculture. The predominant natural landcovers are shrublands (about 72%; mostly chaparral and coastal sage scrub), herblands (about 10%; mostly annual grasslands), and forests (8%; mostly oak and pine woodlands).

The Natural Landscape Blocks are connected by 27 Essential Connectivity Areas, including 17 wholly within the region and 10 connecting to adjoining ecoregions. As a reflection of the region's large human population, numerous roads, and intensive urbanization, its Essential Connectivity Areas tend to connect Natural Landscape Blocks over less natural landcovers than in any other ecoregion except the Great Central Valley. Only about 82% of the land within Essential Connectivity Areas is in natural landcovers, predominantly shrublands (58% of area). They contain a high level of urban development (12% of area) and a large number of roads (an average of 16 km of major roads and 42 km of secondary roads per Essential Connectivity Area). Consequently, the Essential Connectivity Areas in the South Coast Ecoregion have the lowest average Ecological Condition Index of any ecoregion in the state, at only 26.

Due largely to its high biodiversity and level of habitat loss and fragmentation, the South Coast Ecoregion has arguably experienced more science-based conservation planning, and especially connectivity planning, than any region in the country. It is the birthplace of California's Natural Community Conservation Planning program and has been subject to


CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
FIGURE 3.7.
SOUTH COAST ECOREGION
Essential Connectivity Areas*
Less Cost
More Cost
Natural Landscape Blocks
Potential Riparian Connections
Interstate Connections
Ecoregion
*Cumulative cost to ecological flows
0 15 30 60 90 Kilometers
0 10 20 40 60 Miles
1:1,800,000
N
S
E
W
SIERRA MADRE MTNS
TEHACHAPI MTNS
EDWARDS AIR FORCE BASE
Barstow
Mojave River
ORD MTNS
TWENTYNINE PALMS MARINE CORPS BASE
Santa Barbara
Santa Clara River
SAN GABRIEL MTNS
SAN BERNARDINO MTNS
San Bernardino
SANTA MONICA MTNS
Los Angeles
Los Angeles River
Santa Ana River
SAN JACINTO MTNS
White water River
SANTA ANA MTNS
San Clemente
San Luis Rey River
LAGUNA MTNS
San Diego
MEXICO
Caltrans
The Essential Habitat Connectivity map delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale based on available data and assumptions provided in this report. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.

numerous regional Habitat Conservation Plans/Natural Community Conservation Plans over the past two decades. The ecoregion has been intensively studied at regional and local scales for the effects of habitat fragmentation on natural communities and species, and for approaches to sustaining and restoring ecological connectivity to counter these effects (e.g., Beier 1993, Beier et al. 2006, Bolger et al. 1997, Crooks 2002, Riley et al. 2003, Soule et al. 1988, Vandergast et al. 2008). It has also been the focus of intensive, collaborative habitat connectivity planning over the past decade via the South Coast Missing Linkages Project, which has developed 11 detailed and implementable Linkage Designs using focal-species based analyses (Beier et al. 2006, Luke et al. 2004, Penrod et al. 2003, 2004a, 2004b, 2005a, 2005b, 2005c, 2006a, 2006b, 2006c, 2006d; http://scwildlands.org/reports/). When stitched together, these Linkage Designs form an ecoregional connectivity conservation plan. Ten of the 11 Linkage Designs are being actively implemented by cooperating groups of agencies, non-governmental organizations, and other stakeholders.

The South Coast Missing Linkages approach can serve as an example to be repeated and improved upon in other Ecoregions in California and elsewhere. The statewide Essential Habitat Connectivity Network may correspond with local-scale, focal-species Linkage Designs, showing that it captured 81% of the area within the Linkage Designs of the South Coast Missing Linkages Project (Section 3.3.8). Thus, despite the limitations of the coarse, statewide approach used to develop the Essential Habitat Connectivity Map, the Essential Connectivity Areas appear to represent a reasonable first approximation of those areas likely to be included in local Linkage Designs, at least in such high-contrast landscapes as the South Coast Ecoregion.

In addition to the Linkage Designs in the California portion of the South Coast Ecoregion, there are several potential connections to wildland areas in Baja California, Mexico (not mapped). Cross-border planning with Mexican agencies and non-governmental organizations is happening in these areas via the Las Californias Binational Conservation Initiative[23] However, continued development of border fencing to stem illegal immigration presents a major challenge to cross-border connectivity planning.

Future connectivity conservation efforts in the South Coast Ecoregion should continue focusing on implementing the existing 11 Linkage Designs of the South Coast Missing Linkages Project and developing similar Linkage Designs for other Essential Connectivity Areas. Numerous opportunities also exist for road-crossing improvements in the region. Caltrans is currently evaluating road-crossing improvement as part of transportation projects along Highway 101 near Liberty Canyon and along the 118 freeway near Alamos Canyon in the Santa Monica-Sierra Madre Connection (Penrod et al. 2006a), which have long been identified as critical for maintaining connectivity in the region (Soulé 1989, Sauvajot et al. 2000, Riley et al. 2003, Ng et al. 2004, LSA 2004, Riley et al. 2005, Riley et al. 2006). One location that has been long-proposed as a high priority for construction of a wildlife overpass is across Interstate 15 between the Santa Ana Mountain Range and the Palomar Mountain Range near the Riverside County/San Diego County boundary. This is a critical pinch-point in the Santa Ana-Palomar Linkage Design (Luke et al. 2004)—and also within an Essential Connectivity Area—where mountain lions are frequently killed by vehicles (Beier 1995) and

[23] http://consbio.org/what-we-do/las-californias-binational-conservation-initiative/?searchterm=las%20californias.

numerous biologists and stakeholders determined an overpass structure would facilitate population and genetic connectivity for numerous species between otherwise isolated reserve areas (Luke et al. 2004).

Table 3.7. Mean and standard deviation for metrics in 90 Natural Landscape Blocks and 17 Essential Connectivity Areas wholly within the South Coast Ecoregion. See Table 2.4 for data sources and definitions.

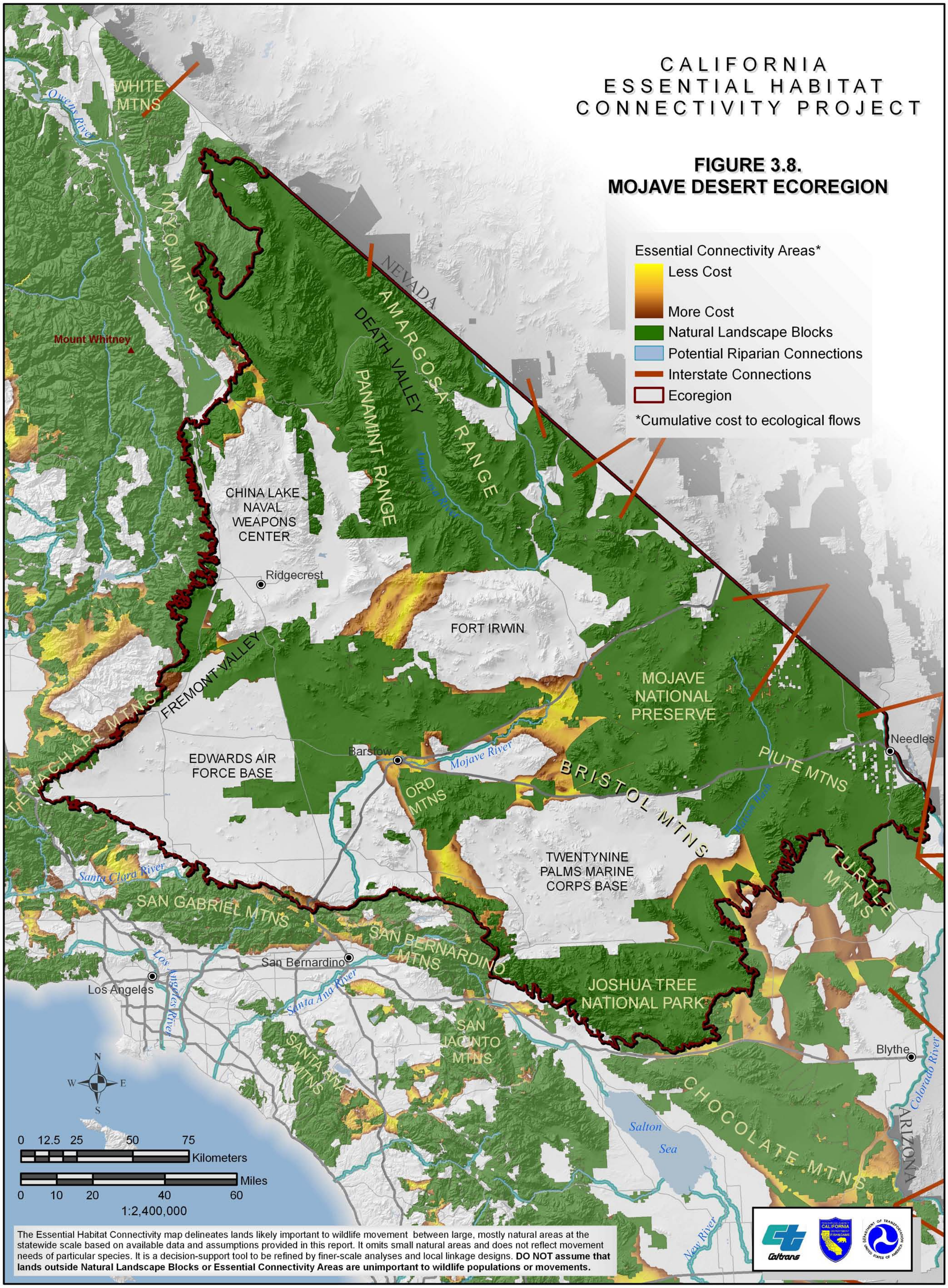
	Descriptor	Mean for 90 Natural Landscape Blocks	Mean for 17 Essential Connectivity Areas
Landform	Elevation (m)	612 (17 to 1,721; 380 SD)	561 (95 to 1,448; 288 SD)
	Elevation range	661 (42 to 2,561; 461 SD)	859 (184 to 1,799; 434 SD)
	Mean Ecological Condition Index	52 (0 to 96; 33 SD)	26 (5 to 51; 14 SD)
	Area in acres	23,400 (2,000 to 437,000; 53,000 SD)	34,000 (4,400 to 119,000; 34,600 SD)
ECA	Shortest straight line within ECA between edges of NLBs (km)	Not applicable	9 (0.1 to 36; 9 SD)
	Length of least cost path within ECA (km)	Not applicable	13 (0.1 to 43; 10 SD)
Protection Status	Percent GAP 1, GAP2, GAP3 or easements	70 (0 to 100; 33 SD)	28 (1 to 81; 26 SD)
	Percent GAP1, GAP2, or easements	51 (0 to 100; 40 SD)	10 (0 to 36; 11 SD)
	Percent in private, unprotected status	30 (0 to 100; 33 SD)	72 (19 to 99; 26 SD)
	Percent of polygon in amphibian, reptile, mammal, or plant rarity hotspot	33 (0 to 100; 43 SD)	44 (0 to 100; 45 SD)
Listed species	Percent in USFWS-designated Critical Habitat	15 (0 to 96; 28 SD)	19 (0 to 54; 17 SD)
	Percent in USFWS-mapped essential habitat	33 (0 to 100; 38 SD)	20 (0 to 77; 24 SD)
	Percent in wetland or vernal pool	1 (0 to 42; 5 SD)	1 (0 to 2; 1 SD)
Land Cover	Percent forest and woodland	8 (0 to 86; 15 SD)	6 (0 to 45; 11 SD)
	Percent shrubland, steppe, or savanna	72 (1 to 93; 20 SD)	58 (4 to 85; 21 SD)
	Percent herbaceous	10 (0 to 42; 9 SD)	15 (4 to 41; 11 SD)
	Percent wetland/riparian	2 (0 to 43; 6 SD)	1 (0 to 3; 1 SD)
	Percent open water	0 (0 to 11; 2 SD)	1 (0 to 4; 1 SD)
	Percent developed	6 (1 to 32; 6 SD)	12 (6 to 19; 4 SD)
	Percent cultivated crops	1 (0 to 25; 4 SD)	5 (0 to 65; 16 SD)
	Percent hay/pasture	0 (0 to 17; 2 SD)	1 (0 to 14; 3 SD)
	Percent barren or other	1 (0 to 12; 1 SD)	1 (0 to 5; 1 SD)

3.2.7. Mojave Desert

The Mojave Desert Ecoregion is a vast arid area in the rain shadow of the southern Sierra Nevada and the Transverse and Peninsular Ranges. It is home to dramatic geological features—including numerous mountain ranges, washes, cliffs, and sand dunes—and is dotted with scattered springs, seeps, and other oases that serve diverse wildlife and endemic plants. Two major riparian corridors—associated with the Amargosa River in the north and the Mojave River in the south—are major arteries of life for the region's diverse wildlife, including a variety of endemic species. However, these and other oases are severely threatened by groundwater pumping, grazing, and other stressors.

The Mojave is 80% managed by federal agencies, and boasts some of the state's largest reserve areas, including Death Valley National Park, Mojave National Preserve, and Joshua Tree National Park. The Bureau of Land Management is the largest land manager in the region, overseeing 8 million acres. The Department of Defense manages five large military bases, which cover about 13% of the ecoregion. Although ecological integrity is severely degraded in portions of these bases due to development and heavy use for military training, other large areas receive little to no use and represent some of the most pristine and intact natural areas in the desert, because they are protected against off-road vehicle use, mining, grazing, and other stressors that have widely degraded habitats on other lands. Most of the 18% of the region that is in unprotected private ownership is concentrated in the western Mojave, which has experienced tremendous urban sprawl and associated habitat loss and fragmentation over recent decades. Highways through the desert are a significant threat to such species as the threatened Mojave desert tortoise (*Gopherus agassizi*). The recent push to greatly increase California's production of renewable energy has also raised concerns that massive solar power developments and associated infrastructure will convert and fragment large areas of native habitat. Sustaining and enhancing habitat connectivity in the face of energy development, urban sprawl, transportation improvements, off-road vehicle use, and other stressors is a major conservation concern in the Mojave. Populations of many of the region's rare and endemic species—such as the desert tortoise, Mohave ground squirrel (*Spermophilus mohavensis*), and desert bighorn sheep (*Ovis canadensis*)—are becoming increasingly isolated from one another, leading to decreased genetic diversity and risk of extirpations.

Due to the large size of existing reserve areas in this ecoregion, relatively few Natural Landscape Blocks and Essential Connectivity Areas were delineated here—although they tend to be very large, ecologically intact, and well-protected (Table 3.8). The ecoregion fully contains 52 Natural Landscape Blocks and shares 27 others with adjacent ecoregions. The Natural Landscape Blocks within the ecoregion have the highest average size (more than 135,000 acres), highest average Ecological Condition Index (89), and highest level of conservation protection (94) of those in any ecoregion. Some Natural Landscape Blocks, such as those associated with the Mojave National Preserve and Death Valley National Park, exceed 1 million acres. The high Ecological Condition Index reflects the region's scarcity of urban and agricultural landcovers and low road density. However, it should be noted that the Ecological Condition Index was unable to reflect such impacts as grazing, mining, invasive plants, and off-road vehicle use, and desert communities are notoriously fragile and slow to recover from such stressors.


CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
FIGURE 3.8.
MOJAVE DESERT ECOREGION
Essential Connectivity Areas*
Less Cost
More Cost
Natural Landscape Blocks
Potential Riparian Connections
Interstate Connections
Ecoregion
*Cumulative cost to ecological flows
WHITE MTNS
INYO MTNS
Mount Whitney
NEVADA
AMARGOSA RANGE
DEATH VALLEY
PANAMINT RANGE
CHINA LAKE NAVAL WEAPONS CENTER
Ridgecrest
FORT IRWIN
FREMONT VALLEY
MOJAVE NATIONAL PRESERVE
TEHACHAPI MTNS
EDWARDS AIR FORCE BASE
Barstow
Mojave River
BRISTOL MTNS
ORD MTNS
PIUTE MTNS
Needles
TWENTYNINE PALMS MARINE CORPS BASE
TURTLE MTNS
Santa Clara River
SAN GABRIEL MTNS
SAN BERNARDINO MTNS
San Bernardino
Los Angeles
Los Angeles River
Santa Ana River
JOSHUA TREE NATIONAL PARK
SAN JACINTO MTNS
SANTA ANA MTNS
Blythe
Colorado River
CHOCOLATE MTNS
ARIZONA
Salton Sea
New River
0 12.5 25 50 75
Kilometers
Miles
0 10 20 40 60
1:2,400,000
The Essential Habitat Connectivity map delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale based on available data and assumptions provided in this report. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.

The five large military bases in the region were almost entirely excluded from the Natural Landscape Blocks, and they represent some of the large "holes" in this Ecoregion's Essential Habitat Connectivity network (Figure 3.8)—despite that large portions of some bases are quite ecologically pristine and support diverse native species. This exclusion occurred because these bases are not considered ecological reserves (i.e., they are in GAP 3 conservation status) and are not included in the data layers used to define High Biological Values (e.g., Critical Habitat or BLM Areas of Critical Environmental Concern)[24]. However, the military has been an active partner in efforts to manage their lands for biological values and to maintain functional ecological connectivity on and across their lands. Ongoing regional and local planning is addressing such issues, and the results should be used to rectify this limitation of the Essential Habitat Connectivity Map.

Similar to the region's Natural Landscape Blocks, Essential Connectivity Areas mapped here average the largest (mean size over 300,000 ac), and best protected (45% in reserve status) of those in any ecoregion, and are second only to the Sonoran Desert Ecoregion in average Ecological Condition Index (80). Again, however, much of the land included within Essential Connectivity Areas is designated multiple-use by the Bureau of Land Management, and subject to such stressors as off-road vehicle use (both legal and unsanctioned), grazing (by livestock as well as feral horses and burros), and mining. Moreover, these Bureau of Land Management lands are under intense pressure for renewable energy development, which could convert and fragment substantial acreages.

There are a number of important conservation and land-use planning efforts already completed or underway in the Mojave Desert Ecoregion, including the California Desert Conservation Area Plan, the Desert Tortoise Recovery Plan, and the Northern, Eastern, and Western Mojave Plans (Bunn et al. 2007). Numerous government agencies, landowners, and conservation non-governmental organizations are very active in wildlife conservation efforts in the region, including the Conservation Fund, The Nature Conservancy, Preserving Wild California, and the interagency Desert Managers Group (See Bunn et al. 2007 for more details). California's Resources Agency, in partnership with other state and federal agencies, also recently initiated the Desert Renewable Energy Conservation Plan (DRECP) to address the impacts of proposed renewable energy developments on rare, Threatened and Endangered Species throughout California's deserts.

Finally, there is also a recently initiated regional connectivity-planning effort—the California Desert Connectivity Project—that is delineating 23 Linkage Designs for 47 target species between wildland blocks throughout California's deserts, using methods similar to those presented in Chapters 4 and 5 of this Report. Unlike this statewide Essential Habitat Connectivity Project, that regional plan specifically targets Gap 3 lands—such as the region's large military bases and Bureau of Land Management holdings—in addition to Gap 1 and 2 reserve areas as potential Natural Wildland Blocks. Thus, landscape blocks and linkages delineated by that finer-scale and evolving regional plan should be used to replace Figure 3.8

[24] Recall that Natural Landscape Blocks were delineated in this region only if they enjoyed high conservation protection (GAP 1 and 2 lands or conservation easements) OR they scored very high (>95) in Ecological Condition Index AND were mapped as having High Biological Value (Section 2.1).

when the results are available. See Section 3.3.10 for a more detailed description of that planning effort.

Table 3.8. Mean and standard deviation for metrics in 52 Natural Landscape Blocks and 7 Essential Connectivity Areas wholly within the Mojave Desert Ecoregion. See Table 2.4 for data sources and definitions.

	Descriptor	Mean for 52 Natural Landscape Blocks	Mean for 7 Essential Connectivity Areas
Landform	Elevation (m)	850 (169 to 1,360; 253 SD)	887 (701 to 1,610; 328 SD)
	Elevation range	879 (83 to 3,442; 752 SD)	1,109 (409 to 1,770; 571 SD)
	Mean Ecological Condition Index	89 (64 to 100; 8 SD)	80 (48 to 96; 17 SD)
	Area in acres	135,400 (2,100 to 1,087,600; 247,800 SD)	312,100 (12,700 to 1,035,600; 389,600 SD)
ECA	Shortest straight line within ECA between edges of NLBs (km)	Not applicable	30 (0.1 to 75; 35 SD)
	Length of least cost path within ECA (km)	Not applicable	38 (0.1 to 89; 41 SD)
Protection Status	Percent GAP 1, GAP2, GAP3 or easements	99 (85 to 100; 2 SD)	87 (53 to 99; 17 SD)
	Percent GAP1, GAP2, or easements	94 (0 to 100; 15 SD)	45 (1 to 92; 33 SD)
	Percent in private, unprotected status	1 (0 to 15 2 SD)	13 (1 to 47; 17 SD)
	Percent of polygon in amphibian, reptile, mammal, or plant rarity hotspot	10 (0 to 100; 25 SD)	1 (0 to 4; 1 SD)
Listed species	Percent in USFWS-designated Critical Habitat	33 (0 to 100; 41 SD)	11 (0 to 32; 12 SD)
	Percent in USFWS-mapped essential habitat	0 (0 to 0; 0 SD)	0 (0 to 0; 0 SD)
	Percent in wetland or vernal pool	0 (0 to 7; 1 SD)	0 (0 to 0; 0 SD)
Land Cover	Percent forest and woodland	0 (0 to 6; 1 SD)	2 (0 to 17; 6 SD)
	Percent shrubland, steppe, or savanna	64 (24 to 100; 20 SD)	58 (24 to 90; 21 SD)
	Percent herbaceous	0 (0 to 12; 2 SD)	0 (0 to 0; 0 SD)
	Percent wetland/riparian	0 (0 to 17; 3 SD)	5 (0 to 26; 9 SD)
	Percent open water	0 (0 to 0; 0 SD)	0 (0 to 0; 0 SD)
	Percent developed	0 (0 to 2; 0 SD)	3 (0 to 11; 4 SD)
	Percent cultivated crops	0 (0 to 1; 0 SD)	0 (0 to 0; 0 SD)
	Percent hay/pasture	0 (0 to 0; 0 SD)	0 (0 to 0; 0 SD)
	Percent barren or other	34 (0 to 74; 20 SD)	32 (7 to 57; 16 SD)

3.2.8. Sonoran Desert

The portion of the Sonoran Desert in California, which is also known as the Colorado Desert, encompasses about 7 million acres between the Peninsular Mountain Range and the Colorado River, south from about Palm Springs, Joshua Tree National Park, and the Turtle Mountains to the Mexican border. This ecoregion differs from the Mojave Desert Ecoregion in being of generally lower elevation, with higher average day-time temperatures, and with two rather than one rainy seasons (whereas nearly all rain in the Mojave falls as gentle winter rains, the Sonoran Desert tends to also receive some late summer rains). This variation makes for a different mix of plant communities (including some endemic communities like fan palm oases), as well as a diverse and somewhat unique fauna. This ecoregion also has several large sand dune systems, including the Algodones Dunes east of Imperial Valley (about 160,000 acres), the Superstition Hills (about 100,000 acres), and the Coachella Valley dunes (once about 64,000 acres, but greatly diminished to only about 8,000 acres due to development that blocks the blowing sands needed to replenish the system). The remaining dune areas provide habitat for a diversity of endemic species that are threatened by off-road vehicle use and disruption of natural sand movements.

The Bureau of Land Management is the region's largest land manager, with about 43% of the ecoregion. Department of Defense lands account for about 7% and Anza-Borrego Desert State Park about 9%. This ecoregion is one of the least populated by humans, with the greatest concentrations of human occupancy and land conversion along the Colorado River in the east and in the Coachella Valley, Imperial Valley, and Borrego Springs in the west. Similar to the Mojave Desert, threats to ecological integrity in the Sonoran include water diversion and ground-water pumping, off-road vehicle use, increasing urbanization (especially in the Coachella Valley and southern Imperial County), renewable energy development, mining, invasive species, and grazing, especially by burros.

The Sonoran Desert Ecoregion has 37 Natural Landscape Blocks, including 25 wholly within the region and 12 shared with other ecoregions. The 25 Natural Landscape Blocks within the ecoregion are on average very large at over 87,400 acres, and they average a very high Ecological Condition Index of 84. However, as in the Mojave, this apparent high level of ecological integrity reflects the paucity of urban and agricultural landcovers and the low number of roads, but it does not account for effects of such stressors as off-road vehicle use, grazing, mining, invasive plants, and disruption of sand-dune replenishment. The Natural Landscape Blocks are primarily in reserves (79%), with only 3% of their area being in private, unprotected status, and the balance mostly being under multiple use management.

The Natural Landscape Blocks are connected by 13 Essential Connectivity Areas, including five wholly contained within the region and eight shared with adjoining regions. The Essential Connectivity Areas are mostly on Bureau of Land Management holdings managed for multiple uses, with only 15% in reserve status and 6% in private, unprotected status. These Essential Connectivity Areas are second only to the Mojave in their average size, at about 119,000 acres, and have the highest Ecological Integrity Index of those in any ecoregion, at 93. The ecoregion is unique in that the Essential Connectivity Areas scored a higher average Ecological Condition Index than the Natural Landscape Blocks they connect, but this could be an artifact of the relatively small sample size and the fact that the Ecological

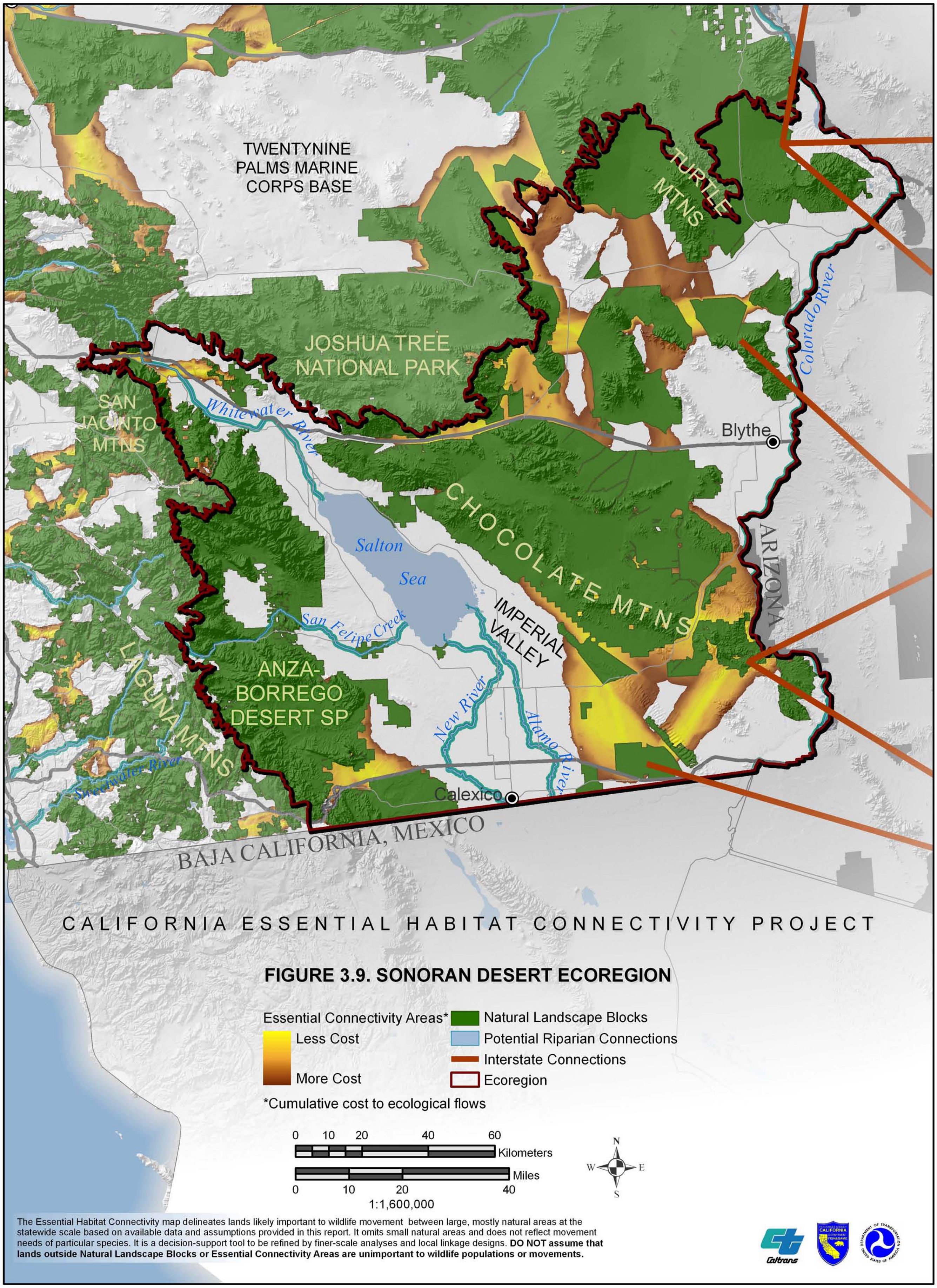


FIGURE 3.9. SONORAN DESERT ECOREGION

Condition Index does not account for the effects of various stressors, like off-road vehicles. Nevertheless, the Sonoran Desert Ecoregion, similar to the Mojave Desert Ecoregion, represents a “low-contrast” landscape for connectivity planning, where the primary focus may be on managing lands in Essential Connectivity Areas for continued compatibility with support of biological resources and landscape permeability to wildlife movement. This focus should include siting renewable energy projects to not block potential wildlife movement corridors (e.g., between mountains occupied by bighorn sheep) or otherwise disrupt ecological flows. Bighorn sheep need to be able to move between subpopulations (or ewe groups) to allow genetic exchange and maintain a viable population structure; and habitat fragmentation can result in genetic isolation and restrict the species’ ability to recolonize if subpopulations are lost (Bunn et al. 2007). Management should also focus on improving road-crossing structures, coupled with roadside fencing designed to keep desert tortoise and other species off roads. As mentioned above, the California Desert Connectivity Project will be developing fine scale Linkage Designs for this ecoregion, which will complement Natural Landscape Blocks and Essential Connectivity Areas identified in Figure 3.9.

Table 3.9. Mean and standard deviation for metrics in 25 Natural Landscape Blocks and 5 Essential Connectivity Areas wholly within the Sonoran Desert Ecoregion. See Table 2.4 for data sources and definitions.

	Descriptor	Mean for 25 Natural Landscape Blocks	Mean for 5 Essential Connectivity Areas
Landform	Elevation (m)	193 (-65 to 410; 147 SD)	152 (41 to 272; 93 SD)
	Elevation range	425 (14 to 1,627; 486 SD)	449 (169 to 678; 214 SD)
	Mean Ecological Condition Index	84 (0 to 100; 26 SD)	93 (87 to 100; 6 SD)
	Area in acres	87,400 (2,100 to 1,125,200; 227,900 SD)	119,000 (6,600 to 217,800; 91,400 SD)
ECA	Shortest straight line within ECA between edges of NLBs (km)	Not applicable	12 (1 to 19; 10 SD)
	Length of least cost path within ECA (km)	Not applicable	15 (1 to 29; 12 SD)
Protection Status	Percent GAP 1, GAP2, GAP3 or easements	97 (86 to 100; 4 SD)	94 (84 to 100; 6 SD)
	Percent GAP1, GAP2, or easements	79 (0 to 100; 34 SD)	15 (0 to 67; 29 SD)
	Percent in private, unprotected status	3 (0 to 14; 4 SD)	6 (0 to 16; 6 SD)
	Percent of polygon in amphibian, reptile, mammal, or plant rarity hotspot	1 (0 to 18; 4 SD)	0 (0 to 2; 1 SD)
Listed species	Percent in USFWS-designated Critical Habitat	31 (0 to 100; 37 SD)	6 (0 to 27; 12 SD)
	Percent in USFWS-mapped essential habitat	4 (0 to 99; 20 SD)	1 (0 to 2; 1 SD)
	Percent in wetland or vernal pool	0 (0 to 2; 0 SD)	0 (0 to 0; 0 SD)
Land Cover	Percent forest and woodland	0 (0 to 2; 0 SD)	0 (0 to 0; 0 SD)
	Percent shrubland, steppe, or savanna	54 (1 to 97; 26 SD)	41 (1 to 88; 34 SD)
	Percent herbaceous	0 (0 to 4; 1 SD)	0 (0 to 0; 0 SD)
	Percent wetland/riparian	15 (0 to 69; 16 SD)	20 (1 to 45; 23 SD)
	Percent open water	1 (0 to 23; 5 SD)	0 (0 to 0; 0 SD)
	Percent developed	0 (0 to 3; 1 SD)	1 (0 to 1; 1 SD)
	Percent cultivated crops	1 (0 to 17; 3 SD)	0 (0 to 1; 0 SD)
	Percent hay/pasture	1 (0 to 22; 4 SD)	0 (0 to 1; 0 SD)
	Percent barren or other	28 (0 to 99; 24 SD)	38 (8 to 98; 35 SD)

3.3. Comparison of the Essential Habitat Connectivity Map to Other Conservation Maps

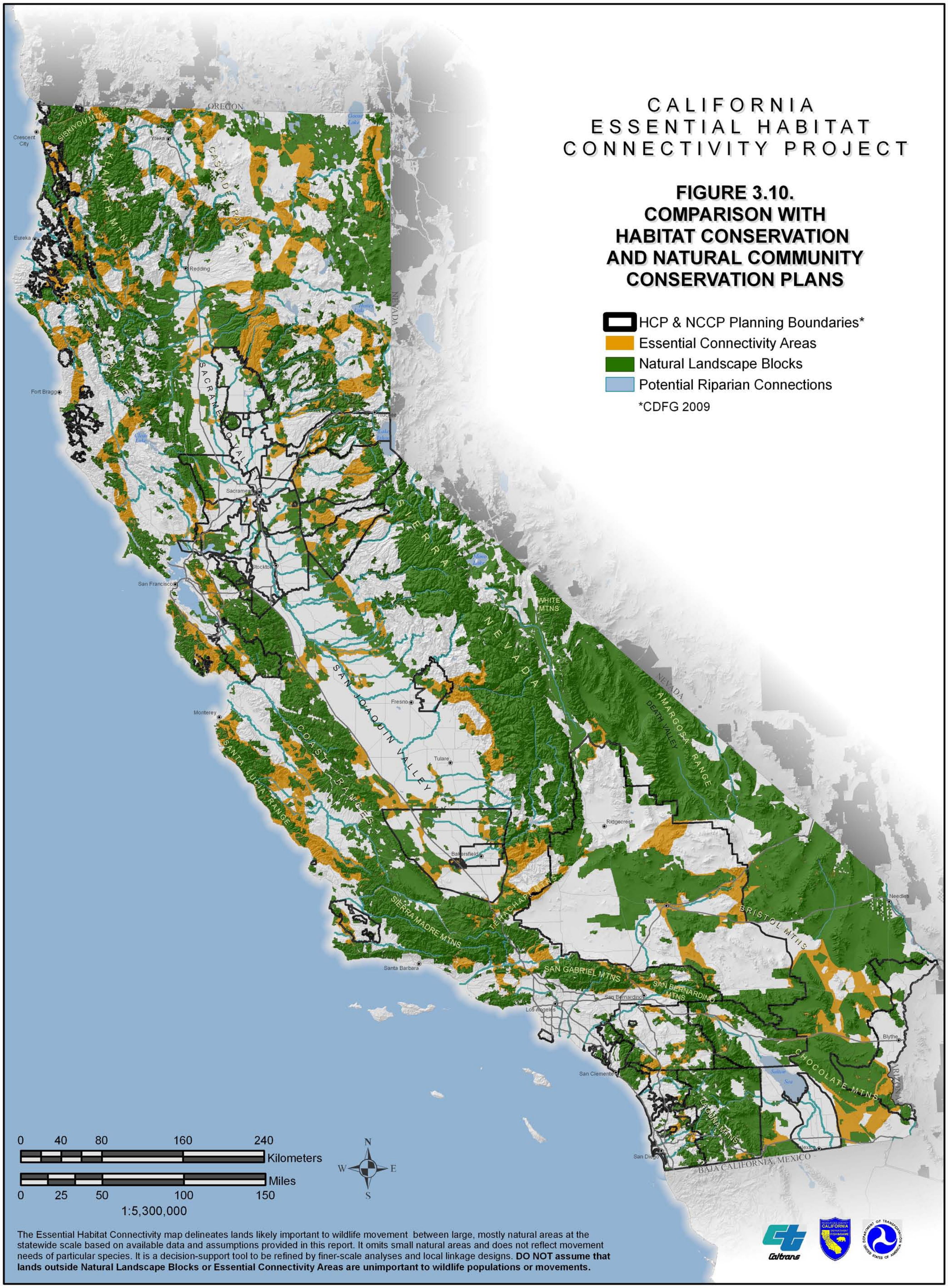
Here we compare the statewide network of Natural Landscape Blocks and Essential Connectivity Areas to relevant maps and data produced by other conservation planning efforts throughout California. This comparison is not exhaustive, but illustrates how the statewide network may complement other planning efforts. This comparison is by its very nature "apples to oranges," such that one should not necessarily expect close correspondence between the Essential Connectivity Map and maps created using different approaches for different objectives. However, where there is concordance between the maps, it reveals potential opportunities for synergistic achievement of conservation goals.

3.3.1. Habitat Conservation and Natural Community Conservation Plans

Habitat Conservation Plans are intended to integrate land-use activities and conservation goals and reduce conflicts between listed species and economic development; they are also required as part of an application for an incidental take permit (i.e., Section 10 (a)(1)(B) of the Endangered Species Act; USFWS 2005). California Department of Fish and Game's Natural Community Conservation Planning program (dfg.ca.gov/habcon/nccp) is an effort by the State to work cooperatively with numerous private and public partners to develop regional or area-wide networks to protect natural ecological communities and their constituent species. The program, which began in 1991 as an experimental program for the South Coast Ecoregion, was later expanded to the entire state with the Natural Community Conservation Planning Act of 2003. It is broader in its orientation and objectives than the California and Federal Endangered Species Acts, which focus on individual species rather than natural communities. While all Natural Community Conservation Plans are also Habitat Conservation Plans, the reverse is not necessarily true.

There are 39 Habitat Conservation Plans throughout the state, 17 which have been approved and are being implemented and 22 that are in the planning stages. Eight of the 17 Habitat Conservation Plans that have been approved and are being implemented are Natural Community Conservation Plans, while 16 of the 22 Habitat Conservation Plans that are in the planning stages are Natural Community Conservation Plans (Figure 3.10). Collectively, the boundaries for these large-scale regional conservation planning efforts cover 28.0 million acres throughout the state.

The California Essential Habitat Connectivity Project network of Natural Landscape Blocks and Essential Connectivity Areas covers 41% of the total area covered by Habitat Conservation Plans and Natural Community Conservation Plans, and only two (Natomas Basin HCP and Palos Verdes Peninsula NCCP/HCP) were not overlapped at all by the network (Table 3.10). The smaller NCCP/HCP planning areas were likely not captured due to the size criteria applied for delineating Natural Landscape Blocks. The relatively low portion (41%) captured by the network is reasonable since this comparison used only the NCCP/HCP planning boundaries, which often encompass large areas of non-habitat. NCCP/HCPs that are currently in the planning phase and future NCCP/HCPs can utilize the



CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
FIGURE 3.10.
COMPARISON WITH
HABITAT CONSERVATION
AND NATURAL COMMUNITY
CONSERVATION PLANS
HCP & NCCP Planning Boundaries*
Essential Connectivity Areas
Natural Landscape Blocks
Potential Riparian Connections
*CDFG 2009
OREGON
Crescent City
Eureka
Redding
Fort Bragg
Sacramento
Stockton
San Francisco
Monterey
Fresno
Tulare
Bakersfield
Ridgecrest
Santa Barbara
Los Angeles
San Bernardino
San Clemente
San Diego
Blythe
Needles
NEVADA
ARIZONA
BAJA CALIFORNIA, MEXICO
SISKIYOU MTNS
CASCADE RANGE
SACRAMENTO VALLEY
SIERRA NEVADA
WHITE MTNS
AMARGOSA RANGE
DEATH VALLEY
SAN JOAQUIN VALLEY
COAST RANGES
SANTA LUCIA RANGE
SIERRA MADRE MTNS
TEHACHAPI MTNS
SAN GABRIEL MTNS
SAN BERNARDINO MTNS
BRISTOL MTNS
CHOCOLATE MTNS
0 40 80 160 240
Kilometers
Miles
0 25 50 100 150
1:5,300,000
N
W
E
S
The Essential Habitat Connectivity map delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale based on available data and assumptions provided in this report. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.
Caltrans

Essential Habitat Connectivity Map and guidelines as a decision-support tool for planning for connectivity within and beyond their planning boundaries.

Table 3.10. Overlap between Natural Landscape Blocks (NLB) and Essential Connectivity Areas (ECA) with Habitat Conservation Plans (HCP) and Natural Community Conservation Plans (NCCP).

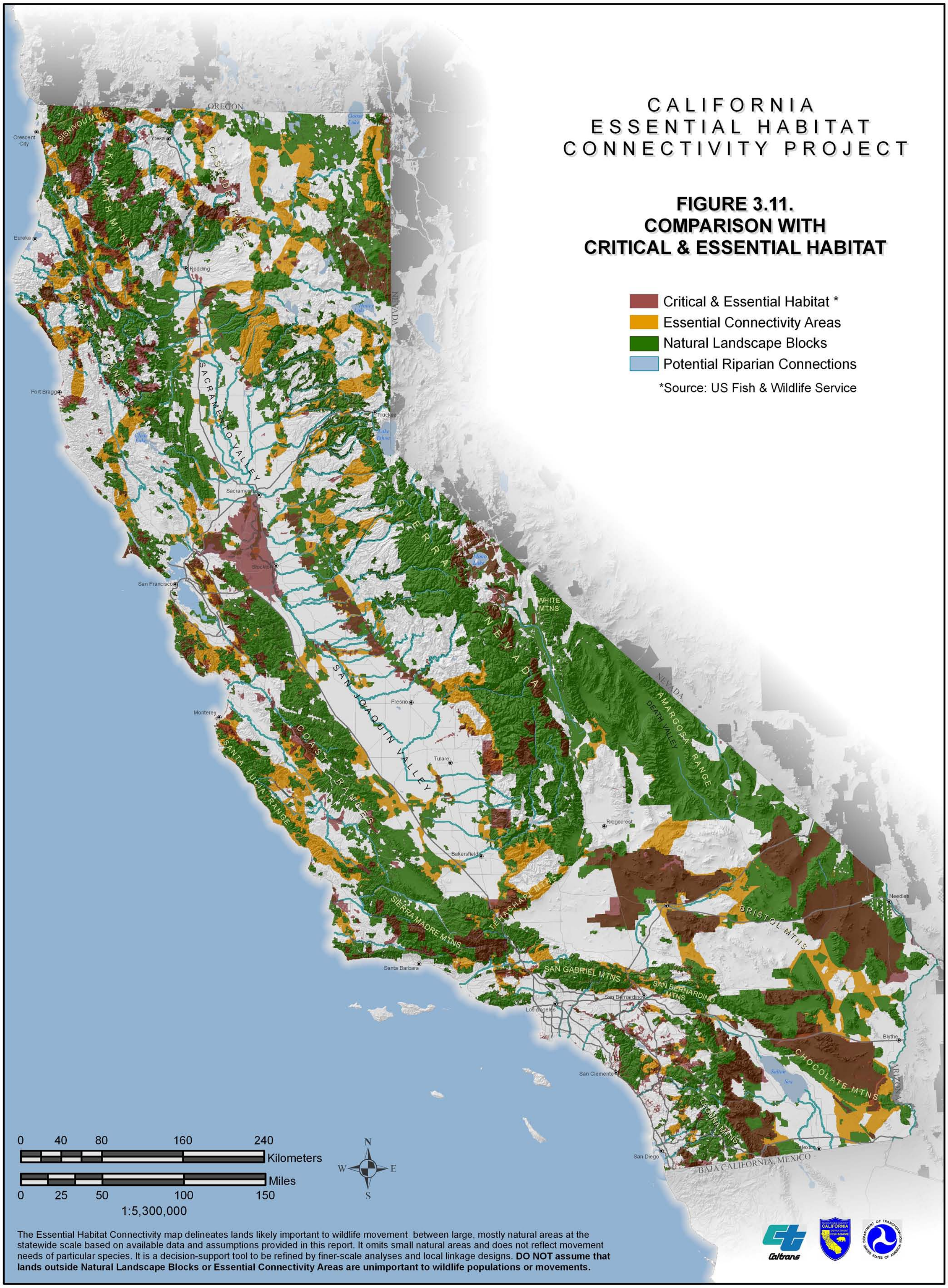
NAME	HCP or NCCP Area (acres)	NLB acres in HCP or NCCP	ECA acres in HCP or NCCP	Percent of HCP/NCCP in NLB/ECA
Altamont Pass Wind Resource Area NCCP/HCP	58,785	37,311	7,116	76%
Bay/Delta Conservation Plan NCCP/HCP	947,105	155,377	63,735	23%
Butte County NCCP/HCP	564,487	107,314	37,712	26%
Calaveras County NCCP/HCP	662,838	253,755	157,419	62%
Central Coastal Orange NCCP/HCP	108,718	58,590	0	54%
Coachella Valley MSHCP NCCP/HCP	1,206,713	696,639	75,379	64%
East Contra Costa County NCCP/HCP	174,042	76,337	0	44%
East Fresno HCP	288,794	68,521	57,302	44%
El Dorado County NCCP/HCP	1,144,943	310,689	222,181	47%
Green Diamond HCP	451,566	68,403	120,614	42%
Humboldt Redwoods Company HCP	200,967	5,867	49,607	28%
Imperial Irrigation District NCCP/HCP	592,481	6,316	8,072	2%
Kern County Valley Floor HCP	1,802,148	441,065	202,441	36%
Kern Water Bank HCP	19,986	977	17,683	93%
Los Osos HCP	3,382	252	436	20%
Lower Colorado River MSCP HCP	1,227,345	576,222	103,533	55%
Mendocino Redwood Company NCCP/HCP	213,435	1,000	7,026	4%
Metropolitan Bakersfield HCP	208,430	13,668	12,282	12%
Natomas Basin HCP	53,158	0	0	0%
Orange County Southern Subregion HCP	124,688	60,829	4	49%
Palos Verdes Península NCCP/HCP	24,815	0	0	0%
Placer County Conservation Plan NCCP/HCP Phase I	244,227	18,296	50,957	28%
Placer County Conservation Plan NCCP/HCP Phase II and III	960,105	287,902	157,680	46%
San Diego E. County MSCP NCCP/HCP	1,538,154	1,203,998	29,596	80%
San Diego MSHCP NCCP/HCP	119,124	3,354	2,624	5%
San Diego MSCP NCCP/HCP	544,505	141,542	42,774	34%
San Diego N.County MSCP NCCP/HCP	353,064	89,849	45,162	38%
San Joaquin County HCP	912,593	145,807	31,428	19%
Santa Barbara Multi-Species HCP	247,530	44,245	31,639	31%
Santa Clara Valley NCCP/HCP	515,217	281,385	91,166	72%
Santa Cruz Sandhills HCP	6,612	1,455	3,951	82%
Solano Multi-Species HCP	582,367	123,155	65,918	32%
South Sacramento HCP	341,314	113,331	36,779	44%
West Mojave Coordinated Management Plan HCP	9,249,223	2,814,589	781,711	39%
Western Riverside MSHCP NCCP/HCP	1,251,450	387,984	139,965	42%
Yolo County Heritage Program NCCP/HCP	653,447	193,206	62,815	39%
Yuba-Sutter NCCP/HCP	445,144	15,510	1,191	4%
Total	**28,042,902**	**8,804,736**	**2,717,900**	**41%**

3.3.2. Critical and Essential Habitat

California has the greatest number of Threatened and Endangered Species in the continental U.S., representing nearly every taxonomic group, from plants and invertebrates to birds, mammals, fish, amphibians, and reptiles (Wilcove et al. 1998). In an analysis that identified "irreplaceable" places for preventing species extinctions (Stein et al. 2000), three out of six of the most important areas in the United States are in California, including the South Coast Ecoregion, San Francisco Bay Area, and Death Valley (along with Hawaii, Southern Appalachians, and the Florida Panhandle). The California Floristic Province, which covers roughly 69% of the state, is one of 25 global hotspots of biodiversity, and the only one in North America (Mittermeier et al. 1998, Mittermeier et al. 1999). As a consequence of habitat conversion to urban and agricultural uses, many areas in the state have become hotspots for species at risk of extinction.

As of December 2, 2009, there were 308 federally listed species in California, including 129 animals and 179 plants (http://ecos.fws.gov). U.S. Fish and Wildlife Service has mapped essential habitat or designated Critical Habitat for 100 of these species, covering a total of 13.5 million acres in Critical Habitat and 1 million acres in essential habitat in California.

A total of 80% of the compiled essential and Critical Habitat was captured within the Essential Habitat Connectivity network of Natural Landscape Blocks (72%; 10.4 million ac) and Essential Connectivity Areas (9%; 1.2 million ac; Figure 3.11). The network captured 50% or more of Critical and or Essential Habitat for 67 of the 100 species, while only 11 species' Critical Habitat was not captured at all by the network (Table 3.11). Many of the species not captured are restricted to very small ranges that occur in highly fragmented urbanized areas, such as the Palos Verdes blue butterfly (*Glaucopsyche lygdamus palosverdensis*), Buena Vista Lake shrew (*Sorex ornatus relictus*), and Ventura Marsh milkvetch (*Astragalus pycnostachyus* var. *lanosissimus*). The network also didn't capture Critical Habitat for two fish, Bonytail chub (*Gila elegans*) and Tidewater goby (*Eucyclogobius newberryi*), which is not surprising given that the Essential Habitat Connectivity Map is focused on terrestrial connectivity.



CALIFORNIA ESSENTIAL HABITAT CONNECTIVITY PROJECT
FIGURE 3.11.
COMPARISON WITH CRITICAL & ESSENTIAL HABITAT
Critical & Essential Habitat *
Essential Connectivity Areas
Natural Landscape Blocks
Potential Riparian Connections
*Source: US Fish & Wildlife Service
OREGON
NEVADA
ARIZONA
BAJA CALIFORNIA, MEXICO
SISKIYOU MTNS
KLAMATH MTNS
CASCADE RANGE
COAST RANGES
SACRAMENTO VALLEY
SIERRA NEVADA
WHITE MTNS
AMARGOSA RANGE
DEATH VALLEY
SAN JOAQUIN VALLEY
SANTA LUCIA RANGE
TEHACHAPI MTNS
SIERRA MADRE MTNS
SAN GABRIEL MTNS
SAN BERNARDINO MTNS
BRISTOL MTNS
CHOCOLATE MTNS
Crescent City
Yreka
Eureka
Redding
Fort Bragg
Truckee
Sacramento
Stockton
San Francisco
Monterey
Fresno
Tulare
Ridgecrest
Bakersfield
Barstow
Needles
Santa Barbara
Los Angeles
San Bernardino
Blythe
San Clemente
San Diego
Calexico
0 40 80 160 240 Kilometers
0 25 50 100 150 Miles
1:5,300,000
N
S
E
W
The Essential Habitat Connectivity map delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale based on available data and assumptions provided in this report. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. **DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.**
Caltrans

Table 3.11. Overlap between Essential Habitat Connectivity Map and Critical and essential habitat by species.[25]

Common Name (*Latin Name*)	**Total Critical and or essential Habitat (acres)**	**Acres Critical or essential habitat in NLBs**	**Acres Critical or essential habitat in ECAs**	**Percent Critical or essential habitat covered by NLB or ECA**
Amargosa Vole (*Microtus californicus scirpensis*)	4,487	4,180	0	93%
Buena Vista Lake Shrew (*Sorex ornatus relictus*)	84	0	0	0%
Fresno Kangaroo Rat (*Dipodomys nitratoides exilis*)	902	0	0	0%
Morro Bay Kangaroo Rat *(Dipodomys heermanni morroensis*)	680	526	0	77%
Peninsular Bighorn Sheep (*Ovis canadensis*)	817,240	767,598	16,996	96%
San Bernardino Kangaroo Rat (*Dipodomys merriami parvus*)	33,317	4,978	10,148	45%
Sierra Nevada Bighorn Sheep *(Ovis canadensis sierrae)*	417,769	412,980	0	99%
California Condor (*Gymnogyps californianus*)	605,171	451,262	81,080	88%
Coastal California Gnatcatcher (*Polioptila californica californica*)	372,667	110,675	58,710	45%
Greater Sage-Grouse (*Centrocercus urophasianus*)	904,283	752,351	9,085	84%
Inyo California towhee (*Pipilo crissalis eremophilus*)	2,169	1,186	0	55%
Least Bell's Vireo (*Vireo bellii pusillus*)	36,988	15,755	3,856	53%
Marbled Murrelet (*Brachyramphus marmoratus*)	741,392	429,204	127,133	75%
Northern Spotted Owl (*Strix occidentalis caurina*)	1,542,861	653,301	356,992	65%
Southwestern Willow Flycatcher (*Empidonax trailii extimus*)	17,212	3,936	2,185	36%
Western Snowy Plover (*Charadrius alexandrinus nivosus*)	7,272	961	2	13%
Alameda Whipsnake (*Masticophis lateralis euryxanthus*)	154,924	108,274	31,444	90%
Arroyo Toad (*Bufo californicus*)	104,720	56,035	9,808	63%
California Red-legged Frog (*Rana aurora draytonii*)	450,177	318,763	54,365	83%
California Tiger Salamander (*Ambystoma californiense*)	210,245	136,618	14,574	72%
Coachella Valley Fringe-toed Lizard (*Uma inornata*)	11,797	9,163	1,623	91%
Desert Tortoise (*Gopherus agassizii*)	4,761,055	4,499,136	103,172	97%
Mountain Yellow-legged Frog (*Rana muscosa*)	8,289	7,868	350	99%
Bonytail Chub (*Gila elegans*)	9,419	0	0	0%

[25] Acres reflect Final Critical Habitat for most species, both essential and Final Critical Habitat for nine species (arroyo toad, tidewater goby, San Diego fairy shrimp, California taraxacum, San Bernardino bluegrass, San Diego thornmint, Santa Ana sucker, spreading navarretia, and thread-leaved brodiaea) and essential habitat for two species (Vail Lake ceanothus and greater sage-grouse).

Delta Smelt (*Hypomesus transpacificus*)	819,293	104,756	45,118	18%
Desert Pupfish (*Cyprinodon macularius*)	770	527	0	68%
Little Kern Golden Trout (*Oncorhynchus aguabonita whitei*)	82,334	82,309	25	100%
Owens Tui Chub (*Gila bicolor snyderi*)	115	89	0	78%
Razorback Sucker (*Xyrauchen texanus*)	5,720	156	300	8%
Santa Ana Sucker (*Catostomus santaanae*)	23,736	10,615	555	47%
Tidewater Goby (*Eucyclogobius newberryi*)	1,589	20	0	1%
Bay Checkerspot Butterfly (*Euphydryas editha bayensis*)	23,923	6,7766	15,370	93%
Conservancy fairy shrimp (*Branchinecta conservatio*)	161,627	121,653	14,548	84%
Delta green ground beetle (*Elaphrus viridis*)	1,077	743	0	69%
Laguna Mountains Skipper (*Pyrgus ruralis lagunae*)	6,259	4,035	395	71%
Longhorn fairy shrimp (*Branchinecta longiantenna*)	13,547	4,432	58	33%
Morro shoulderband snail (*Helminthoglypta walkeriana*)	2,566	1,149	124	50%
Palos Verdes blue butterfly (*Glaucopsyche lygdamus palosverdensis*)	91	0	0	0%
Quino checkerspot butterfly (*Euphydryas editha quino*)	171,764	89,779	17,991	63%
Riverside fairy shrimp (*Streptocephalus woottoni*)	307	39	232	88%
San Diego fairy shrimp (*Branchinecta sandiegonensis*)	13,146	6,020	200	47%
Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*)	515	460	0	89%
Vernal pool fairy shrimp (*Branchinecta lynchi*)	590,004	336,494	81,075	71%
Vernal pool tadpole shrimp (*Lepidurus packardi*)	228,783	145,684	39,011	81%
Zayante band-winged grasshopper (*Trimerotropis infantilis*)	11,140	1,462	8,176	87%
Amargosa niterwort (*Nitrophila mohavensis*)	1216	0	0	0%
Antioch Dunes evening primrose (*Oenothera deltoides* ssp. *Howellii*)	305	0	0	0%
Ash Meadows gumplant (*Grindelia fraxinopratensis*)	295	0	0	0%
Ash-gray indian paintbrush (*Castilleja cinerea*)	1,768	803	487.57	73%
Baker's larkspur (*Delphinium bakeri*)	1,831	881	797.46	92%
Bear valley sandwort (*Arenaria ursina*)	1,412	471	465.03	66%
Braunton's milk-vetch (*Astragalus brauntonii*)	3,299	2,548	458.63	91%
Butte County meadowfoam (*Limnanthes floccosa* ssp. *Californica*)	16,644	7,251	238.55	45%
California taraxacum (*Taraxacum californicum*)	1,956	541	459.25	51%
Colusa grass (*Neostapfia colusana*)	152,033	114,989	16,873.63	87%
Contra costa goldfields (*Lasthenia conjugens*)	14,739	4,083	1,579.05	38%
Contra costa wallflower (*Erysimum capitatum* var. *angustatum*)	305	0	0	0%
Cushenbury buckwheat (*Eriogonum ovalifolium* var. *vineum*)	6,959	4,858	1,086	85%

Cushenbury milk-vetch (*Astragalus albens*)	4,370	3,411	787	96%
Cushenbury oxytheca (*Oxytheca parishii* var. *goodmaniana*)	3,153	2,315	283	82%
Fish slough milk-vetch (*Astragalus lentiginosus* var. *piscinensis*)	8,084	7,849	0	97%
Fleshy owl's-clover (*Castilleja campestris* ssp. *succulenta*)	175,745	122,399	11,557	76%
Gaviota tarplant (*Deinandra increscens* ssp. *Villosa*)	9,679	7,363	0	76%
Greene's tuctoria (*Tuctoria greenei*)	145,051	106,152	16,176	84%
Hairy orcutt grass (*Orcuttia pilosa*)	79,557	56,031	3,525	75%
Hoover's spurge (*Chamaesyce hooveri*)	114,637	79,422	22,859	89%
Keck's checker-mallow (*Sidalcea keckii*)	1,081	704	16	67%
Kneeland Prairie penny-cress (*Thlaspi californicum*)	74	0	0	0%
La Graciosa thistle (*Cirsium loncholepis*)	41,070	8,947	0	22%
Large-flowered fiddleneck (*Amsinckia grandiflora*)	160	152	0	95%
Lompoc yerba santa (*Eriodictyon capitatum*)	6,397	4,063	0	64%
Lyon's pentachaeta (*Pentachaeta lyonii*)	3,579	2,492	471	83%
Mexican flannelbush (*Fremontodendron mexicanum*)	228	228	0	100%
Monterey spineflower (*Chorizanthe pungens* var. *pungens*)	18,949	2,410	7,122	50%
Munz's onion (*Allium munzii*)	1,245	648	17	53%
Nevin's Barberry (*Berberis nevinii*)	5	5	0	100%
Otay tarplant (*Deinandra conjugens*)	6,333	2,870	0	45%
Parish's daisy (*Erigeron parishii*)	4,424	2,744	1,108	87%
Peirson's milk-vetch (*Astragalus magdelanae* var. *peirsonii*)	21,864	21,193	543	99%
Purple amole (*Chlorogalum purpureum*)	1,530	0	758	50%
Robust spineflower (*Chorizanthe robusta* var. *robusta*)	469	157	11	36%
Sacramento orcutt grass (*Orcuttia viscida*)	33,277	29,549	1,611	94%
San Bernadino Mountains bladderpod (*Lesquerella kingii* ssp. *Bernardina*)	1,026	478	0	47%
San Bernardino bluegrass (*Poa atropurpurea*)	2,531	979	397	54%
San Diego thornmint (*Acanthomintha ilicifolia*)	1,749	800	310	63%
San Joaquin orcutt grass (*Orcuttia inaequalis*)	136,188	76,686	17,518	69%
Santa Cruz tarplant (*Holocarpha macradenia*)	2,902	295	70	13%
Scott's Valley polygonum (*Polygonum hickmanii*)	288	0	288	100%
Slender orcutt grass (*Orcuttia tenuis*)	94,265	49,274	15,728	69%
Soft-bird's beak (*Cordylanthus mollis* ssp. *mollis*)	2,292	1,384	703	91%
Solano grass (*Tuctoria mucronata*)	440	0	0	0%
Southern mountain wild buckwheat (*Eriogonum kennedyi* var. *austromontanum*)	903	130	319	50%
Spreading navarretia (*Navarretia fossalis*)	14,273	3,036	2,864	41%
Suisun thistle (*Cirsium hydrophilum* var. *hydrophilum*)	2,120	1,662	454	99.8%
Thread-leaved brodiaea (*Brodiaea filifolia*)	6,403	3,537	193	58%

Vail Lake ceanothus (*Ceanothus ophiochilus*)	198	198	0	100%
Ventura marsh milk-vetch (*Astragalus pycnostachyus* var. *lanosissimus*)	426	0	0	0%
Willowy monardella (*Monardella linoides* ssp. *viminea*)	73	0	73	100%
Yadon's piperia (*Piperia yadonii*)	2,169	191	215	19%
Yellow larkspur (*Delphinium luteum*)	2,521	750	1,673	96%

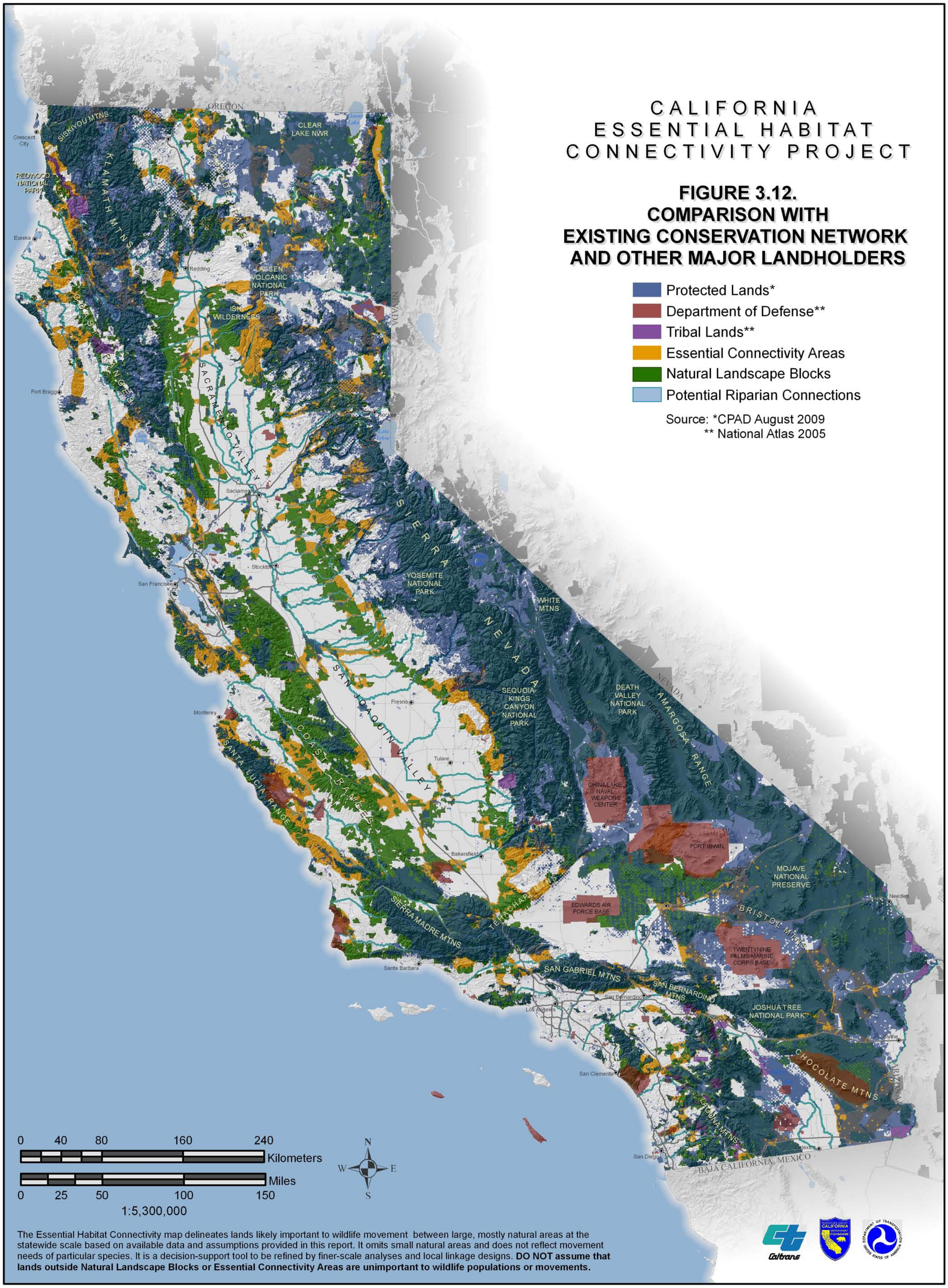
3.3.3. Existing Conservation Network and other Major Landholders

Significant conservation investments have been made throughout the State of California. As of August 27, 2009, the California Protected Areas Database included 48.7 million acres of protected lands in fee ownership by public agencies and non-profits in the state held (GreenInfo Network 2009a). Other major lands contributing in varying degrees to the state's conservation network include 4.1 million acres administered by the Department of Defense and 0.7 million acres owned by Native American tribes.

Roughly 76% of the protected lands in the California Protected Areas Database were captured by the Essential Habitat Connectivity Map's network of Natural Landscape Blocks (67% or 32.6 million acres) and Essential Connectivity Areas (9% or 4.5 million acres; Table 3.12 and Figure 3.12). The network captured almost all (99.6%) National Park Service lands, 91% of conservation lands administered by non-governmental organizations, 80% of California Department of Parks and Recreation lands, and 80% of various county lands. The network also captured 31% of lands administered by the Department of Defense and 34% of land owned by Native American tribes (Table 3.12).

Table 3.12. Overlap between Essential Habitat Connectivity Map and ownership of various land management agencies.

Land Management Agency	Total Acres	Overlap by Network (acres)	Percent
US Forest Service	20,503,618	14,965,074	73%
US Bureau of Land Management	15,031,297	10,640,318	71%
National Park Service	7,487,770	7,456,417	99.6%
California Department of Parks and Recreation	1,444,053	1,239,620	86%
US Fish and Wildlife Service	332,841	218,182	66%
California Department of Fish and Game	624,826	435,594	70%
US Bureau of Reclamation	176,301	26,742	15%
US Army Corps of Engineers	47,404	20,858	44%
Non Governmental Organization	577,942	523,423	91%
Other Federal	8,847	5,811	66%
Other State	854,550	541,537	63%
Special District	553,778	330,071	60%
City	692,581	496,730	72%
County	309,300	248,284	80%
Unknown	4,815	1,793	37%
Totals	**48,649,923**	**37,150,455**	**76%**


CALIFORNIA ESSENTIAL HABITAT CONNECTIVITY PROJECT
FIGURE 3.12.
COMPARISON WITH EXISTING CONSERVATION NETWORK AND OTHER MAJOR LANDHOLDERS
Protected Lands*
Department of Defense**
Tribal Lands**
Essential Connectivity Areas
Natural Landscape Blocks
Potential Riparian Connections
Source: *CPAD August 2009
** National Atlas 2005
OREGON
NEVADA
ARIZONA
BAJA CALIFORNIA, MEXICO
CLEAR LAKE NWR
SISKIYOU MTNS
KLAMATH MTNS
REDWOOD NATIONAL PARK
LASSEN VOLCANIC NATIONAL PARK
ISHI WILDERNESS
SACRAMENTO VALLEY
SIERRA NEVADA
YOSEMITE NATIONAL PARK
WHITE MTNS
SEQUOIA KINGS CANYON NATIONAL PARK
DEATH VALLEY NATIONAL PARK
AMARGOSA RANGE
CHINA LAKE NAVAL WEAPONS CENTER
FORT IRWIN
MOJAVE NATIONAL PRESERVE
EDWARDS AIR FORCE BASE
BRISTOL MTNS
TWENTYNINE PALMS MARINE CORPS BASE
JOSHUA TREE NATIONAL PARK
CHOCOLATE MTNS
SAN JOAQUIN VALLEY
COAST RANGES
SANTA LUCIA RANGE
SIERRA MADRE MTNS
TEHACHAPI MTNS
SAN GABRIEL MTNS
SAN BERNARDINO MTNS
Crescent City
Eureka
Redding
Fort Bragg
Sacramento
Stockton
San Francisco
Monterey
Fresno
Tulare
Bakersfield
Santa Barbara
Los Angeles
San Bernardino
San Clemente
San Diego
Needles
0 40 80 160 240 Kilometers
0 25 50 100 150 Miles
1:5,300,000
N S E W
The Essential Habitat Connectivity map delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale based on available data and assumptions provided in this report. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.
Caltrans

3.3.4. 2001 California Missing Linkages Project

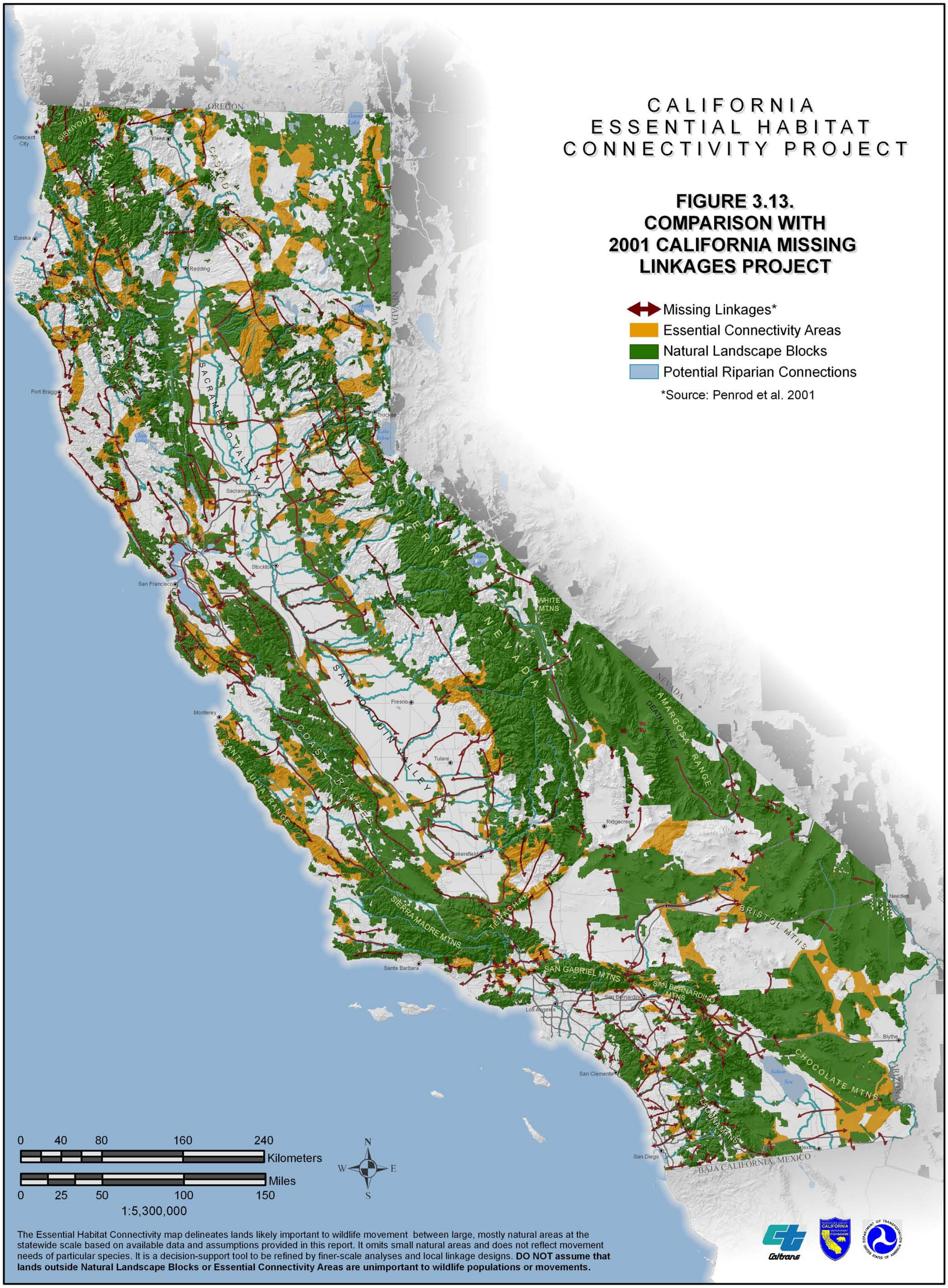
In 2000, the California-wide Missing Linkages Conference brought together land managers and planners, conservationists, and scientists from each ecoregion in the state to identify the location of, and threats to, the most important movement corridors for California's wildlife (Penrod et al. 2001). This one-day forum included breakout sessions by ecoregion where participants shared their knowledge by marking the locations of important movement corridors throughout the state on ecoregional maps. Over 160 scientists, conservationists, land managers, and planners identified 232 linkages, each represented by a placeholder arrow.

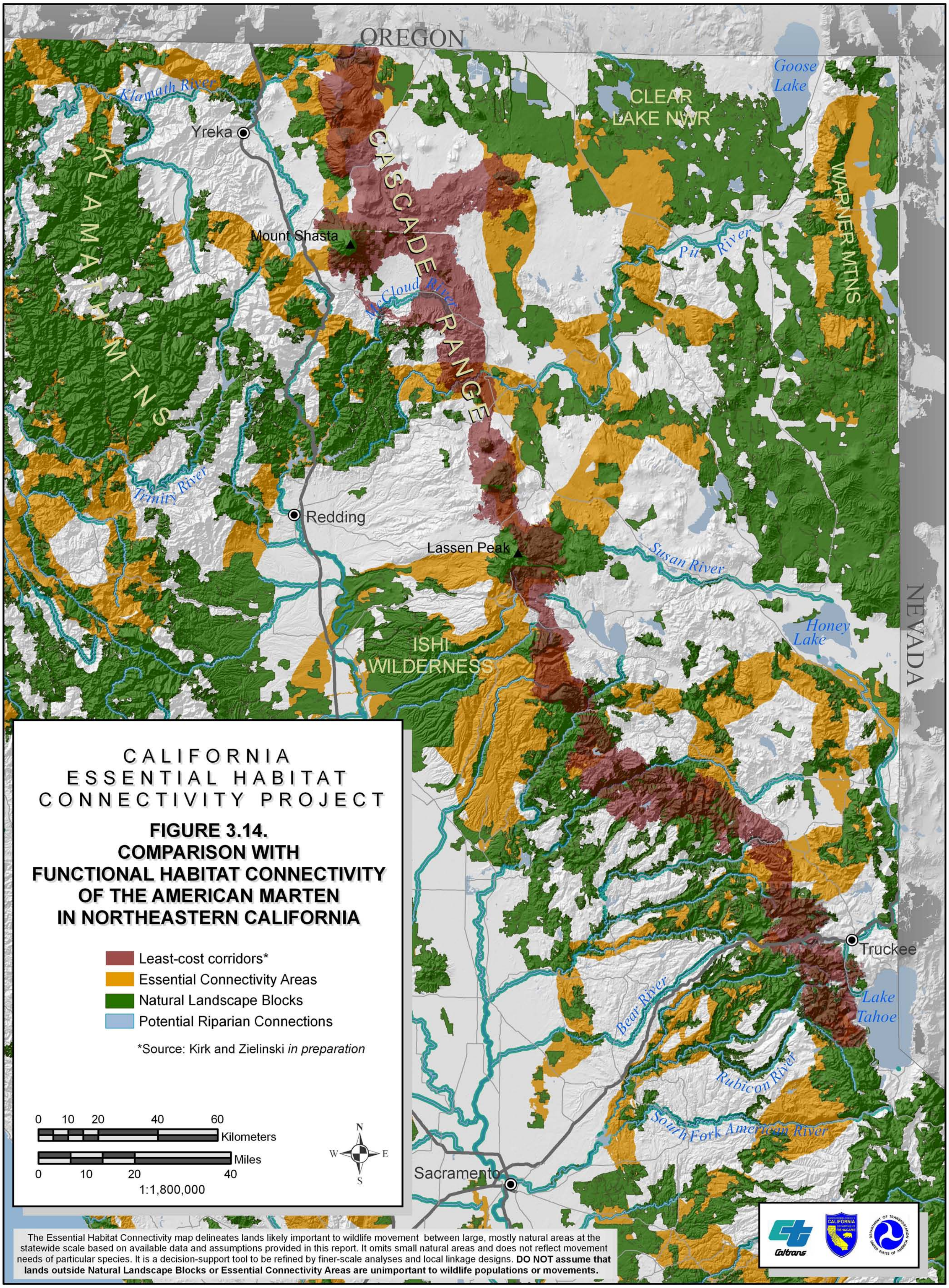
Many of the statewide Missing Linkages arrows were not captured by the Essential Habitat Connectivity Map (Figure 3.13). Most of the arrows were drawn between protected areas, which do not necessarily correspond with Natural Landscape Blocks based on ecological condition and other biological modifiers. Many other arrows were drawn across transportation barriers and are addressed as Road Fragmentations rather than Essential Connectivity Areas. In addition, several of the arrows are truly "Missing Linkages" where extensive restoration would be needed to re-establish connectivity function.

3.3.5. Functional Habitat Connectivity of the American Marten in Northeastern California

Kirk and Zielinski (in preparation) evaluated habitat connectivity for the American marten (*Martes americana*) by assessing the structural and functional aspects of the landscape as they affect marten movements within a typical home range and potential dispersal distances of juvenile martens. Structural connectivity was evaluated using a regional-scale GIS model of reproductive habitat (Kirk 2007). Functional connectivity was assessed using least-cost corridor modeling between seven targeted endpoints known to serve as core habitat for the marten. The analyses produced six least-cost corridors which serve to sequentially connect from the Oregon border to Mt. Shasta Wilderness, to Thousand Lakes Wilderness, to Lassen National Park Wilderness, to Bucks Lake Wilderness, to Lakes Basin Plumas National Forest, to Desolation Wilderness. The six least-cost corridors were delineated for marten using the top 25% permeability slice.

Approximately 53% of the total area delineated by the least-cost corridors for marten (Kirk and Zielinski *in preparation*) was captured by the California Essential Habitat Connectivity Project's network of Natural Landscape Blocks (29% or 471,232 acres) and Essential Connectivity Areas (23% or 375,798 acres; Figure 3.14). The network captured 50% or more of four of the six least-cost corridors delineated for marten (Table 3.13). While the Essential Connectivity Map captured all of the targeted Wilderness Areas in Natural Landscape Blocks and the majority of least-cost corridors south of the Thousand Lakes Wilderness, the least-cost corridor between Mt. Shasta Wilderness and Thousand Lakes Wilderness was not well addressed by the network. This is likely due to the long span of Shasta National Forest crossed by the marten linkage that lacks large protected areas that would qualify as Natural Landscape Blocks. In addition, because the marten prefers dense, higher-elevation forests, the species-based model is biased toward least-cost corridors following or connecting higher elevation ridges and peaks, whereas our least-cost corridors tend to follow the shortest routes having natural landcover, regardless of elevation or the type


CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
FIGURE 3.13.
COMPARISON WITH
2001 CALIFORNIA MISSING
LINKAGES PROJECT
Missing Linkages*
Essential Connectivity Areas
Natural Landscape Blocks
Potential Riparian Connections
*Source: Penrod et al. 2001
0 40 80 160 240
Kilometers
Miles
0 25 50 100 150
1:5,300,000
N
W
E
S
The Essential Habitat Connectivity map delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale based on available data and assumptions provided in this report. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.


OREGON
NEVADA
Klamath River
Yreka
KLAMATH MTNS
CASCADE RANGE
Mount Shasta
McCloud River
CLEAR LAKE NWR
Goose Lake
WARNER MTNS
Pit River
Trinity River
Redding
Lassen Peak
Susan River
Honey Lake
ISHI WILDERNESS
Truckee
Lake Tahoe
Bear River
Rubicon River
South Fork American River
Sacramento
CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
FIGURE 3.14.
COMPARISON WITH
FUNCTIONAL HABITAT CONNECTIVITY
OF THE AMERICAN MARTEN
IN NORTHEASTERN CALIFORNIA
Least-cost corridors*
Essential Connectivity Areas
Natural Landscape Blocks
Potential Riparian Connections
*Source: Kirk and Zielinski in preparation
0 10 20 40 60 Kilometers
Miles 0 10 20 40
1:1,800,000
N W E S
The Essential Habitat Connectivity map delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale based on available data and assumptions provided in this report. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.
Caltrans

of natural landcover. Hence our Essential Connectivity Network likely includes more shrubland and woodland communities at lower elevation, on average, than would be selected by martens.

Table 3.13. Overlap between Essential Habitat Connectivity Map and American marten connectivity areas in northeastern California (Kirk and Zielinski, in preparation).

Marten Connections	Marten LCC (acres)	NLB Overlap (acres)	ECA Overlap (acres)	Network Overlap (acres)	Percent
Oregon Border - Mt. Shasta Wilderness	439,442	46,655	153,991	200,646	46%
Mt. Shasta Wilderness - Thousand Lakes Wilderness	385,734	58,844	52,115	110,960	29%
Thousand Lakes Wilderness - Lassen Natl. Park Wilderness	86,794	49,584	18,261	67,844	78%
Lassen Natl. Park Wilderness - Bucks Lake Wilderness	146,777	56,841	57,883	114,724	78%
Bucks Lake Wilderness - Lakes Basin Plumas Natl. Forest	333,910	140,155	68,010	208,165	62%
Lakes Basin Plumas Natl. Forest - Desolation Wilderness	207,631	119,154	25,538	144,691	70%
Total	**1,600,290**	**471,232**	**375,798**	**847,030**	**53%**

3.3.6. Wildlands Conservation in the Central Coast Region of California

The Guide to Conservation for the Central Coast Region of California (Thorne et al. 2002) presents a network of core habitat areas and habitat linkages that were developed based on the needs of three mammal focal species: mountain lion (*Puma concolor*), San Joaquin kit fox (*Vulpes macrotis mutica*), and pronghorn antelope (*Antilocapra americana*). This network forms the connective terrestrial backbone of the Wildlands Conservation Plan for the Central Coast Ecoregion (Thorne et al. 2002), while aquatic habitat needs were addressed by identifying strategies for long-term restoration of steelhead trout (*Oncorhynchus mykiss*) populations.

The framework for developing the Wildlands Conservation Plan is based on the preferred habitat of the four focal species and involved three major steps (Thorne et al. 2002): (1) delineate a conservation network based on the habitat and spatial requirements for the three mammal species, which together use a majority of habitat types in the region; (2) assess how the resulting Mammal Network overlaps with the target areas identified for the conservation and restoration of steelhead habitat; and (3) conduct representation analyses to evaluate how well the Mammal Network captures elements of biodiversity in the region, including oaks, important bird habitats, The Nature Conservancy portfolio sites, serpentine geology, old-growth redwoods, and California red-legged frog (*Rana aurora draytonii*) and tiger salamander (*Ambystoma tigrinum*) populations.

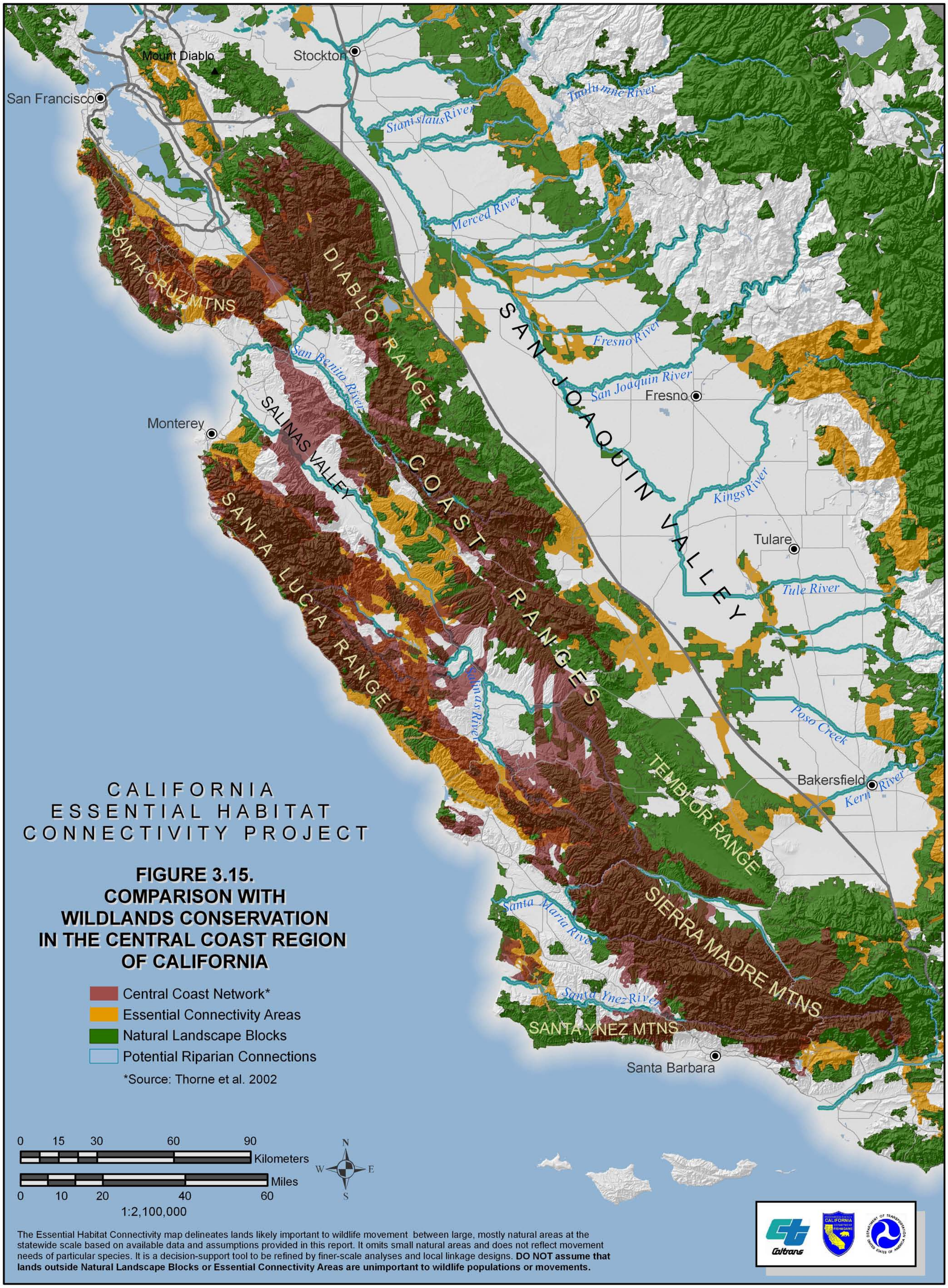
The resulting network identified roughly 68% (5.4 million acres) of the region as potential core habitat areas and habitat linkages that should be further evaluated for their conservation value (Thorne et al. 2002). The targeted biodiversity elements were well-represented in the proposed network: oak communities (75-92% for five species), The Nature Conservancy portfolio sites (73%), serpentine rock (82%), old-growth redwoods (91%), coastal sage/chaparral (92%), and non-native grasslands (77%), red-legged frogs (50%) and California tiger salamanders (53%).

Roughly 84% of the Central Coast Network (Thorne et al. 2002) was captured by the Essential Habitat Connectivity Map's network of Natural Landscape Blocks (70% or 3.8 million ac) and Essential Connectivity Areas (14% or 747,603 ac; Figure 3.15). However, a few of the habitat linkages identified by Thorne et al. (2002) were not captured, which emphasizes the need for focal-species analyses (see Chapter 5). Key connections that were not captured by the network include the Santa Cruz Mountains to the Gabilan Range and connections to the Santa Lucia Range through the Salinas Valley.

3.3.7. A Potential Regional Conservation Network for the Central Valley Ecoregion

Huber et al. (2010) developed a potential regional conservation network for the Central Valley using the MARXAN reserve selection algorithm and least-cost corridor analysis. Conservation targets used to develop the network included seven focal species and one ecological community: tule elk (*Cervus elaphus nannodes*), pronghorn antelope, bobcat (*Lynx rufus*), San Joaquin kit fox, giant garter snake (*Thamnophis gigas*), western yellow-billed cuckoo (*Coccyzus americanus occidentalis*), and Swainson's hawk (*Buteo swainsoni*), and vernal pool community complexes (Huber 2008). In order to assemble a conservation network in this region, where the remaining natural areas are primarily small and highly fragmented remnants surrounded by an agricultural matrix, significant habitat restoration will be necessary. Therefore, in addition to habitat suitability indices based on existing conditions, they also considered the context and "restorability" of human-converted planning units. Connectivity analyses were then conducted individually for each of the five mobile terrestrial focal species only between the cores that were selected for that species.

This regional analysis identified 52 core reserves (i.e., conservation opportunity areas) ranging in size from 5,152 acres to 291,000 acres, and covered 12% (1.8 million acres) of the total land area of the ecoregion. Least-cost corridor analyses delineated 388 species-specific corridors linking the core areas (bobcat = 120, giant garter snake = 27, kit fox = 50, tule elk = 121), covering 18% (4.1 million ac) of the ecoregion. Approximately 63% of the combined core reserves and corridors delineated for the Central Valley (Huber et al. 2010) were captured by the Essential Habitat Connectivity Map's network of Natural Landscape Blocks (46% or 2.7 million ac) and Essential Connectivity Areas (17% or 1.0 million ac; Figure 3.16; Table 3.14). While there was good overlap with the core reserves and Natural Landscape Blocks, fewer of the corridors were captured by the Essential Connectivity Areas, which is likely due to the approach that Huber et al. (2010) took for looking at future restoration opportunities rather than just existing conditions.


CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
FIGURE 3.15.
COMPARISON WITH
WILDLANDS CONSERVATION
IN THE CENTRAL COAST REGION
OF CALIFORNIA
Central Coast Network*
Essential Connectivity Areas
Natural Landscape Blocks
Potential Riparian Connections
*Source: Thorne et al. 2002
0 15 30 60 90
Kilometers
Miles
0 10 20 40 60
1:2,100,000
N
E
S
W
Mount Diablo
Stockton
San Francisco
Tuolumne River
Stanislaus River
Merced River
SANTA CRUZ MTNS
DIABLO RANGE
SAN JOAQUIN VALLEY
Fresno River
San Joaquin River
Fresno
San Benito River
Monterey
SALINAS VALLEY
COAST RANGES
SANTA LUCIA RANGE
Kings River
Tulare
Tule River
Salinas River
Poso Creek
Bakersfield
Kern River
TEMBLOR RANGE
SIERRA MADRE MTNS
Santa Maria River
Santa Ynez River
SANTA YNEZ MTNS
Santa Barbara
Caltrans
The Essential Habitat Connectivity map delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale based on available data and assumptions provided in this report. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.

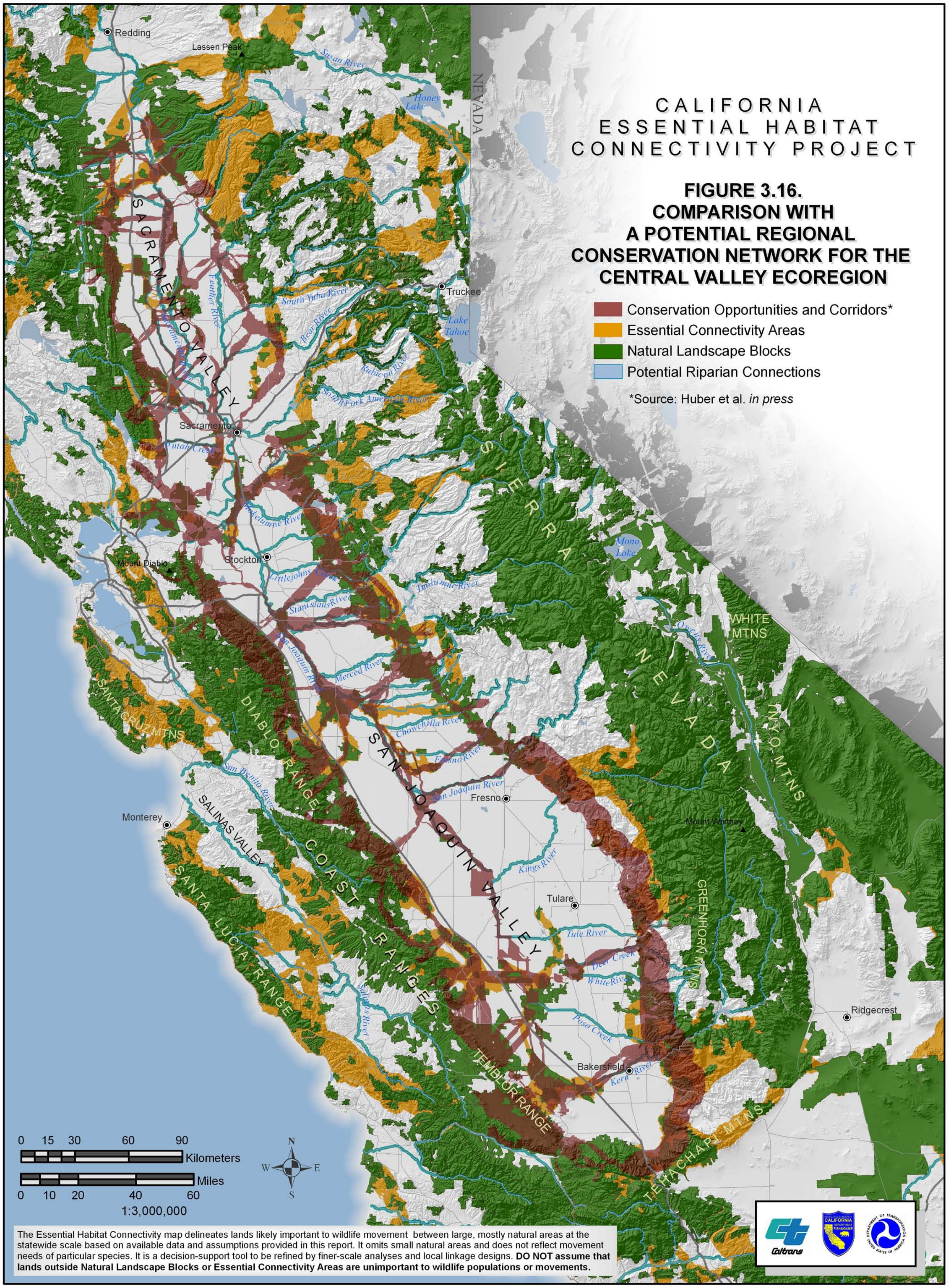

CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
FIGURE 3.16.
COMPARISON WITH
A POTENTIAL REGIONAL
CONSERVATION NETWORK FOR THE
CENTRAL VALLEY ECOREGION
Conservation Opportunities and Corridors*
Essential Connectivity Areas
Natural Landscape Blocks
Potential Riparian Connections
*Source: Huber et al. in press
Redding
Lassen Peak
Susan River
Honey Lake
NEVADA
SACRAMENTO VALLEY
Feather River
South Yuba River
Bear River
Truckee
Lake Tahoe
Rubicon River
South Fork American River
Sacramento
Putah Creek
SIERRA NEVADA
Mokelumne River
Stockton
Mount Diablo
Littlejohns Creek
Tuolumne River
Stanislaus River
Mono Lake
WHITE MTNS
Owens River
San Joaquin River
Merced River
SANTA CRUZ MTNS
DIABLO RANGE
Chowchilla River
SAN JOAQUIN VALLEY
Fresno River
INYO MTNS
San Benito River
San Joaquin River
Fresno
Monterey
SALINAS VALLEY
COAST RANGES
Mount Whitney
Kings River
SANTA LUCIA RANGE
Tulare
GREENHORN MTNS
Tule River
Deer Creek
White River
Salinas River
Ridgecrest
Poso Creek
TEMBLOR RANGE
Bakersfield
Kern River
TEHACHAPI MTNS
0 15 30 60 90
Kilometers
Miles
0 10 20 40 60
1:3,000,000
N
W
E
S
The Essential Habitat Connectivity map delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale based on available data and assumptions provided in this report. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.
Caltrans

Table 3.14. Overlap between Essential Habitat Connectivity Map and a Potential Regional Conservation Network for the Central Valley Ecoregion (Huber et al. 2010).

Comparison Description	Total Overlap (acres)	Percent	Overlap with Corridors (acres)	Percent	Overlap with Conservation Opportunities	Percent
Corridors and Opportunities Overlap with NLB	2,730,665	46%	1,635,436	28%	1,095,230	19%
Corridors and Opportunities Overlap with ECA	1,001,369	17%	807,763	14%	193,606	3%
Corridors and Opportunities Overlap with Network	**3,732,034**	**63%**	**2,443,198**	**42%**	**1,288,836**	**22%**

3.3.8. South Coast Missing Linkages Project

South Coast Missing Linkages has prioritized and designed landscape linkages that are widely considered the backbone of a conservation strategy for southern California (Beier et al. 2006). The linkages cover 2.1 million acres and stitch together over 18 million acres of existing conservation investments (national forests, state and national parks, etc.) to form the South Coast Wildland Network, maintaining connected wildlife populations from the southern Sierra Nevada to Baja California, and from the beaches of Camp Pendleton eastward to the deserts of Anza-Borrego Desert State Park.

Eleven focal species-based Linkage Designs were developed to form the South Coast Wildland Network (Beier et al. 2006, Luke et al. 2004, Penrod et al. 2003, 2004a, 2004b, 2005a, 2005b, 2005c, 2006a, 2006b, 2006c, 2006d; http://scwildlands.org/reports/). The number of focal species for each linkage ranged from 14 to 34. Least-cost corridor analyses and patch configuration analyses (Chapter 5) were conducted to develop a linkage design that served all species.

Roughly 81% of the combined South Coast Missing Linkage Designs were captured by the Essential Habitat Connectivity Map's network of Natural Landscape Blocks (55% or 1.1 million ac) and Essential Connectivity Areas (26% or 533,250 ac; Figure 3.17; Table 3.15). The Essential Connectivity Map captured the majority of all Linkage Designs identified by the South Coast Missing Linkages effort, except two. The western branch of the San Bernardino – Granite Connection was not included largely due to the stringent criteria used to define Natural Landscape Blocks in the Mojave Ecoregion. In the San Bernardino-San Jacinto Connection, only the eastern-most branches of the Linkage Design were captured by the network. This is largely due to the fact that the least-cost corridors for the Essential Habitat Connectivity Map were run between centroids within the targeted Natural Landscape Blocks, while the South Coast Missing Linkages effort conducted Least Cost Corridor analyses for three focal species (mountain lion, American badger, and mule deer) using potential breeding habitat within the San Bernardino National Forest and small protected lands in the Badlands area, south of the San Bernardino Mountains, as the targeted endpoints for the analyses.

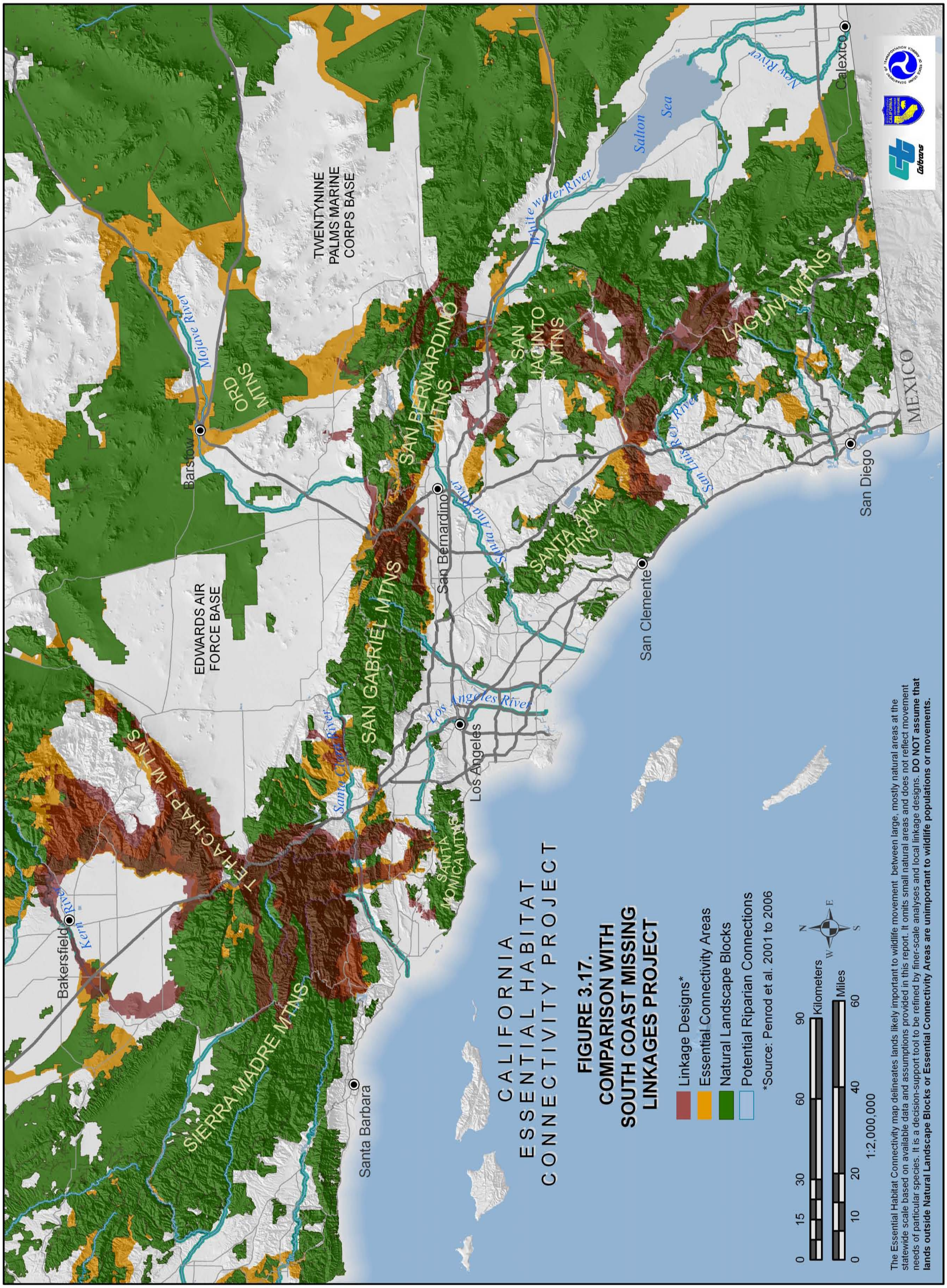

CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
FIGURE 3.17.
COMPARISON WITH
SOUTH COAST MISSING
LINKAGES PROJECT
Linkage Designs*
Essential Connectivity Areas
Natural Landscape Blocks
Potential Riparian Connections
*Source: Penrod et al. 2001 to 2006
0 15 30 60 90 Kilometers
0 10 20 40 60 Miles
1:2,000,000
N
S
E
W
The Essential Habitat Connectivity map delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale based on available data and assumptions provided in this report. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. **DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.**
Caltrans
EDWARDS AIR FORCE BASE
TWENTYNINE PALMS MARINE CORPS BASE
ORD MTNS
SAN GABRIEL MTNS
SAN BERNARDINO MTNS
SAN JACINTO MTNS
SANTA ANA MTNS
LAGUNA MTNS
TEHACHAPI MTNS
SIERRA MADRE MTNS
SANTA MONICA MTNS
MEXICO
Bakersfield
Barstow
San Bernardino
Los Angeles
San Clemente
San Diego
Calexico
Santa Barbara
Kern River
Mojave River
Santa Clara River
Los Angeles River
Santa Ana River
White water River
San Luis Rey River
New River
Salton Sea

Table 3.15. Overlap between Essential Habitat Connectivity Map and Linkage Designs from the South Coast Missing Linkages Project.

Linkage Design	Total Acres	Overlap by NLB (acres)	Overlap by ECA (acres)	Overlap by Network (acres)	Percent Overlap
Tehachapi	661,127	233,222	280,957	514,179	78%
Sierra Madre-Castaic	537,534	431,768	72,383	504,151	94%
Santa Monica-Sierra Madre	112,943	40,752	39,199	79,951	71%
San Gabriel-Castaic	24,571	296	19,348	19,644	80%
San Gabriel-San Bernardino	135,145	79,534	45,987	125,522	93%
San Bernardino - Granite	11,946	3,228	2,306	5,534	46%
San Bernardino-Little San Bernardino	62,069	47,681	4,097	51,777	83%
San Bernardino-San Jacinto	53,532	16,178	6,174	22,352	42%
Palomar-San Jacinto/Santa Rosa	208,753	128,456	25,776	154,232	74%
Santa Ana-Palomar	105,176	53,238	37,024	90,262	86%
Peninsular-Borrego	150,735	101,152	0	101,152	67%
Totals	**2,063,532**	**1,135,505**	**533,250**	**1,668,755**	**81%**

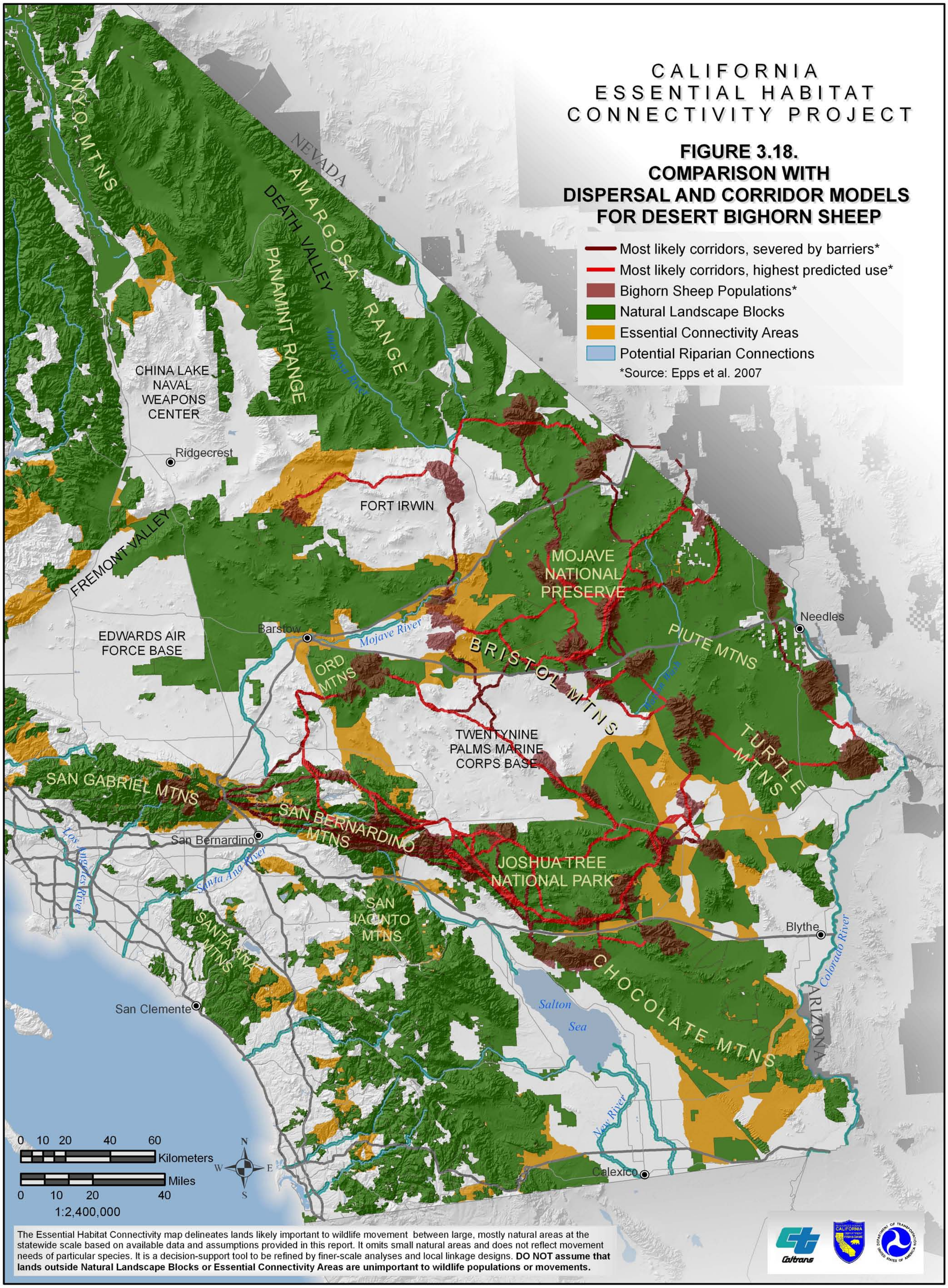
3.3.9. Dispersal and Corridor Models for Desert Bighorn Sheep

Epps et al. (2007) used spatially explicit, high-resolution genetic data to infer variation in movements of desert bighorn sheep (*Ovis canadensis nelsoni*) in portions of the Mojave and Sonoran Desert ecoregions to examine the impact of terrain and roads on movement and predict possible movement corridors. Least-cost path models estimated effective geographical distances among 26 populations.

Approximately 86% of the population polygons delineated for desert bighorn sheep (Epps et al. 2007) were captured by the Essential Habitat Connectivity Map's network of Natural Landscape Blocks (82% or 1.2 million ac) and Essential Connectivity Areas (4% or 59,490 ac; Figure 3.18). Roughly 86% (7,363 km; 4,575 mi) of the most likely paths with the highest predicted use were captured by the statewide network and 85% (3,537 km; 2,198 mi) of the most likely paths severed by barriers were captured. One notable omission is an Essential Connectivity Area between Joshua Tree National Park and the Newberry-Rodman Area of Critical Environmental Concern that links the Sheephole, Bullion, and Bristol Mountains, which Epps et al. (2007) identified as a most likely corridor, highest predicted use.

3.3.10. California Desert Connectivity Project

The goal of this ongoing project is to identify areas where maintaining or restoring ecological connectivity is essential to conserving biological diversity within California deserts in the face of human land-uses and climate change (www.scwildlands.org). This recently initiated effort is conducting a comprehensive connectivity assessment to identify wildland blocks of high ecological integrity, and key habitat connectivity areas between them and to adjacent



CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
FIGURE 3.18.
COMPARISON WITH
DISPERSAL AND CORRIDOR MODELS
FOR DESERT BIGHORN SHEEP
Most likely corridors, severed by barriers*
Most likely corridors, highest predicted use*
Bighorn Sheep Populations*
Natural Landscape Blocks
Essential Connectivity Areas
Potential Riparian Connections
*Source: Epps et al. 2007
INYO MTNS
NEVADA
AMARGOSA RANGE
DEATH VALLEY
PANAMINT RANGE
Amargosa River
CHINA LAKE NAVAL WEAPONS CENTER
Ridgecrest
FORT IRWIN
FREMONT VALLEY
MOJAVE NATIONAL PRESERVE
EDWARDS AIR FORCE BASE
Barstow
Mojave River
Needles
PIUTE MTNS
ORD MTNS
BRISTOL MTNS
TWENTYNINE PALMS MARINE CORPS BASE
TURTLE MTNS
SAN GABRIEL MTNS
SAN BERNARDINO MTNS
San Bernardino
Los Angeles River
Santa Ana River
JOSHUA TREE NATIONAL PARK
SAN JACINTO MTNS
SANTA ANA MTNS
Blythe
Colorado River
CHOCOLATE MTNS
San Clemente
Salton Sea
ARIZONA
New River
Calexico
0 10 20 40 60 Kilometers
0 10 20 40 Miles
1:2,400,000
N
W
E
S
The Essential Habitat Connectivity map delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale based on available data and assumptions provided in this report. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.
Caltrans

ecoregions. The project is using similar methods as those used for the South Coast Missing Linkages effort (Section 3.3.8.).

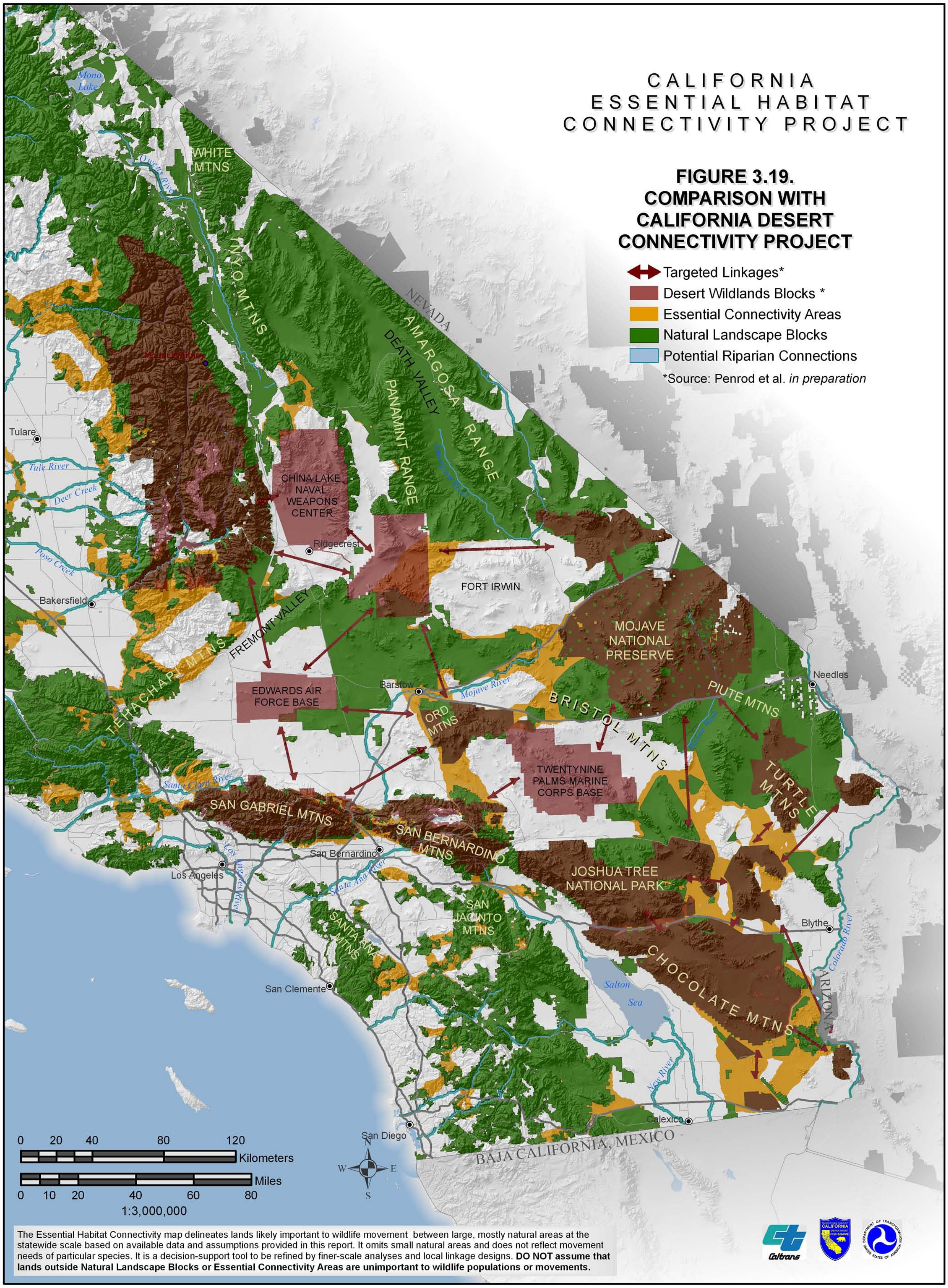
Targeted wildland blocks for this effort are GAP 1, 2, and 3 lands, which primarily include National Parks, Preserves, National Forests, Bureau of Land Management Wilderness Areas, and lands administered by the Department of Defense. Twenty-three linkages are being addressed that scored high in terms of biological irreplaceability and threat based on a formal evaluation of 47 potential connections in the desert. The project is addressing the habitat and movement requirements of 47 focal species (10 amphibians and reptiles, 13 mammals, 10 birds, 9 plants, and 5 invertebrates). Eighteen of the 23 targeted linkages being addressed by the California Desert Connectivity Project are fairly well captured by the Essential Habitat Connectivity Map, though the Essential Connectivity Areas will certainly be refined and improved based on the focal species analyses currently being conducted for the project (Figure 3.19). Four out of five of the targeted linkages not addressed by the network are intended to provide connectivity to Department of Defense lands, which were not captured as Natural Landscape Blocks due to the strict criteria used to define these in the desert ecoregions.

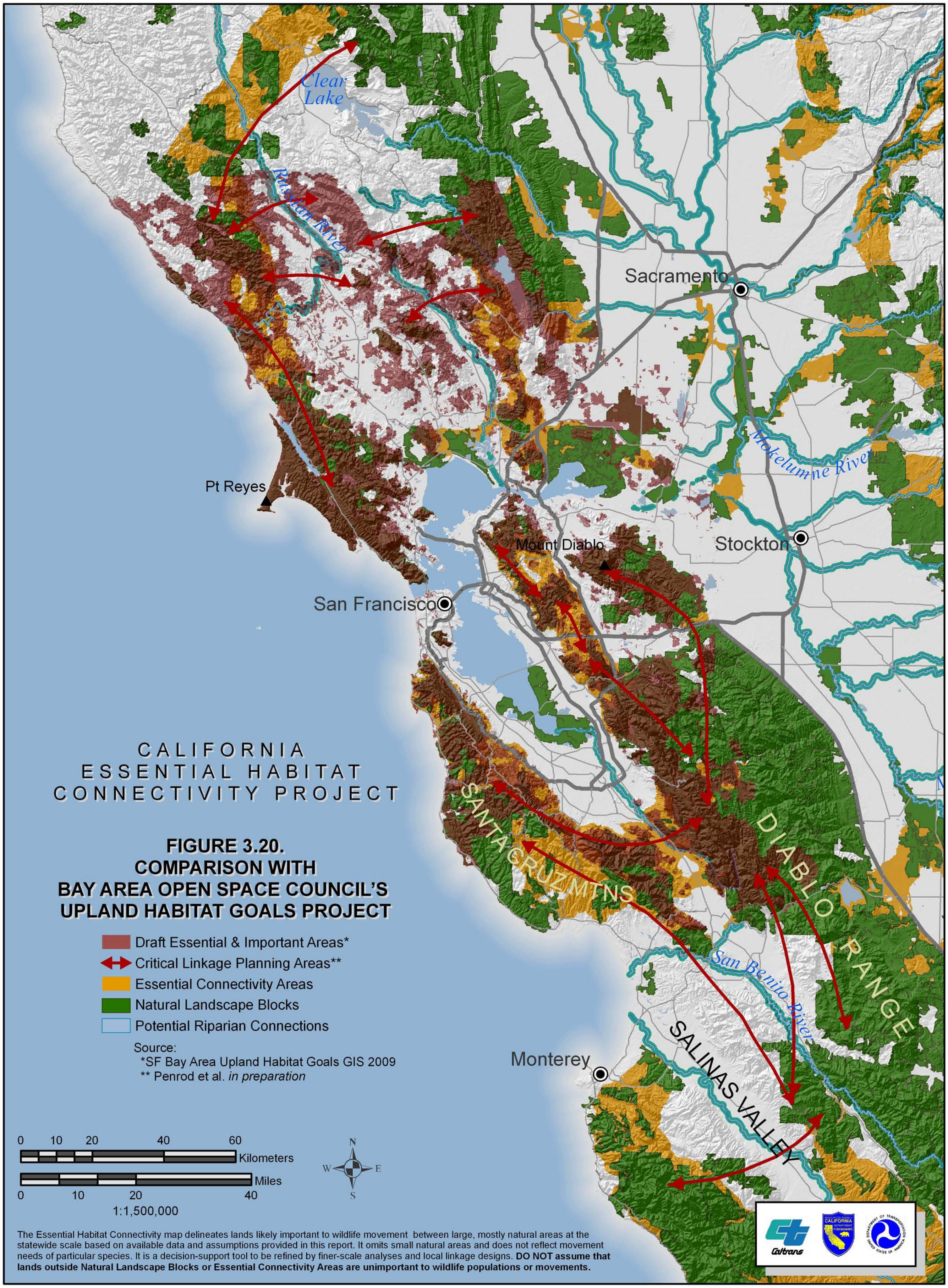
3.3.11. Bay Area Open Space Council's Upland Habitat Goals Project

The San Francisco Bay Area Upland Habitat Goals Project (www.openspacecouncil.org) is a science-based effort to promote landscape-level conservation in nine counties in the Bay Area (Weiss et al. 2008). A Draft Conservation Lands Network was generated using MARXAN software, which allows the analyst to assess multiple factors, such as conservation targets, goals, land use, adjacency to protected lands, and the ecological integrity of the landscape. The Upland Goals Project used MARXAN to identify "essential" and "important" areas. The resulting GIS database and reference document are decision-support tools to inform and support agencies and organizations seeking to preserve, enhance and restore the biological diversity of upland habitats in the region (Weiss et al. 2008).

The Upland Habitat Goals Project establishes a blueprint for core area delineation. A recently initiated project, Bay Area Critical Linkages, will add to that blueprint by completing 12 to 15 detailed Linkage Designs to ensure connectivity and thus viability of large core conservation areas. The comprehensive linkages strategy will include focal species-based Linkage Designs, based on the methodology developed for the South Coast Missing Linkages Project (Beier et al. 2006), implementation strategies and tools, and a monitoring framework.

The Upland Habitat Goals Project is still in draft form and is slated for completion in mid 2010. Using the project's Draft Conservation Lands Network, 68% of the network was captured by the Essential Habitat Connectivity Map's network of Natural Landscape Blocks (Figure 3.20). If we compare the network to only essential conservation areas, the overlap increases to 70%, while 18% of the important conservation priorities are captured. Eight of the 15 planning areas identified by the Bay Area Critical Linkages Project were addressed by the coarse-scale statewide network developed by the California Essential Habitat Connectivity Project, which further highlights the need for local-scale, focal-species analyses that will be carried out as part of the Bay Area Critical Linkages Project. The notable target


CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
FIGURE 3.19.
COMPARISON WITH
CALIFORNIA DESERT
CONNECTIVITY PROJECT
Targeted Linkages*
Desert Wildlands Blocks *
Essential Connectivity Areas
Natural Landscape Blocks
Potential Riparian Connections
*Source: Penrod et al. in preparation
Mono Lake
WHITE MTNS
INYO MTNS
NEVADA
AMARGOSA RANGE
DEATH VALLEY
PANAMINT RANGE
Tulare
Tule River
Deer Creek
Poso Creek
Bakersfield
CHINA LAKE NAVAL WEAPONS CENTER
Ridgecrest
FORT IRWIN
FREMONT VALLEY
TEHACHAPI MTNS
MOJAVE NATIONAL PRESERVE
EDWARDS AIR FORCE BASE
Barstow
Mojave River
Needles
BRISTOL MTNS
PIUTE MTNS
ORD MTNS
TWENTYNINE PALMS MARINE CORPS BASE
TURTLE MTNS
Santa Clara River
SAN GABRIEL MTNS
SAN BERNARDINO MTNS
San Bernardino
Los Angeles
Los Angeles River
Santa Ana River
JOSHUA TREE NATIONAL PARK
SAN JACINTO MTNS
SANTA ANA MTNS
Blythe
Colorado River
San Clemente
Salton Sea
CHOCOLATE MTNS
ARIZONA
New River
Calexico
San Diego
BAJA CALIFORNIA, MEXICO
0 20 40 80 120
Kilometers
Miles
0 10 20 40 60 80
1:3,000,000
N
W
E
S
The Essential Habitat Connectivity map delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale based on available data and assumptions provided in this report. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.
Caltrans


Clear Lake
Russian River
Sacramento
Mokelumne River
Pt Reyes
Mount Diablo
Stockton
San Francisco
CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
SANTA CRUZ MTNS
DIABLO RANGE
FIGURE 3.20.
COMPARISON WITH
BAY AREA OPEN SPACE COUNCIL'S
UPLAND HABITAT GOALS PROJECT
Draft Essential & Important Areas*
Critical Linkage Planning Areas**
Essential Connectivity Areas
Natural Landscape Blocks
Potential Riparian Connections
San Benito River
Source:
*SF Bay Area Upland Habitat Goals GIS 2009
** Penrod et al. *in preparation*
Monterey
SALINAS VALLEY
0 10 20 40 60
Kilometers
Miles
0 10 20 40
1:1,500,000
N
W
E
S
Caltrans
The Essential Habitat Connectivity map delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale based on available data and assumptions provided in this report. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. **DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.**

areas that were not included as Natural Landscape Blocks in the Essential Habitat Connectivity Map are the northern and southern Mayacamas Mountains, while key connections not captured by the network include the Santa Cruz Mountains to the Gabilan Range and connections to the Santa Lucia Range through the Salinas Valley. These same connections were also identified by the Central Coast Network (Thorne et al. 2002).

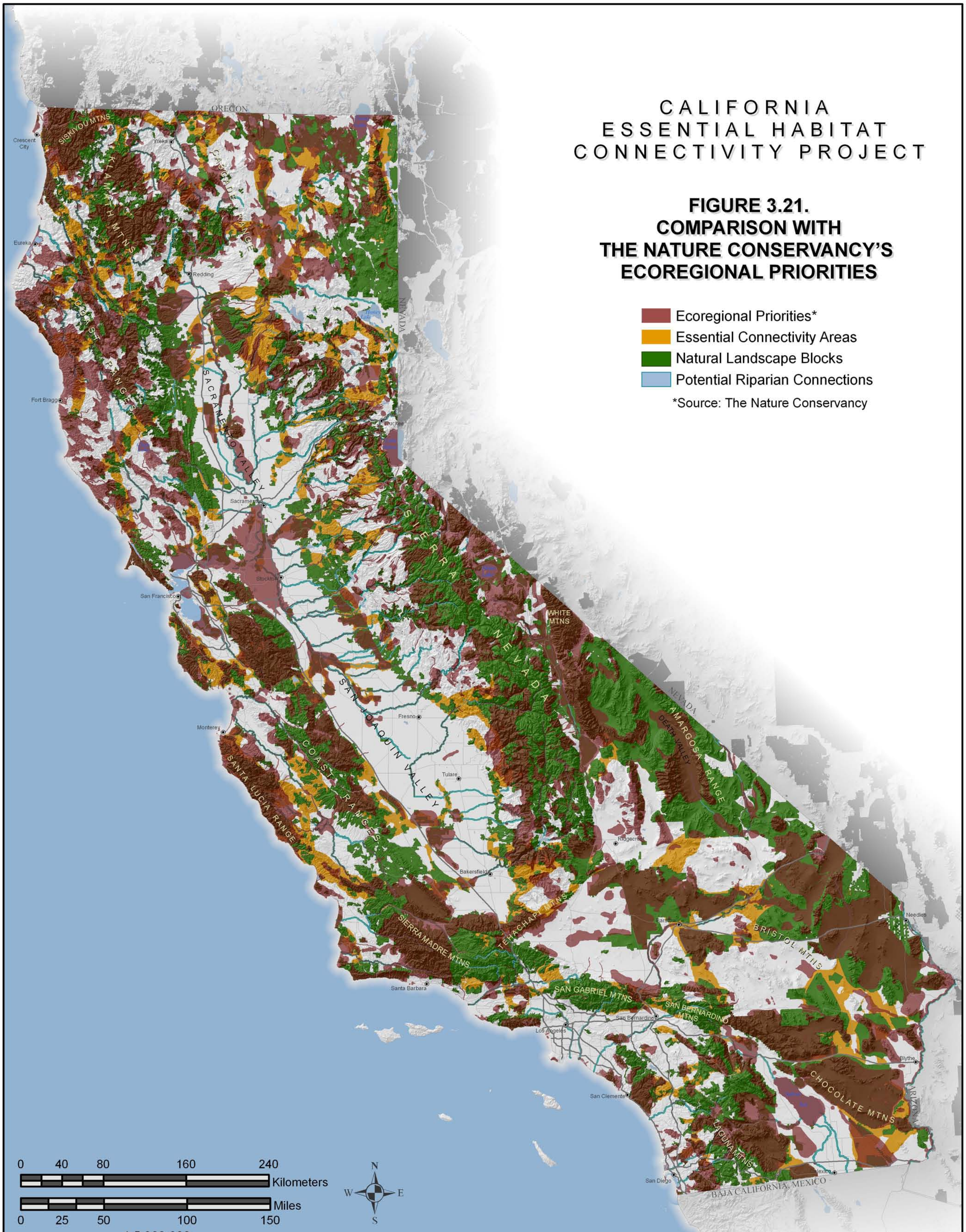
3.3.12. The Nature Conservancy's Ecoregional Priorities

The Nature Conservancy identifies its ecoregion-based priorities through a rigorous, iterative process involving five major steps: (1) identifying conservation targets, (2) gathering information, (3) setting goals, (4) assessing viability, and (5) assembling portfolios. The first step is to identify conservation targets or the species, natural communities, and ecosystems in a given ecoregion. The next step is to gather data about these conservation targets from a variety of sources, including Natural Heritage programs, satellite images, and rapid ecological assessments. Once the data are gathered, goals are set for each conservation target based on how much is needed and in what distribution to ensure long-term survival of each target. The ecoregional planning team then assesses the viability of each occurrence of each conservation target to ensure survival over the long term by choosing the best and most healthy examples of each target. All this information is analyzed to design an efficient network of conservation areas (or portfolio) that if protected in its entirety will ensure the preservation of biodiversity within an ecoregion (www.nature.org).

The Nature Conservancy has delineated 41.2 million acres throughout the state as conservation priorities or portfolio sites, with 36.8 million ac in terrestrial ecosystems, 347,391 acres in marine ecosystems, and 4.1 million ac in aquatic ecosystems. A total of 69% of the compiled portfolio sites were captured by the California Essential Habitat Connectivity Project's network of Natural Landscape Blocks (58% or 24.1 million ac) and Essential Connectivity Areas (10% or 7,008 ac; Figure 3.21; Table 3.16). That number goes up slightly to 72% if we compare only the terrestrial based portfolio sites, which are more closely aligned with the Essential Habitat Connectivity Map. Note that the focus of portfolio sites is on areas *in need of protection*, whereas our Natural Landscape Blocks tend to include mostly *already protected* lands, one would not necessarily expect high overlap between the two.

Table 3.16. Overlap between Essential Habitat Connectivity Map and The Nature Conservancy's Portfolio Sites in California.

	Terrestrial		Marine		Aquatic	
Description of Comparison	**Acres**	**Percent**	**Acres**	**Percent**	**Acres**	**Percent**
Portfolio Overlap with NLBs	22,658,506	62%	99,317	29%	1,308,796	32%
Portfolio Overlap with ECAs	3,779,346	10%	17,273	5%	482,661	12%
Portfolio Overlap by Network	26,437,852	72%	116,589	34%	1,791,455	44%



The Essential Habitat Connectivity map delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale based on available data and assumptions provided in this report. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. **DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.**

3.3.13. California Rangeland Conservation Coalition Focus Areas

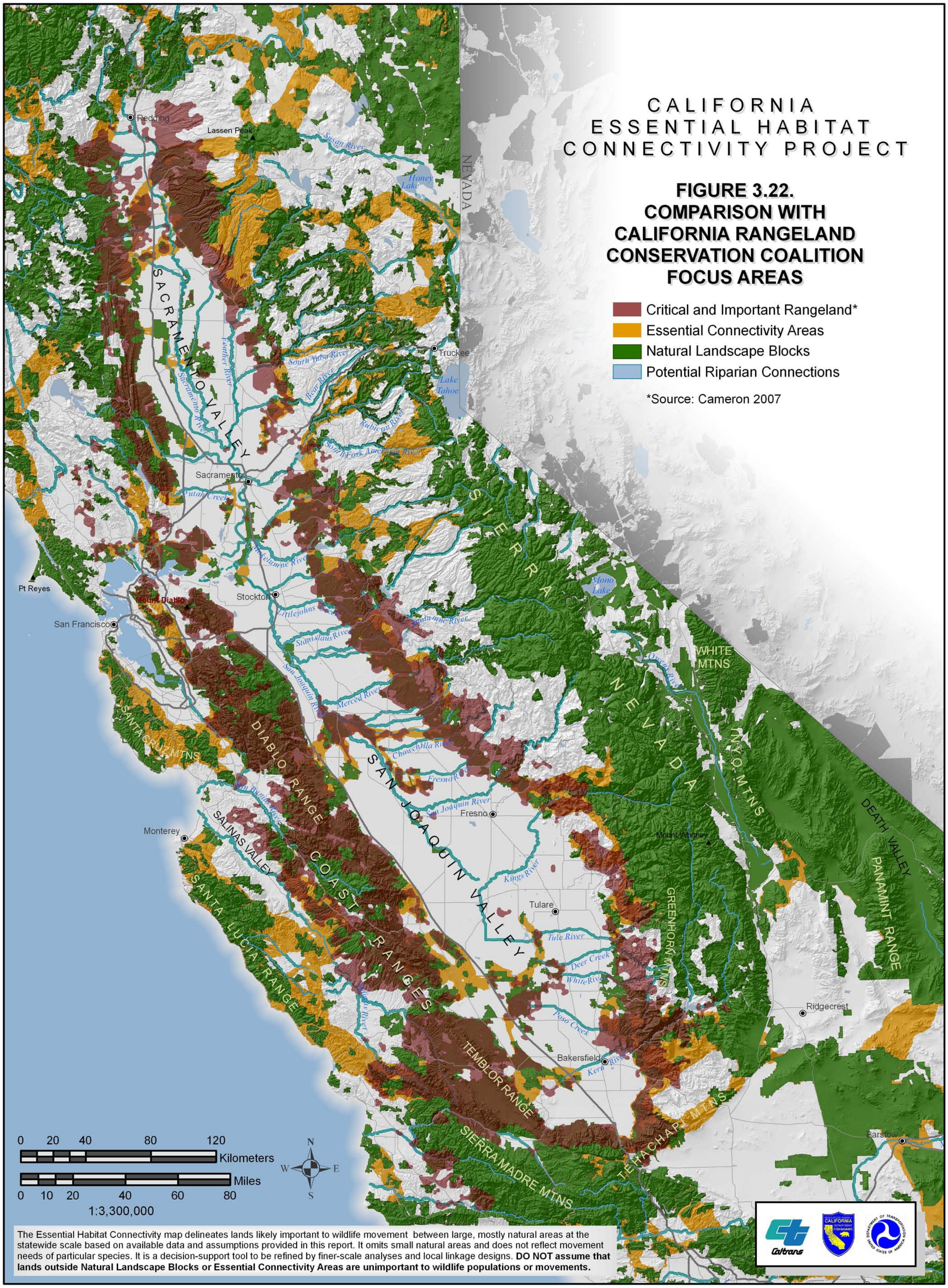
The California Rangeland Conservation Coalition (www.carangeland.org) is a consortium of ranchers, resource professionals from federal and state agencies, and environmentalists who have been working together since 2005 to conserve and enhance rangelands of high biological value encircling the Central Valley, including the Sierra foothills and interior Coast Ranges, while maintaining a viable ranching industry. Rangelands have been identified as one of the most threatened habitats in the western United States (Maestas et al. 2003, Theobald 2005, Cameron 2007). As such, the Coalition prioritized areas of privately owned rangelands encircling California's Central Valley that have high biodiversity value and require conservation action in the next 2-10 years (Cameron 2007).

Conservation targets integrated into the prioritization process included terrestrial systems and communities (i.e., grassland, blue oak woodland, riparian woodland and scrub, vernal pools) and several species (Cameron 2007). Rare, endemic, or sensitive rangeland animals considered conservation targets included blunt-nosed leopard lizard (*Gambelia sila*), giant kangaroo rat (*Dipodomys ingens*), riparian woodrat (*Neotoma fuscipes riparia*), San Joaquin antelope squirrel (*Ammospermophilus nelsoni*), San Joaquin kit fox, San Joaquin pocket mouse (*Perognathus inornatus*), short-nosed kangaroo rat (*Dipodomys nitratoides brevina*), Tipton kangaroo rat (*Dipodomys nitratoides nitratoides*), Tulare grasshopper mouse (*Onychomys torridus tularensis*), and Fresno kangaroo rat. Breeding and winter grassland birds considered conservation targets included loggerhead shrike (*Lanius ludovicianus*), northern harrier (*Circus cyaneus*), lark sparrow (*Chondestes grammacus*), ferruginous hawk (*Buteo regalis*; winter only), prairie falcon (*Falco mexicanus*), and white-tailed kite (*Elanus leucurus*). Two anadromous fish were also considered conservation targets including steelhead trout (Central Coast Evolutionary Significant Unit [ESU] and Central Valley ESU) and spring-run chinook salmon (*Oncorhynchus tshawytscha*; Central Valley ESU). This process identified 9.7 million acres of priority rangelands, delineating 6.4 million acres as critical and 3.3 million acres as important.

Approximately 73% of the priority rangelands were captured by the Essential Habitat Connectivity Map's network of Natural Landscape Blocks (58% or 5.6 million ac) and Essential Connectivity Areas (15% or 1.4 million ac), including 49% delineated as critical rangeland and 24% identified as important rangeland (Figure 3.22; Table 3.17). The tremendous overlap emphasizes the critical role that working landscapes can play in maintaining functional connectivity across the landscape.

Table 3.17. Overlap between Essential Habitat Connectivity Map and California Rangeland Conservation Coalition Focus Areas.

	Total Rangeland Overlap (acres)	Total Percent	Critical Rangeland (acres)	Total Percent	Important Rangeland (acres)	Total Percent
Rangeland overlap NLBs	5,623,785	58%	3,835,408	40%	1,788,377	19%
Rangeland overlap ECAs	1,404,272	15%	861,148	9%	543,124	6%
Rangeland overlap total network	**7,028,057**	**73%**	**4,696,557**	**49%**	**2,331,500**	**24%**


CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
FIGURE 3.22.
COMPARISON WITH
CALIFORNIA RANGELAND
CONSERVATION COALITION
FOCUS AREAS
Critical and Important Rangeland*
Essential Connectivity Areas
Natural Landscape Blocks
Potential Riparian Connections
*Source: Cameron 2007
Redding
Lassen Peak
Susan River
Honey Lake
NEVADA
SACRAMENTO VALLEY
Feather River
Sacramento River
South Yuba River
Bear River
Truckee
Lake Tahoe
Rubicon River
South Fork American River
Sacramento
Putah Creek
Mokelumne River
SIERRA NEVADA
Pt Reyes
Mount Diablo
Stockton
San Francisco
Littlejohns Creek
Tuolumne River
Stanislaus River
Mono Lake
WHITE MTNS
Owens River
San Joaquin River
Merced River
SANTA CRUZ MTNS
DIABLO RANGE
Chowchilla River
SAN JOAQUIN VALLEY
Fresno River
INYO MTNS
San Benito River
San Joaquin River
Fresno
DEATH VALLEY
Monterey
SALINAS VALLEY
COAST RANGES
Mount Whitney
Kings River
PANAMINT RANGE
SANTA LUCIA RANGE
Tulare
GREENHORN MTNS
Tule River
Deer Creek
White River
Ridgecrest
Poso Creek
TEMBLOR RANGE
Bakersfield
Kern River
TEHACHAPI MTNS
SIERRA MADRE MTNS
Barstow
0 20 40 80 120
Kilometers
Miles
0 10 20 40 60 80
1:3,300,000
N
W
E
S
The Essential Habitat Connectivity map delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale based on available data and assumptions provided in this report. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.
Caltrans

3.3.14. Audubon's Important Bird Areas

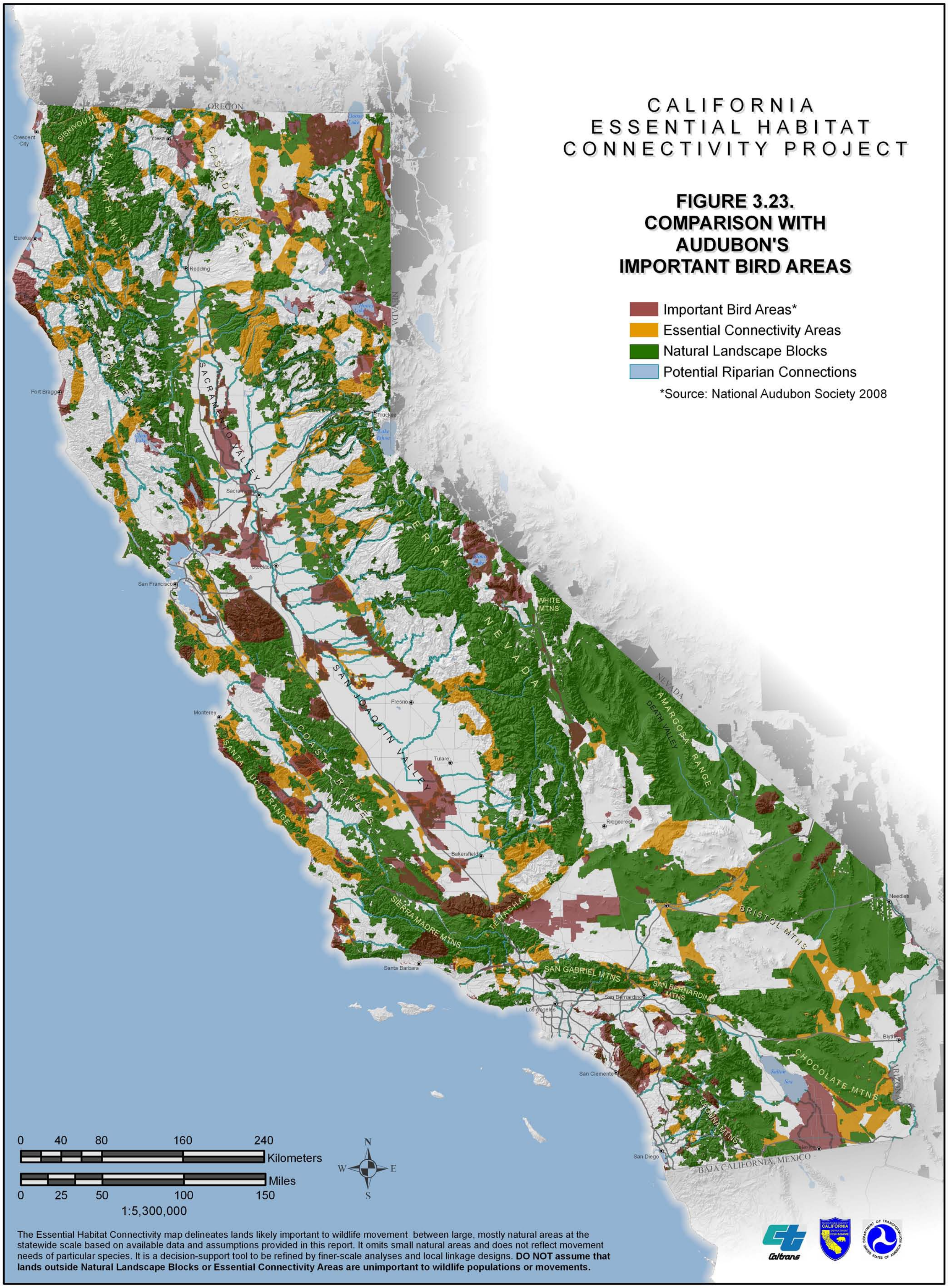
Important Bird Areas identify and promote conservation of habitats supporting avian biodiversity (National Audubon Society 2008). This international program was initiated in 1985 due to concerns about the loss and fragmentation of important bird habitat. The National Audubon Society (2008) describes Important Bird Areas as "sites that provide essential habitat for (i) rare, threatened or endangered birds, (ii) exceptionally large congregations of shorebirds, or (iii) exceptionally large congregations of waterfowl." The designation of a site as an Important Bird Area, while providing no regulatory authority, can be used to leverage conservation efforts that help to conserve essential bird habitat in the state.

As of 2008, over 10,000 Important Bird Areas have been designated worldwide, including 145 in California. The California Important Bird Areas range in size from 16 acres (Pier 400 Tern Colony) to 624,000 acres (Imperial Valley). Important Bird Areas on mainland California occupy approximately 10.7 million acres throughout the state, of which roughly 1.3 million acres are covered by open water (e.g., lakes, reservoirs, bays) that were not included when generating comparison statistics.

Approximately 53% of the Important Bird Areas were captured by the Essential Habitat Connectivity Map's network of Natural Landscape Blocks (43% or 4.1 million ac) and Essential Connectivity Areas (9% or 0.9 million ac; Figure 3.23), with the network capturing 58% or greater in most Important Bird Area Regions (Table 3.18). The low proportion of overlap in the desert ecoregions is due in part to the strict criteria used to delineate Natural Landscape Blocks in the desert which excluded Edwards Air Force Base. In addition, the Important Bird Area south of the Salton Sea is dominated by agricultural lands, which affected the Ecological Condition Index used to define Natural Landscape Blocks; the same is true for Important Bird Areas excluded from the network in the Sacramento Valley.

Table 3.18. Overlap between Essential Habitat Connectivity Map and Audubon Society Important Bird Areas by Region.

Important Bird Area Regions	IBA Area (acres)	Overlap with NLBs (acres)	Overlap with ECAs (acres)	Percent Covered by Network
Central Coast	773,196	340,031	212,413	71%
Colorado - Mojave Desert	1,694,568	365,017	32,278	23%
North Coast - Klamath	681,808	186,324	24,497	31%
Sacramento Valley	722,184	131,328	50,369	25%
San Francisco Bay Area	958,200	701,114	83,151	82%
San Joaquin Valley	1,875,823	964,767	257,659	65%
Sierra Nevada - Modoc	1,971,820	982,696	170,978	59%
South Coast	736,139	385,325	57,959	60%
Total	**9,413,739**	**4,056,601**	**889,304**	**53%**


CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
FIGURE 3.23.
COMPARISON WITH
AUDUBON'S
IMPORTANT BIRD AREAS
Important Bird Areas*
Essential Connectivity Areas
Natural Landscape Blocks
Potential Riparian Connections
*Source: National Audubon Society 2008
OREGON
NEVADA
ARIZONA
BAJA CALIFORNIA, MEXICO
Crescent City
Eureka
Redding
Fort Bragg
Sacramento
San Francisco
Monterey
Fresno
Tulare
Bakersfield
Ridgecrest
Santa Barbara
Los Angeles
San Bernardino
San Clemente
San Diego
Needles
Blythe
SISKIYOU MTNS
KLAMATH MTNS
CASCADE RANGE
COAST RANGE
SACRAMENTO VALLEY
SIERRA NEVADA
WHITE MTNS
SAN JOAQUIN VALLEY
COAST RANGES
SANTA LUCIA RANGE
AMARGOSA RANGE
DEATH VALLEY
TEHACHAPI MTNS
SIERRA MADRE MTNS
BRISTOL MTNS
SAN GABRIEL MTNS
SAN BERNARDINO MTNS
CHOCOLATE MTNS
0 40 80 160 240
Kilometers
Miles
0 25 50 100 150
1:5,300,000
N
W
E
S
The Essential Habitat Connectivity map delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale based on available data and assumptions provided in this report. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.
Caltrans

Chapter 4. Framework for Regional Analyses

This Report provides a map of large Natural Landscape Blocks and Essential Connectivity Areas throughout the State of California. If conserved and restored, this network of wildlands should help support interacting wildlife populations, evolutionary processes, and range shifts of species in a changing climate. This large, linked network is essential to support large carnivores, large gene pools, and high species diversity that can flow also into smaller natural areas. But this network excludes natural areas smaller than 10,000 acres (in the deserts, Sierra Nevada, and other relatively intact ecoregions) or 2,000 acres (in the Central Valley and other highly fragmented ecoregions). In this Chapter, we present approaches to mapping natural areas and connectivity areas at the regional (sub-state) scale.

Are regional analyses necessary? Can they sometimes delay on-the ground conservation? If one's goal is to develop a detailed action plan for one or several of the Essential Connectivity Areas described in this Report, one could bypass regional analyses altogether and proceed directly to Linkage Design as described in Chapter 5. Indeed, a proposed development or agricultural conversion project that might adversely impact an Essential Connectivity Area should trigger the development of a Linkage Design for that Essential Connectivity Area, regardless of whether a regional analysis has been conducted. The lack of a regional-scale analysis should not be used as an excuse to avoid or delay local-scale analysis.

Why conduct regional analyses? First, these analyses help planners comprehensively consider regional needs for connectivity, including needs of natural areas smaller than considered in this statewide Report. Second, prioritization among connectivity areas is probably best done at a regional scale, for biogeographic and geopolitical reasons described below. Regional prioritization is important because it allows planners to focus local-scale analyses (Chapter 5) in the most critical or most threatened connectivity areas. Additionally, regional analyses allow for more involvement and input from scientists and planners with local knowledge and can help rectify errors of omission in the statewide network. Finally, regional analyses can take advantage of spatial datasets that we could not use in this report because the datasets did not cover the entire state.

4.1. Defining the Region

During the process of conducting the statewide analysis, determinations regarding delineating the Natural Landscape Blocks were made with the state scale in mind. For analysis at a finer scale, the following are key considerations in defining a region:

- It should be small enough that natural areas smaller than 10,000 acres can be mapped and considered, but large enough to be meaningful for assessing a network of landscape blocks and connectivity areas.
- It should comprise an area of relatively homogeneous environmental and planning context. Although every region in California is heterogeneous, planning is more efficient if similar problems and strategies apply to most of the region.

The Jepson Manual (Hickman 1993) recognizes 10 ecoregions in California: North Coast Mountains, Modoc Plateau, Cascades, Sierra Nevada, Eastern Sierra Nevada, Central Valley, Mojave Desert, Sonoran Desert, South Coast, and Central Coast Mountains. Following Penrod et al. (2001), this Report lumped these into eight ecoregions by considering the Cascades part of the Modoc Plateau and the Eastern Sierra Nevada part of the Sierra Nevada (although we subsequently subdivided two ecoregions based on development patterns). Jepson ecoregions or USDA ecological sections or subsections (Miles and Goudey 1998) are appropriate units for regional analyses of connectivity because each ecoregion has relatively homogeneous vegetation, animal species, and human impacts on the landscape. In California, analyses for Jepson ecoregions have been conducted for the Central Coast (Thorne et al. 2002), South Coast (2003-2006; www.scwildlands.org), Central Valley (Huber et al. 2010) and are currently being developed for the Mohave-Sonoran Deserts (2009-2011, also by SC Wildlands).

Alternatively, the region can be defined by administrative boundaries, such as the boundaries of a Caltrans district, a California Department of Fish and Game Region, a Metropolitan Planning Organization, an Association of Governments, or a Natural Community Conservation Plan. It may be desirable to use a hybrid regional scheme that is both biological and organizational, such as the bioregions adopted by the California Biodiversity Council (http://biodiversity.ca.gov/bioregions.html). Funding agencies also can define the region, as occurred for the Bay Area Critical Linkages Project (2010-2011). In this case, the region is coextensive with the northern part of the Central Coast Jepson ecoregion as defined in this Report and extends into the southern part of the North Coast Jepson ecoregion. As long as the key factors listed above are considered, there are other good ways to define a region.

4.2. Products of a Regional Connectivity Analysis

Ideally, the products of a regional connectivity analysis would include all of the following bulleted items. At a minimum, it should include the first two items.

- A map of natural landscape blocks and connectivity areas in the region, including some connectivity areas that extend beyond the boundary of the region. We address this in detail in Section 4.3.
- Documentation, descriptions, and strategies related to the map. The analogous sections of this Report provide a good template for these products.
- A list of a subset of connectivity areas most crucial to ecological integrity of the region. We address this in detail in Section 4.4.
- For each connectivity area identified as most crucial, a Linkage Design produced by local-scale analysis (Chapter 5).

The most well-known example of a regional analysis is South Coast Missing Linkages (Figure 4.1; South Coast Wildlands 2008, Beier et al. 2006) and the accompanying 11 individual Linkage Designs for the South Coast Ecoregion (available at www.scwildlands.org). Figure 4.1 depicts the major protected Natural Landscape Blocks in green, and the Linkage Designs for the 11 most important connectivity areas in red. The

Linkage Designs were developed based on the habitat and movement needs of multiple focal species and all but one (i.e., San Bernardino-Granite) are being actively implemented. The South Coast ecoregion contains an additional 58 connectivity areas (not depicted on the map below) that were identified in the 2001 statewide Missing Linkages effort (Penrod et al. 2001). Future work is needed to identify the next set of priority connectivity areas and develop Linkage Designs for them, as outlined in Chapter 5. This South Coast ecoregional analysis included detailed Linkage Designs to adjacent ecoregions within California. One shortcoming of the effort was that, due to data limitations and cultural sensitivities, the project was not able to provide detailed Linkage Designs for three critical linkages crossing into neighboring Baja California, Mexico; however, the need for cross-border connectivity is being addressed via other avenues[26]. Future regional analyses could also improve on the South Coast Missing Linkages analysis by using formal procedures to consider climate change. Nonetheless, South Coast Missing Linkages remains a useful example for future efforts.

Figure 4.1. South Coast Missing Linkages includes Linkage Designs for the 11 most important connectivity areas (red polygons) among the major protected Natural Landscape Blocks (green).

[26] Cross-border planning with Mexican agencies and non-governmental organizations is happening through a separate venue, the Las Californias Binational Conservation Initiative (http://consbio.org/what-we-do/las-californias-binational-conservation-initiative/?searchterm=las%20californias).

4.3. Producing a Regional Map of Natural Landscape Blocks and Connectivity Areas

In this section we describe three key steps for producing a regional map of Natural Landscape Blocks and Connectivity Areas, and several options for each of these steps. We offer these recommendations to developers of a regional analysis:

- Involve the end-users early in the design process. The users should collectively agree on what types of areas they want to connect, which areas need connectivity, and which areas merit the highest priority for detailed Linkage Designs.
- Insist on data layers and criteria that can be applied across the entire region. Avoid data that were collected in only part of the region, because this creates a bias against poorly studied areas.
- Insist that each attribute layer is produced by a quantitative procedure rather than expert opinion. For instance, if a binary attribute such as "important for seasonal migration" or "important for climate change" is to be used, the attribute must be operationally defined and consistently applied across the landscape, rather than subjectively assigned to each polygon by expert opinion[27].
- Strive to make the entire process as transparent and repeatable as possible. Users rightly distrust black boxes. It is also easier to update a transparent analysis as new or better data become available.

4.3.1. Delineate Natural Landscape Blocks

Connectivity is meaningful only with reference to what is being connected. The following approaches – or combinations of them – can be used to define wildland blocks:

1. Hold an *expert workshop* at which knowledgeable participants draw polygons on a map.
2. Select areas of *high ecological integrity*, such as low road density, and low proportion of area converted to urban, agricultural, or industrial use.
3. Select *protected areas* – areas where biodiversity and natural landscape character are protected by law or landowner mission.
4. Use *optimization techniques*, such as *simulated annealing*, to identify areas that meet quantitative biodiversity targets in a compact area.
5. Use a *map that another agency has already developed to conserve biodiversity* (e.g., The Nature Conservancy's Ecoregional Priorities, biodiversity hotspots, CDFG Areas of Conservation Emphasis, Critical Habitat for listed species).
6. Develop maps of *modeled habitat for a suite of species*.

---

[27] Expert opinion may be used to score attribute classes, e.g., to assign one score to all polygons that support migration and another score to polygons that do not support migration, as long as the underlying map is generated by a consistent procedure.

7. Use *highways* either to split Natural Landscape Blocks or to modify preliminary blocks developed by one of the above procedures.

For the statewide map in this Report, we identified preliminary Natural Landscape Blocks as areas of *high ecological integrity* (#2) or areas of *high protection status* (#3), as modified by mapped *biodiversity areas* (#5). We further modified the Natural Landscape Blocks by splitting them at each major or secondary *highway crossing* (#7). Although we recommend our combination of approaches, we describe the advantages and disadvantages of each approach so that developers of regional analyses can make choices that are most favored by end users.

4.3.1.1. EXPERT WORKSHOPS

An expert workshop is an efficient way to draw on the knowledge of the many people who know the status of biodiversity across the region. Much of their knowledge comes from unpublished information and personal familiarity with diverse landscapes. The approach is efficient, in that large areas can be mapped in a short time at low cost. For example, in a one-day statewide workshop at the San Diego Zoo in November 2000, some 200 participants developed a map of hundreds of Natural Landscape Blocks and potential linkages across the State of California (Penrod et al. 2001).

The downside of this approach is that the process is not transparent, quantitative, and repeatable, and the outputs tend to be vague. For instance, the 2001 Missing Linkages report did not clearly map the Natural Landscape Blocks. Although the report raised the level of awareness of connectivity throughout the state, its vagueness and lack of rigor limited the degree to which it could be used as a decision support tool.

4.3.1.2. AREAS OF HIGH ECOLOGICAL INTEGRITY

In this approach, the landscape is portrayed in a Geographic Information System (GIS) as a grid of squares, typically 30 m to 200 m on a side. Such a grid is called a *raster*, and each square is called a *pixel*. Ecological integrity of each pixel is calculated as a function of attributes that are quantified for every pixel in the analysis area. Pixel attributes related to ecological integrity may include landcover, land use, urban area density, distance to nearest road, road density near the pixel (measured as length of road per unit area), or other variables. Then contiguous clusters of pixels that are good enough (above a certain threshold ecological integrity) and big enough (above a minimum area threshold) are identified as Natural Landscape Blocks. The analyst may also impose a shape requirement, so that an elongated strip of natural land, such as power line right of way in an urban area, is not considered a Natural Landscape Block.

In this Report, we used Ecological Integrity (Davis et al. 2003, 2006) as the main determinant of Natural Landscape Blocks (Chapter 2). The attributes used to define Natural Landscape Blocks were proportion of land in natural landcover, distance to road (weighted by road class and traffic volume), forest structure (for forest types that have potential for commercial timber extraction), and housing density (houses per acre).

We recommend Ecological Integrity as the main determinant of Natural Landscape Blocks in regional analyses, because this approach efficiently identifies large natural areas, even if they are unprotected. The approach is transparent, repeatable, and relatively simple. Hoctor et al. (2000), Carr et al. (2002), and Marulli and Mallarach (2005) also used Ecological Integrity to define Natural Landscape Blocks. In conducting a regional analysis, the analyst must work with scientists and other end users to select the following attributes:

- Pixel attributes. We offer the following recommendations:
  - Use only a small number of attributes. Models with too many attributes lack transparency and risk becoming black boxes that lose stakeholder trust.
  - Proportion of land in natural landcover should be one of the attributes. In regions that are highly dominated by agriculture or other human uses, it may be appropriate to identify lands with high restoration potential, and to assign them a score that recognizes this potential.
  - Some variable related to roads, such as distance to highway or paved road, should be one of the attributes.
  - If an attribute related to housing density is used, be careful with the US Census Block data. Census Blocks vary in size and shape, and the Census Bureau does not report where houses occur within the Census Block. In our statewide analysis, when a heavily-populated Census Block extended into an unpopulated natural area, all pixels in the Census Block, even those in pristine areas, were assigned the average housing density of that Block. Because our Natural Landscape Blocks were large, these errors probably had minimal impact on our statewide analysis, but they could cause a regional analysis to fail to recognize some small but important Natural Landscape Blocks in or near heavily-populated areas. If the region is small enough, the analyst can overlay census blocks on an air photo or other suitable data layer, and split the "problem" Census Blocks. Alternatively, road density may be a good surrogate for housing density in a region.
- Pixel size. We recommend a pixel size consistent with the finest data layer used in the analysis, typically 30 m.
- Moving window size for attributes expressed as ratios (such as proportion of land in natural state or miles of road per square mile), spatial averages (such as average housing density or average forest canopy closure), or distances at which an effect becomes negligible (such as distance from a road or urban edge). To select a moving window size, one can start with a range of estimates from relevant literature (e.g., on edge effects), and then try distances within that range and judge whether the resulting map looks reasonable. Most analysts find that a moving window radius or distance of 100 m to 500 m provides reasonable results.
- Whether to combine attributes using Boolean functions, arithmetic mean, arithmetic sum, geometric mean, or some combination of these functions. Boolean functions and geometric means sometimes better reflect the situation where deficiency in one attribute cannot be compensated by good values for other attributes. As with the previous decision, some trial-and-error is useful. Again, we recommend keeping the process as transparent as possible.

- Minimum size threshold to qualify as a Natural Landscape Block. Many end users will want a low threshold, and the analyst should try to meet this demand, unless it produces an unreadable map or cannot be justified with existing data.
- Whether to impose a shape requirement to avoid designating a long, narrow, highly edge-affected area as a Natural Landscape Block. The opinions of end users should be decisive on this matter. In a GIS, such areas can readily be identified as potential blocks whose entire area is less than a specified distance from the block's edge.

4.3.1.3. PROTECTED AREAS

In this approach, the analyst selects all parcels that meet a certain level of protection, such as all lands in certain GAP[28] protection status. Contiguous parcels above the threshold protection status and above the minimum size threshold are designated as Natural Landscape Blocks. The approach is straightforward and unambiguous. The resulting connectivity map connects only to existing conservation investments, precluding "corridors to nowhere" – i.e., mapped connections to lands that could be developed in the future. The downside of the approach is that it "writes off" natural landscapes that are not currently protected. In some regions, the majority of large natural landscapes may be privately owned and unprotected. Some of these areas may be at low risk of development due to rugged terrain or lack of access to water, and others could be conserved in the future.

Because using protection status as the sole determinant of a Natural Landscape Block would fail to recognize some valuable wild landscapes, we recommend using protection status in conjunction with ecological integrity, as we did in Chapter 2.

4.3.1.4. SIMULATED ANNEALING

The basic idea behind simulated annealing (Ball and Possingham 2000, Possingham et al. 2000) is to depict the landscape either as a grid of cells, or as a group of irregularly shaped polygons (e.g., watersheds, ownership parcels). The analyst must have an estimate of how much each grid cell or polygon can contribute to biodiversity targets. The targets are typically to achieve a certain number of occurrences of each species, or each type of natural vegetation community, and to do so at the smallest cost. Two aspects of cost are generally considered: total land area (which can be expressed in dollars if land values of different parcels are known) and the amount of edge (cost of managing a protected area and ensuring its integrity increases with amount of edge). The combination of cells or polygons that achieves all targets at the lowest cost is the optimal solution.

---

[28] GAP protection status (Crist 2000). Status 1: permanent protection from conversion of natural landcover and a mandated management plan to maintain a natural state and disturbance events, e.g., designated wilderness, national parks. Status 2: permanent protection from conversion of natural landcover and a mandated management plan to maintain a primarily natural state, but may receive uses that degrade the quality of existing natural communities, including suppression of natural disturbance. Status 3: permanent protection from conversion of natural landcover for most of the area, but subject to extractive uses of either a broad, low-intensity type (e.g., logging) or localized intense type (e.g., mining); protection to federally listed species throughout the area. Status 4: no public or private mandates or easements prevent conversion of natural habitat types to anthropogenic habitat types.

Mathematically, finding the optimal solution is difficult. With only 100 polygons, there are over a trillion quadrillion possible combinations of polygons to evaluate; for larger landscapes, the problem is worse. Fortunately, ecologists at University of Queensland developed an approach that efficiently identifies optimal or near-optimal solutions. They have packaged this as the software program MARXAN, freely available at http://www.uq.edu.au/marxan/. An excellent, non-technical, illustrated overview of the procedure is available at http://www.mosaic-conservation.org/cluz/marxan_intro.html. An earlier version of MARXAN is SITES, which has been used by The Nature Conservancy in many ecoregional assessments in the US. CLUZ is an ArcView extension that provides an interface between MARXAN (which uses text-based input files) and GIS datasets.

We suggest caution in using simulated annealing to define Natural Landscape Blocks, because connectivity should not be limited solely to the smallest landscape areas needed to meet identified goals. Such a procedure is appropriate when one is allocating scarce dollars for acquisition or easements. But connectivity planners typically want to maintain or improve connectivity to all wildland blocks – not just those that contain high biodiversity or meet other goals in a small area. Therefore we recommend procedures that identify large, intact natural landscape areas in their entirety, rather than the smallest portion necessary to meet specified goals.

4.3.1.5. EXISTING CONSERVATION MAPS

Many agencies have developed maps to conserve biodiversity that cover broad regions. For example, The Nature Conservancy has developed maps of conservation priorities in most states and ecoregions. California Department of Fish and Game is developing a series of data layers to identify Areas of Conservation Emphasis. The US Fish and Wildlife Service has designated Critical Habitat for many species listed under the Endangered Species Act. All such maps depict areas with documented value to biodiversity, and thus seem appropriate for designation as Natural Landscape Blocks. This approach has two disadvantages. First, it can fail to recognize biodiversity "coldspots" – that is, those large, functioning ecosystems that lack high biodiversity or special status species (Karieva and Marvier 2003) but may nevertheless be important to conserving natural communities, biodiversity, and ecological functions. Second, some designated Critical Habitat and some rare species occurrences occur in highly degraded, un-natural landscapes, and some rare endemic plants or insects may occur in small, naturally-isolated populations that do not need connectivity.

In light of these disadvantages, we recommend using mapped biological values as modifiers to ecological integrity in designating Natural Landscape Blocks in a regional analysis, as we did in this statewide Report (see Chapter 2). In selecting data layers, we recommend map layers that cover the entire region. In this regard the Bureau of Land Management Areas of Critical Environmental Concern (ACEC) was a less than ideal data layer because those Areas are designated exclusively on federal land.

4.3.1.6. HABITAT CORES FOR A SUITE OF SPECIES

Few US states or ecoregions have defined Natural Landscape Blocks based on habitat cores for a suite of species. Huber et al. (2010) defined cores in the Great Central Valley using several focal species. Colorado initiated a focal species approach in 2005, and Washington state initiated one in September 2008, with a target date of late 2010 for the statewide map[29]. In Colorado, the Southern Rockies Ecosystem Project (2005) convened expert workshops that produced hand-drawn habitat core areas for 27 focal species, and 176 hand-drawn linkage areas among these core areas; the planned Phase II mapping has yet to occur. The Washington effort selected 16 focal species to represent five major vegetation biotypes (Semidesert, Northern Rocky Mountain, Subalpine, Alpine, and Vancouverian). They plan to develop 16 statewide maps, one for each species, showing core habitats (based on a model) connected by least-cost corridors using estimated resistance or movement parameters for each species. These 16 maps will then be joined into a statewide linkage map.

There are advantages to this approach. Most end-users are comfortable with species conservation as a goal, so Natural Landscape Blocks based on species are easy for both scientists and non-scientists to appreciate. Also, agencies have regulatory authority to protect and manage species. Linkages are ultimately intended to serve particular species by allowing for gene flow, demographic rescue, recolonization, and range shift in response to climate change. There is a risk that a linkage based on non-species criteria (e.g., ecological integrity) could fail to include a good linkage for some species. Finally, species-based approaches can be validated using empirical data to determine whether species are actually using them as anticipated.

This approach also has several disadvantages. First, it is difficult to select focal species that represent the entire biota of a state or region. It is also difficult to reliably define each species' core habitat. Once core habitats are mapped for each species, one would have to invent procedures to overlay the many maps (16 in Washington, 24 in Colorado) to produce a coherent set of Natural Landscape Blocks. Finally, having started by defining Natural Landscape Blocks based on species, efforts in Colorado and Washington intend to take the logical "next step," namely using focal species to develop detailed Linkage Designs for each pair of blocks to be connected. In effect, there will be no statewide map until all the individual Linkage Designs are complete. Indeed Washington may decide not to designate Natural Landscape Blocks at all, but instead to develop 16 connectivity maps – one per species – and then attempt to merge these 16 single-species maps into a statewide connectivity map. It is a monumental task to simultaneously work at spatial scales from statewide (or regional) to individual Linkage Designs, and to do all tasks well.

These difficulties dissuaded us from using this approach in this statewide Report for California. Nonetheless, the focal species approach has many advantages, and we hope that Colorado or Washington, or perhaps a regional analysis in California, will provide the first prototype. Because there are no completed examples using multiple species to define Natural Landscape Blocks, we have provided only a few caveats, but no specific guidance, on this approach.

[29] For a relatively small region (2,500 km^2; 965 mi^2) in northern Italy, Bani et al. (2002) defined core areas for a suite of forest birds and carnivores as areas above a minimum size and minimum number of detections in over 1,000 point counts and transects of the area. They used these cores as start- and end-points for a regional network of corridors. Planners would probably be compelled to use modeled rather than empirical species distributions in larger planning regions within US states.

4.3.2. Determine which Natural Landscape Blocks need to be connected

For a region with 100 Natural Landscape Blocks, there are 4,950 pairs of landscape blocks, and thus 4,950 potential linkages[30]. But each Natural Landscape Block does not necessarily need to connect to every other Natural Landscape Block in the landscape. Therefore scientists and planners must determine which pairs of blocks need to be connected. Simple graph-theoretic procedures such as Delaunay triangulation can identify a set of Natural Landscape Blocks that are the closest neighbors to a given Natural Landscape Block, but these procedures are so mechanical that they will identify neighboring pairs even if they are separated by lands unsuitable for connectivity, such as highly urbanized areas or open water.

Because we could not find any literature to suggest how to identify pairs, we developed a set of rules (Chapter 2) to do so. We refer to this process as drawing "sticks" because we indicated each pair by drawing a straight line (stick) between the centers of the two Natural Landscape Blocks. The stick does not indicate where the connective area lies in map space, but simply indicates the *intent to conserve* connectivity between the Natural Landscape Blocks. We recommend that regional planning efforts use and modify our set of rules to produce results that make sense in the region. Our rules were developed in light of the following overarching motivations:

- Provide enough redundancy that all of the largest Natural Landscape Blocks and well-connected clusters of Natural Landscape Blocks have more than one connection to the larger constellation of Natural Landscape Blocks.
- Avoid drawing a stick that represents a linkage that never existed (e.g., across a major lake or bay) or has been irretrievably lost (e.g., where the only possible connectivity area would have to cross broad swaths of highly urbanized land).
- Minimize unnecessary redundancy, preferentially deleting sticks that represent inferior linkages.
- Never delete a stick that represents a linkage that is currently providing meaningful levels of animal movement, even if connectivity can be achieved by an alternative chain of sticks.

4.3.3. Depict Connectivity Areas on a Map

If a regional effort has sufficient time and money, or if there are only a few "sticks" in the region, we recommend conducting detailed Linkage Designs (see Chapter 5) for all sticks and ignoring the rest of this section. More commonly, limited resources compel planners to use some sort of placeholder to depict connectivity areas on a map, and to develop a few key Linkage Designs at a time. Potential placeholders include:

- *Major riparian corridors*. The major riverine or riparian corridors should be depicted on every regional map, regardless of how connectivity areas are additionally depicted by sticks, arrows, or polygons. Least-cost modeling (and other GIS approaches used, recommended, and discussed in this report) are useful for mapping the needs of terrestrial wildlife, but simply mapping rivers and streams is a more effective and efficient way to map connectivity for fish and other aquatic species.

[30] More generally, for *n* Natural Landscape Blocks, there are $n*(n-1)/2$ possible pairs of blocks.

- *Centroid-to-centroid sticks* (see above). This choice can be implemented quickly, and we recommend it for depicting each "road fragmentation stick," which represents two landscape blocks separated only by a road, canal, railroad, or similar linear barrier to wildlife. However, we do not recommend using sticks to represent more complex connectivity areas. Because the connectivity area is not mapped, it cannot be described in the way we were able to describe mapped placeholders in this Report (Sections 3.1 and 3.2). More importantly, a "stick map" is not useful as a decision support tool, because a project proponent or permit-granting agency cannot reliably use the stick location to assess whether a project may impact the connectivity area represented by the stick.
- *Hand-drawn arrows or polygons*, from an expert workshop or panel. This approach was used by the earlier California Missing Linkages effort (Penrod et al. 2001) and the Arizona Wildlife Linkage Assessment (Nordhaugen et al. 2006). It is a fast, efficient way to draw on knowledge of many people, including unpublished knowledge. On the other hand, the approach is not repeatable or transparent. It is also subject to over-interpretation because users of the map tend to forget the polygon or arrow is just a placeholder to signal the need for a detailed Linkage Design. If a proposed project does not lie under the arrow or polygon, it is too easy for a project proponent or permit-granting agency to assume the project will not affect the connectivity area.
- *Modeled polygons* like those in this report are produced by transparent and repeatable procedures. If this option is selected, we recommend generating these polygons by least-cost modeling[31]. Least-cost modeling requires one of two types of resistance maps, namely:
    - *Landscape resistance to movement of multiple focal species.* If this option is chosen, the resulting polygon will not be a placeholder, but rather a true Linkage Design. As mentioned in the first paragraph of this subsection, we recommend this option if there are sufficient resources to pursue it, because a full Linkage Design based on the needs of multiple species is superior to a placeholder polygon based on naturalness. Refer to Chapter 5 for guidance on linkage design.
    - *Landscape departure from natural conditions*. This option has the advantage of being quick, and the disadvantage that natural conditions are an imperfect proxy for the needs of multiple species. In this Report, the resistance map was based on landcover (80% of the resistance score, representing today's resistance to wildlife movement) and GAP status (20% of resistance score, representing human commitment not to increase resistance in the future). We modified the landcover map by reclassifying any pixel crossed by a road into a "road" landcover class, and assigned high resistance to pixels in a road

[31] Least-cost modeling is described in detail in Section 5. Instead of least-cost modeling, polygons can be modeled using individual-based movement models, circuit theory, or climate models coupled with a dispersal chain or network flow model. These three competing approaches do provide valuable information about connectivity, but are not yet sufficiently developed to serve as tools for mapping connectivity area. Because these latter three approaches may soon become useful for regional analysis or for linkage design, we describe them in Appendix E.

class. Although resistance scores for landcovers and GAP classes were assigned subjectively, they produced results that seemed reasonable for the landscapes we knew well. We recommend using similar procedures to ours (Chapter 2) because they are simple, repeatable, and easy to understand. A key issue is selecting how broad a swath should be included in the connectivity area. This decision is difficult because least-cost modeling does not allow the analyst to specify a uniform or minimum width, but instead requires the analyst to select the lowest-cost percentage of the landscape, such as the lowest-cost 4% or 6%. In this Report, the most-permeable 5% slice of the landscape produced reasonable connectivity areas, but we recommend experimenting with different percents in several highly divergent linkage areas in each regional landscape. We strongly recommend favoring a relatively large percentage of the landscape. If the regional plan starts with an overly large connectivity area, requires a fine-scale analysis before approving a project that may affect the linkage, and then finds that the Linkage Design is much smaller than the placeholder polygon, no harm has occurred to either the linkage or the project proponent. In contrast, if the regional plan depicts too small a connectivity area, the regional map would be a poor decision support tool.

4.4. Identify a Subset of Most Crucial Connectivity Areas

The steps described up to this point will produce new or different versions of Figures 3.2 through 3.9 in this report, perhaps scaled down to or below the ecoregional level. The main products would be a map of Natural Landscape Blocks (including blocks smaller than recognized at the statewide level), road fragmentation sticks, and placeholder polygons for connectivity areas that are more complex than the road fragmentation sticks. The products should also include supporting documentation, descriptive statistics for each connectivity area, and recommendations for how the map should be used.

Although following the steps outlined above would result in a useful regional product, we recommend that a regional analysis should go two steps further, by identifying a subset of connectivity areas that are most crucial to the ecological integrity of the ecoregion, and using fine-scale analysis (Chapter 5) to replace the placeholder polygons with detailed Linkage Designs in those crucial areas. The South Coast Missing Linkages map (Figure 4.1) is a good example of these additional products. The map conveys the overall vision of regional connectivity in a visually powerful way, and the accompanying Linkage Designs are implementable conservation plans.

In this section, we describe strategies to identify the crucial connectivity areas. Although this is a type of prioritization, we emphatically do not recommend any ranking scheme that would label some connectivity areas as “unimportant.” Instead, the goal is to identify a subset of the connectivity areas whose conservation or restoration would do the most to create a wildland network in the region, *without* ranking individual connectivity areas. Collectively, these crucial connectivity areas create a network of natural areas, such that the value of each linkage depends on maintaining all the others. It would therefore be meaningless to rank connectivity areas within the crucial group. It would also be counterproductive to assign low importance to one or more connectivity areas outside this group.

The crucial connectivity areas can be identified through one or more of the following procedures:

- *Opinions of end-users*. Given that the end users are actually going to implement the Linkage Designs, their opinions about which linkages to conserve are important. However, the end users typically want some guidance to help them choose wisely. Thus some of the other procedures should probably be used to help inform their opinions.
- *Quantifying biological and physical characteristics* of each connectivity area and its associated Natural Landscape *Blocks*, such as the variables defined in Section 2.4 and reported in *Appendices* B and C. South Coast Missing Linkages (Beier et al. 2006) and the Arizona Wildlife Linkage Assessment (Nordhaugen et al. 2006) weighted each variable and used the weighted sum as a "biological value score" for each linkage. If weights are to be used, we suggest that end-users set weights in a workshop setting, which encourages participants to be consistent and appreciate the priorities of other end users. A critical part of the workshop exercise is a "live" spreadsheet[32] that lets participants see how changes in weights affect the overall score of each linkage. The data table should be populated with values before the workshop, so that workshop participants can focus on the weighting scheme. Several members of the consulting team have participated in weight-setting workshops, and were impressed with the ability of participants to reach consensus in a couple hours of discussion. The only public products of the workshop should be the weighting scheme and the unranked list of most crucial connectivity areas. Final scores for any or all connectivity areas are subject to misinterpretation.
- *Quantifying threats and opportunities* to each connectivity area. Threats and opportunities are more difficult to quantify than physical and biological attributes. We strongly recommend using only variables whose values can be obtained from existing GIS layers (e.g., percent of polygon in a particular landcover or GAP status), an existing database (e.g., a database of projects in the 10-year transportation plan), or a spatially-explicit quantitative model (e.g., an urban growth model, such as developed by Huber 2008). These attributes can be weighted to produce an overall threat and opportunity score. If weighting is to be used, we again recommend that end-users set weights in a workshop. We suggest that each connectivity area be displayed in a 2-dimensional graph, with overall weighted biological score on the x-axis, and overall threat and opportunity score on the y-axis, so that the most crucial areas appear in the upper right of the graph (Beier et al. 2006).

There is no Reliable Connectivity Metric!

None of the attributes listed in Table 2.4 provides an overall metric of how much a connectivity area contributes to statewide or regional connectivity. Using the weighting

[32] See sample spreadsheet at http://corridordesign.org/designing_corridors/pre_modeling/prioritizing_linkages .

schemes described in the previous two paragraphs is one way to try to create a single score, but this composite score is not a direct measure of what each connectivity area is worth. Graph theory (Bunn et al. 2000, Urban and Keitt 2001, Theobald 2006, Minor and Urban 2007, Pascual-Hortal and Saura 2008) provides several metrics that purport to do just that. However, in the opinion and experience of the consulting team, each graph theory metric fails in this regard[33]. For example, Pascual-Hortal and Saura (2006) applied nine metrics to 14 pairs of artificial landscapes created by starting with an original landscape (A) from which connective elements were removed to create a second landscape (B). None of the nine metrics consistently decreased from landscape A to the paired landscape B. Pascual-Hortal and Saura (2006, 2008) offered a new Integral Index of Connectivity (IIC) as a measure that consistently decreased as connectivity was degraded, and they successfully applied it to a conservation planning problem in Spain. However, IIC did not work as a useful metric when the consulting team applied it to the linkages in this Report. We believe it failed because most Natural Landscape Blocks in California, including each of the largest blocks with the highest ecological integrity, had at least two chains of sticks that could connect (directly or indirectly) to almost every other Natural Landscape Block, even ones at the opposite end of the state. Thus removal of any single stick had a trivial impact on statewide connectivity. Southern Rockies Ecosystem Project (2005:20) noted similar results for other connectivity metrics[34]. The good news is that California still has a potentially well-connected network of wildlands. The bad news is that in a well-connected network, no single linkage or handful of linkages stands out as most crucial.

Reflecting on our experience with these metrics, we believe that the most important linkages in a region or state should not be identified by ranking all the linkages individually and then selecting the top 9 or top 19. What is needed is *not* a scoring mechanism for *individual linkages*, but rather a way to identify *which ensemble of linkages* provides the strongest foundation for a regional network. We believe that various ensembles of linkages can best be evaluated by a yet-to-be-invented form of simulated annealing (Section 4.3.1.4), spatially-explicit population models (Carroll et al. 2003), circuit theory (a new type of graph theory – McRae 2006), or a new graph theory metric better suited to complex networks. Until such a scheme is developed, we suggest that end users select among several alternative maps, each depicting one set of top-priority linkages. Tables of descriptors of the Natural Landscape Blocks and connectivity areas should be available to help inform their choices.

4.5. Adaptive Mapping and Planning

Conservation planning, like every other type of planning for linked human-natural systems, is never "done." After a Regional Plan is completed, human activities will split some large natural blocks into two or more smaller blocks, creating new connectivity areas between the

[33] Fundamental graph-theory concepts underlie all GIS raster operations, including least-cost modeling. Graph theory applications can help understand connectivity in many landscapes. Our only point here is that graph theory does not provide a metric that meaningfully states the value of one linkage in a state or large region containing many complexly interconnected Natural Landscape Blocks.

[34] Southern Rockies Ecosystem Project (2005: 29-30) presented a new metric *L*, intended to quantify the importance of each Linkage in a landscape. *L* results from a chain of equations such that the relationships between *L* and tangible traits such as area and distance are not obvious. Future analysis confirming the properties and behavior of *L* may demonstrate its utility.

new blocks. Human activities also might preclude animal movement in some mapped connectivity areas, thus taking them off the map. Not all changes will be for the worse. Indeed, as a result of the Regional Plan, some connectivity areas will be conserved and restored. Protection will be extended to some unprotected areas within Natural Landscape Blocks. Because of all these positive and negative developments, a new set of most crucial connectivity areas will emerge several years after a Regional Plan is completed. Every Regional Plan – just like this statewide effort – will eventually become obsolete.

This obsolescence will require a new round of identifying connectivity areas and new subsets of connectivity areas that would do the most to secure and expand the region's wildland network. Although each effort should acknowledge its own mortality, we do not recommend that each Regional Plan outline the process of its own revision. Many of the data layers and analytic tools used in this report did not exist 15 years ago. New and improved data layers and analytic tools will doubtless be available by the time a Regional Plan needs to be updated.

Revision might be triggered by a new Regional Transportation Plan, revision of land use plans by one or several counties, a new NCCP, or dramatic improvements in data or analytic tools. Regional planning entities should evaluate the regional connectivity analysis when they use it in other plan updates to make sure it is still relevant and adequate. For conservation plans with long time horizons (e.g., 50 years for some NCCPs), planners may need to periodically reevaluate the efficacy of the regional connectivity analysis.

In Chapter 5, we present an approach that is currently available to develop individual Linkage Designs more robust in the face of climate change. As climate modeling becomes more sophisticated and accurate, climate change should be considered in both statewide and regional connectivity maps.

Chapter 5. Framework for Local-scale Analyses

The statewide map of Natural Landscape Blocks and Essential Connectivity Areas can help inform and motivate regional connectivity analyses (Chapter 4), local-scale Linkage Designs (this Chapter), and road improvement plans (Chapter 6). The goal of developing a Linkage Design is to map the specific lands and spell out the specific actions needed to maintain or restore functional connections for species or ecological processes between two or more Natural Landscape Blocks.

In this chapter we provide step-wise procedures for developing Linkage Designs and plans. Except for the relatively new set of instructions related to climate change, each set of instructions provided here has proved useful in local-scale analysis in California and elsewhere over the last six years, and thus represents the state of the science of Linkage Design. However, the science and data sources for modeling landscape connectivity, wildlife habitat, and wildlife movement are evolving rapidly. We note some up-and-coming approaches and procedures in the narrative, in footnotes, and in Appendix E. Our approaches (and the new approaches on the horizon) could be dramatically improved by new GIS data layers, such as high-resolution maps of soil traits or perennial waters reliably and accurately mapped across the spatial extent of an analysis area. In ten years, perhaps sooner, many sections of this chapter will be out of date.

We recommend designing linkages primarily on the basis of focal species (Beier and Loe 1992), following these major steps:

1. *Delineate Natural Landscape Blocks:* Connectivity is meaningful only with reference to the areas to be connected. See Section 4.3.1 for various approaches for delineating blocks.
2. *Engage stakeholders:* The implementers need to be involved from the start (Section 5.2).
3. *Select focal species:* Select focal species from diverse taxonomic groups to represent a diversity of habitat requirements and movement needs (Section 5.3.2).
4. *Map corridors for focal species:* Conduct least-cost corridor analysis for each focal species to identify one or several swaths of habitat that support movement and gene flow of all species (the rest of Section 5.3).
5. *Consider climate change:* Add additional swaths of habitat to increase the utility of the linkage under unknown future climate (Section 5.4).
6. *Evaluate and refine the preliminary Linkage Design:* The most permeable landscape (identified in the previous two steps) may not be very permeable for some species. Therefore planners must analyze the spatial distribution of suitable habitat, especially habitat patches large enough to support breeding, for each species. By evaluating the configuration and extent of potential cores and patches relative to the dispersal ability of focal species, planners can assess whether the preliminary Linkage Design is likely to serve the species, and add habitat to ensure all selected focal species are

accommodated. At this stage, all major rivers and streams should also be added to the Linkage Design unless they are already included in it.

7. *Assess in the field:* Conduct fieldwork to ground-truth existing habitat conditions, document existing barriers and potential passageways, identify restoration opportunities, and consider management options (Section 5.7).

8. *Develop the Linkage Design Action Plan:* Compile results of analyses and fieldwork into a comprehensive report detailing what is required to conserve and improve linkage function, including priority lands for conservation, specific management recommendations, and prescription for mitigating roads and other barriers.

When should a Linkage Design be developed? Ideally, regional Linkage Design efforts such as those in the Central Coast (Thorne et al. 2002), South Coast (Beier et al. 2006), Central Valley (Huber et al. 2010), California Deserts and Bay Area (both Penrod et al. in preparation) will be carried out in each ecoregion in California. However, a few other examples of scenarios that might trigger the development of a Linkage Design are (1) a proposed development project might adversely impact an Essential Connectivity Area; (2) a transportation improvement project is planned in an Essential Connectivity Area, providing an opportunity for improving wildlife movement and habitat connectivity; and (3) a Habitat Conservation Plan, Natural Community Conservation Plan, or Blueprint Plan is being prepared. We caution that a Linkage Design should be based on existing baseline conditions or, as in the case of the Central Valley effort (described in Section 3.3.7) on context and restorability of habitats and *not* on potential future build out scenarios. Basing the analysis on future development scenarios makes it difficult to know what could be achieved for wildlife connectivity. Basing the analysis on existing or restorable conditions provides a biologically optimum plan. Although compromises may occur during implementation, the biological optimum provides a useful reference condition, so that decision-makers can evaluate trade-offs and make good compromises.

Why focal species? Without focal species, we would be designing linkages primarily on the basis of natural landcover, with no way of knowing whether such a connection succeeds in serving biodiversity in any way besides adding some acres of habitat. Focal species also provide a basis for justifying linkage width, which habitats it should include, and the need to include both riparian and upland areas. Future generations of biologists will assess the success of the linkage based on whether it serves the particular species.

5.1. Products of a Linkage Design

A Linkage Design is a detailed action plan for maintaining and improving connectivity that includes:

- Clearly stated goals for the Linkage Design.
- A description of the Natural Landscape Blocks to be served by the linkage, including information on the ecological significance of the connection, vegetation and land-use patterns, and existing conservation investments whose integrity is affected by the linkage.

- An analytic approach that is transparent and repeatable.
- A narrative for each focal species, including justification for selection, distribution and status, habitat associations, spatial patterns, and conceptual basis for species models.
- A narrative describing how climate change was considered in developing the Linkage Design.
- Maps and narratives describing the spatial distribution of habitat in the Linkage Design for each focal species, an assessment of how well the linkage will support movement by each focal species, and spatially-explicit descriptions of impediments to animal movement.
- Prescriptions for maintaining and improving connectivity, such as needs and opportunities for habitat restoration, and recommendations to mitigate the effects of various impediments to connectivity, such as roads, rail lines, in-stream barriers, and urban and rural development.
- Land protection and stewardship opportunities, including existing planning efforts addressing the conservation and use of natural resources in the planning area and other implementation opportunities for agencies, organizations, and individuals interested in helping conserve the connection.
- A description of how the linkage can be incorporated in existing conservation measures (e.g., NCCP, HCP, General Plan open space elements), including statutory or regulatory language relevant to conserving connectivity.

5.2. Stakeholder Engagement

Conserving landscape linkages between natural wildlands usually requires strong collaboration among land management agencies, conservation groups, transportation and resources agencies, sovereign Native American tribes, and many others. Numerous conservation efforts are underway throughout the state, but most have distinct planning jurisdictions too small to conserve ecosystem processes and functions. Involving all relevant agencies and organizations from the inception of the Linkage Design process can promote coordination across jurisdictional boundaries and the partnerships needed to implement the resulting Linkage Design. Participation in a habitat connectivity workshop, to lay the biological foundation for planning in the linkage, can help create momentum and generate enthusiasm for implementation of the resulting plan (Beier et al. 2006). Stakeholders should be given the opportunity to participate in every aspect of the Linkage Design process, including development of the work plan, selection of focal species, review of draft analyses, and roll-out of the final report.

Most stakeholder participation will occur in workshops. The invitation should clearly define the goal of each workshop and explain what it is—and what it is not—to every invitee. Not all stakeholders need or want to attend every workshop. One paragraph can provide enough information to let each person decide whether to attend. If it cannot be stated in a paragraph, the goal is not clearly defined.

Who should be invited to participate? Land management agencies, state and federal wildlife management agencies, conservation non-governmental organizations, transportation agencies, county and municipal planners, local land trusts and conservancies, first nations (Native American tribes), military bases, utility districts, developers, ranchers, universities and other research entities, biological consulting firms, and other potential stakeholders should all be invited. An open door demonstrates that the process is transparent, honest, and inclusive. The plan and its scientific basis are improved by having stakeholders challenge assumptions and offer novel ideas.

5.3. Producing Corridors for Focal Species

Species have been the only focus in almost every published Linkage Design (Beier et al. 2008) and species are the primary focus of the approach we describe here. Additional procedures to make the linkage more robust to climate change (Section 5.4) are desirable, but are still experimental.

5.3.1. Overview and Justification for the Least-Cost Modeling Approach

Here we describe a set of recommended procedures for Linkage Design. Our approach uses least-cost modeling to identify areas best able to support movement between Natural Landscape Blocks for each of several focal species. Our approach also uses patch configuration analysis (Section 5.6) to evaluate how well the design supports movement for these species. Patch configuration analysis is also used to consider the needs of focal species for which a least-cost model is not appropriate.

Least-cost modeling is a GIS technique that models the relative cost for a species to move between Natural Landscape Blocks (more specifically, suitable habitat within each block) based on how each species is affected by various landscape characteristics. The landscape is portrayed in a GIS as a grid of squares; such a grid is called a *raster*, and each square is called a *pixel*. Resistance values are calculated for each pixel in the raster as a function of the input data layer's attributes representing habitat characteristics, such as landcover, topography, and level of human disturbance. *Resistance* refers to the difficulty of moving through a pixel and *cost* is the cumulative resistance incurred in moving from the pixel to targeted endpoints in each Natural Landscape Block. Early examples of least-cost modeling identified a least-cost path—that is, a string of pixels that is only one pixel wide. A pixel-wide path is not a realistic proposal for conservation, so most conservation GIS analysts now identify the lowest-cost *swath* of pixels, which is called a *least-cost corridor*. The least-cost corridor represents the land that best supports species movement between wildland blocks under the model's assumptions (Adriaensen et al. 2003, Beier et al. 2008).

For each focal species, the steps in a least-cost corridor analysis are:

1. Calculate habitat suitability as a function of pixel attributes such as landcover, distance to nearest road, topographic position, and elevation.
2. Use habitat suitability to map patches of breeding habitat.
3. Develop a resistance map (Section 5.3.4). When there are appropriate data on movement of the focal species, calculate resistance as a function of pixel attributes.

Such data are lacking for most species, in which case the inverse of habitat suitability can be used as the resistance map.

4. Select habitat patches within each Natural Landscape Block as targeted end points and calculate cost-weighted distance from each terminus, which calculates a value for every pixel that is the least accumulated cost of traveling from each pixel to the source.
5. Select an appropriate contour (% "slice") to delineate the least-cost corridor.

Individual-based movement models and circuit theory are potential alternatives to least-cost modeling. Both approaches are based on movement needs of focal species, require the same GIS layers, and have the same technical issues as least-cost modeling. In addition, each of these two approaches must overcome unique conceptual or technical hurdles (described in Appendix E) before they can be used to design corridors. Although these alternatives are promising tools for designing corridors in the future, 23 of 24 published corridor or Linkage Designs reviewed by Beier et al. (2008) used least-cost modeling, and none used individual-based movement models or circuit theory[35].

Over the last six years the least-cost modeling procedures described here were used to produce 11 Linkage Designs in California's South Coast Ecoregion (www.scwildlands.org) and 16 Linkage Designs in Arizona (www.corridordesign.org/arizona). They are currently being used to design linkages in the San Francisco Bay Area and in California's Mohave and Sonoran Desert Ecoregions. Beier et al. (2008) outline 16 key analytic decisions that must be made during a Linkage Design based on focal species, and describe some alternatives to the procedures outlined here. This same guidance is repackaged for an audience of GIS analysts and the ecologists at http://corridordesign.org/designing_corridors, which also provides ArcGIS tools for most of the GIS procedures.

5.3.2. Select Focal Species

Each Linkage Design should have multiple focal species, which may include not only mammals but also reptiles, fishes, amphibians, plants, birds, and invertebrates. Lambeck (1997) introduced the focal species concept, and explained how these species can be identified. We recommend inviting biologists from agencies, nongovernmental organizations, universities, tribes, consulting companies, and major landowners to help identify species that would serve as a collective umbrella for all native species and ecological processes. We suggest inviting specialists with local knowledge of each taxonomic group. We recommend that focal species be selected at a workshop, where work can occur within taxonomic sub-groups or as a single group. Selection could also occur by conference call or emailed submissions from individuals. Participants should be provided detailed maps on which they can delineate species occurrences, known or suspected core areas, potential barriers, and areas that need restoration to support movement by nominated focal species. The participant should complete a form for each species nominated, confirming its occurrence in the linkage area, and justifying why it would be useful as a focal species.

[35] The 24th study (Williams et al. 2005) used linked emission scenarios, climate models, climate envelopes, and dispersal chain modeling.

Because large carnivores like bears and mountain lions live at low density and are among the first to be harmed by loss of connectivity, they are appropriate focal species for Linkage Design (Beier 1993; Servheen et al. 2001; Singleton et al. 2002). They also make popular flagship species to increase stakeholder support for linkage conservation. Nonetheless, a linkage should not be designed solely for large carnivores, or any single species. Many species need linkages to maintain genetic diversity and metapopulation stability. Furthermore, most large carnivores are habitat generalists that can move through marginal and degraded habitats, and a corridor designed for them does not serve most habitat specialists with limited mobility (Beier et al. 2009). Indeed, successful implementation of a single-species corridor for large carnivores could have a "negative umbrella effect" if land-use planners and conservation investors become less receptive to subsequent proposals for less charismatic species. The umbrella effect of large carnivores best serves biodiversity if these species are part of a linkage designed for a broad array of native species.

A good suite of focal species would include species in each of several categories; some species may qualify in more than one category:

- *Area-sensitive species:* species with large home ranges or requiring long-distance dispersal for metapopulation persistence (e.g., mountain lion, badger, mule deer, bighorn sheep). These species will be the first to disappear or become ecologically trivial when linkages are severed.
- *Barrier-sensitive species:* species most reluctant to traverse roads, fences, canals, urban areas, and other barriers in the planning area.
- *Less mobile species:* species whose mobility is limited due to extreme habitat specialization, small home range, or short dispersal movements. These species will often be corridor-dwellers (Beier and Loe 1992)—that is, they will require multiple generations to move their genes between Natural Landscape Blocks.
- *Habitat specialists:* one or more species strongly associated with each major vegetation type or topographic element in the linkage area.
- *Species distributed among blocks as a metapopulation*: species requiring dispersal between Natural Landscape Blocks for metapopulation persistence; species requiring connectivity to avoid genetic divergence of a now-continuous population.
- *Ecological indicators:* species tied to an important ecological process, such as predation, pollination, sand transport, or fire regime. A linkage that serves these species is more likely to support ecological interactions and processes.
- *Non-flying migratory populations:* Seasonal migration is crucial for some of California's mule deer populations, and a few other species in California. Although some birds and flying invertebrates also migrate, they typically can fly for tens or hundreds of miles across unsuitable habitat, so their migration is unlikely to be affected by the Linkage Design.

<u>Patch configuration analysis is used for *all* focal species; least-cost modeling is used for *some* focal species</u>. Least-cost modeling is not appropriate for two types of focal species: (1)

Most flying species[36], including most bats, insects, and birds (except perhaps for sedentary species that do not fly long distances between habitat areas, such as gnatcatchers, wrentits, thrashers, quail, or roadrunners). (2) A species that occurs only in the area between wildland blocks but is not a current or historic resident in the Natural Landscape Blocks[37]. Although least-cost modeling is not appropriate for these species, we recommend considering connectivity needs of these species by modeling suitable patches of habitat (Section 5.3.4) and analyzing the configuration of habitat patches (Section 5.6). For each species, a narrative should explain justification for selection, distribution and status, habitat associations, spatial patterns, and the conceptual basis for the model parameters (example narratives at www.scwildlands.org).

We recommend consulting an expert on each focal species, preferably someone with local experience, to parameterize the model and review the results produced by the model. Clevenger et al. (2002) found that expert-based models that did not include a literature review performed significantly worse than literature-based expert models. Therefore, each participating expert should review all papers on habitat selection by the focal species and closely-related species. To parameterize the model, the expert must:

- Assign a *weight* to each habitat *factor* affecting habitat suitability. *Factors* are data layers available in GIS format, such as landcover, elevation, topographic position, and distance to nearest road. The *weight* indicates the relative influence of each factor, such that the weights for all factors sum to 100%.
- For factors that are distributed as continuous variables, such as elevation or distance to road, divide the variable into *classes* (bins) that are meaningful for the species[38]. For instance, if a species occurs only between approximately 1,000 and 2,000 m, the expert might create 5 elevation classes, such as 0-900 m, 900-1,100 m, 1,100-1,900 m, 1,900-2,100 m, and >2,100 m that could be confidently scored.
- Assign a *habitat suitability score* to each class within each factor. For example, within the factor *landcover*, the expert would assign habitat suitability scores for grasslands, scrublands, and juniper woodlands; within the factor elevation, he or she would assign a score to each elevation class. Our procedures require habitat suitability to be scaled from 0 (unsuitable) to 100 (best habitat), with scores of 60 or more indicating habitat suitable for breeding. The expert should be advised to assign a score of 0 only if the elevation class, landcover, distance to road class, or topographic position is absolutely unsuitable for the species.
- Estimate *minimum patch size*, i.e., the smallest area needed to support breeding by the species.
- Estimate *longest documented dispersal distance*, that is, the longest distance an

[36] Highly mobile flying species do not move in pixel-to-pixel fashion, as assumed by least-cost modeling. In the future, new approaches may model movement of such species in a meaningful way.
[37] Beier et al. (2006) discuss other, relatively uncommon conditions in which least-cost modeling is not appropriate.
[38] One could develop an equation that relates habitat suitability to the pixel's elevation, but it is typically easier and more appropriate to divide elevation into classes. Consider for example, how difficult it would be for a species expert to devise an equation to represent the highly non-linear response of a species to elevation in this example.

individual of the species has been documented to move from its birthplace to the place where it becomes a breeding adult. The expert should provide citations for this information, or indicate that it is based on unpublished data. If there are no data for the species, the expert can make inferences from closely related species, or species of similar body size, mobility, and natural history.

5.3.3. Compile and Refine Digital Data Layers

Habitat models are based on factors such as landcover, topography, and roads, not because these fully describe habitat, but because these are usually the only relevant factors available as GIS layers. Therefore models are incomplete to the extent that they exclude important factors that are not mapped across the entire analysis area. Models are also inaccurate because landcover—the most important factor in most models—is typically mapped with only 60%-80% accuracy (Yang et al. 2001)[39]. Nonetheless, models are a transparent way to organize what we do know about each species, and thus are useful.

The GIS layers needed for permeability analyses include digital elevation models, roads, and landcover[40]. Each GIS data layer should be compiled at the resolution of the finest GIS layer, typically a 30 x 30-m cell. The source, type, scale, accuracy (if known), and date of each data layer should be reported. Road and vegetation layers should be compared to recent high-resolution aerial photos and manually updated to reflect recent changes. GIS layers of land ownership types, protected lands, and species occurrences are also helpful to display and interpret outputs. Additional spatial data layers such as maps of soil properties or locations of water sources may be useful for some focal species, but in most analysis area these attributes are not mapped reliably at high resolution throughout the area.

Topographic position and slope are variables derived from a digital elevation model. The topographic position index (Jenness 2006) categorizes each pixel into one of four topographic positions (canyon bottoms, ridgelines, flats, or slopes) based on the pixel elevation and slope. Topographic position is important because some species are known to be associated with canyon bottoms, steep slopes, or other topographic positions. Elevation can be used as a factor if the species is known to occur within a certain range of elevation.

The road layer consists of lines, from which the analyst must derive either road density or distance to roads. Many least-cost models use road density within a moving window around the focal pixel (e.g., kilometers of paved road per square kilometer) as a variable. Unfortunately, despite the seeming scale-invariance of length per length-squared, the calculated value of road density changes non-intuitively with the size of the moving window, making it difficult to estimate resistance for road density classes (D. Majka and P. Beier, unpublished data). Furthermore, published estimates of animal occurrence with respect to road density cannot be translated to a different moving window size. Therefore we

---

[39] Vegetation for a portion of the state has been mapped at a fine scale (1-2 acre minimum mapping unit) at a level of accuracy well above 80% (http://www.dfg.ca.gov/biogeodata/vegcamp/). Direction for expanding and standardizing this spatial data within CDFG also comes from AB2785.

[40] Other layers can and should be used, especially if they allow the model to be improved with empirical data on habitat use or movement. However, many empirical studies and habitat models rely on variables that are not available in GIS format.

recommend using distance to nearest road as the road-related variable. Scientific reports using this metric can be directly imported into the model.

5.3.4. Developing Maps of Resistance and Habitat Patches

Ideally, resistance to ecological flows should be empirically measured from movements of focal species or estimates of gene flow rates across various landscape features (e.g., cover types, roads[41], topographic features). Advances in use of GPS tracking devices and genetic analyses may provide empirical estimates of resistance of landscape features to ecological flows. Currently, however, there is virtually no scientific literature estimating resistance, so almost all least-cost models therefore assume that resistance is linearly related to habitat suitability. For example, if habitat suitability for a focal species is scored 0 to 100, resistance could be scored as 100 minus suitability or the reciprocal of suitability. A slightly simpler approach, which we use here, is to scale suitability such that zero indicates the highest suitability, and larger values[42] indicate progressively more unsuitable habitat. Although our approach follows the common practice of assuming resistance is linearly related to habitat suitability, we recommend using empirical estimates of resistance when they are available.

Habitat suitability values are calculated separately for each focal species, because a given attribute (e.g., percent forest cover) does not affect each species in the same way. The weighted arithmetic mean is the most commonly used algorithm to combine weights, but the weighted geometric (multiplicative) mean better reflects a situation in which one habitat factor limits suitability in a way that cannot be compensated by other factors. For instance, if a species is never found above 2,000 m, a pixel at 2,500 m should be considered unsuitable even if landcover, distance from road, and topographic position are optimal. Therefore, we suggest using a weighted geometric (multiplicative) mean to combine the influence of the various factors:

$$\text{Suitability} = (S_A\hat{}W_A) * (S_B\hat{}W_B) * (S_C\hat{}W_C),$$

where S_A, S_B, and S_C are suitability ratings for the pixel's particular class within factors A, B, and C, respectively, and W_A, W_B, and W_C are the factor weights. The weighted geometric mean is strongly influenced by suitability scores of zero or near zero, such that if a score for any class is 0, then suitability of the pixel remains 0 regardless of other factor weights or scores.

The next procedure is to define *habitat patches* to be used a start and end points of least-cost corridor models, as modeled patches of low resistance in the least-cost model, and as meaningful descriptors in patch configuration analysis (Section 5.6). A habitat patch is a cluster of pixels that are good enough (mean score above 60 [or other threshold set in Section

[41] We discourage the practice of assigning low resistance to road pixels that contain an existing or proposed crossing structure. Such a practice forces the modeled corridor through the crossing structure, even if it is located in poor habitat, and thus prevents the analyst from identifying the best locations for crossing structures.

[42] In most of our work, we created a scale for suitability (and resistance) that ranges from 0 to 25 or 0 to 100. As mentioned in Section 2.3.1, we suggest that the upper bound should be about 1,000 times the lower bound to enable the analyst to model situations with extremely high resistance to ecological flows. Extremely high values should be reserved for the few features that, on the basis of strong empirical evidence, are almost totally impermeable to the focal species or process.

5.3.2]) and big enough (i.e., larger than the *minimum patch size* specified by the species expert) to support breeding.

5.3.5. Least-cost Corridor Modeling

Running the least-cost model requires specifying the endpoints that are to be connected. Rather than simply using the targeted Natural Landscape Blocks as terminuses, we recommend using habitat patches within the Natural Landscape Blocks. If the two Natural Landscape Blocks are irregularly shaped such that the facing edges nearly touch at one point but are elsewhere much farther apart, the least-cost model will tend to run through the narrowest gap, even if habitat there is much less suitable than a longer, less direct path. In these situations, to give the model "room to run" and "find" the more appropriate least-cost corridor, we recommend drawing parallel lines within the Natural Landscape Blocks and selecting patches behind these lines as target endpoints for the analysis.

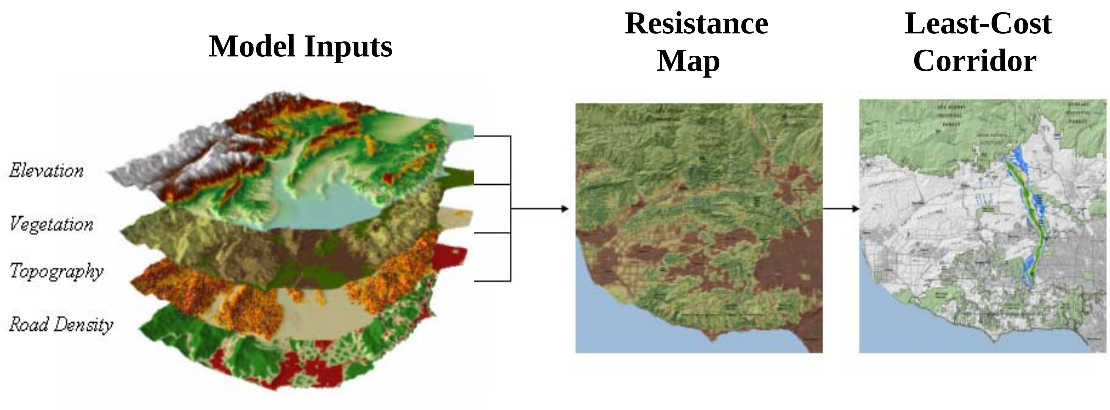


Figure 5.1. Resistance (usually the inverse of habitat suitability) is a function of elevation, vegetation, topography, and a road-related variable. The swath of pixels with the lowest cost (cumulative resistance from each terminus) is the least cost corridor.

To model the needs of corridor dwellers (species that require several generations to move through the corridor) the least-cost model may produce better results if the analyst assigns all pixels within *habitat patches* a resistance value near zero. We recommend this procedure when modeling a species with a few habitat patches embedded in a matrix dominated by poor habitat. In such situations the procedure tends to produce a corridor that links those patches in stepping-stone fashion. Nevertheless, if the habitat quality in a large fraction of the matrix is near the threshold between suitable and unsuitable, a slight decrease in the threshold can cause most of the matrix to be mapped as a habitat patch, resulting in a highly linear corridor that fails to include the highest-quality habitat. In these situations we discourage use of this procedure unless the analyst is confident that the threshold is precisely known.

Once the targeted endpoints are identified, the analyst calculates the cost-weighted distance (cumulative resistance) from each terminus and then sums the two raster outputs to produce the corridor result. The analyst then selects a "slice" (% cost contour) of the corridor output to delineate the least-cost corridor. A key decision is how to select a slice that is wide enough for the species. For a corridor dweller, one suggestion is that the least-cost corridor should be as wide as the species' typical home range. However, if the focal species is strongly territorial, this could result in corridors fully occupied by home ranges where social interactions impede movement through the corridor. Therefore we suggest that minimum width for a corridor dweller should be considerably more than one home range width along all or most of the length of the corridor. Passage species able to move through the least-cost corridor in one or several days can doubtless pass through areas narrower than their typical home range, thus consideration of the biology of the focal species should be used to recommend a reasonable minimum width.

5.4. Producing Corridors to Support Movement During Climate Change

Climate change has arrived in California. During the past century, the earth's temperatures have warmed faster than at any other time within the past 650,000 years, and the western United States are warming faster than the rest of the nation. Moser et al. (2009) describe how climate change is already occurring in California: Since 1920, California's annual nighttime temperatures have increased 0.33 °F per decade, daytime temperatures have increased 0.1 °F per decade, and sea levels along California's coast have risen seven inches. Although irrigation has reduced the expected warming from climate change in the Central Valley, the amount of water available for irrigation is expected to decline because Sierra snowpack is melting earlier in the spring season. As irrigation decreases, warming in the Central Valley will accelerate. California wildfires have increased in frequency, duration, and size. In the future, increasing frequency of extreme sea-level events may threaten Delta levees and the Bay-Delta ecosystem, and may increase the risk of saltwater intrusion into coastal aquifers. The future will almost certainly bring increased winter rainfall (and less snow), earlier spring runoff, and increased frequency of extreme storm events. In the context of Linkage Design, the most important finding is that the geographic ranges of many of California's plants and animals are shifting northward and toward higher elevations. For example, the western edge of the ponderosa pine forest in the Sierra Nevada moved 4.4 miles eastward and shifted upward by about 637 feet, with the previously ponderosa-dominant areas being replaced by oaks and other trees (Thorne et al. 2006).

Adaptation to climate change is necessary. Even under the most optimistic scenarios of emissions and carbon sequestration programs, past emissions will drive temperature and precipitation changes for at least 50 years (IPCC 2001). These changes will cause range shifts by plants and animals and reassembly of biotic communities (Lovejoy and Hannah 2005). Three adaptation strategies may improve the ability of organisms to respond to change. First, conserving or increasing genetic diversity can help species adapt evolutionarily to new temperature and precipitation regimes (Skelly et al. 2007; Millar et al. 2007). Second, managers can translocate species to areas expected to have suitable future climate (McLachlan et al. 2007; Hunter 2007). Third, managers can support range shifts by enlarging protected areas or linking them with corridors (Hannah et al. 2002).

Enhancing connectivity is an essential adaptation strategy. This strategy avoids over-reliance on evolutionary response or the artificiality of assisted colonization. It is also consistent with paleoecological evidence that extensive shifts in "species' geographical ranges have been the most important response of biota to past large, rapid climatic changes" (Huntley 2005:121). Lovejoy and Hannah (2005), Hannah and Hansen (2005), Heller and

Zavaleta (2009), and other major reviews conclude that enhancing connectivity and linking natural landscapes is the single most important adaptation strategy to conserve biodiversity during climate change. Sadly, only three studies (Williams et al. 2005, Rouget et al. 2006, Phillips et al. 2008) designed linkages expressly to conserve movement during climate change. All other Linkage Designs have been designed for focal species, using models for which landcover was the dominant driving factor. Because landcover will change over the next 100 years, each of these designs is potentially at risk of failing to fully provide functional connectivity in the face of climate change.

5.4.1. Overview and Justification of the Land Facet Approach

In light of these considerations, and strongly-expressed concerns from the Multidisciplinary Team at the initial meeting for this Project, we provide procedures to design corridors and linkages that should provide connectivity during climate change and during future periods of climate quasi-equilibrium. Our procedures define corridors of physical landscape features; these corridors are combined with the focal species corridors (Section 5.3) to produce a Linkage Design (Sections 5.5 and 5.6). Thus the new corridors complement, rather than replace, focal species corridors[43].

The land facet approach is still under development. Paul Beier, Brian Brost, and Jeff Jenness at Northern Arizona University have used land facets to create Linkage Designs for three essential connectivity areas in Arizona. In spring 2010, they will submit a more detailed "cookbook," targeted at linkage designers, to a peer-reviewed journal and will release free ArcGIS 9.3 tools at www.corridordesign.org. We emphasize that the land facet approach is not as well-developed as least-cost modeling. With the enormous recent attention to climate change, new and better approaches may emerge within a few years. We strongly urge analysts to look for alternatives, and to consider the land facet approach one reasonable way to address this crucial issue. This approach is subject to much less uncertainty than the only alternative proposed so far, uses data layers already assembled for focal species modeling, and is cheap in terms of computing time. Before describing the land facet approach, we briefly discuss what appears to be a more direct and obvious approach.

Why not design linkages by modeling climate change and species response to climate change? Two efforts have done this, namely Williams et al. (2005) and Phillips et al. (2008). They conducted complex analyses in which an emission scenario drove a global model of air and ocean circulation. The circulation model was downscaled to predict future climate at a finer regional scale (2.9-km^2 cells). Climate envelope models were then used to produce dynamic maps of the expected future distribution of biomes or species to map a corridor that would support range shift by focal species (in this case, plants in the family Protaceae). Unfortunately, each step has enormous uncertainty. For example, total emissions during 2000-2100 vary by a factor of six among the six major emission scenarios[44] (IPCC 2001).

[43] As previously stated, the Essential Connectivity Areas in this report are intended to be replaced by detailed designs based on focal species and land facets (or another climate change approach). Although climate change will affect the *character* of California's natural landscapes, these landscapes will be in approximately the same *locations* as the Natural Landscape Blocks in this report, and thus it makes sense to design linkages to connect them. We expect the typical linkage design will be mostly within the Essential Connectivity area because it represents a large fraction of the most natural land between Natural Landscape Blocks.

[44] The models of Williams et al. (2005) and Phillips et al. (2008) used only one emission scenario.

Worse yet, during the first six years of the century, actual emissions exceeded *all* of these scenarios (Raupach et al. 2007). For a single emission scenario, the seven air-ocean global circulation models[45] produce markedly different climate projections (Raper and Giorgi 2005; IPCC 2001). Finally, climate-envelope models may perform no better than chance (Beale et al. 2008). Because these sophisticated models have not been able to simulate the large shifts that paleoecologists have documented during the last 100,000 years of glacial oscillations, Overpeck et al. (2005:99) concluded that the "lesson for conservationists is not to put too much faith in simulations of future regional climate change" in designing robust conservation strategies. Finally, the resolution of the final maps (pixel sizes in square kilometers) is coarser than the typical scale at which lands are targeted for conservation. Although this modeling approach ingeniously and directly simulates the actual processes of emission, climate change, and species response, it is not yet a useful tool to help design a linkage between two Natural Landscape Blocks.

So what is a good alternative? Wessels et al. (1999) coined the term *land facets* for *recurring areas of relatively uniform topographic and soil attributes*. Hunter et al. (1988:380) suggested that conservation planners should protect areas with optimal diversity of such landscape units: "we advocate basing the coarse-filter approach on physical environments as 'arenas' of biological activity, rather than on communities, the temporary occupants of those arenas." The idea is rooted in the life zone concept of C. Hart Merriam (1890), who observed that plant and animal communities were predictably associated with particular combinations of latitude, elevation, and aspect. The idea is also rooted in the "state factor model of ecosystems," which holds that the species present at any given site are a function of climate, other organisms present in or adjacent to the site, disturbance regime, topography, the underlying geological material, and time (Jenny 1941; Amundson and Jenny 1997). Land facets reflect the stable state factors, namely topography, geology, and time (geology and time represented by a single soil-related variable). Other state factors—climate, interspecific interactions, dispersal, and disturbance regimes—are subject to change under a warming climate and are thus less reliable for conservation planning. Protecting diverse physical environments may also ensure the persistence of the ecological and evolutionary processes that maintain and generate biodiversity (Cowling et al. 1999, Noss 2001, Moritz 2002, Cowling et al. 2003, Rouget et al. 2006, Pressey et al. 2007, Klein et al. 2009). Thus, a linkage that includes strands of each land facet should support species movements in any future climate regime, and a linkage that includes a strand with high diversity of land facets should support species movements during periods of climate instability. Beier and Brost (2010) present the conceptual basis of the land facet approach in detail, and discuss a few of the key issues in applying the approach to Linkage Design.

A land facet Linkage Design looks a lot like a focal species Linkage Design. Like linkages designed for multiple focal species, linkages designed for a diversity of land facets (Figure 5.2) contain multiple strands. Specifically the Linkage Design for land facets includes:

- Several (typically 5-15) corridors, each of which is designed to maximize continuity of one of the major land facets that occurs in the planning area. Each such strand or

[45] The models of Williams et al. (2005) and Phillips et al. (2008) used only one air-ocean global circulation model, which was downscaled using one of several possible regional circulation models.

corridor is intended to support occupancy and between-block movement by species associated with that land facet in periods of climate quasi-equilibrium. Like each focal species corridor, each land facet corridor is produced by least-cost modeling.

- One corridor with high beta diversity (i.e., high local interspersion of facets; Figure 5.2) to support range shift, species turnover, and other ecological processes relying on interaction between species and environments. The high diversity corridor is also produced by least-cost modeling.
- A riverine strand to support aquatic species, nutrient and sediment flows, and upland-wetland interactions. Although such a corridor could be produced by an automated GIS procedure, hand-drawing the major riverine connection is easier.

Can the land facet approach be used in analyses of regional or statewide connectivity? It took many person-hours to develop procedures that produce repeatable, interpretable results at the level of one Essential Connectivity Area. With additional work, a land facet approach probably could be developed for other scales.

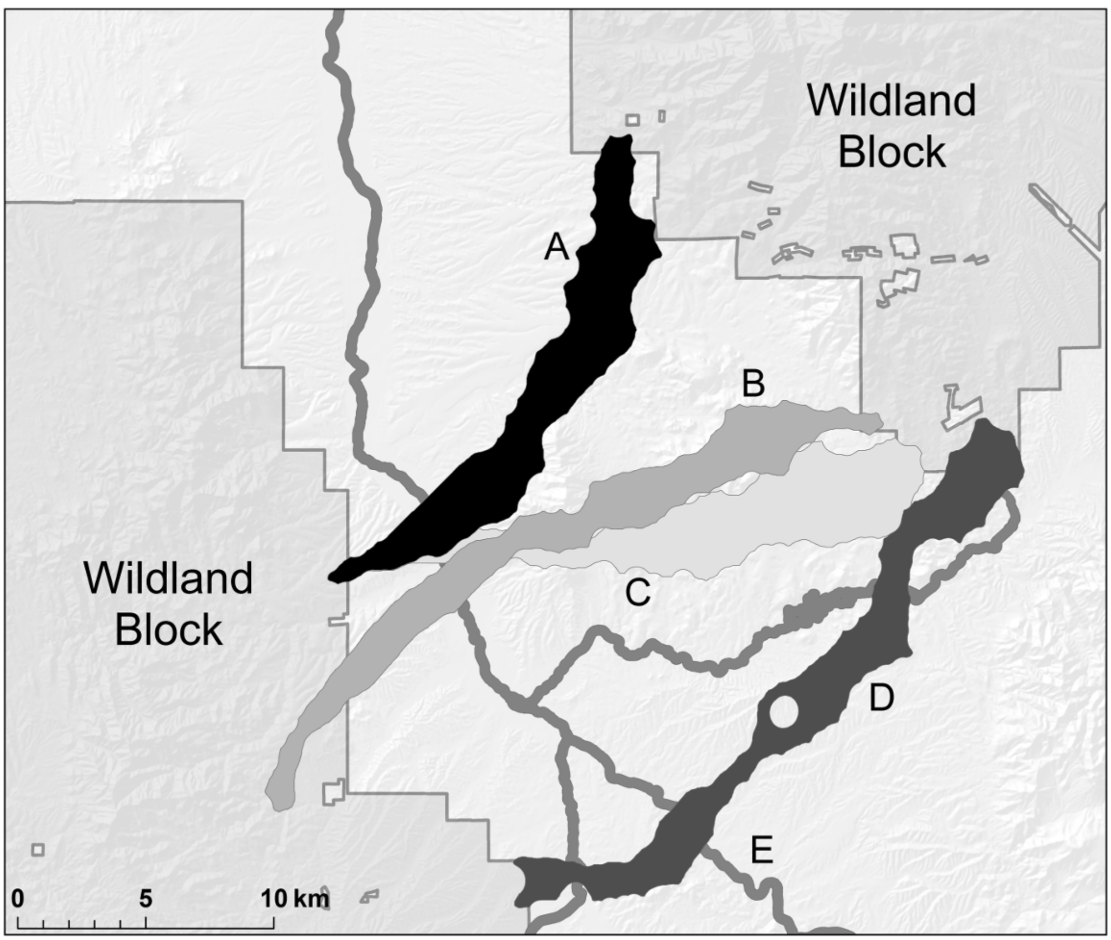


Figure 5.2. A multistranded linkage of land facets designed to allow species to shift their ranges in response to climate change and to support movement during periods of quasi-equilibrium. Area A optimizes continuity for high local diversity of land facets. Other areas provide the best continuity of high-insolation, steep slopes (area B), low-elevation, gentle canyons (area C), and low-elevation,

gentle ridges (area D). Area E encompasses the region's main river and its only perennial tributaries from each wildland block.

5.4.2. Defining and Mapping Land Facets

Ideally soil attributes should be used along with topographic attributes to define land facets. Unfortunately, soil maps have many limitations (Sanchez et al. 2009). For instance, polygons may lack values for a certain attribute or contain several states of that attribute, indicating the presence of unmapped heterogeneity. In most nonagricultural parts of the western United States, soil maps consist of large, heterogeneous polygons from which inferences about relevant traits, such as moisture, texture, depth, or soil nutrients, cannot be made (Beier and Brost 2010). Therefore, in this description of the approach, land facets are based only on topographic variables. Because the approach can use both categorical and continuous variables, it can readily be adapted to accommodate categorical soil variables (such as soil type) and continuous soil variables (such as soil depth or moisture). We strongly encourage use of relevant soil data if they are available throughout a planning area.

Moore et al. (1991) and Franklin (1995) discuss approximately 20 topographic variables that can be derived from a digital elevation model (DEM). To maintain easily interpretable and biologically meaningful land facets, Beier and Brost (2010) recommend using four variables to define land facets from 30-m digital elevation model:

1. Topographic position: Each pixel is assigned to one of three classes, namely canyon, ridges, and slopes (including flat slopes), by comparing the elevation of the pixel to the average elevation within a 200-m radius (Jenness 2006).
2. Annual solar insolation: Sum of instantaneous radiation at half-hour intervals for one day per month over a calendar year using the 'Solar Radiation' tool in ArcGIS 9.3 (ESRI, Redlands, California). The tool calculates half-hour radiation as a function of latitude, aspect, slope, and topographic shading, but ignores thickness of atmosphere and cloud cover.
3. Steepness, expressed as percent slope.
4. Elevation.

To ensure that the classification represents the land facets of the Natural Landscape Blocks, Beier and Brost (2010) recommend using only pixels inside the blocks to define the land facets. Later, pixels in the rest of the rest of the analysis area will be assigned to appropriate land facets. Using only the pixels inside the Natural Landscape Blocks, the procedures (www.corridordesign.org) start with these two steps:

1. Assign each pixel into broad classes of the categorical variable topographic position. This classifies each pixel as a ridge, canyon, or slope pixel. The procedure allows other categorical variables, such as soil type, but the default is topographic position.

2. Characterize each slope pixel based on all three continuous variables (steepness, elevation, insolation). Characterize each ridge or canyon pixel based only on steepness and elevation[46].

Within each topographic position, the procedures involve the following sequential steps:

1. Identify outliers[47], i.e., cells with combinations of values of the continuous variables that rarely occur in the Natural Landscape Blocks, and remove them from the analysis. These cells often occur in isolated patches and are limited to a small portion of the landscape. Outliers produce clusters that span a large fraction attribute space, with a diffuse or diluted ecological interpretation. Extreme cells also shift the position of the cluster centroid to a sparse region of multivariate space.
2. Use multivariate procedures to classify the pixels into *c* natural clusters or groups, for each value of *c* from 1 to 10. For instance, a three-way split of ridges might include high elevation-steep, low elevation-steep, and low elevation-gentle classes. Beier and Brost (2010) explain why fuzzy *c*-means cluster analysis (Dimitriadou et al. 2009) is superior to hierarchical cluster analysis, nonmetric multidimensional scaling, and two-step cluster analysis.
3. Identify the number of classes, *c*, that best corresponds to the natural multivariate "lumpiness" in the continuous variables. This step requires examining several goodness of fit metrics, evaluating interpretability of classes, draping maps of facet polygons over a topographic hillshade, plotting facet centroids in multivariate space, and inspection of the proposed class map by someone familiar with the landscape to assess whether the *c* clusters correspond to natural units or impose artificially discrete categories on a continuous landscape.
4. Use a confusion matrix to identify poorly classified pixels, such as slope pixels that assign with roughly equal probability to the "warm, steep, high elevation" and the "cold, steep, high elevation" classes. Remove poorly classified pixels from the analysis to produce a set of distinctive land facets.

These procedures will typically produce a set of 8-16 land facets, such as "high elevation, steep ridges" and "low elevation, gentle, hot, slopes."

---

[46] Insolation is not used to identify subclasses of ridges or canyons, because ridges and canyons are usually symmetrical features, that is, a high-insolation ridge is almost always close to a low-insolation ridge. A classification that used insolation to define land facets within ridges would identify different land facets for their opposing sides, such as north-facing and south-facing ridgelines, despite their otherwise similarity. This unnecessarily complicates corridor design because the opposing sides of canyons and ridges are generally close in proximity and can be treated as a unit for conservation purposes. In developing these procedures in real landscapes, Brost and Beier (unpublished data) found that splitting ridges and canyons on insolation always produced redundant corridors, such as a "cold, high elevation, steep ridge" corridor that was completely intertwined with a "hot, high elevation, steep ridge" corridor.

[47] By default the procedure (kernel density estimation) identifies the most extreme 10% as outliers, but the user can over-ride this setting. Because outliers are defined relative to cells inside Natural Landscape Blocks, the proportion of cells in the matrix classed as outliers will differ from 10% or other specified value.

5.4.3. Developing Maps of Resistance

In focal species approaches to designing linkages, the resistance of a cell represents the difficulty of movement through that cell for a focal species. For the land facet approach, the resistance of a cell is based on the departure of that cell from the prototypical cell of the focal land facet. In particular, we recommend using Mahalanobis distance as the resistance metric. Mahalanobis distance can be thought of as the number of "multivariate standard deviations" between the attributes of a pixel and the ideal values for the focal land facet type. For each land facet type, the procedures include the following steps:

- Calculate Mahalanobis distance for every pixel in the analysis area, using the following ideal values:
  - Mean elevation of pixels in the focal land facet within the Natural Landscape Blocks.
  - Mean insolation of pixels in the focal land facet within the Natural Landscape Blocks.
  - Mean steepness of pixels in the focal land facet within the Natural Landscape Blocks.
  - 100% of pixels in a 100-m radius of the focal facet type.
- Use aerial photographs (if GIS land-cover layers are not up-to-date) to digitize urban or developed areas such as mines that are unlikely to support wildlife movement, even if they otherwise are of a focal facet type. Assign "no data" resistance values (equivalent to infinite resistance) to these pixels. This prevents a corridor from being identified through areas unlikely to support species movements. We caution against wholesale exclusion of agricultural areas, especially if they can be restored to natural vegetation or occupy a large portion of the most productive land facets (those with gentle slopes and high soil moisture).

In addition to linkage for individual land facets, we recommend designing a single linkage with maximum interspersion of land facets. To do so, our procedures produce a resistance map as follows:

- Calculate Shannon's diversity index, H', of land facets in a 5-pixel radius (McCune and Grace 2002). Shannon's index incorporates richness and evenness into a single measure. Thus, a high index is achieved by not only maximizing the number of land facets within the neighborhood, but also balancing representation of those facets.
- Calculate resistance of a pixel as 1/(H' + 0.1). This formula[48] assigns low resistance to pixels with a high diversity index.
- As in designing linkages for individual land facets, remove areas unsuitable for connectivity from the resistance surface.

[48] Adding 0.1 precludes undefined values which would occur in the unlikely event that all cells in a neighborhood are outliers.

5.4.4. Least-cost Corridor Modeling

The procedures to produce a least-cost corridor for each land facet type are very similar to those used to develop least-cost corridors for focal species:

- Define corridor termini (potential start and end points) as areas within the wildland blocks that contained the most occurrences of the focal land facet[49].
- Calculate the cost-weighted distance (cumulative resistance) from each terminus and sum the two resulting raster outputs to produce the corridor results.
- Select a "slice" (cost contour) of the corridor output to delineate the least-cost corridor. We suggest selecting the slice with an approximate minimum width of 1 km over its length for corridors < 10 km long, increasing to an approximate minimum width of 2 km for much longer corridors. We chose these minima because they are similar to the widths that typically resulted from the analyses for focal species.

To produce a single corridor with maximum interspersion of land facets, our procedures use the following steps:

- To define corridor termini, follow these steps within each Natural Landscape Block separately:
  - Identify the half[50] of all cells inside each Natural Landscape Blocks with the highest H' values and aggregate them into polygons.
  - Retain the largest 50% of the polygons as termini[51].
- Calculate the cost-weighted distance (cumulative resistance) from each terminus and sum the two resulting raster outputs to produce the corridor results.
- Select a "slice" (cost contour) of the corridor output that is approximately 1 km to 2 km wide, as for the least-cost corridors for individual land facets.

Rivers and ephemeral drainages span elevation gradients in a way that increases interspersion and promotes ecological processes and flows, such as movement of animals, sediment, water, and nutrients. Because mechanical geospatial algorithms may fail to identify important riverine connections that are obvious to a human expert, we recommend manual inclusion of riverine elements if necessary (e.g., Cowling et al. 1999, 2003).

5.5. Joining the Corridors for Focal Species and Land Facets into a Preliminary Linkage Design

The preliminary linkage design is the simple union of all the least-cost corridors described in Sections 5.3 and 5.4, namely the least-cost corridors for all focal species, all land facets, the land facet diversity corridor, and the major riverine or riparian corridors. The biological

---

[49] By default, the procedure aggregates all cells with at least one occurrence of the facet within a 3-cell radius into polygons, and retains the largest 50% of these polygons in each respective wildland block as termini. The user can over-ride these settings. In three Arizona landscapes, the largest polygons produced by these settings always contained a high density of the focal facet type.

[50] The user can select a different threshold.

[51] The user can select a different percentage.

significance of the union can best be described as the zone within which the modeled species would encounter the least energy expenditure and the most favorable habitat as they move between targeted protected areas, and which should best support species movement during climate change and during future periods of relative climate stability. The output does not consider dispersal limitations of the focal species (Section 5.6) or identify barriers to movement (Section 5.7). Rather, it identifies the best zone available for focal species movement based on the data layers used in the analyses.

How much overlap is likely to occur between the corridors for focal species and the corridors for land facets? B. Brost and P. Beier (Northern Arizona University, unpublished data) have developed Linkage Designs based on land facets for three landscapes in Arizona. Linkage Designs for focal species had previously been released for each landscape (www.corridordesign.org/arizona). The union of land facet corridors was about 28% larger than the union of focal species corridors, and performed as well as or better than the union of species corridors in providing connectivity for 25 of 28 focal species-landscape combinations[52]. In contrast, the union of focal species provided excellent connectivity for only 24 of 35 land facets. By slightly expanding the land facet linkage design to accommodate the three poorly-served species, a blended design was able to serve all focal species and all land facets in an area about 29% larger than the focal species design.

5.6. Using Patch Configuration Analysis, Adding Streams and Rivers, and Imposing a Minimum Linkage Width to Create the Final Linkage Design

Although the least-cost union identifies the best zone available for movement based on the data layers used in the permeability analyses, it does not address whether suitable habitat in the union occurs in large enough patches to support viable populations and whether these patches are close enough together to allow for inter-patch dispersal for species that require multiple generations to traverse the linkage. For such species, the linkage must support a collection of breeding patches separated by distances within the dispersal range of the species, such that movement and gene flow can occur in steppingstone fashion over several generations.

Patch configuration analysis starts by overlaying habitat patches (Section 5.3.4) on a map of the least-cost union, and then comparing distances between habitat patches to the maximum dispersal distance of the species. Because most methods used to document dispersal distance underestimate the true value (LaHaye et al. 2001, Beier et al. 2006), we recommend estimating the maximum dispersal distance as twice the *longest documented dispersal distance* (Section 5.3.2). This assumption is conservative in the sense that it would assign importance to habitat patches that may appear to be isolated based on documented dispersal distances. In our experience, most breeding patches are captured by the preliminary Linkage Design. Species-specific habitat patches should be added to the linkage if the addition would reduce the need for individuals to move distances longer than the estimated dispersal capability of the focal species. A species expert should be consulted to determine if the

[52] There were 21 different focal species, but several occurred in > 1 landscape, such that there were 28 combinations of focal species and landscapes.

preliminary Linkage Design captured enough of these habitat patches to serve the species or if additional patches should be added to ensure that the Linkage Design provides sufficient live-in or "move-through" habitat for the species' needs.

At this point in the analysis, if the linkage design does not include the major riverine or riparian connections between Natural Landscape Blocks, these rivers and streams should be manually added to the linkage design. Simply including rivers and streams is more efficient than least-cost modeling to map connectivity for fish and other aquatic species

Chokepoints in the Linkage Design may prevent organisms from moving through the linkage. To ensure that functional processes are protected, a minimum width should be imposed for all portions of a final Linkage Design. The minimum should be wide enough to provide live-in habitat for species with dispersal distances shorter than the linkage. Harrison (1992) proposed a minimum corridor width for a species living in a linkage as the width of one individual's territory (assuming territory width is half its length). Thus, a minimum corridor width of 1 km would accommodate home ranges of up to about 2 km^2, which is larger than home ranges of most reptiles, amphibians, and small mammals. To serve larger species such as mountain lion, mule deer and badger, minimize edge effects (Environmental Law Institute 2003), and reduce the risk that territorial behavior of medium-sized animals might impede movement (Section 5.3.5), we recommend a minimum width of 2 km (1.2 mi). Beier et al. (2008) provide additional rationale for broad minimum widths.

For a variety of species, including those not formally modeled, a wide linkage helps ensure availability of appropriate habitat, host plants (e.g., for butterflies), pollinators, and areas with low predation risk. In addition, fires and floods are part of the natural disturbance regime in many ecoregions and a wide linkage allows for a semblance of these natural disturbances to operate with minimal constraints from adjacent urban areas. A wide linkage should also enhance the ability of the biota to respond to climate change, and buffer against edge effects.

5.7. Assess Linkage Design in the Field

After the analyses are completed, fieldwork should be conducted in the Linkage Design to ground-truth existing habitat conditions, document existing barriers and potential passageways, and identify restoration opportunities and management prescriptions. Because major roads, railroads, and canals usually present the most formidable potential barriers, such features that transect the linkage design should be evaluated[53]. This would include characterizing existing structures, such as bridges or culverts that may accommodate road crossings by wildlife. Although most such structures were initially built to accommodate streamflow, research and monitoring have confirmed that these structures can facilitate wildlife movement. Therefore, all existing structures (e.g., bridge, underpass, overpass, culvert, pipe) should be photo documented and the following data collected: shape; height,

[53] Natural barriers, such as rivers, may impede movement by some species. There is virtually no research on interventions to mitigate natural barriers, because ecologists respect natural barriers as a part of the evolutionary landscape. Nonetheless, if human development has destroyed historical areas that once provided upland connectivity for such species, it may be appropriate to consider steps to mitigate natural barriers.

width, and length of the passageway; floor type (metal, dirt, concrete, natural); passageway construction (concrete, metal, other); visibility to other side; light level; fencing that acts as a barrier or funnel to wildlife movement; and vegetative cover within and near the passageway. Field biologists should also record their impression of current and potential levels of animal movement at all potential choke-points.

There may be no existing structures in the lowest-cost area of the Linkage Design. In such cases wildlife may be crossing a road at grade, or may not be crossing at all. Careful evaluation of these areas for wildlife trails or other diagnostic signs can help to identify areas where crossing structures should be installed. Canals or aqueducts may also be potential barriers to wildlife movement in a linkage but a vegetated landbridge, at least 300 feet wide may restore wildlife movement. Each important location should be recorded with a Global Positioning System (GPS) device. Data on existing structures should be presented in a map and table.

The analyst should compare these data on existing conditions to guidelines in Chapter 6, and the Wildlife Crossings Guidance Manual (Meese et al. 2009). This comparison will suggest whether permeability is sufficient for wildlife movement. If not, the plan should include prescriptions to upgrade existing structures and add new ones.

Field biologists should also identify other habitat restoration needs and opportunities, such as removing barriers to stream flow or removing large patches of invasive plants. Existing urban and rural development, mining operations, wind turbines, and recreational activity centers that may impede the utility of the linkage should be described and geo-referenced.

5.8. Linkage Design Action Plan

Implementing a Linkage Design will likely require collaboration among county planners, land and resource management agencies, transportation agencies, conservancies, non-governmental organizations and private landowners. The Linkage Design Action Plan should provide detailed documentation, descriptions, and strategies related to the Linkage Design map. It should help conserve the connection by providing detailed descriptions of existing barriers within the linkage and recommended actions to improve linkage function.

The plan should also provide a description of how the linkage can be incorporated in existing conservation measures (e.g., NCCP, HCP, General Plan open space elements) and identify existing planning efforts addressing the conservation and use of natural resources in the planning area and other implementation opportunities for agencies, organizations, and individuals interested in helping conserve the connection. For example, the plan can be used as a resource for regional land managers to guide how they can best help sustain biodiversity and ecosystem processes by implementing the Linkage Design. Relevant aspects of the plan can be folded into management plans of agencies and organizations administering conservation lands in the vicinity of the Linkage Design. Transportation agencies can use the plan to design new projects and find opportunities to upgrade existing structures. Regulatory agencies can use this information to help inform decisions regarding impacts on streams and other habitats. The plan can also help motivate and inform construction of wildlife crossings, watershed planning, habitat restoration, conservation easements, zoning, land acquisition, and the siting of conservation and mitigation banks.

Public education and outreach are vital to implementation of a Linkage Design—both to change land use activities that threaten wildlife movement and to generate appreciation for the importance of the linkage and the wildland blocks the Linkage Design will help sustain. The biological information, maps, figures, tables, and photographs in the plan should be materials ready for interpretive programs. Public education can encourage residents at the urban-wildland interface to become active stewards of the land and generate a sense of place and ownership for local habitats and processes. Such voluntary cooperation is essential to preserving linkage function.

Chapter 6. Framework for Considering Roads in Natural Landscape Blocks and Essential Habitat Connectivity Areas

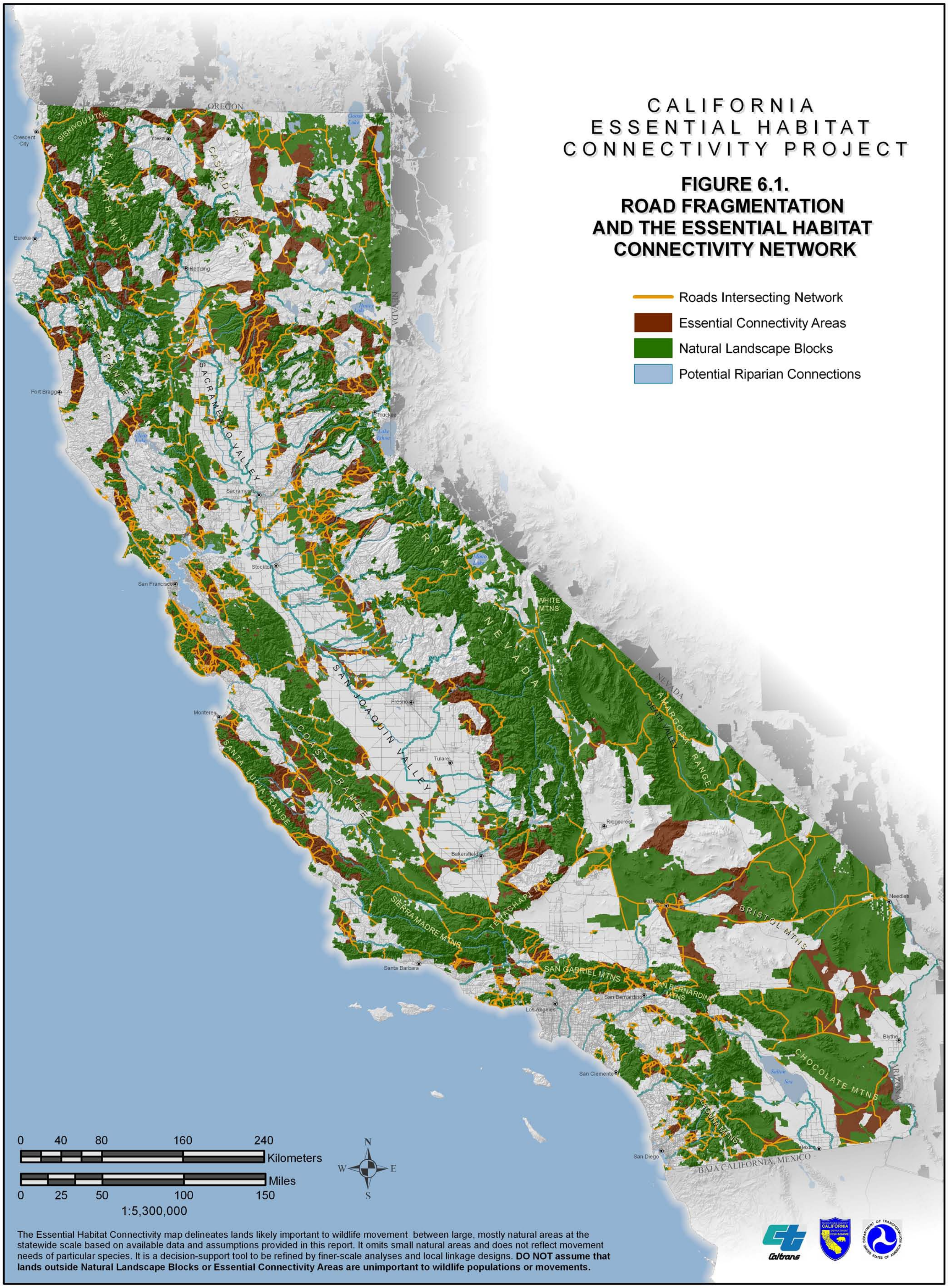
The Essential Habitat Connectivity Map can be used as a resource to guide more detailed efforts to address the fragmenting affects of roads, perform regional connectivity analyses, and design local-scale linkages. This chapter provides (1) a framework for how to evaluate existing or planned roads in Natural Landscape Blocks or Essential Connectivity Areas, (2) guidance to help avoid, minimize, and mitigate the impacts of roads on connectivity, and (3) guidance on enhancement projects to make existing or new roads more permeable. This section is relevant to all paved roads, not just highways. We focus especially on crossing structures, which can be highly effective measures for enhancement and mitigation.

Chapter 3 includes maps of 850 Natural Landscape Blocks in California, and 744 pairs of neighboring Natural Landscape Blocks for which connectivity should be conserved and enhanced (excluding 31 linkages from a Natural Landscape Block in California to a Natural Landscape Block outside California). Of these, 552 pairs of Natural Landscape Blocks were separated only by a road, with no significant fragmentation by urbanization, intensive agriculture, or other land uses that remove natural landcover (Figure 6.1). In these cases, mitigating the impacts of roads is the primary action needed to maintain or restore connectivity.

Road fragmentation is also important in the 192 Essential Connectivity Areas delineated using least-cost modeling. Of these, 66% (127 ECAs) are crossed by major roads, and 92% (177 ECAs) are crossed by secondary highways. Overall, major or secondary highways occur in 96% of Essential Connectivity Areas. Smaller paved roads probably occur in all Essential Connectivity Areas. Because roads can act as filters or barriers to wildlife movement and other ecological flows (Forman et al. 2003), mitigating their impacts is an important strategy for enhancing connectivity in nearly all Essential Connectivity Areas[54].

Arizona provides an example of how a statewide connectivity map can inform road planning. Arizona Department of Transportation, Arizona Game and Fish Department, and Federal Highways Administration were key funders and developers of the 2006 Arizona Wildlife Linkage Assessment. Immediately after the plan was developed, detailed Linkage Designs were completed in 16 priority Essential Connectivity Areas. Furthermore the agencies committed to the highest level of mitigation for roads that crossed protected Natural Landscape Blocks (even in the absence of a linkage design). As a result, the agencies are now implementing several dramatic mitigation and enhancement measures. For instance, two wildlife overpasses are being constructed in 2010, primarily for bighorn sheep, as part of

[54] Note that this chapter focuses on roads as barriers to wildlife movement. However, several other types of linear infrastructure, such as rail, water conveyance, etc. may also impact wildlife corridors and should be evaluated and then avoided, minimized, and mitigated as appropriate. Some methodology presented in this Chapter may also be suitable for these other types of linear infrastructure.



CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
FIGURE 6.1.
ROAD FRAGMENTATION
AND THE ESSENTIAL HABITAT
CONNECTIVITY NETWORK
Roads Intersecting Network
Essential Connectivity Areas
Natural Landscape Blocks
Potential Riparian Connections
OREGON
NEVADA
ARIZONA
BAJA CALIFORNIA, MEXICO
SISKIYOU MTNS
KLAMATH MTNS
CASCADE RANGE
COAST RANGE
SACRAMENTO VALLEY
SIERRA NEVADA
WHITE MTNS
AMARGOSA RANGE
SAN JOAQUIN VALLEY
COAST RANGES
SANTA LUCIA RANGE
SIERRA MADRE MTNS
TEHACHAPI MTNS
SAN GABRIEL MTNS
SAN BERNARDINO MTNS
BRISTOL MTNS
CHOCOLATE MTN
Crescent City
Yreka
Eureka
Redding
Fort Bragg
Truckee
Sacramento
Stockton
San Francisco
Monterey
Fresno
Tulare
Ridgecrest
Bakersfield
Barstow
Needles
Santa Barbara
Los Angeles
San Bernardino
San Clemente
Blythe
San Diego
0 40 80 160 240 Kilometers
0 25 50 100 150 Miles
1:5,300,000
N
W
E
S
The Essential Habitat Connectivity map delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale based on available data and assumptions provided in this report. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.
Caltrans

mitigation for the realignment of US-93 between Kingman, Arizona, and Las Vegas, Nevada. In December 2009, Pima County, Arizona, committed bond dollars to build a wildlife overpass across State Route 77 between the Tortolita and Santa Catalina Mountains near Tucson. Within five years, Arizona Department of Transportation will build overpasses, primarily for pronghorn, on State Route 64 and US-89 north of Flagstaff.

6.1. Impact of Roads on Connectivity

The physical footprint of the nearly 4 million miles of roads in the United States is considerable[55], and the *ecological* footprint of the road network extends much farther (Forman et al. 2003). Direct effects of roads include road mortality, habitat fragmentation and loss, and reduced connectivity. The severity of these effects depends on the ecological characteristics of a given species (Table 6.1). Direct roadkill affects most species, with severe documented impacts on wide-ranging predators such as the cougar in southern California, the Florida panther, the ocelot, the gray wolf, and the Iberian lynx (Forman et al. 2003). In a 4-year study of 15,000 km of road observations in Organ Pipe Cactus National Monument, Rosen and Lowe (1994) found an average of at least 22.5 snakes per km per year killed due to vehicle collisions. Roads cause habitat fragmentation because they break large habitat areas into smaller habitat patches that support fewer individuals, which can increase loss of genetic diversity and risk of local extinction. Additionally, roads may prevent access to essential physical or biological features necessary for breeding, feeding, or sheltering.

In addition to these obvious effects, noise from traffic or road construction may alter habitat use and activity patterns, increase stress, reduce reproductive success, and increase predation risk for terrestrial vertebrates (Bowles 1995, Larkin et al. 1996). Roads also increase the spread of exotic plants and animals, promote erosion, create barriers to fish, and pollute water sources with roadway chemicals (Forman et al. 2003). Recent studies demonstrate that vehicles deposit 300 to 800 exotic seeds per square meter per year to roadside areas, often from several kilometers away (von der Lippe and Kowarik 2007). Highway lighting also has important adverse impacts on animals (Rich and Longcore 2006).

Table 6.1. The ecological effects of roads vary with species traits.

	Effect of roads		
Characteristics making a species vulnerable to road effects (from Forman et al. 2003)	**Road mortality**	**Habitat loss**	**Reduced connectivity**
Attraction to road habitat	★		
High intrinsic mobility	★		
Habitat generalist	★		
Multiple-resource needs	★		★
Large area requirement/low density	★	★	★
Low reproductive rate	★	★	★
Behavioral avoidance of roads			★

[55] A single freeway (typical width = 50 m, including median and shoulder) crossing diagonally across a 1-mile section of land results in the loss of 4.4% of habitat area for any species that cannot live in the right-of-way.

6.2. Where to Mitigate or Enhance

The environmental effect analysis for any substantial highway project should consider habitat fragmentation, loss of habitat connectivity, effects on designated critical habitats, and direct or indirect effects to wild animals and plants (Forman and Alexander 1998), as well as dangers to humans due to vehicle-wildlife collisions. Meese et al. (2009) provide guidance on data collection and impact assessment to help evaluate where avoidance, minimization, enhancement or mitigation for Caltrans' road projects should occur.

This Report provides additional information, namely maps Natural Landscape Blocks and Essential Connectivity Areas (Chapter 3), a framework to identify additional blocks and connectivity areas (Chapter 4), and a framework to produce detailed Linkage Designs (Chapter 5). These mapped polygons should help inform decisions in planning and project delivery about where to mitigate and what level of investment is required (Table 6.2). In locations where a road crosses a Natural Landscape Block in protected status, the strongest enhancement and mitigation measures should be used. Protected status represents a significant public investment and commitment to ecological integrity, and roads should not compromise that investment. In contrast, it may or may not be appropriate to fully mitigate an existing or proposed road across an unprotected Natural Landscape Block, depending on land ownership and intended future land use. In such cases, the impact analysis should consider the fact that the area is a Natural Landscape Block, and make an informed decision whether to mitigate to the level appropriate for a protected Natural Landscape Block.

Table 6.2. For major road projects (new road or road alignment, adding a lane, building a new interchange, constructing or renovating a bridge or culvert), appropriate mitigation depends on the location of the project and an evaluation of its effects. Analysis of impacts would occur for all projects; the table suggests additional actions or analysis appropriate for effects occurring in important connectivity areas.

	Protection Status	
Project Location	**Protected**[a]	**Not Protected**
Within Natural Landscape Block	Mitigate to highest standards (Section 6.3) throughout the area. When modifying existing roads, seek opportunities to *enhance* wildlife movement.	Impact analysis should consider NLB designation.
Within Essential Connectivity Area	Conduct local-scale analysis (Chapter 5) and replace ECA with a Linkage Design.	
Within Linkage Design	Mitigate to standards suggested by the Linkage Design in locations suggested by the Linkage Design. When modifying existing roads, seek opportunities to *enhance* wildlife movement.	
Outside NLB, ECA, or Linkage Design	This Report adds no special considerations[b].	

[a] Protected lands (GAP status 1, 2, or 3) include all lands in which natural landcover is protected from conversion to human land uses throughout most of the area, even though some extractive uses such as logging, grazing, or mining may occur in parts of the area. Protected lands include private lands protected by easements.
[b] Analysis of impacts should occur for these projects, because they may affect movement of locally-important wildlife.

Specific guidance on where to locate crossing structures or other measures to minimize effects of roads on wildlife movement can come from one of two sources:

- Field data such as road kill, wildlife tracks or trails, locations of radio-tagged animals, or repeated observations of wildlife (Meese et al. 2009). These data are most useful when they provide evidence of wildlife crossing—i.e., mitigations should occur in the areas with greatest wildlife movement. However we caution that lack of evidence of wildlife movement cannot be interpreted as lack of need for crossing structures or other mitigations, for two reasons:
    - Because many roads were built without considering wildlife movement, the lack of movement today is no indication of levels of movement that will occur after transportation-related projects to enhance wildlife movement. For example, elk and other wildlife crossed SR-260 in central Arizona much more often two years after a two-lane road was replaced by a four-lane divided road that included crossing structures integrated with roadside fencing (Dodd et al. 2007b).
    - It takes a large effort to detect rare movements, and rare movements can be critical to population survival (Beier 1993). For example, adjacent to the Santa Ana Mountains in southern California, Morrison and Boyce (2009) reported that none of three radio-tagged mountain lions attempted to cross SR-91 and I-15. Beier (1995) had earlier tagged 32 mountain lions in the Santa Ana Mountains and documented several successful crossings of both highways.
- Modeled wildlife corridors, such as those produced during the process of Linkage Design (Chapter 5). Ideally, these models should be parameterized using field data collected in or near the linkage area.

6.3. Avoidance and Mitigation Measures for Roads

The Wildlife Crossings Guidance Manual (Meese et al. 2009) provides detailed guidance, specific to particular groups of wildlife, regarding crossing structures, fencing, median barriers, signs, lighting, speed bumps, vegetation management, animal detection systems, and animal escape devices. The Wildlife Crossings Guidance Manual addresses both modification of existing highways and design of new roads. Clevenger and Huijser (2009) provide thorough, well-illustrated technical guidelines for the planning, design and evaluation of wildlife crossing structures and associated fencing and gates to facilitate road-crossing for particular species and species groups in different landscapes. The Wildlife and Roads website of the Transportation Research Board (http://www.wildlifeandroads.org/) offers a decision tree for transportation planners and examples of successful mitigations, and provides links to other helpful documents and websites. In this section, we draw on these documents and other literature to provide general guidance for enhancing wildlife connectivity across roads.

Avoidance of new roads in Essential Connectivity Areas and Natural Landscape Blocks is more effective than mitigation as a strategy to conserve connectivity. However, where roads already exist, or where there are proposals to build or expand roads within Essential Connectivity Areas or Natural Landscape Blocks, wildlife crossing structures, integrated with roadside fencing, can facilitate wildlife movement across roads. These structures include wildlife overpasses, underpasses, bridges, and culverts. Although many of these structures were not originally constructed with ecological connectivity in mind, many species benefit from them (Clevenger et al. 2001; Forman et al. 2003). No single crossing structure will allow all species to cross a road. For example rodents prefer to use small culverts, while bighorn sheep prefer vegetated overpasses or open terrain below high bridges. A concrete box culvert may be readily accepted by a mountain lion or bear, but not by a deer or bighorn sheep (Clevenger and Waltho 2005). Small mammals, such as deer mice and voles, prefer small culverts to wildlife overpasses (McDonald and St Clair 2004). Some mammals avoid crossing two-lane roads, even when traffic is as low as 100 vehicles per day (McGregor et al. 2008); thus crossing structures may be needed even on lightly-used small roads.

Wildlife overpasses are most often designed to improve opportunities for large mammals to cross busy highways. As of 2003, about 50 overpasses had been built in the world. Only six of these are in North America (Forman et al. 2003), but these numbers are increasing dramatically (for example the five overpasses underway and planned in Arizona, as noted in the introduction to this Chapter). Overpasses are typically 30 to 50 m wide, but can be as wide as 200 m. Overpasses are readily used by large mammals in Europe (van Wieren and Worm 2001). In Banff National Park, Alberta, grizzly bears, wolves, bighorn sheep, deer, elk, and moose prefer overpasses to underpasses, while species such as mountain lions prefer underpasses (Clevenger and Waltho 2005).

Wildlife underpasses include viaducts, bridges, culverts, and pipes, and are often designed to ensure adequate drainage beneath highways. Bridged crossing structures (where the road is supported on piers or abutments above a watercourse) differ from culverts (a round or rectangular tube under a road) in several ways. The most important difference is that the streambed under a bridge is mostly native rock and soil (instead of concrete or corrugated metal in a culvert) and the area under the bridge is large enough that a semblance of a natural stream channel returns a few years after construction. Even when rip-rap or other scour protection is installed to protect bridge piers or abutments, stream morphology and hydrology usually return to near-natural conditions in bridged streams, and vegetation often grows under bridges. In contrast, vegetation does not grow inside a culvert, and hydrology and stream morphology are permanently altered not only within the culvert, but for some distance upstream and downstream from it.

Bridged underpasses are best for deer and other animals that prefer open crossing structures, and tall, wide bridges are best. Mule deer in southern California avoid small underpasses, and only use underpasses under large spanning bridges (Ng et al. 2004). The average size of underpasses used by white-tailed deer in Pennsylvania was 15 ft (4.6 m) wide by 8 ft (2.4 m) high (Brudin 2003). Because most small mammals, amphibians, reptiles, and insects need vegetative cover for security, bridged undercrossings should extend to uplands beyond the scour zone of the stream, and should be high enough to allow enough light for vegetation to grow underneath. In the Netherlands, rows of stumps or branches under crossing structures increased connectivity for smaller species crossing floodplains under bridges (Forman et al. 2003). Black bear and mountain lion prefer less-open structures (Clevenger and Waltho 2005).

Culverts, if well-designed and located, can be an excellent way to mitigate the effects of roads for small and medium sized mammals (Clevenger et al. 2001; McDonald and St Clair 2004). Pipe culverts and concrete box culverts are used by many species, including mice, shrews, foxes, rabbits, armadillos, river otters, opossums, raccoons, ground squirrels, skunks, coyotes, bobcats, mountain lions, black bear, great blue heron, long-tailed weasel, amphibians, lizards, snakes, and southern leopard frogs (Yanes et al. 1995, Brudin 2003, Dodd et al. 2004, Ng et al. 2004). Black bear and mountain lion prefer less open structures; large culverts can provide connectivity for these species (Clevenger and Waltho 2005). In south Texas, bobcats often used 1.85-m x 1.85-m box culverts to cross highways, preferred structures near suitable scrub habitat, and sometimes used culverts to rest and avoid high temperatures (Cain et al. 2003).

Culvert usage can be enhanced by providing a natural substrate bottom, and in locations where the floor of a culvert is persistently covered with water, a ledge established above water level can provide terrestrial species with a dry path through the structure (Cain et al. 2003). It is important that both ends of the culvert be flush with the surrounding terrain so that animals can easily enter and exit. When culverts are built solely to accommodate peak flows, the upper ends are often partway up the fill slope, far above the natural stream bottom, and the lower ends either have a concrete pour-off of 8-12 inches (20 cm – 30 cm) or develop a pour-off lip due to scouring action of water. A pour-off of several inches makes it unlikely that many small mammals, snakes, and amphibians will find or use the culvert.

Based on the increasing number of scientific studies on wildlife use of highway crossing structures, we offer these guidelines for crossing structures intended to facilitate wildlife passage across roads and railroads. These recommendations also apply to canals (Peris and Morales 2004, Rautenstrauch and Krausman 1989).

1. **Multiple types of crossing structures should be constructed and maintained to provide connectivity for all species likely to use a given area** (Little 2003). Different species prefer different types of structures (Clevenger et al. 2001; McDonald and St Clair 2004; Clevenger and Waltho 2005; Mata et al. 2005). For deer or other ungulates, an open structure such as a bridge is crucial. For medium-sized mammals, black bear, and mountain lions, large box culverts with natural earthen substrate flooring are optimal (Evink 2002). For small mammals, pipe culverts with a diameter between 1 and 3 feet (0.3 and 0.9 meters) are preferable (Clevenger et al. 2001; McDonald and St Clair 2004).

2. **Crossing structures should be spaced based on home range size of species to be accommodated**. Because most reptiles, small mammals, and amphibians have small home ranges, metal or cement box culverts should be installed at intervals of 150-300 m (Clevenger et al. 2001). For ungulates (deer, pronghorn, bighorn) and large carnivores, larger crossing structures such as bridges, viaducts, or overpasses should be located no more than 1.5 km apart (Mata et al. 2005; Clevenger and Wierzchowski 2006). Inadequate size and insufficient number of crossings are the two primary causes of poor use by wildlife (Ruediger 2001).

3. **Suitable habitat for species should occur on both sides of the crossing structure** (Ruediger 2001; Barnum 2003; Cain et al. 2003; Ng et al. 2004). This guideline applies to both local and landscape scales. On a local scale, vegetative cover should be present near entrances to give animals security, and reduce negative effects of lighting and noise (Clevenger et al. 2001; McDonald and St Clair 2004). A lack of suitable habitat adjacent to culverts originally built for hydrologic function may prevent their use as potential wildlife crossing structures (Cain et al. 2003). On the landscape scale, "crossing structures will only be as effective as the land and resource management strategies around them" (Clevenger et al. 2005). Suitable habitat must be present throughout the linkage for animals to use a crossing structure.

4. **Whenever possible, suitable habitat should occur *within* the crossing structure.** This recommendation can best be achieved by having a bridge high enough to allow sufficient light for vegetation to grow under the bridge, and by making sure that the bridge spans some upland habitat that is not regularly scoured by floods. Where this is not possible, rows of stumps or branches under large span bridges can provide cover for smaller animals such as reptiles, amphibians, rodents, and invertebrates, although regular maintenance is required to replace artificial cover removed by floods. Within culverts, mammals and reptiles prefer earthen to concrete or metal floors.

5. **Structures should be monitored for, and cleared of, obstructions such as detritus or silt blockages that impede movement.** Small mammals, carnivores, and reptiles avoid crossing structures with significant detritus blockages (Yanes et al. 1995; Cain et al. 2003; Dodd et al. 2004). In southern California and Arizona, over half of box culverts less than 8 x 8 ft (2.4 m x 2.4 m) have large accumulations of branches, Russian thistle, sand, or garbage that impede animal movement (Beier, personal observation). Bridged undercrossings rarely have similar problems.

6. **Fencing should keep animals off the road and direct them towards crossing structures, and should never block entrances to crossing structures** (Yanes et al. 1995, Gagnon et al. 2007). In Florida, construction of a barrier wall to guide animals into a culvert system resulted in 93.5% reduction in roadkill, and also increased the total number of species using the culvert from 28 to 42 (Dodd et al. 2004). Fences, guard rails, and embankments at least 2 m high discourage animals from crossing roads (Barnum 2003; Cain et al. 2003; Malo et al. 2004). One-way ramps on roadside fencing can allow an animal to escape if it is trapped on a road (Forman et al. 2003). In areas where bridges or causeways pass through shorebird habitat, fencing or metal poles 9 to 14 feet tall (height of tallest vehicles expected) on both sides of the bridge can reduce shorebird mortality by about two thirds (A. Bard, Florida Department of Environmental Protection[56]).

[56]http://www.fhwa.dot.gov/environment/wildlifeprotection/index.cfm?fuseaction=home.viewArticle&articleID=5 A similar design by K. Price and K. Lee (Caltrans) and S. Brown (US FWS) is being planned for the Schuyler Heim bridge in Los Angeles.

7. **Raised sections of road discourage animals from crossing roads, and should be used when possible to encourage animals to use crossing structures**. Clevenger et al. (2003) found that vertebrates were 93% less susceptible to road-kills on sections of road raised on embankments, compared to road segments at the natural grade of the surrounding terrain.

8. **Manage human activity near each crossing structure**. Clevenger and Waltho (2000) suggest that human use of crossing structures should be restricted and foot trails relocated away from structures intended for wildlife movement. However, a large crossing structure (viaduct or long, high bridge) should be able to accommodate both recreational and wildlife use. Furthermore, if recreational users are educated to maintain utility of the structure for wildlife, they can be allies in conserving wildlife corridors. At a minimum, nighttime human use of crossing structures should be restricted.

9. **Design crossing structures specifically to provide for animal movement**. Because traffic noise within an undercrossing can discourage passage by wildlife, new, quieter designs are needed to minimize vehicle noise in underpasses (Gagnon et al. 2007). Ungulates prefer undercrossings with sloped earthen sides to vertical concrete sides (Dodd et al. 2007). High openness ratio (height x width divided by length) promote animal travel. Perhaps the best way to achieve this open ratio is to minimize the distance an animal must travel within the structure (Dodd et al. 2007). Most culverts are designed to carry water under a road and minimize erosion hazard to the road. Culvert designs adequate for transporting water often have pour-offs at the downstream ends that prevent wildlife usage. At least one culvert every 150-300 m of road should have both upstream and downstream openings flush with the surrounding terrain, and with native landcover up to both culvert openings, as noted above.

10. **Consider climate change in the design of crossing structures.** Climate change is expected to increase total global precipitation, but precipitation will increase greatly in some areas and will be unchanged, or even decrease, in other locations. During the last century in California, extreme storm events have become more frequent, and some wildlife species have shifted their geographic ranges northward and upward in elevation (Moritz et al. 2008, Moser et al. 2009). These trends are likely to accelerate in the future (Moser et al. 2009). Future changes in land use (such as potential abandonment of agricultural land), complex interactions of precipitation and temperature, and future interactions among species will result in range shifts that are not simple movements northward and higher in elevation (Halpin 1997, Peterson et al. 2005). These trends have implications for design of crossing structures. Perhaps most important, crossing structures should be built to accommodate flows exceeding historic floods. In addition, bridge spans should be long enough to span some upland habitat that will not be scoured by future floods. Finally, crossing structures to accommodate large mammals should be built even in Essential Connectivity Areas where large mammals do not occur today but historically occurred or are projected to occur in the future.

Chapter 7. Strategies for Integrating and Institutionalizing the California Essential Habitat Connectivity Project

7.1. The Collective Mission to Conserve Connectivity

Maintaining and enhancing functional ecological connectivity across California's landscape in the face of human development and climate change is no easy task, and no single agency or small group of agencies can tackle it alone: Collaboration and coordination are key. The Multidisciplinary Team for the California Essential Habitat Connectivity Project was therefore purposely diverse—with 62 local, regional, state, federal, and tribal agencies, comprising over 200 members, asked to serve as ambassadors for connectivity within and outside their agencies.

Each agency invited to join the Multidisciplinary Team has a unique role to play in conserving ecological connectivity while also pursuing its own mission—whether it involves improving transportation, delivering water and power, providing recreational opportunities, or conserving biological diversity. For example, infrastructure planning agencies—such as the California Department of Transportation and California Department of Water Resources—have stewardship goals to protect and enhance California's ecological resources while serving the needs of California's growing population. Wildlife agencies—such as the U.S. Fish and Wildlife Service, U.S. National Marine Fisheries Service, and California Department of Fish and Game—actively plan for conservation of biodiversity and rare species, while also serving as regulators and land managers. Land-management agencies—like the National Park Service, U.S. Forest Service, U.S. Bureau of Land Management, and California State Parks—seek to maintain functional ecological connectivity to meet their charge of managing our public lands for natural resource values and recreational and other opportunities. The objectives of numerous other resource agencies—such as the California Energy Commission, California Department of Forestry and Fire Protection, and U.S. Bureau of Reclamation—can also benefit from and contribute to ecological connectivity in some capacity, despite their widely different missions. Finally, local and regional planning agencies—such as city and county planning departments or regional councils of governments—try to improve the conservation of open space and natural resources within their jurisdictions by incorporating and helping implement wildlife movement and habitat connectivity plans. Thus, while each of these agencies has its own unique mission, there are commonalities, and connectivity conservation fits all of them to some degree.

Likewise many hundreds of non-governmental non-profit organizations throughout the state have missions dedicated to land conservation, habitat restoration, endangered species protection, environmental planning, environmental advocacy, etc. that are focused or tangential to conserving ecological connectivity. Additionally, many universities are contributing research and knowledge towards increasing habitat connectivity. These organizations have served a critical role in conserving California's diverse landscapes and maintaining and enhancing ecological connectivity, working both on their own and in partnership with public agencies. These non-governmental organizations and universities will continue to serve a key role in helping to implement a statewide network of wildlands that provides functional ecological connectivity across the California landscape.

One key to successful connectivity conservation is to capitalize on opportunities for inter-agency collaboration, such as Natural Community Conservation Plans, Habitat Conservation Plans, Regional Blueprint Plans, watershed plans, or non-governmental organization (NGO) guided regional linkage plans (such as the South Coast Missing Linkages, Bay Area Critical Linkages, and California Desert Connectivity Projects). The Essential Habitat Connectivity Project was designed to support such collaborative planning efforts. It is hoped that the data and strategies generated by the California Essential Habitat Connectivity Project will facilitate coordinated efforts to conserve connectivity. The data itself will be available to any interested agency or organization, as described in Chapter 8. Below, we present strategies for incorporating this analysis into conservation and planning programs at several spatial scales on the California landscape. The programs that are listed below are only a small sample of the many conservation and planning programs occurring at the regional, statewide, and local levels. Many other existing agencies and programs at a variety of spatial scales may want to incorporate this information into their plans and activities. Likewise, private landowners may want to use this information to understand how they can be a part of a regional conservation goal or engage in the discussion.

7.2. Collaborative Conservation Programs: Planning and Funding Opportunities for Connectivity

This section describes a variety of existing conservation programs, plans, and regulations whose continued implementation could both benefit, and benefit from, the products of the Essential Habitat Connectivity Project. These programs cover a wide array of spatial scales—from western North America to the State of California to various regions or local areas within the state.

7.2.1. Connectivity Conservation for the Western United States

Western Governors' Association. In 2008, the Western Governors' Association established the Western Governors' Wildlife Council (WGWC), a group of representatives from 19 western states. The mission of the Western Governors' Wildlife Council, consistent with Western Governors' Association Resolution 07-01, is to identify key wildlife corridors and crucial wildlife habitats in the west, and coordinate implementation of needed policy options and tools for preserving those landscapes. A draft white paper (Western Governors' Association 2009) calls for standardization of data and definitions so connectivity analyses can be performed across state boundaries. California is actively participating in the Western Governors' Wildlife Council to help with this standardization, so that its Essential Habitat Connectivity Map and other biological data sets will be available and useful to bordering states for achieving connectivity conservation at the broadest possible scale. We also expect that these data will help California to define its "Wildlife Sensitivity Areas," an analysis each state is completing for the Western Governors' Association.

Western Regional Partnership. The Western Regional Partnership is a senior policy level partnership among the Department of Defense, other federal agencies, and state and tribal executive leadership in the states of Arizona, California, Nevada, New Mexico, and Utah. The Western Regional Partnership has established a Wildlife Corridors, Critical Habitat, and Threatened and Endangered Species Committee, with the goal of sharing best practices for addressing preservation, maintenance, and restoration of wildlife corridors and crucial habitats. California's Essential Habitat Connectivity Map will likely be used in this Committee's pilot project in the Mojave Desert Region. The Western Regional Partnership highlights such pilot projects to attract federal funding for conserving connectivity.

Landscape Conservation Cooperatives. The U.S. Fish and Wildlife Service has initiated the Landscape Conservation Cooperatives Program, which is a national framework composed of 22 geographic areas that collectively will comprise a seamless national network of landscapes capable of sustaining abundant, diverse, and healthy populations of fish, wildlife, and plants (http://www.fws.gov/science/shc/lcc.html). The program was initiated in 2009 to emphasize strategic conservation on a landscape scale through the development of self-directed conservation-science partnerships between the U.S. Fish and Wildlife Service, U.S. Geological Survey, and other federal agencies, states, tribes, non-governmental organizations, universities, and stakeholders within a geographically defined area. California is part of four Landscape Conservation Cooperatives, which include North Pacific (North Coast Ecoregion in California, and all habitats west of the Cascade crest in Oregon and Washington, and extending into coastal habitats of Southeast Alaska), Great Basin (Modoc Plateau and the Eastern Sierra Nevada and parts of Oregon, Idaho, Nevada, and Utah), Desert (Mojave and Sonoran deserts in California, and parts of Nevada, Arizona, New Mexico, and Texas, extending down into mainland Mexico and Baja California Norte), and California (the rest of the state and the coastal region of Baja California Norte).

Landscape Conservation Cooperatives (USFWS 2009) will provide scientific and technical support for landscape-level conservation—such as biological planning, conservation design, prioritizing, and coordinating research, and designing species inventory and monitoring programs. They will provide the connection between science and conservation delivery without duplicating existing partnerships. By functioning as a network of interdependent units, Landscape Conservation Cooperatives are anticipated to be able to accomplish a conservation mission no single agency or organization can accomplish alone.

Landscape Conservation Cooperatives (USFWS 2009) will regularly evaluate the effectiveness of scientific information and conservation actions and support necessary adjustments as new information and data become available. This iterative process of information sharing will help scientists and resource managers deal with uncertainties across the landscape (e.g., climate change) and provide spatially explicit decision-support tools to compare and contrast the implications of management alternatives. The California Essential Habitat Connectivity Map will be a key data source used by each of the four Landscape Conservation Cooperatives that cover California.

7.2.2. California Statewide Conservation

State Wildlife Action Plan. The California Wildlife Action Plan (Bunn et al. 2007) is the State's strategy for wildlife conservation. It answers three primary questions: (1) What are the species and habitats of greatest conservation need? (2) What are the major stressors affecting California's native wildlife and habitats? and (3) What are the actions needed to restore and conserve California's wildlife, thereby reducing the likelihood that more species will become threatened or endangered? The Plan identifies habitat fragmentation as a major stressor on wildlife. Connectivity conservation is identified as a key action both statewide and in four of eight terrestrial ecoregions analyzed in the Plan; however, the Plan did not provide a map or list of priorities for important connectivity areas or linkages. The California Essential Habitat Connectivity Project was designed to fill this need. The Wildlife Action Plan highlights the need to proactively integrate conservation planning with urban and transportation planning, also a goal of the Essential Habitat Connectivity Project, which has fostered partnerships and strategic planning among state agencies responsible for conservation and infrastructure. The Essential Habitat Connectivity map will be used with other biological data sets and decision-support tools in an upcoming revision of the State Wildlife Action Plan.

Wildlife Conservation Board Acquisition Planning. The Wildlife Conservation Board (WCB) acquires land on behalf of the Department of Fish and Game. Starting in 2010, Wildlife Conservation Board acquisition priorities for the Department of Fish and Game will be informed by Areas of Conservation Emphasis Phase II (ACE II), an internal evaluation of biological and recreational value using GIS data and modeling supported by expert opinion. The California Essential Habitat Connectivity Map will be an input data set to ACE II, drawing attention to linkages in acquisition planning.

California Climate Change Adaptation Strategy. The Biodiversity and Habitat Sector of the California Climate Adaptation Strategy calls for creating a large-scale, well-connected, sustainable system of protected areas across the state (California Natural Resources Agency 2009). This strategy follows an assumption that climate change will cause shifts in the ranges and distributions of individual species. Those species that have the capacity to respond will require movement corridors that are not blocked by human development or other disturbances. The Essential Habitat Connectivity Map is a key data set in implementing this strategy, as it identifies natural landscape corridors least resistant to movement by organisms. It provides an important "snapshot in time" of areas on which to focus acquisition in the near future. However, this Project did not explicitly model how climate change may affect any particular species or natural communities, and future work should refine the Essential Habitat Connectivity Map with additional analyses that consider focal resources and their likely responses to climate change, as described in Chapters 4 and 5.

> *Jim Branham, Executive Officer, Sierra Nevada Conservancy:* "The Essential Habitat Connectivity Project can assist the Conservancies in their regional planning efforts and may also provide additional data for funding or acquisition assistance. The Sierra Nevada Conservancy collaborates with stakeholders throughout the Sierra in conservation and resource management planning. The Essential Habitat Connectivity Project data can be used to assist in grant review and to inform planning efforts throughout the Sierra with partners."

State Conservancies. There are nine State Conservancies established by legislation to help protect regional resources of statewide significance: Baldwin Hills Conservancy, California Tahoe Conservancy, Coachella Valley Mountains Conservancy, San Diego River Conservancy, San Gabriel and Lower Los Angeles Rivers and Mountains Conservancy, San Joaquin River Conservancy, Santa Monica Mountains Conservancy, Sierra Nevada Conservancy, State Coastal Conservancy. These nine Conservancies assist with resource protection in various ways, though most coordinate local efforts, have regional conservation plans, or provide grants and funding assistance. Some hold title or manage land for conservation. The Essential Habitat Connectivity Project can assist the Conservancies in their regional planning and may also provide additional data to prioritize funding or acquisition assistance.

Statewide Land Trusts and Conservation Organizations. There are several national, regional, and state non-governmental or not-for-profit organizations working within the State of California with missions that focus on habitat or land conservation. Some of these non-profit organizations are national or international concerns with locally focused programs, such as The Nature Conservancy, Sierra Club, Audubon, Defenders of Wildlife, PRBO Conservation Science, Center for Biological Diversity, Natural Resources Defense Council, Ducks Unlimited, Quail Unlimited or Mule Deer Foundation, while others are statewide organizations, such as the California Native Plant Society or California Oaks Foundation. Statewide planning efforts such as The Nature Conservancy's Ecoregional Priorities or Audubon California's Important Bird Areas (described in Chapter 3) may use the Essential Habitat Connectivity Map to inform the next iterations of these planning efforts, but ultimately implementation of these plans is done at the regional or local level.

7.2.3. Regional and Local Conservation

Natural Community Conservation Planning and Habitat Conservation Planning. The Natural Community Conservation Planning (NCCP) Program is an unprecedented effort by the State of California and private and public partners that takes a broad-scale, ecosystem approach to planning for sustaining biological diversity while allowing for economic land uses (http://www.dfg.ca.gov/habcon/nccp/). The NCCP Act of 2003 requires every plan to establish linkages between reserves, both within a designated Natural Community Conservation Plan area and to adjacent habitat areas beyond the planning boundary. Because the Natural Community Conservation Planning approach is grounded in the principles of conservation science, which stress the importance of ecological connectivity, nearly every NCCP plan addresses habitat connectivity and wildlife movement corridors in some manner. There are currently 24 Natural Community Conservation Plans around the state (including both completed and in-progress plans), involving over 60 local government jurisdictions, innumerable landowners, federal wildlife authorities, and numerous conservation organizations and other stakeholders. The Essential Habitat Connectivity Map and guidelines can serve as a primary decision-support tool in planning for connectivity within and among individual Natural Community Conservation Plans.

Every year federal dollars are available to states through Section 6 of the Endangered Species Act. Administered by the U.S. Fish and Wildlife Service[57], non-traditional Section 6 Habitat Conservation Planning Assistance grants provide funds for creating Habitat Conservation Plans, through funding of tasks necessary in the plan development phase—for example, baseline surveys and inventories, preparation of plan and environmental review documents, and outreach. The Habitat Conservation Planning Land Acquisition grants provide funds for land acquisitions associated with approved Habitat Conservation Plans. California has been very successful in the national competition for non-traditional Section 6 grant funds. Grant proposals for plans with large geographic areas, multiple species, high match amounts, multiple stakeholders, and high conservation importance score high. Starting with the 2011 grant cycle, each proposal will also be rated on how well the plan proposes to mediate effects of climate change. Since connectivity is the primary climate change adaptation strategy for California (California Natural Resources Agency 2009), those plans that clearly demonstrate attention to habitat connectivity will be considered more competitive.

Regional Land Management Planning. The large land managing agencies in California each coordinate management planning among individual units within their own systems. For example, the U.S. Fish and Wildlife Service has policies for its refuge system; the U.S. Forest Service coordinates revisions of forest plans; and the U.S. National Park Service and U.S. Bureau of Land Management have programs for natural resource management. All agencies have inventory and monitoring programs. In addition, there are community-based natural resource management efforts, such as Coordinated Resource Management Plans. The maps and data created by the Essential Habitat Connectivity Project can be used to help focus management actions in locations where connectivity should be maintained, enhanced, or restored.

> *Don Yasuda, Wildlife Biologist, USDA Forest Service:* "The Forest Service does a lot with our State and Private Forestry program in coordination with private landowners and local governments. We could use a product like this to inform some of our grants to better achieve connectivity objectives through these programs. I also see the Forest Service along with everyone else using this to look at continuing bioregional connectivity planning for climate change adaptation. This information will be a solid base for evaluation of connectivity and climate change adaptation during Forest Plan revision. I think we'll use this data to also inform us for landscape threat evaluations related in the forestlands to wildfire and insect and disease threats to connectivity as well as climate change threats. We could do the same (but with different criteria) in the chaparral and hardwood forest NLBs and corridors. This will help us prioritize and manage functioning landscapes as well as strategize future management for impaired or threatened landscapes."

Regional Conservancies, Land Trusts and Conservation Organizations. Many of these not-for-profit or non-governmental organizations generally have missions to protect, acquire, and restore land for conservation on a local or regional level. Many non-profit organizations work closely with local, state, and federal agencies toward common natural resources conservation goals. Several land trusts and conservancies are focused on specific geographic areas and may target lands that support threatened or endangered species. Some may hold and manage land in perpetuity, while others simply hold land in trust until it can be acquired

[57] Many other funding resources may be available to agencies or organizations for planning purposes. The U.S. Fish and Wildlife Service Pacific Southwest Region maintains a matrix of potential federal, state, local, non-profit and corporate funding that can be accessed at http://www.fws.gov/cno/docs/CPP_Grants.xls.

by a public resources agency. Many organizations have programs focused on environmental education and stewardship, others advocate for conservation of particular lands or species of interest, while others are primarily focused on acquiring land for its habitat and recreational values. There are various ways that non-profit organizations may use the Essential Habitat Connectivity Map depending on the mission of the organization. Land trusts and conservancies may use the products of this Report to target areas for land acquisition or restoration. They may also use this information in educational outreach, in their land management practices, or in grant or funding applications. Some of these organizations may also take a lead role in local or regional connectivity planning and can use these products to inform those efforts. Other conservation organizations may use the Essential Habitat Connectivity Map to advocate for protection or restoration of specific Natural Landscape Blocks and Essential Connectivity Areas.

Landowner Incentive Programs. The California Land Conservation Act of 1965 (commonly referred to as the Williamson Act)[58] enables local governments to enter into contracts with landowners to restrict the use of specific parcels to agricultural or related open space uses in return for much reduced property tax assessments. Local governments then receive an annual subvention of forgone property tax revenues from the state via the Open Space Subvention Act of 1971. As of 2007, approximately 16.5 million acres in state were under the Williamson Act. Due to the state's recent budgetary constraints, subvention payments to local government have been temporarily suspended. It is anticipated that subvention payments will be available again once the economy rebounds. The Williamson Act program will continue to have a significant, positive impact on California agriculture and land-use planning.

The Farm Security and Rural Investment Act of 2002 (Farm Bill) responds to and provides funding for a broad range of emerging natural resource challenges faced by farmers and ranchers, including soil erosion, wetlands, wildlife habitat, and farmland protection. The Farm Bill has several programs, including the Corridor Conservation Program, Farmland Protection Program, Wetlands Reserve Program, and Wildlife Habitat Incentives Program (www.ers.usda.gov/features/farmbill/2002farmact.pdf). Even more conservation incentives are offered in the 2008 Farm Bill. "Safe Journeys: Opportunities for Wildlife Conservation through the Farm Bill" (Environmental Defense Fund, 2009) outlines a number of actions agencies and conservation groups can undertake to maximize the conservation benefits that this updated Farm Bill can deliver.

Strategic Growth Council (SB 732). Senate Bill 732 (Chapter 729, 2008) created the Strategic Growth Council (SGC) which is a cabinet level committee that is charged with coordinating activities of state agencies to improve air and water quality, protect natural resource and agriculture lands, increase availability of affordable housing, improve infrastructure systems, promote public health, and assist state and local entities in the planning of sustainable communities[59]. The allocation of Proposition 84 planning grants and planning incentive funds for encouraging the planning and development of sustainable communities is one program that the Strategic Growth Council administers. The Strategic

[58] http://www.conservation.ca.gov/DLRP/lca/Pages/Index.aspx
[59] http://www.sgc.ca.gov/about_us.html

Growth Council is also required to provide, fund, and distribute data and information to local governments and regional agencies that will assist in developing and planning sustainable communities. The Essential Habitat Connectivity Project products can help the Strategic Growth Council meet their intent and objectives, to expedite the development of regional transportation and land use modeling by supporting the data gathering and model development necessary to comply with SB 732 and provide policy level guidance on integrating the protection of essential habitat connectivity areas in strategic growth analyses.

Conservation in General Plan Updates for Cities and Counties. All of California's 480 cities and 58 counties are required to prepare General Plans for their long range growth and development. The Governor's Office of Planning and Research is required to adopt and periodically update General Plan Guidelines for local jurisdictions to use in preparing their general plans. The 2003 guidelines are currently being updated, providing an opportunity to recommend how information and strategies produced by the California Essential Habitat Connectivity Project can be incorporated into local land use planning.

7.3. Coordinated Infrastructure and Mitigation Planning: Policy and Funding Opportunities for Connectivity

7.3.1. Statewide Infrastructure Planning

California Transportation Plan 2035. The California Transportation Plan 2035 is a statewide, long-range (20-year) plan that spells out the goals, policies, and strategies for meeting California's future transportation needs at the local, regional, and state level. Policies designed to enhance and conserve environmental resources in the 2035 Plan include: (1) integrate land use, transportation, and environmental planning; (2) promote environmental stewardship and sustainability; (3) integrate environmental considerations into all aspects of transportation decision-making; and (4) identify and implement climate change mitigation and adaptation strategies. This plan provides strategic direction to California's 44 regional transportation-planning agencies that are responsible for planning, prioritizing, and funding regional transportation plans. The 2035 Plan is currently being updated to meet new trends and challenges, such as climate change, to better integrate transportation planning with environmental and natural resource planning (e.g., SAFETEA-LU), providing a timely opportunity for integrating the results of the Essential Habitat Connectivity Map.

> *Larry Vinzant, Federal Highways Administration*, "The Essential Habitat Connectivity Project could provide valuable information that could be incorporated into the transportation planning process. Identification of essential habitat early in the planning process would allow the stakeholders to consider alternatives that would avoid impacts to the habitat and/or incorporate important mitigation features such as wildlife crossings. By having the data available on a region or statewide basis, transportation planning agencies could identify how all of the proposed projects in the Regional Transportation Plan impact essential habitat, rather than looking at it piecemeal on a project-by-project basis. The project's products also could provide valuable insight into the long-term ramifications of climate change and help address new initiatives such as livable and sustainable communities, of which the natural environment is an important component."

The Essential Habitat Connectivity Map clearly furthers the goal of maintaining a connected California. It can also help to make transportation planning projects more cost efficient and help reduce dangerous interactions between vehicles and wildlife. Transportation planners will now be able to take into account Essential Connectivity Areas early in their planning processes, which will allow them to take connectivity conservation actions early, when such decisions are both less costly and more effective. For example, the Essential Habitat Connectivity Map could be used to adjust proposed road alignments or to design wildlife crossing structures during planning and design of a transportation project, rather than addressing project impacts to habitat connectivity later, as expensive remedial actions. In planning for existing highway enhancements, agencies such as the California Department of Transportation may prioritize enhancement or remediation for highways crossing Essential Connectivity Areas or Natural Landscape Blocks where animal-vehicle collisions could pose a safety threat.

> *Gregg Erickson, California Department of Transportation*, "As we look at growth, development and climate change, evaluating areas in the state essential for habitat connectivity and wildlife movement is critical to help us evaluate how we can adapt. The California Essential Habitat Connectivity Project provides a new bridge between local/regional wildlife fragmentation studies and the long awaited statewide inter-regional view of habitat connectivity contained within the report. This will inform policies such as the California Transportation Plan and Wildlife Action Plan and establish a framework and data set for finer scale consideration during local planning with a new found ability to integrate local and statewide perspectives in a transparent manner. The collaborative effort that produced this report will be critical to help us adapt as we move forward focusing on the most effective and efficient solutions. We look forward to expanding our partnerships as we plan together for infrastructure as well as natural resources."

The Essential Habitat Connectivity Map provides information that can assist planners with integrating transportation planning with natural resource planning and meet challenges posed by climate change. Many spatial data layers generated by this project will be available through BIOS (http://bios.dfg.ca.gov) and Data Basin (http://databasin.org) (see Chapter 8). Yet another tool is the California Transportation Investment System, which maps short- and long-range projects planned by State and regional transportation agencies. All three of these systems provide transportation and land-use planners with tools to evaluate planned and programmed project locations relative to Natural Landscape Blocks and Essential Connectivity Areas, and thus to identify opportunities for maintaining, improving, or restoring functional habitat connectivity across existing or planned transportation barriers. The California Transportation Investment System displays the existing transportation system along with programmed transportation improvement projects that are currently underway and where projects will be planned over the next 20 years. Information on programmed and planned projects includes highway, local, rail, airport, bicycle, pedestrian, transit, and Proposition 1B projects at both the state and regional levels.

California Water Plan. The California Water Plan (California Department of Water Resources 2009) is the state's water strategic plan. The plan, which is updated every five years, presents basic data and information on California's water resources, including water supply evaluations and assessments of agricultural, urban, and environmental water uses, to quantify the gap between water supplies and uses. A component of the plan focuses on how to coordinate water planning with land-use plan plans and programs of other state agencies. Volume 1, Chapter 3, of the 2009 update outlines companion state plans, including those related to conservation, such as the California Wildlife Action Plan (Bunn et al., 2007) while Volume 1, Chapter 6, calls for improved data and analysis to facilitate such integrated planning. The Essential Habitat Connectivity Project helps to fill an identified gap in environmental data.

7.3.2. Regional and Local Infrastructure and Mitigation Planning

California Regional Blueprint Planning Program. The California Regional Blueprint Planning Program, administered by the California Department of Transportation, provides essential support for integrated regional transportation and land-use planning to achieve sustainable regional growth patterns that includes protecting natural resources. This program has provided a vital source of funding for comprehensive regional planning efforts throughout the State of California. There are 44 Metropolitan Planning Organizations and Regional Transportation Planning Agencies throughout the state. Since the inception of the Blueprint Program, 17 Metropolitan Planning Organizations and 14 Regional Transportation Planning Agencies have participated in blueprints or blueprint related efforts. One of the primary elements of the program is regional scenario planning to engage the public and stakeholders in identifying a preferred growth scenario. Blueprint Planning processes can use the Essential Habitat Connectivity Map to provide connectivity related constraints to growth during scenario planning. It can also be used to identify areas where regional connectivity analysis (Chapter 4) or Linkage Designs (Chapter 5) should be developed and incorporated into scenario planning to provide more detail. Similar planning processes taking place in response to SAFETEA-LU 6001 requirements in the preparation of Regional Transportation Plans or SB375 Sustainable Community Strategies can also use the map. While the data generated for the Essential Habitat Connectivity Map may be appropriate to incorporate into the simulation computer modeling in some areas, finer-scale regional connectivity analyses will likely be necessary for most regions of California. Agencies engaged in specific transportation projects that occur in Natural Landscape Blocks or Essential Connectivity Areas should consider developing a Linkage Design (Chapter 5) and address improving connectivity across transportation barriers (Chapter 6).

Regional Advance Mitigation Efforts. Some agencies responsible for multiple infrastructure projects are proactively attempting to mitigate their habitat level impacts by integrating their obligations into regional conservation objectives. The Regional Advance Mitigation Planning (RAMP) effort is evaluating ways to integrate regional conservation designs and mitigation assessment for Department of Water Resources and Caltrans projects in a particular region collectively, by evaluating the expected spatial extent of habitat impacts and associated mitigation requirements. Areas are identified by considering several natural resource data sets in conjunction with anticipated impacts associated with specific resources and habitat types. The California Essential Habitat Connectivity map and data can be considered in this analysis to help connect the network/mitigation plan design and to reflect connectivity in a regional advance mitigation plan. Should funding mechanisms become available to implement a Regional Advance Mitigation Planning program, investments in more holistic mitigation planning and implementation are possible. A good on-the-ground example of advance mitigation efforts at a regional scale is The Elkhorn Slough Early

Mitigation Partnership (http://elkhornslough.ucdavis.edu/). It provides early mitigation for a series of future transportation improvement projects within the Elkhorn Slough Watershed. Conservation and mitigation banks, described below, are heralded as an example for the RAMP effort and could provide a tool for advanced mitigation.

Conservation and Mitigation Banks. A conservation or mitigation bank is privately or publicly owned land managed for its natural resource values and established in advance of compensatory mitigation needs. In exchange for permanently protecting the land, a bank sponsor is authorized by regulatory agencies to sell credits as compensation for specific impacts to habitats and species within a defined service area. These credits may be sold to developers or other infrastructure agencies needing to satisfy permit or other legal requirements for projects that significantly impact the environment.

Both types of banks can have a habitat and listed species component. However, mitigation banks specifically have a Clean Water Act Section 404 component overseen by the U.S. Army Corps of Engineers (USACE) and the U.S. Environmental Protection Agency (USEPA). In California, the Department of Fish & Game has oversight authority for both types of banks and partners with federal agencies, such as U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish & Wildlife Service and the National Marine Fisheries Service, who share similar regulatory authorities and compensatory mitigation requirements.

Banks help consolidate small, fragmented mitigation projects into larger contiguous sites with higher habitat values. Depending on their location, they can significantly contribute to habitat connectivity. The California Essential Habitat Connectivity Map and associated data can contribute to the strategic siting of new conservation and mitigation banks, thereby increasing habitat connectivity. The Department of Fish & Game will be better positioned to recommend to bank sponsors priority areas for banks[60].

Infrastructure Budget Cycle: Funding for Connectivity Planning. Government agencies that develop such infrastructure as roads, waterworks, and energy delivery often impact natural ecosystems, but they also have unique opportunities to contribute to the conservation of regional natural resources through compensatory mitigation. Infrastructure development requires a planning, funding, and implementation cycle that can frequently take a decade or longer, but biological mitigation is often planned and implemented late in this process, on a piece-meal project-by-project basis. If infrastructure agencies (or other regional planning entities) consider products of the California Essential Habitat Connectivity Project in long-range planning as suggested above, they can program the needed funds to implement connectivity within each region. Exploring funding estimates for necessary data development, enhancement, avoidance, minimization, or mitigation opportunities will allow agencies to budget for these improvements either in advance of specific projects or associated with specific projects. Impact fees or mitigation fees may provide funding for implementation as well as avoidance measures. Local taxes or assessments, such as TransNet in San Diego County, can also be considered for this purpose.

---

[60] http://www.dfg.ca.gov/habcon/conplan/mitbank/mitbank_policies/cmb_notaccept.html

7.4. Legislative Framework for Assuring Connectivity

Below we present state and federal legislation that is key to supporting or ensuring the conservation of connectivity in California.

Assembly Bill 2785. Introduced by Assembly Member Ira Ruskin and passed in 2008, this bill directs the California Department of Fish and Game to map essential wildlife corridors and habitat linkages. Amendments to Section 1932 of the California Fish and Game Code are as follows: "*Develop and maintain a spatial data system that identifies those areas in the state that are most essential for maintaining habitat connectivity, including wildlife corridors and habitat linkages. This data should include information essential for evaluating the needs of wildlife species, as defined in Section 711.2 that require habitat connectivity for their long-term conservation, including distribution and movement patterns.*" Not only has the Essential Habitat Connectivity Project gone a long way towards meeting this mandate, the mandate itself sets up funding possibilities from the state budget for future analyses. The Department's effort to provide detailed mapping of vegetation data has also been expanded as a result of this legislation, further assuring that the data necessary for regional connectivity analyses and detailed Linkage Designs are available when needed.

The Safe Accountable Flexible Efficient Transportation Equity Act of 2005 (SAFETEA-LU). The Safe Accountable Flexible Efficient Transportation Equity Act of 2005 (SAFETEA-LU) is currently up for reauthorization[61]. Section 6001 of SAFETEA-LU requires state and regional transportation planning agencies to complete regular plans and transportation improvement programs that identify proposed transportation and transit enhancement activities. SAFETEA-LU further directs agencies to incorporate natural resource considerations directly into transportation planning analysis and documents. Information about types of potential environmental mitigation activities and comparison with other relevant plans, including state conservation plans or maps and inventories of natural or historic resources, is also required. The Essential Habitat Connectivity Map can inform state, regional, and local transportation plans and integrated planning efforts about natural areas that are crucial to the continued functioning of the state's ecosystems.

NCCP Act of 2003. The NCCP Act of 2003 requires every plan to establish linkages between reserves, both within a designated Natural Community Conservation Planning area and to adjacent habitat areas beyond the planning boundary. The Essential Habitat Connectivity Map and guidelines should serve as a primary decision-support tool in planning for connectivity, especially regional connectivity across the boundaries of individual Natural Community Conservation Plans.

California Environmental Quality Act (CEQA). The results of the Essential Habitat Connectivity Project can be used in evaluating California Environmental Quality Act projects. The California Environmental Quality Act checklist specifically asks whether a proposed project would "interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites". If the boundary of a proposed

[61] http://www.fhwa.dot.gov/reauthorization/

project is in the vicinity of an Essential Connectivity Area, it should be called out as a potentially significant biological effect in California Environmental Quality Act comment letters by the California Department of Fish and Game, the trustee agency for fish and wildlife resources of the state. Further analysis or the development of a Linkage Design (Chapter 5) may be necessary to ensure a project can avoid, minimize, or mitigate impacts to connectivity.

California Endangered Species Act (CESA). The California Endangered Species Act establishes a petitioning process whereby individuals, organizations, or the California Department of Fish and Game can submit petitions to the Fish and Game Commission requesting that a species, subspecies or variety (taxa) of plant or animal be state-listed as Threatened, Endangered, and (for plants only) Rare. As with the federal Endangered Species Act (below), it provides law and regulations for the conservation of such listed taxa. Sections 2050 et seq. of the Fish and Game Code declare intent and policy that all state agencies seek conservation for listed taxa and define conservation to include -- among many other measures -- habitat acquisition, restoration and maintenance. The California Essential Habitat Connectivity Project will help agencies locate places to acquire or restore habitat where it will be most effective, particularly for species that require large connected areas across the landscape.

National Environmental Policy Act (NEPA). The National Environmental Policy Act requires federal agencies to integrate environmental considerations and impact analysis into decision making processes and alternatives development for projects or program level plans. The products of the California Essential Habitat Connectivity Project can help federal agencies analyze the significance of effects related to a proposed action. A regional or local level connectivity analysis may be needed in order to obtain the appropriate level of detail for determining significance or informing alternatives analysis.

Endangered Species Act (ESA). The Federal Endangered Species Act provides law and regulations for the consideration of the conservation and recovery of federally-listed Threatened and Endangered species. (For purposes of the ESA, species are defined to include subspecies, varieties and, for invertebrates, distinct population segments.) When evaluating the effects of a federal, state or local action on species covered by the Act, an assessment of the needs of a particular species for feeding, breeding, and shelter are considered. Feeding, breeding and shelter often includes the connectivity of habitat so that a species may access areas for different life cycle activities. The regional and local level analysis will help identify the areas essential for species covered under the Act. Simply considering a particular species and its range and population can provide insight for an effects analysis.

Clean Water Act (CWA). The objective of the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act (CWA), is to restore and maintain the chemical, physical, and biological integrity of the nation's waters by preventing point and nonpoint pollution sources, providing assistance to publicly owned treatment works for the improvement of wastewater treatment, and maintaining the integrity of wetlands. The Essential Habitat Connectivity Map depicts biological integrity of habitats that include the nation's waters and wetlands. Note that the analysis did not specifically focus on aquatic or invertebrate movement; however, wetlands and associated habitats are represented. A regional or local level analysis might appropriately have more of an aquatic than a terrestrial focus, depending on the region.

Chapter 8. Framework for Data Distribution and Evaluation

Through the methods and decision processes described in the previous chapters, numerous spatial data layers (GIS layers) were generated by this project. To maximize the utility of the products, many of the final data layers will be made available to the public in electronic form. A selected set of final results data layers will be published from two separate websites—initially from BIOS, managed by California Department of Fish and Game (http://bios.dfg.ca.gov), and soon afterward from Data Basin, managed by the Conservation Biology Institute (http://databasin.org). Both are interactive web-based systems that will allow users to gain access to the data layers created from this project, but they offer different capabilities and user experiences (Figure 8.1).

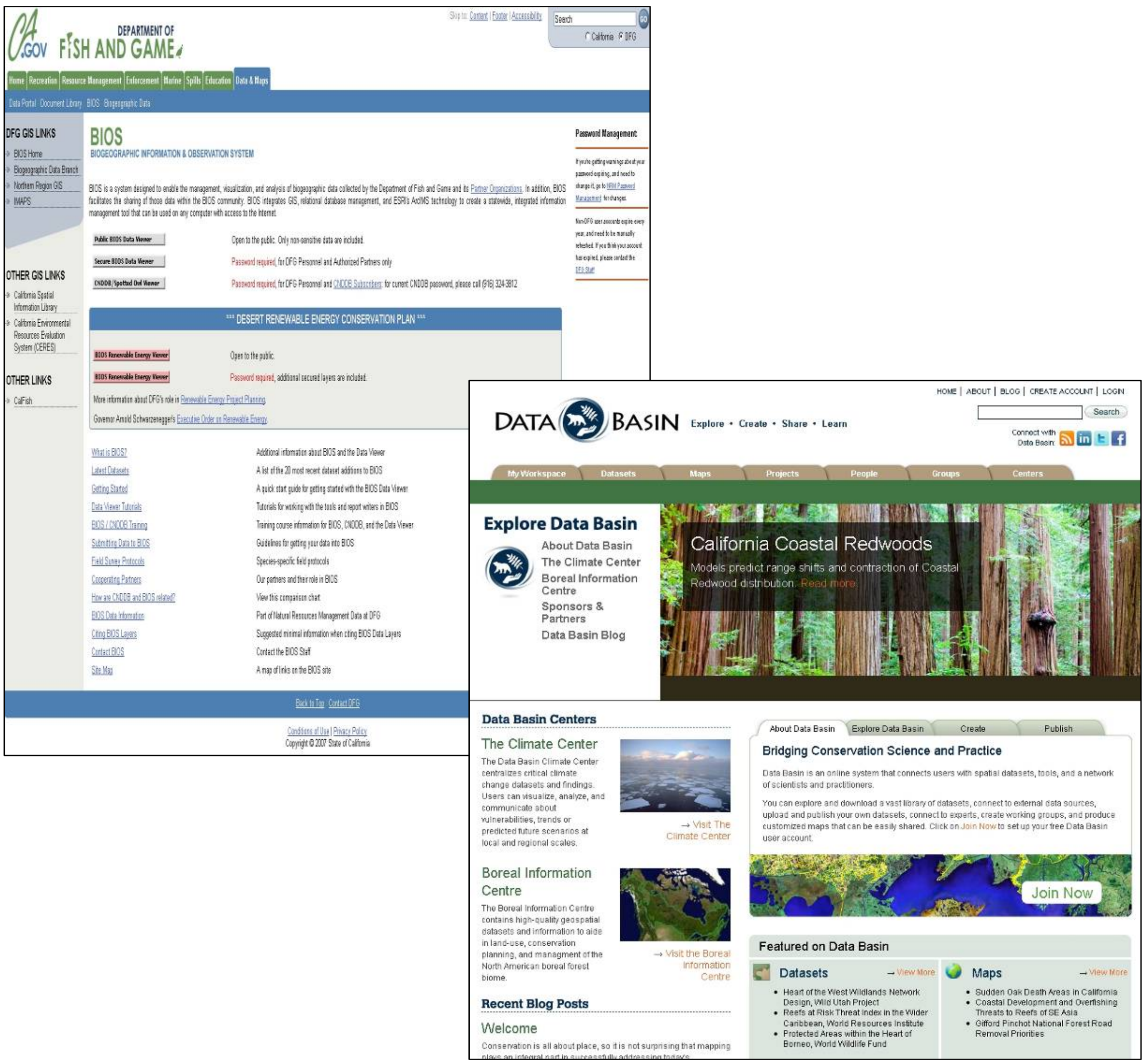


Figure 8.1. Snapshots of BIOS (http://bios.dfg.ca.gov) and Data Basin (http://databasin.org) website homepages.

8.1. GIS Layers and Metadata

Of the many hundreds of data layers generated during the project, the key input data layers created for the analysis (e.g., Natural Landscape Blocks and resistance surface) and final results data layers (e.g., Essential Connectivity Areas) will be provided via BIOS and Data Basin (Table 8.1). For each data layer, complete metadata will be included. From the BIOS and Data Basin sites, public data layers will be downloadable from ESRI's ArcGIS Online site as ESRI layer packages, which include the file geometry, attributes, metadata, and styling (http://www.esri.com).

Table 8.1. List of data layers provided electronically in BIOS and Data Basin.

Data Layer Name	Description File	File Format
NLB_gen	General Natural Landscape Blocks	Polygon Feature Class
NLB_dissect	Natural Landscape Blocks dissected by major and secondary roads (used as termini in least-cost corridor modeling and to generate comparison statistics)	Polygon Feature Class
Sticks	Diagrammatic linear linkage between centroids of Natural Landscape Blocks	Line Feature Class
ECAs	Unsplit version of the Essential Connectivity Areas (n=168)	Polygon Feature Class
ECAs_split	Split version of the Essential Connectivity Areas (n=192)	Polygon Feature Class
Least_Cost_Corridors	Mosaic of least-cost corridor results for all Essential Connectivity Areas. The minimum cell value was used for overlapping cells.	Raster Dataset
Cost_Surface	Statewide resistance surface generated for least-cost path models	Raster Dataset
NatAreas_small	Natural areas smaller than 2,000 acres that otherwise meet NLB criteria	Feature Class

8.2. Ability to Map and Print Locally

Both BIOS and Data Basin will allow users to visualize the data layers provided from the project in conjunction with other data layers already hosted by each system (Figure 8.2). The public map interface for BIOS uses ArcIMS technology and allows the user to conveniently turn a pre-selected set of data layers on or off (using pre-rendered styling) against a shaded relief map of California. The individual datasets from this project will be uploaded into BIOS and provided as options for users to see. Also, users have access to pertinent metadata for each data layer hosted on the site, and they can print the map results easily from a standard map template.

Data Basin is deployed on the Amazon cloud and operates using ArcServer technology with additional functional support provided from ArcGIS Online. The map interface includes several ESRI basemaps that can be easily selected, and against which users can visualize any collection of datasets found in the Data Basin data library or other available map services outside of Data

Basin (Figure 8.2). Once in the map viewer, users are given the tools to easily style (i.e., change colors and symbols on) their own map and then save them to the system within their own workspaces. A user's workspace can either be kept private or shared with others.

The individual datasets from the connectivity project will be uploaded into Data Basin and placed into a project folder called the California Essential Habitat Connectivity Project. This published project folder will also contain many of the maps provided in the report in an editable form. Users can essentially open each map and download or print "as is" or customize it in some way. They can change styling of the existing layers and/or add other data layers, searchable from the system or uploaded by them. Users will be permitted to download all datasets as ESRI layer packages (Zipped files containing file geometry, attribute tables, metadata, and styling information) for direct use on their own desktops using ArcGIS.

Both BIOS and Data Basin provide links to important documents. In both systems, links to the full report (including appendices) will be made available.

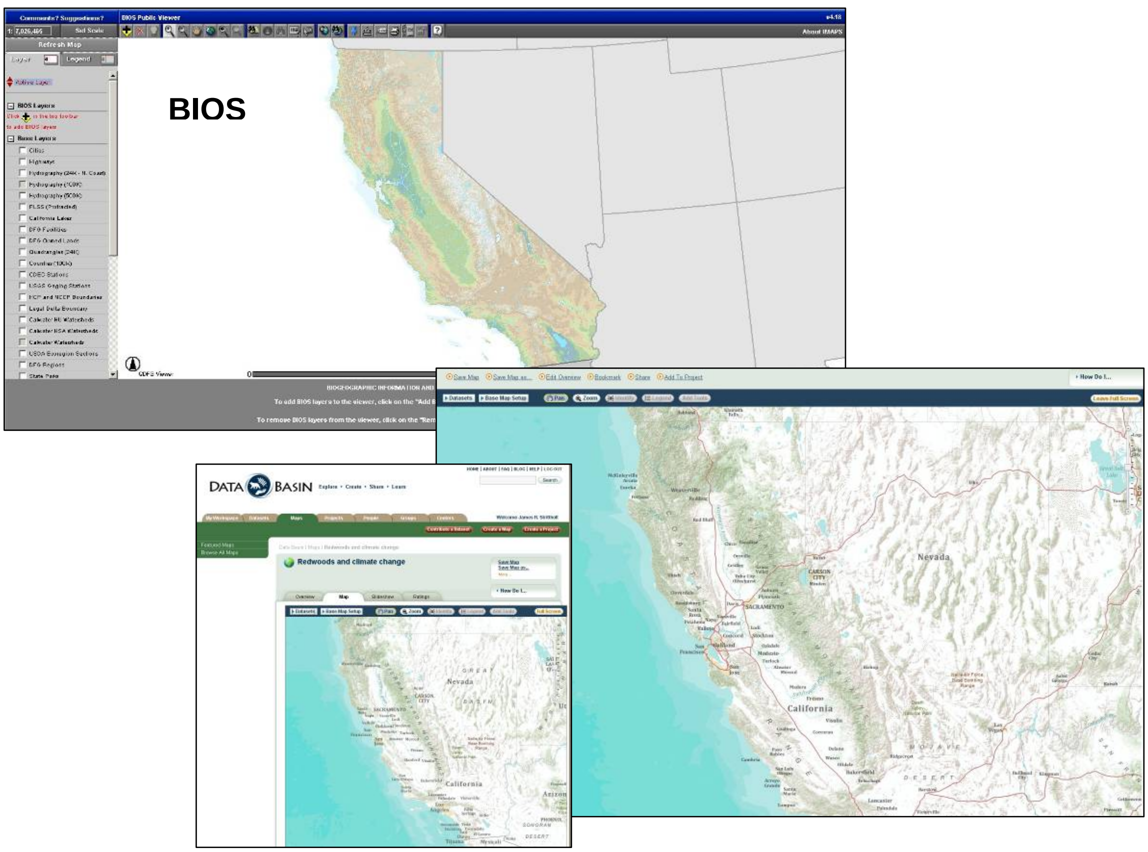


Figure 8.2. Snapshots of BIOS and Data Basin website map interfaces. Data Basin provides two different views (partial and full screen).

8.3. Ability to Add New Data Layers Over Time

Both BIOS and Data Basin allow the addition of data layers over time. BIOS managers and agency partners select relevant biological datasets to host and provide users access in accordance with data custodian wishes. For many data layers, BIOS provides free public access. For data identified by the custodians as sensitive data, access is controlled using a password system. As new data layers become available or existing data layers are updated, BIOS will expose them.

Data Basin was developed to be a spatial data sharing site and allows users to upload their own data layers into the system. Although data sharing remains Data Basin's primary focus, some datasets are sensitive by nature. Therefore, users are given complete control over access – they can elect to keep their data layers completely private, useable only by a select group of other Data Basin users, or made totally public (at which time the data layer is searchable by the system). In the context of the connectivity project, users will always have access to the final results data layers as well as any new layers that either they upload themselves or are provided by others.

Regardless of the system used, data sharing and access is an important common need. Without sharing, making better planning and management decisions becomes impossible. Over the years, technology has evolved rapidly – perhaps faster than our society can adjust. The major challenges to data and information access are no longer technical; they are social. Rigid control of data and information has had direct benefits to individuals and institutions. This long-held practice has resulted in financial rewards, job security, and power over decision making. As we rapidly move into the Web 2.0 world, sharing is becoming more commonplace and society is finding incentives to encourage this important behavior. Effective connectivity planning requires the most current and accurate spatial data available, and these data are generated by many different parties. Data sharing and access will continue to be critical as we move into the future.

As part of this project, the team is publishing the data and results using the Internet to allow maximum accessibility and tools to help all users understand habitat connectivity better. These user-friendly tools also allow users to make their own customized maps, add new datasets, and find people of similar interests or specific expertise. It is the hope of the project team that this body of work will not be the end, but a beginning. Connecting California's wild spaces into a functional natural network will require the involvement of many, and learning from each other is critical to success. By publishing the data and information from this project as described in this chapter, we hope users will continue to add to this body of knowledge so that all of us can learn and move toward this common vision.

Chapter 9. Literature Cited

Adriaensen, F., J.P. Chardon, G. deBlust, E. Swinnen, S. Villalba, H. Gulinck, and E. Matthysen. 2003. The application of 'least-cost' modeling as a functional landscape model. Landscape and Urban Planning 64:233–247.

Amundson, R., and H. Jenny. 1997. On a state factor model of ecosystems. BioScience 47:536-543.

Ball, I.R. and H.P. Possingham. 2000. MARXAN (V1.8.2): Marine Reserve Design Using Spatially Explicit Annealing, a Manual.

Bani, L., M. Baietto, L. Bottoni, and R. Massa. 2002. The use of focal species in designing a habitat network for a lowland area of Lombardy, Italy. Conservation Biology 16:826-831.

Barnum, S.A. 2003. Identifying the best locations along highways to provide safe crossing opportunities for wildlife: a handbook for highway planners and designers. Colorado Department of Transportation.

Beale, C.M., J.J. Lennon, and A. Gimona. 2008. Opening the climate envelope reveals no macroscale associations with climate in European Birds. Proceedings of the National Academy of Sciences 105:14908-14912.

Beier, P. 1993. Determining minimum habitat areas and corridors for cougars. Conservation Biology 7:94-108.

Beier, P. 1995. Dispersal of juvenile cougars in fragmented habitat. J. Wildlife Management 59:228-237.

Beier, P., and R.F. Noss. 1998. Do habitat corridors provide connectivity? Conservation Biology 12:1241-1252.

Beier, P., and S. Loe. 1992. A checklist for evaluating impacts to wildlife movement corridors. Wildlife Society Bulletin 20:434-440.

Beier, P, D Choate, and R.H Barrett. 1995. Activity patterns of cougars during different behaviors. J. Mammalogy 76:1056-1070.

Beier, P, D.R. Majka, and S.L. Newell. 2009. Uncertainty analysis of least-cost modeling for designing wildlife linkages. Ecological Applications 19:2067-2077.

Beier, P., D.R. Majka, and W.D. Spencer. 2008. Forks in the road: choices in procedures for designing wildlife linkages. Conservation Biology 22:836-851.

Beier, P.B., K.L. Penrod, C.L. Luke, W.D. Spencer, and C.R. Cabanero. 2006. South Coast Missing Linkages: restoring connectivity to wildlands in the largest metropolitan area in the United States. In KR Crooks and MA Sanjayan, editors. Connectivity Conservation. Cambridge University Press.

Bittman. R. 2001. The California Natural Diversity Database: A Natural Heritage Program for Rare Species and Vegetation. Fremontia Vol 29:3-4. July/October 2001.

Bolger D.T., A.C. Alberts, R.M. Sauvajot, P. Potenza, C.McCalvin, D. Tran, S. Mazzoni, and M.E. Soulé. 1997. Response of rodents to habitat fragmentation in coastal southern California. Ecological Applications: 7(2):552-563.

Bowles, A.E. 1995. Responses of wildlife to noise. Pages 109–156 in R. L. Knight and K. J. Gutzwiller, editors. Wildlife recreationists: coexistence through management and research. Island Press, Washington, D.C.

Brudin III, C.O. 2003. Wildlife use of existing culverts and bridges in north central Pennsylvania. International Conference on Ecology and Transportation (ICOET) 2003.

Bunn, A.G., D.L. Urban, and T.H. Keitt. 2000. Landscape connectivity: a conservation application of graph theory. Journal of Environmental Management 59:265-278.

Bunn, D., A. Mummert, R. Anderson, K. Gilardi, M. Hoshovsky, S. Shanks, K. Stahle, and K. Kriese. 2007. California wildlife: Conservation challenges (comprehensive wildlife conservation strategy). A report of the California Department of Fish and Game. Prepared by The Wildlife Diversity Project, Wildlife Health Center, University of California, Davis. 496pp.

Cain, A.T., V.R. Tuovila, D.G. Hewitt, and M.E. Tewes. 2003. Effects of a highway and mitigation projects on bobcats in Southern Texas. Biological Conservation 114:189-197.

CalAtlas Teale Hydrology. 2003. California Hydrology. Original source U.S. Geological Survey.

California Department of Fish and Game. 1997. California Central Valley Wetlands and Riparian GIS. GIS Data. Biogeographic Data Branch. Sacramento, California.

California Department of Fish and Game. 2003a. Atlas of the biodiversity of California. Sacramento, California.

California Department of Fish and Game. 2003b. Rarity-weighted richness index hotspots from Atlas of the Biodiversity of California. GIS data. Biogeographic Data Branch. Sacramento, California.

California Department of Fish and Game. 2008. California Wildlife Habitat Relationships System hexagon intersections of species' ranges. GIS data. Biogeographic Data Branch. Sacramento, California.

California Department of Fish and Game. 2009. Habitat Conservation Plan (HCP) and Natural Community Conservation Plan (NCCP) Boundaries in California. GIS data. Habitat Conservation Planning Branch. Sacramento, California.

California Department of Fish and Game and California Interagency Wildlife Task Group. 2000. Standards and Guidelines for CWHR Species Models. Technical Report No. 31. California Wildlife Habitat Relationships System, California Department of Fish and Game. Sacramento, California.

California Department of Fish and Game, Pacific States Marine Fisheries Commission. 2003. Statewide 1:100k Routed Hydrography for California. September 2003.

California Department of Forestry and Fire Protection (FRAP). 2002. Multi-source Land Cover Data (v02_2). http://frap.cdf.ca.gov/projects/frap_veg/index.asp

California Department of Forestry and Fire Protection (FRAP). 2003. Development footprint.

GIS dataset. http://frap.cdf.ca.gov/data.html

California Department of Transportation. 2001. California motor vehicle stock, travel and fuel use forecast. California Department of Transportation Division of Transportation System Information. Sacramento, California.

California Department of Water Resources. 2009. California Water Plan: Update 2009. Pre-final Draft. October 7, 2009. http://www.waterplan.water.ca.gov/cwpu2009/

California GAP Analysis. 1998. Land-cover for California. Biogeography Lab, University of California, Santa Barbara, Santa Barbara, California. http://www.biogeog.ucsb.edu/projects/gap/gap_data.html

California Natural Resources Agency. 2004. Calwater 2.2.1 (The California Interagency Watershed Map of 1999). http://www.ca.nrcs.usda.gov/features/calwater#Data

California Natural Resources Agency. 2009. 2009 California Climate Adaptation Strategy: A Report to the Governor of the State of California in Response to Executive Order S-13-2008. 200pp.

Cameron, D. 2007. California Rangeland Conservation Coalition Biological Prioritization of Rangelands: Approach and Methods. 14pp.

Carr, M. H., T. D. Hoctor, C. Goodison, P. D. Zwick, J. Green, P. Hernandez, C. McCain, J. Teisinger, and K.Whitney. 2002. Final report. Southeastern ecological framework. The GeoPlan Center, University of Florida, Gainesville.

Carroll, C., R. F. Noss, P. C. Paquet, and N. H. Schumaker. 2003. Use of population viability analysis and reserve selection algorithms in regional conservation plans. Ecological Applications 13:1773-1789.

Clevenger AP, Wierzchowski J, Chruszcz B, Gunson K. 2002. GIS-generated, expert-based models for identifying wildlife habitat linkages and planning mitigation passages. Conservation Biology 16: 503-514.

Clevenger, A.P., and N. Waltho. 2000. Factors influencing the effectiveness of wildlife underpasses in Banff National Park, Alberta, Canada. Conservation Biology 14:47-56.

Clevenger, A.P., and N. Waltho. 2005. Performance indices to identify attributes of highway crossing structures facilitating movement of large mammals. Biological Conservation 121:453-464.

Clevenger, A.P., B. Chruszcz, and K. Gunson. 2001. Drainage culverts as habitat linkages and factors affecting passage by mammals. Journal of Applied Ecology 38:1340-1349.

Clevenger, A.P., B. Chruszcz, and K.E. Gunson. 2003. Spatial patterns and factors influencing small vertebrate fauna road-kill aggregations. Biological Conservation 109:15-26.

Clevenger, A.P., and J. Wierzchowski. 2006. Maintaining and restoring connectivity in landscapes fragmented by roads. Pages 502-535 in KR Crooks and MA Sanjayan, editors. Connectivity Conservation. Cambridge University Press.

Clevenger, T., and M.P. Huijser. 2009. Handbook for design and evaluation of wildlife crossing structures in North America. Federal Highways Administration, Washington D.C.

Conservation Biology Institute (CBI). 2009. Protected Areas Database (PAD). Conservation Biology Institute. Corvallis, Oregon.

Cowling, R.M., R.L. Pressey, A.T. Lombard, P.G. Desmet, and A.G. Ellis. 1999. From representation to persistence: requirements for a sustainable system of conservation areas in the species-rich Mediterranean-climate desert of southern Africa. Diversity and Distributions 5:51-71.

Cowling, R.M., R.L. Pressey, M. Rouget, and A.T. Lombard. 2003. A conservation plan for a global biodiversity hotspot, the Cape Floristic Region, South Africa. Biological Conservation 112:191-216.

Crist, P. J. 2000. Mapping and Categorizing Land Stewardship, in A Handbook for Gap Analysis. Version 2.1.0. http://www.gap.uidaho.edu/handbook/CompleteHandbook.pdf

Davis, F. W., C. Costello, and D. Stoms. 2006. Efficient conservation in a utility-maximization framework. Ecology and Society 11(1):33. Available online at: http://www.e cologyandsociety.org/vol11/iss1/art33/main.html

Davis, F. W., C. Costello, D. M. Stoms, E. Machado, and J. Metz. 2004. A framework for setting land conservation priorities in the Sierra Nevada. In: Murphy, Dennis D. and Stine, Peter A., editors. Proceedings of the Sierra Nevada Science Symposium. Gen. Tech. Rep. PSW-GTR-193. Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture: 195-206. Available online at: http://www.fs.fed.us/psw/publications/documents/psw_gtr193/psw_gtr193_5_4_Davis_and_others.pdf

Davis, F. W., D. M. Stoms, C. Costello, E. Machado, J. Metz, R. Gerrard, S. Andelman, H. Regan, and R. Church. 2003. A framework for setting land conservation priorities using multi-criteria scoring and an optimal fund allocation strategy. National Center for Ecological Analysis and Synthesis, University of California, Santa Barbara, California, USA. Available online at: http://www.biogeog.ucsb.edu/pubs/Technical%20Reports/TerrBiod_framework-report.pdf.

Diamond, T. 2010. Using GIS and road kill data to evaluate the effectiveness of habitat connectivity models and to identify habitat characteristics associated with North American Badger movement patterns. M.S. Thesis, San Jose State University, San Jose, California.

Dickson, B.G., and P. Beier. 2002. Home range and habitat selection by adult cougars in southern California. Journal of Wildlife Management 66:1235-1245.

Dickson, B.G., and P. Beier. 2007. Quantifying the influence of topographic position on cougar movement in southern California USA. Journal of Zoology (London) 271:270-277.

Dickson, B.G., J.S. Jenness, and P. Beier. 2005. Influence of vegetation, topography, and roads on cougar movement in southern California. Journal of Wildlife Management 69:264-276.

Dimitriadou, E., K. Hornik, F. Leisch, D. Meyer, and A. Weingessel. 2009. e1071: Misc Functions of the Department of Statistics (e1071), TU Wien. R package version 1.5-19.

Dodd, C.K, W.J. Barichivich, and L.L. Smith. 2004. Effectiveness of a barrier wall and culverts in reducing wildlife mortality on a heavily traveled highway in Florida. Biological Conservation 118:619-631.

Dodd, N. L., J. W. Gagnon, A. L. Manzo, and R. E. Schweinsburg. 2007. Video surveillance to assess highway underpass use by elk in Arizona. Journal of Wildlife Management 71:637-645.

Environmental Defense Fund. 2009. Safe journeys: Opportunities for wildlife conservation through the Farm Bill. http://www.edf.org/documents/9238_Safe_Journeys_report.pdf.

Environmental Law Institute. 2003. Conservation thresholds for land use planners. Environmental Law Institute, Washington, D.C. Available from www.elistore.org

Epps, C.W., J.D. Wehausen, V.C. Bleich, S.G. Torres, and J.S. Brashares. 2007. Optimizing dispersal and corridor models using landscape genetics. Journal of Applied Ecology 44:714-724.

Evink, G.L. 2002. Interaction between roadways and wildlife ecology. National Academy Press, Washington, D.C.

Environmental Systems Research Institute (ESRI). 2008. StreetMapNA (9.3). Environmental Systems Research Institute, Redlands, CA.

Forman, R.T.T., D. Sperling, J.A. Bissonette, A.P. Clevenger, C.D. Cutshall, V.H. Dale, L. Fahrig, R.L. France, C.R. Goldman, K. Heanue, J. Jones, F. Swanson, T. Turrentine, and T.C. Winter. 2003. Road Ecology: Science and Solutions. Island Press: Washington, D.C.

Forman, R.T.T. and L. Alexander. 1998. Roads that their major ecological effects. Annual Review of Ecology and Systematics 29:207-231.

Franklin, J. 1995. Predictive vegetation mapping: geographic modeling of biospatial patterns in relation to environmental gradients. Progress in Physical Geography 19:474-499.

Franklin, J., P. McCullough, and C. Gray. 2000. Terrain variables used for predictive mapping of vegetation communities in Southern California. Pages 391-422 in J. P. Wilson and J. C. Gallant, editors. Terrain analysis: principles and applications. Wiley and Sons, New York.

Gagnon, J.W., T.C. Theimer, N.L. Dodd, A.L. Manzo, and R.E. Schweinsburg. 2007. Effects of traffic on elk use of wildlife underpasses in Arizona. Journal of Wildlife Management 71:2324-2328.

GreenInfo Network. 2009a. California Protected Area Database (CPAD). www.calands.org

GreenInfo Network. 2009b. Easements - Proprietary dataset.

Halpin, P.N. 1997. Global climate change and natural-area protection: management responses and research direction. Ecological Applications 7:828-843.

Hannah, L., and L. Hansen. 2005. Designing landscapes and seascapes for change. Pages 329-341 in T. E. Lovejoy and L. Hanna, editors. Climate change and biodiversity. Yale University Press, New Haven, Connecticut.

Hannah, L., G.F. Midgley, T. Lovejoy, W.J. Bond, M. Bush, J.C. Lovett, D. Scott, and F.I. Woodward. 2002. Conservation of biodiversity in a changing climate. Conservation Biology 16:264-268.

Hanski, I., and M. Gilpin. 1991. Metapopulation Dynamics. Academic Press, London.

Harrison, R. L. 1992. Toward a theory of inter-refuge corridor design. Conservation Biology 6:293–295.

Heller, N.E., and E.S. Zavaleta. 2009. Biodiversity management in the face of climate change: a review of 22 years of recommendations. Biological Conservation 142:14-32.

Hickman, J.C. 1993. The Jepson Manual of Higher Plants of California. University of California Press.

Hoctor, T.S., M.H. Carr, and P.D. Zwick. 2000. Identifying a linked reserve system using a regional landscape approach: the Florida Ecological Network. Conservation Biology 14:984–1000.

Holland, R.F., United States Fish and Wildlife Service and California Department of Fish and Game. 1998. Vernal pool complexes – Central Valley, 1989-1998. GIS Data. Distributed by California Department of Fish and Game. Sacramento, California.

Holland, R.F., United States Fish and Wildlife Service and California Department of Fish and Game. 2003. South Coast Ranges vernal pools. GIS Data. Distributed by California Department of Fish and Game. Sacramento, California.

Huber, P.R., S.E. Greco, and J.H. Thorne. 2010. Spatial scale effects on conservation network design: trade-offs and omissions in regional versus local scale planning. Landscape Ecology, DOI 10.1007/s10980-010-9447-4. http://www.springerlink.com/content/c3564585tt2uj64l/

Huber P.R. 2008. The effects of spatial and temporal scale on conservation planning and ecological networks in the Central Valley, California. Dissertation, University of California, Davis.

Hunter, M.L., Jr. 2007. Climate change and moving species: furthering the debate on assisted colonization. Conservation Biology 21:1356-1358.

Hunter, M.L., Jr, G.L. Jacobson Jr., and T. Webb III. 1988. Paleoecology and the coarse-filter approach to maintaining biological diversity. Conservation Biology 2:375-385.

Huntley, B. 2005. North temperate responses. Pages 109-124 in T. E. Lovejoy and L. Hanna, editors. Climate change and biodiversity. Yale University Press, New Haven, Connecticut.

Intergovernmental Panel on Climate Change (IPCC). 2001. Climate change 2001: the scientific basis. IPCC, Geneva.

Jenness, J. 2003. Mahalanobis distances (mahalanobis.avx) extension for ArcView 3.x, Jenness Enterprises. Available at: http://www.jennessent.com/arcview/mahalanobis.htm.

Jenness, J. 2006. Topographic Position Index (tpi_jen.avx) extension for ArcView 3.x, v. 1.3a. Jenness Enterprises. Available at: http://www.jennessent.com/arcview/tpi.htm.

Jones, A.L., M. Perlmutter, W.B. Monahan, and D. Yun. 2008. Mapping California's Important Bird Areas. Prepared by Audubon California with support from California Polytechnic Institute. Audubon California, Sacramento, CA

Kareiva, P. and M. Marvier. 2003. Conserving biodiversity coldspots. American Scientist 91:344-351.

Kirk, T.A. 2007. Landscape-scale habitat associations of the American marten (*Martes americana*) in the greater southern Cascades region of California. M.S. Thesis, Humboldt State University.

Kirk, T.A., and W.J. Zielinski. In preparation. Functional habitat connectivity of the American marten (*martes americana*) in northeastern California: A geographic information system assessment. Prepared for Lassen National Forest.

Klein, C., K. Wilson, M. Watts, J. Stein, S. Berry, J. Carwardine, M.S. Smith, B. Mackey, and H. Possingham. 2009. Incorporating ecological and evolutionary processes into continental-scale conservation planning. Ecological Applications 19:206-217.

LaHaye, W.S., R.J. Gutiérrez, and J.R. Dunk. 2001. Natal dispersal of the spotted owl in southern California: dispersal profile of an insular population. The Condor 103:691-700.

Lambeck, R.J. 1997. Focal species: a multi-species umbrella for nature conservation. Conservation Biology 11:849-856.

Larkin, R., L.L. Pater, and D. Tazik. 1996. Effects of military noise on wildlife: a literature review. U.S. Army Construction Engineering Research Laboratory Technical Report 96/21, Champaign, Illinois, USA.

Logan, K.A., and L.L. Sweanor. 2001. Desert Puma. Island Press.

Little, S.J. 2003. The influence of predator-prey relationships on wildlife passage evaluation. International Conference on Ecology and Transportation (ICOET) 2003.

Lovejoy, T.E., and L. Hannah, editors. 2005. Climate change and biodiversity. Yale University Press, New Haven, Connecticut.

LSA Associates, Inc. 2004. Final Wildlife Corridor Assessment Ventura State Route 118. Prepared for Caltrans District 7 Division of Environmental Planning.

Luke, C., K. Penrod, C.R. Cabanero, P. Beier, and W. Spencer. 2004. A Linkage Design for the Santa Ana – Palomar Mountain Connection: one of the South Coast’s 15 Missing Linkages. Unpublished report. San Diego State University Field Station Programs, San Diego, California. www.fs.sdsu.edu

Maestas, J.D., R.L. Knight, and W.C. Gilgert. 2003. Biodiversity across a rural land-use gradient. Conservation Biology 17:1425-1434.

Malo, J.E., F. Suarez, and A. Diez. 2004. Can we mitigate animal-vehicle accidents using predictive models. Journal of Applied Ecology 41:701-710.

Marsh, D. 2007. Edge effects of gated and ungated roads on terrestrial salamanders. Journal of Wildlife Management 71:389-394.

Marulli, J., and J.M. Mallarach. 2005. A GIS methodology for assessing ecological connectivity: application to the Barcelona metropolitan area. Landscape and Urban Planning 71:243–262.

Mata, C., I. Hervas, J. Herranz, F. Suarez, and J.E. Malo. 2005. Complementary use by vertebrates of crossing structures along a fences Spanish motorway. Biological Conservation 124:397-405.

McCune, B., and J.B. Grace. 2002. Analysis of Ecological Communities. MjM Software Design: Gleneden Beach, Oregon.

McDonald, W., and C.C. St Clair. 2004. Elements that promote highway crossing structure use by small mammals in Banff National Park. Journal of Applied Ecology 41: 82-93.

McGregor, R.L., D.J. Bender, and L. Fahrig. 2008. Do small mammals avoid roads because of the traffic? Journal of Applied Ecology: 45:117–123.

McLachlan, J.S., J.J. Hellman, and M.W. Schwartz. 2007. A framework for debate of assisted colonization in an era of climate change. Conservation Biology 21:297-302.

McRae, B. 2006. Isolation by resistance: a model of gene flow in heterogeneous landscapes. Evolution 60:1551–1561.

McRae, B.H., and P. Beier. 2007. Circuit theory predicts gene flow in plant and animal populations. Proceedings of the National Academy of Sciences of the United States of America 104:19885–19890.

McRae, B.H., B.G. Dickson, T.H. Keitt, and V.B. Shah. 2008. Using circuit theory to model connectivity in ecology, evolution, and conservation. Ecology 89:2712-2724.

Meese, R.J., F.M. Shilling, and J. Quinn. 2009. Wildlife crossings guidance manual. California Department of Transportation, Sacramento. available at http://www.dot.ca.gov/hq/env/bio/wildlife_crossings/

Miles, S.R., and C.B. Goudey. 1998. Ecological subregions of California: Section and subsection descriptions. USDA Forest Service, Pacific Southwest Region, San Francisco, CA. Internet number R5-EM-TP-005-NET.

Millar, C.I., N.L. Stephenson, and S.L. Stephens. 2007. Climate change and forest of the future: managing in the face of uncertainty. Ecological Applications 17:2145-2151.

Minor, ES, and DL Urban. 2007. Graph theory as a proxy for spatially-explicit population models in conservation planning. Ecological Applications 17:1771-1782.

Mittermeier, R.A., N. Myers, and C.G. Mittermeier (eds.). 1999. Hotspots: Earth's biologically richest and most endangered terrestrial ecosystems. CEMAX, Mexico City.

Mittermeier, R.A., N. Myers, J.B. Thomsen, G.A.B. de Fonceca, and S. Olivieri. 1998. Biodiversity hotspots and major tropical wilderness areas: approaches to setting conservation priorities. Conservation Biology 12:516-520.

Moore, I.D., R.B. Grayson, and A.R. Ladson. 1991. Digital terrain modeling: a review of hydrological, geomorphological, and biological applications. Hydrological Processes 5:3-30.

Moritz, C. 2002. Strategies to protect biological diversity and the evolutionary processes that sustain it. Systematic Biology 51:228-254.

Moritz, C., J.L. Patton, C.J. Conroy, J.L. Parra, G.C. White, and S.R. Beissinger. 2008. Impact of a century of climate change on small-mammal communities in Yosemite National Park, USA. Science 322:2261-264.

Morrison, S.A., and W.M Boyce. 2009. Implementing corridors in a connectivity endgame: some lessons from mountain lions. Conservation Biology 23:275-85.

Moser, S., G. Franco, S. Pittiglio, W. Chou, and D. Cayan. 2009. The future is now: an update on climate change impacts and response options for California. California Energy Commission, PIER Energy-Related Environmental Research Program. CEC-500-2008-071

National Atlas of the United States. 2005. Federal and Indian Lands of the United States: National Atlas of the United States, Reston, Virginia.

National Audubon Society. 2008. Mapping California's Important Bird Areas. 65pp.

Ng, S.J., J.W. Dole, R.M. Sauvajot, S.P.D. Riley, and T.J. Valone. 2004. Use of highway undercrossings by wildlife in southern California. Biological Conservation 115:499-507.

Nordhaugen, S.E., E. Erlandsen, P. Beier, B.D. Eilerts, R. Schweinsburg, T. Brennan, T. Cordery, N. Dodd, M. Maiefsky, J. Przybyl, S. Thomas, K. Vacariu, and S. Wells. 2006. Arizona Wildlife Linkage Assessment.

North Fork Associates. 2000. Placer County vernal pool resource inventory. GIS Data. Distributed by California Department of Fish and Game. Sacramento, California.

Noss, R.F. 2001. Beyond Kyoto: forest management in a period of rapid climate change. Conservation Biology 15:578-590

O'Connell, M. 2009. Preliminary threats analysis: Primary drivers of change in the ecosystems of the Irvine Ranch Natural Landmarks. 7pp.

Overpeck, J., J. Cole, and P. Bartlein. 2005. A 'paleoperspective' on climate variability and change. Pages 91-108 in T. E. Lovejoy and L. Hanna, editors. Climate change and biodiversity. Yale University Press, New Haven, Connecticut.

Pascual-Hortal, L, and S Saura. 2006. Comparison and development of new graph-based landscape connectivity indices: towards the prioritization of habitat patches and corridors for conservation. Landscape Ecology 21:959-967.

Pascual-Hortal, L, and S Saura. 2008. Integrating landscape connectivity in broad-scale forest planning through a new graph-based habitat availability methodology: application to capercaillie (Tetrao urogallus) in Catalonia (NE Spain). European Journal of Forest Resources 127:23-31.

Penrod, K., C. Cabanero, C. Luke, P. Beier, W. Spencer, and E. Rubin. 2003. South Coast Missing Linkages Project: A Linkage Design for the Tehachapi Connection. South Coast Wildlands Project, Idyllwild, CA. www.scwildlands.org.

Penrod, K., C. Cabañero, P. Beier, C. Luke, W. Spencer, and E. Rubin. 2004. South Coast Missing Linkages Project: A Linkage Design for the San Gabriel-Castaic Connection. South Coast Wildlands, Idyllwild, CA. www.scwildlands.org.

Penrod, K., C. Cabañero, P. Beier, C. Luke, W. Spencer, and E. Rubin. 2005. South Coast Missing Linkages Project: A Linkage Design for the San Bernardino-Granite Connection. South Coast Wildlands, Idyllwild, CA. www.scwildlands.org.

Penrod, K., C. Cabañero, P. Beier, C. Luke, W. Spencer, and E. Rubin. 2005. South Coast Missing Linkages Project: A Linkage Design for the San Bernardino-Little San Bernardino Connection. South Coast Wildlands, Idyllwild, CA. www.scwildlands.org.

Penrod, K., C. Cabañero, P. Beier, C. Luke, W. Spencer, and E. Rubin. 2005. South Coast Missing Linkages Project: A Linkage Design for the Sierra Madre-Castaic Connection. South Coast Wildlands, Idyllwild, CA. www.scwildlands.org.

Penrod, K., C. Cabañero, P. Beier, C. Luke, W. Spencer, and E. Rubin. 2006. South Coast Missing Linkages Project: A Linkage Design for the San Bernardino-San Jacinto Connection. South Coast Wildlands, Idyllwild, CA. www.scwildlands.org.

Penrod, K., C. Cabañero, P. Beier, C. Luke, W. Spencer, and E. Rubin. 2006. South Coast Missing Linkages Project: A Linkage Design for the Palomar-San Jacinto/Santa Rosa Connection. South Coast Wildlands, Idyllwild, CA. www.scwildlands.org.

Penrod, K., C. Cabañero, P. Beier, C. Luke, W. Spencer, and E. Rubin. 2006. South Coast Missing Linkages Project: A Linkage Design for the Peninsular-Borrego Connection. South Coast Wildlands, Idyllwild, CA. www.scwildlands.org.

Penrod, K., C. Cabañero, P. Beier, C. Luke, W. Spencer, E. Rubin, R. Sauvajot, S. Riley, and D. Kamradt. 2006. South Coast Missing Linkages Project: A Linkage Design for the Santa Monica-Sierra Madre Connection. South Coast Wildlands, Idyllwild, CA. www.scwildlands.org.

Penrod, K., C. Cabañero, P. Beier, C. Luke, W. Spencer, E. Rubin, S. Loe, and K. Meyer. 2004. South Coast Missing Linkages Project: A Linkage Design for the San Gabriel-San Bernardino Connection. South Coast Wildlands, Idyllwild, CA. www.scwildlands.org.

Penrod, K., R. Hunter, and M. Marrifield. 2001. Missing Linkages: restoring connectivity to the California landscape. California Wilderness Coalition, The Nature Conservancy, US Geological Survey, Center for Reproduction of Endangered Species, and California State Parks.

Peris, S., and J. Morales. 2004. Use of passages across a canal by wild mammals and related mortality. European Journal of Wildlife Research. 50: 67-72.

Peterson, A.T., H. Tian, E. Martinez-Meyer, J. Soberson, V. Sanchez-Cordero, and B. Huntley. 2005. Modeling distributional shifts in individual species and biomes. Pages 211-228 in T.E. Lovejoy and L. Hanna, editors. Climate change and biodiversity. Yale University Press.

Phillips, S.J., P. Williams, G. Midgley, and A. Archer. 2008. Optimizing dispersal corridors for the Cape Proteaceae using network flow. Ecological Applications 18:1200-1211.

Possingham, H. P., I. R. Ball and S. Andelman. 2000. Mathematical methods for identifying representative reserve networks. Pages 291-305 In: S. Ferson and M. Burgman (eds). Quantitative methods for conservation biology. Springer-Verlag, New York.

Pressey, R. L., M. Cabeza, M.E. Watts, R.M. Cowling, and K.A. Wilson. 2007. Conservation planning in a changing world. Trends in Ecology and Evolution 22:583-592.

Raper, S.C.B., and F. Giorgi. 2005. Climate change projections and models. Pages 199-210 in T.E. Lovejoy and L. Hanna, editors. Climate change and biodiversity. Yale University Press, New Haven, Connecticut.

Raupach, M.R., G. Martland, P. Clais, C. Le Quere, J.D. Canadell, G. Klepper, and C.B. Field. 2007. Global and regional drivers of accelerating CO_2 emissions. Proceedings of the

National Academy of Sciences 104:10288-10293.

Rautenstrauch, K.R., and P.R. Krausman. 1989. Preventing mule deer drowning in the Mohawk canal, Arizona. Wildlife Society Bulletin 17:281–286.

Rich, C., and T. Longcore. 2006. Ecological effects of artificial night lighting. Island Press.

Riley, S.P.D., R.M. Sauvajot, J. Sikich, and E. York. 2006. Mountain lion ecology, behavior and conservation in the fragmented urban landscape of Santa Monica Mountains National Recreation Area and surrounding parklands. National Park Service Technical Report submitted to California Department of Parks and Recreation.

Riley, S.P.D., R.M. Sauvajot, T.K. Fuller, E.C. York, D.A. Kamradt, C. Bromley, and R.K. Wayne. 2003. Effects of urbanization and habitat fragmentation on Bobcats and coyotes in southern California. Conservation Biology 17:566-576.

Rosen, P.C., and C.H. Lowe. 1994. Highway mortality of snakes in the Sonoran Desert of southern Arizona. Biological Conservation 68: 143-148.

Rouget, M, R.M. Cowling, A.T. Lombard, A.T. Knight, and G.I.H. Kerley. 2006. Designing large-scale conservation corridors for pattern and process. Conservation Biology 20:549-561.

Ruediger, B. 2001. High, wide, and handsome: designing more effective wildlife and fish crossings for roads and highways. ICOET 2001.

Sanchez, P.A. and 20 others. 2009. Digital soil map of the world. Science 325:680-681.

Sauvajot, R.M., E.C. York, T.K. Fuller, H.S. Kim, D.A. Kamradt, and R.K. Wayne. 2000. Distribution and status of carnivores in the Santa Monica Mountains, California. Preliminary results from radio telemetry and remote survey cameras.

Servheen, C., J.S. Walker, and P. Sandstrom. 2001. Identification and management of linkage zones for grizzly bears between the large blocks of public land in the northern Rocky Mountains. Proceedings of International Conference on Ecology and Transportation 161-179.

Shirk, A.J. 2009. Mountain goat genetic structure, molecular diversity, and gene flow in the Cascade Range, Washington. M.S. Thesis, Western Washington University.

Singleton, P.H., W.L. Gaines, and J.F. Lehmkulhl. 2002. Landscape permeability for large carnivores in Washington: a geographic information system weighted distance and least-cost corridor assessment. Research Paper PNW-RP-549. USDA Forest Service, Portland, Oregon.

Skelly, D.K., L.N. Joseph, H.P. Possingham, L.K. Freidenburg, T.J. Farrugia, M.T. Minnison, and A.P. Hendry. 2007. Evolutionary responses to climate change. Conservation Biology 21:1353-1355.

Soulé, M.E. 1989. USDI National Park Service Proposed Land Exchange: Wildlife Corridors. Unofficially released report prepared for the Santa Monica Mountains National Recreation Area. In Keeley, J.E., M.B. Baer-Keeley, and C.J. Fotheringham (Eds), second interface between ecology and land development in California. U.S. Geological Survey, Sacramento, CA. pp. 113-123.

Soulé, M.E, D.T. Bolger, A.C. Alberts, J. Wrights, M. Sorice, and S. Hill. 1988. Reconstructed dynamics of rapid extinctions of chaparral-requiring birds in urban habitat islands. Conservation Biology 2:75-92.

South Coast Wildlands. 2008. South Coast Missing Linkages: A Wildland Network for the South Coast Ecoregion. Produced in cooperation with partners in the South Coast Missing Linkages Initiative. Available online at http://www.scwildlands.org.

South Coast Wildlands. 2008. Protected Lands.

Southern Rockies Ecosystem Project. 2005. Linking Colorado's landscapes: a statewide assessment of wildlife linkages, phase I report. Southern Rockies Ecosystem Project, Denver, Colorado.

Spencer, W.D., H. Rustigian, R.M. Scheller, A.D. Syphard, J.R. Strittholt, B.C. Ward. 2008. Baseline evaluation of fisher habitat and population status and effects of fires and fuels management on fishers in the southern Sierra Nevada. Report to the USDA Forest Service, Pacific Southwest Region. 133pp. http://consbio.org/what-we-do/southern-sierra-nevada-fisher-assessment/sothern-sierra-nevada-fisher-assessment

Stein, B.A., L.S. Kutner, and J.S. Adams, Eds. 2000. Precious Heritage: the status of biodiversity in the United States. Oxford University Press. 399pp.

Theobald, D.M. 2005. Landscape Patterns of Exurban Growth in the USA from 1980 to 2020. Ecology and Society 10(1).

Theobald, D.M. 2006. Exploring the functional connectivity of landscapes using landscape networks. Pages 416-444 (Chapter 17) in K.R. Crooks and M.A. Sanjayan, editors. Connectivity Conservation. Cambridge University Press.

Thorne, J., D. Cameron, and V. Jigour. 2002. A Guide to Wildlands Conservation in the Central Coast Region of California. A Project of the California Wilderness Coalition. 152pp.

Thorne, J. H., P. R. Huber, E. H. Girvetz, J. Quinn, and M. C. McCoy. 2009. Integration of regional mitigation assessment and conservation planning. Ecology and Society 14(1): 47. http://www.ecologyandsociety.org/vol14/iss1/art47/

Thorne, J.H., R. Kelsey, J. Honig, and B. Morgan. 2006. The Development of 70-Year-old Wieslander vegetation type maps and an assessment of landscape change in the Central Sierra Nevada. California Energy Commission, PIER Energy-Related Environmental Program. CEC 500-2006-107.

Urban, D., and T Keitt. 2001. Landscape connectivity: a graph-theoretic perspective. Ecology 82:1205-1218.

U.S. Bureau of Land Management, California State Office. 2000. BLM Areas of Critical Environmental Concern in California. http://www.ca.blm.gov/gis/downloadindex.html#Designated_Boundary

U.S. Census Bureau. 2002. TIGER/Line files: technical documentation. Geography Division, U.S. Census Bureau, Washington, D.C.

U.S. Census Bureau. 2008. TIGER/Line files: technical documentation. Geography Division, U.S. Census Bureau, Washington, D.C. http://www.census.gov/geo/www/tiger/tgrshp2007/tgrshp2007.html

U.S. Fish and Wildlife Service. 1998. Recovery plan for upland species of the San Joaquin Valley, California. Region 1, Portland, Oregon. 319pp.

U.S. Fish and Wildlife Service. 2005. Habitat Conservation Plans: Working Together for Endangered Species. 28pp.

U.S. Fish and Wildlife Service. 2006. California Wetlands.

U.S. Fish and Wildlife Service. 2008. Critical and essential habitat. http://criticalhabitat.fws.gov/

U.S. Fish and Wildlife Service. 2009. California Landscape Conservation Cooperatives. 2pp.

U.S. Geological Survey GAP Program, 2008. GAP Ecological Systems. Available at: http://gapanalysis.nbii.gov/portal/community/GAP_Analysis_Program/Communities/Maps,_Data,_&_Reports/Find_Updated_GAP_Regional_Data/

van Wieren, S.E., and P.B. Worm. 2001. The use of a motorway wildlife overpass by large mammals. Netherlands Journal of Zoology 51:97-105.

Vandergast, A.G., A.J. Bohonak, S.A. Hathaway, J. Boys and R.N. Fisher. 2008. Are hotspots of evolutionary potential adequately protected in southern California? Biological Conservation 141:1648–1664.

von der Lippe, M., and I. Kowarik. 2007. Long-distance dispersal of plants by vehicles as a driver of plant invasions. Conservation Biology 21:986-996.

Weiss, S.B., N. Schaefer and R. Branciforte. 2008. San Francisco Bay Area Upland Habitat Goals Preserving Biological Diversity for Future Generations. Methodology and Vegetation Representation Analysis. 98pp.

Wessels, K J., S. Freitag, and A.S. van Jaarseld. 1999. The use of land facets as biodiversity surrogates during reserve selection at a local scale. Biological Conservation 89:21-28.

Western Governors' Wildlife Council. 2009. Western Regional Wildlife Decision Support System: Definitions and Guidance for State Systems. White paper draft for discussion – December 9, 2009. http://www.westgov.org/index.php?option=com_contentandview=articleandid=123andItemid=68

Wikramanayake, E., M. McKnight, E. Dinerstein, A. Joshi, B. Gurung, and D. Smith. 2004. Designing a conservation landscape for tigers in human-dominated ecosystems. Conservation Biology 18:839-844.

Wilcove, D.D., D. Rothstein, J. Dubow, A. Phillips, and E. Losos. 1998. Quantifying threats to imperiled species in the United States. BioScience 48:607-615.

Williams, P., L. Hannah, S. Andelman, G. Midgley, M. Araujo, G.Hughes, L. Manne, E. Martinez-Meyer, and R. Pearson. 2005. Planning for climate change: identifying minimum-dispersal corridors for the cape Protaceae. Conservation Biology 19:1063–1074.

Yanes, M., J.M. Velasco, and F. Suárez. 1995. Permeability of roads and railways to vertebrates: the importance of culverts. Biological Conservation 71:217-222.

Yang, L., S.V. Stehman, J.H. Smith, and J.D. Wickham. 2001. Thematic accuracy of MRLC land cover for the eastern United States. Remote Sensing of Environment 76:418–4282.

Zhang, Y., W. Wang, X. Zhange, and Y. Li. 2008. A cluster validity index for fuzzy clustering. Information Sciences 178:1205-1218.

Appendices

A. Work Plan

B. Detailed Characteristics of Essential Connectivity Areas

C. Detailed Characteristics of Natural Landscape Blocks

D. List of Acronyms

E. New Approaches to Analysis of Connectivity

California Essential Habitat Connectivity Project
Work Plan
April 2009

Introduction: The California Department of Transportation (Caltrans), in partnership with the California Department of Fish and Game (CDFG), has commissioned a team of technical consultants (Consulting Team) to assist them in producing a statewide assessment of essential habitat connectivity. Caltrans intends to use this assessment to comply with Section 6001 of SAFETEA-LU and thus avoid, minimize, or mitigate impacts to habitat connectivity during the planning process. CDFG will also use the statewide assessment in updating the State Wildlife Action Plan and in complying with AB2785 and SB85. CDFG and USFWS intend the assessment to assist them in developing NCCPs and HCPs. The assessment may also assist metropolitan planning organizations in complying with SB375 and related laws.

On October 7, 2008, a Multidisciplinary Team (MDT) of stakeholders from various federal, state, and local agencies was convened to discuss desirable characteristics of the following three primary products of the California Essential Habitat Connectivity Project.

1. A statewide map depicting areas essential for habitat connectivity.
2. A matrix summarizing biological values of the linkages to inform conservation decisions.
3. A strategic plan that outlines an approach for finer-scale analyses and local or regional connectivity plans, which are to be performed outside the scope of this statewide assessment.

Also at the October 7, 2008 workshop, some members of the MDT volunteered to assist the Consulting Team in making key technical decisions regarding these three products. These volunteers are called the Technical Advisory Group (TAG). The TAG met at a workshop on January 29, 2009 to discuss the

Abbreviations

AB2785: Requires CDFG to map essential wildlife corridors and habitat linkages.
ACE: Areas of Conservation Emphasis being defined by CDFG.
Caltrans: California Department of Transportation.
CDFG: California Department of Fish & Game.
CNDDB: California Natural Diversity Database.
Consulting Team: Consulting Team contracted for this project, including The Dangermond Group, Conservation Biology Institute, SC Wildlands, and Paul Beier, working collaboratively with Caltrans and CDFG representatives.
HCP: Habitat Conservation Plan developed under Section 10 of the US Endangered Species Act.
MDT: Multidisciplinary Team of representatives from federal, state, and local agencies involved in conservation, land-use, or transportation planning and implementation.
NCCP: Natural Communities Conservation Plan.
SAFETEA-LU: Safe Accountable Flexible Efficient Transportation Equity Act of 2005.
SB375: Requires regional transportation plans to include strategies to meet goals for reducing greenhouse gas emissions.
SB85: Requires CDFG to develop vegetation mapping standards.
SWAP: State Wildlife Action Plan.
TNC: The Nature Conservancy.
TAG: Technical Advisory Group. A group of about 30 volunteers from local, state, and federal government who are assisting the Consulting Team make key technical decisions.

approach for producing the first two products: (1) the Statewide Essential Habitat Connectivity Map and (2) the Matrix of Biological Value of the Linkages (formerly "prioritization"). The Strategic Plan (product 3) will be developed based on ongoing input from the TAG and MDT.

Project Mission Statement: The purpose of the California Essential Habitat Connectivity Project is to develop a habitat connectivity map and a plan that will help infrastructure, land use, and conservation planners maintain and restore a connected California, while simultaneously making infrastructure planning projects more cost efficient.

Purpose of Work Plan: The purpose of this Work Plan is to guide the consultant team, provide an outline that identifies specific steps that require TAG input, and serve as the primary document for outside peer review. With distribution of this Final Work Plan we are at Action Step 2.3 (having revised the Draft Work Plan based on initial TAG input and outside peer review; see below).

Review and Input Process: We will hold web based meetings with the TAG at appropriate milestones in the process to obtain input and review of interim products. We will use Data Basin as a method of sharing, receiving input, and refining maps, models, and other work products throughout the project. Data Basin is an innovative web tool (http://databasin.org/about_data_basin) that connects users with conservation datasets, tools, and expertise. Individuals and organizations can explore and download a vast library of conservation datasets, upload their own data, comment on or add to other's data, and produce customized maps and charts that can be easily shared. In addition we will hold one additional workshop with the TAG to review products, and one final workshop with the MDT (outlined below).

Strategic Action #1: Reach Consensus on Work Plan Approach

(Completed March 2009)

Action Step 1.1: Produce a Draft Work Plan prior to the January 29, 2009 meeting that includes options for the TAG to consider.

Action Step 1.2: Develop and provide background materials to the TAG prior to meeting.

Action Step 1.3: Hold the January 29, 2009 meeting with the TAG to evaluate options and criteria for constructing and prioritizing statewide habitat connectivity map and reach consensus on the Work Plan approach.

Action Step 1.4: Revise the Work Plan based on information received from the TAG at the January 29, 2009 meeting. Include details on specific action steps that need to be completed, determine the schedule, and identify the individuals responsible for each step.

Action Step 1.5: Circulate revised Work Plan to the TAG for review and input.

Strategic Action #2: Outside Peer Review of Planned Approach

(Completed April 2009)

Action Step 2.1: Peer review. We asked academic experts in conservation biology, conservation planning, and linkage design not associated with this project to review the Work Plan and background materials from the January 29, 2009 TAG meeting (e.g., approach document and associated appendix). We will also request that they review subsequent products as they are completed via Data Basin. Comments on the Draft Work Plan received from the following experts were used to complete this Final Work Plan: Dr. Reed Noss (University of Central Florida), Dr. Kevin Crooks (Colorado State University), Dr. Dave Theobald (Colorado State University), Dr. John Wiens (PRBO Conservation Science), and Dr. Kate Wanner (Trust for Public Land). No stipends were available for this task.

Action Step 2.2: Circulate work plan. Circulate work plan and comments from the peer reviewers to the TAG for a second review and input cycle.

Action Step 2.3: Finalize work plan. Finalize work plan based on comments received in Steps 2.1 and 2.2.

Strategic Action #3: Construct Statewide Wildlife Habitat Connectivity Map (September 2009 targeted completion date)

The goal for this strategic action is to identify, at a gross, statewide scale, areas where maintaining or restoring functional ecological connectivity is essential to conserving the state's biological diversity. The intent is to create a baseline map of essential connectivity areas, based largely on GIS data layers that reflect ecological integrity or "naturalness" of land features, and therefore likely to reflect the needs of diverse species and ecological processes. Thus, this statewide map will provide a relatively "top-down, broad-brush" depiction of essential connectivity areas, with the intent that finer resolution mapping and analysis will later be performed (outside the current scope of work) using finer resolution and "bottom-up" (e.g., species-based) modeling and analyses.

The Strategic Plan (Strategic Action #6) will provide detailed recommendations for how to perform these additional analyses and delineate essential connectivity areas at ecoregional and local scales. The approach for developing the statewide map has been designed to be conservative — erring on the side of being inclusive rather than exclusive of essential connectivity areas. It is also to be as transparent, scientifically defensible, and repeatable as possible.

This statewide connectivity map will not be developed using explicit climate-change models or other future scenario analyses. The Strategic Plan will recommend additional analyses that could be used to address future changes, including adaptation to climate change, under future scenarios.

This process will not explicitly address freshwater or marine connectivity issues. However, natural riparian corridors are considered in identifying essential connectivity areas because they are important to maintaining diverse geological and ecological processes and facilitate movements of diverse species, including terrestrial as well as aquatic species.

Action Step 3.1: Assemble and prepare data layers. The Consulting Team will work with MDT to identify and obtain all essential and available data layers, including GIS and ancillary data that can inform the analyses.

Action Step 3.2: Define analysis area. The analysis area is defined as the entire state of California plus a buffer into adjacent Oregon, Nevada, Arizona, and Baja California to ensure that cross-border connections are also addressed.

To define the buffer into adjacent states and Baja California we will use a biologically driven but flexible set of rules. This flexible rule set may define the analysis extent by using one or more of the following techniques: (1) the edge of the nearest areas of high ecological integrity outside of the state, (2) edge of nearest protected areas (e.g., based on GAP 1 & 2 ratings)[1], and (3) the edge of known, important habitat areas for key species (e.g., desert tortoise recovery areas). We will focus our attention within the state and depict cross-border linkages with placeholder arrows, indicating future collaboration with neighbors.

Action Step 3.3: Conduct analysis to define natural landscape blocks. We will define *natural landscape blocks* as any large (size to be determined based on pilot testing and TAG input) existing natural open space having relatively high ecological integrity. For this exercise, ecological integrity will be defined by a select set of surrogate data themes that provide our best estimate of relative levels of naturalness. Additional biological modifiers may be added to further discriminate the California landscape. The model for mapping natural landscape blocks will be based on the following criteria:

- Road Density:
  ESRI StreetMapNA Major roads data (9.3, 2008) for US, 1:100,000, vector

- Percent Impervious Surface:
  National Land Cover Database 30m raster, 2001, US Geological Survey

---

[1] GAP Status 1: An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a natural state within which disturbance events (of natural type, frequency, and intensity) are allowed to proceed without interference or are mimicked through management.

GAP Status 2: An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a primarily natural state, but which may receive use or management practices that degrade the quality of existing natural communities.

- Percent Agriculture (not including rangelands): LANDFIRE.EXISTING_VEGETATION_TYPE, USDA Forest Service, 90m grid, 2006; and FRAP

- Percent Urban (using one or more of the following):
  - FRAP, Multi-Source Land Cover Data (CWHR), raster, 2002, 100m
  - LANDFIRE.EXISTING_VEGETATION_TYPE, USDA Forest Service, 90m grid, 2006
  - FRAP, Development Footprint, 2002, 30m, 1:100,000 (derived from Census housing density, and USGS land cover data).
  - NLCD, Land Cover, 21 broad land cover classes, raster, 2001, 30m

- Conservation Status (appropriately weighted to reflect correlation with biodiversity protection, combining the following databases):
  - Conservation Biology Institute Protected Areas Database 2008
  - SC Wildlands Protected Lands for the south (using data from The Nature Conservancy, Santa Monica Mountains Conservancy, National Park Service, and California Protected Areas Database as of November 2008).
  - GAP status codes weighted according to level of protection.

<u>Potential Biological Modifiers</u>

- Vernal Pools and Wetlands:
  - Central Valley Vernal Pool Complexes, DFG, 1998
  - California Central Valley Wetlands and Riparian GIS, DFG, 1997
  - Placer County Vernal Pool Resource Inventory, DFG, 2000
  - South Coast Ranges Vernal Pools, DFG, 2003
  - California Wetlands, USFWS, 2006
  - Wetland Reserve Program Lands, if available

- Rarity-Weighted Richness Index (includes rare plants substrates): CDFG, 2009, grid cell size to be determined

- Essential Habitat identified by USFWS for Federally listed species. Essential Habitat includes geographic areas essential to a species' conservation, including those areas that may be excluded from designated Critical Habitat for economic or other reasons, such as coverage in long-term conservation agreements.

Data resolution will be 100m. We will apply a relatively fine moving-window averaging algorithm to produce a map showing a gradient of ecological integrity. We will evaluate different window sizes, weights, and criteria to avoid losing smaller natural landscape blocks in developed areas. Pilot analyses suggest that a moving window of about 5 km is best. The approach will include model logic that employs neighborhood averaging, weighting, and "or" logic functions to avoid inappropriately competing criteria against one another (for example, an area could be of high ecological integrity in part due to presence of vernal pools *or* rare plant substrates *or* Essential Habitat, etc.).

From the results, we will select thresholds for the level of integrity and the size of contiguous areas that will constitute our natural landscape blocks. Areas outside these blocks will be treated as matrix lands through which connectivity needs will be assessed. We may use different thresholds in different ecoregions in order to delineate the best remaining blocks. The threshold may be specified as a rule, (e.g., greater than a certain percentile of integrity within each ecoregion, or within a large subset of an ecoregion) but the rationale will be clearly defined. The TAG was comfortable with a minimum size of about 6,000 acres, but perhaps smaller in more developed ecoregions (e.g., <2000 acres in Central Valley), or larger in wilder ecoregions (e.g., Sierra Nevada). The TAG will have an opportunity to review the initial determinations for size thresholds in Action Step 3.5.

Action Step 3.4: Determine which pairs of natural landscape blocks to connect. After natural landscape blocks are defined, we will use expert opinion to determine which blocks should be connected using such factors as landscape context (e.g., are the blocks adjacent?), ecological context (e.g., do the blocks share species that require movement?), existence of barriers (are there absolute barriers between blocks that cannot be mitigated?), and ecological processes (would connecting these blocks accommodate migrations or ecological shifts due to climate change or disturbance factors?). We will attempt to develop a repeatable set of rules for this step, and will describe the factors we considered and our rationale for each linkage. The Consulting Team will take the first pass at identifying the proposed linkage network for the state and post the draft map and ancillary datasets (e.g., Penrod et al. 2001) on Data Basin for the TAG to review and provide input.

Action Step 3.5: Provide draft results of action step 3.3 and 3.4 to the TAG for review and comment. The maps and ancillary datasets used by the team in previous steps will be provided via Data Basin. Reviewers can also evaluate results using their own data layers. We will provide a summary document and supporting data as necessary. Members of the TAG who comment or make suggested edits to the map must also explain their rationale. We will have either a conference call or webinar with the TAG to familiarize them with Data Basin and walk them through the approach for this step. The TAG will have two weeks after the webinar to submit comments.

Action Step 3.6: Incorporate revisions from TAG.

Action Step 3.7: Conduct analyses to delineate essential connectivity areas. We will use *least-cost corridor modeling* to define *essential connectivity areas* for each pair of natural landscape blocks that are determined to require connectivity. We will use the centroid of each natural landscape block as terminuses for each analysis.

To develop the resistance surface or cost raster for least-cost modeling we will use data inputs with a resolution of 30m or 100m. Criteria that may contribute to the cost surface include:

- road density or distance to road

- railroads
- percent natural landcover (100m), or natural vs. not natural landcover (30m) Different categories of urban and agriculture will be defined relative to their likely effects on overall habitat permeability, based, for example, on number of dwelling units/acre or type of agriculture (row crops, rice, vineyards, or orchards). Rangelands will generally be considered natural grasslands rather than agriculture.
- percent impervious surface
- percent wetland or riparian

We will then add natural streams that provide potential aquatic or riparian connections between the natural landscape blocks if a linkage polygon does not encompass these streams already. Streams will be buffered on each side out to 250 m or to any substantial barriers to movement, such as urban edge.

For five sample essential connectivity areas, we will compare our coarse-level modeling results with finer scale connectivity model results based on focal species. Comparisons will be focused in areas in which fine-scale linkage designs based on multiple focal species, some of which are listed and sensitive, have been completed (e.g., for the South Coast Missing Linkages project; Beier et al. 2006). To the degree possible, these five areas will be representative of different ecoregions throughout the state.

We will define the cost threshold to apply throughout the state (or ecoregion) using a threshold that encompasses all focal species' least-cost corridors. For example, if the most permeable (lowest cost) 5% threshold based on ecological integrity encompasses all focal species' least-cost corridors in all five sample areas, we would use 5% as the threshold for least-cost modeling in all essential connectivity areas. This analysis should help reassure users who are skeptical of using ecological integrity as the resistance layer by selecting a cost threshold that is likely to accommodate the needs of diverse focal species.

If the comparison shows that the ecological integrity raster based approach is severely lacking, we will explore adding a limited number of additional datasets to improve the performance.

Action Step 3.8: Evaluate utility of essential connectivity areas. We will select an illustrative subset of essential connectivity areas (at least one per ecoregion), and describe and evaluate the utility of each through (1) review by species experts, and (2) comparison of our polygons with maps produced by other linkage planners (Davis and Cohen 2008, Penrod et al., 2008, 2006, 2005, 2004, 2003). For each essential connectivity area, we will identify a suite of species expected to use the area, and consider ecological processes, functions, and limitations. We will utilize Wildlife Habitat Relationship data (modeled habitat for 700 vertebrate species) or other existing habitat suitability models (e.g., desert tortoise, bighorn sheep) to identify the suite of species that may be served by each essential connectivity area.

Action Step 3.9: Submit essential connectivity areas results to the TAG for review via Data Basin.

Action Step 3.10: Incorporate minor changes based on input from the TAG.

Strategic Action #4: Compare Essential Connectivity Map to other Conservation Maps (October 2009 targeted completion date)

Action Step 4.1: Compare results to other conservation and pertinent maps. We will overlay the results of the analyses to delineate natural landscape blocks and essential connectivity areas with other conservation plans and assess differences. Maps used for these comparisons may include those identified in:

- Missing Linkages (Penrod et al. 2001; statewide arrows based on expert opinion)
- Existing regional linkage plans prepared by various academic or non-profit organizations (Davis and Cohen 2008)
- Conservation priority areas or portfolios identified by TNC
- Digitally available reserve designs for NCCPs, HCPs, and MSCPs
- Critical habitat designated by USFWS for threatened or endangered species, as well as Essential Habitat identified by USFWS for Federally listed species
- Protected Lands (even though protected lands will be used as input to model, this overlay will show hard line boundaries of public/private conservation lands)
- Bay area focus priority conservation areas developed by CBI
- California Rangeland Conservation Coalition Focus Area Prioritization map
- Predictive models of climate change
- Multi-taxa genetic landscapes (Vandergast et al., 2008)

We will discuss compatibility with other statewide plans (e.g., regional transportation plans, State Wildlife Action Plan) and online databases.

Action Step 4.2: Provide comparison summary to the TAG.

Strategic Action #5: Describe Relative Biological Value of Connectivity Areas (November 2009 targeted completion date)

The goal of this strategic action is to describe the mapped linkages according to their *biological value*. The values assigned are emphatically *not* intended to set agendas for any regulatory, management, or conservation entity. Rather the assigned values of each linkage are intended to serve the following limited purposes:

- Each agency can use these description of statewide biological value as one of several inputs into their own prioritization scheme. The agency will continue to set its own priorities based on its particular mission.
- CDFG, Caltrans, or another state or regional entity can voluntarily allocate planning resources for development of fine-scale linkage conservation plans, modification of the SWAP, or development of a new NCCP or HCP.
- To allow agencies and conservation planners to focus conservation or mitigation in particular areas of high biological importance.
- To provide public information that can highlight essential connectivity areas in California.

Action Step 5.1: Select and calculate metrics for biological value of essential connectivity areas. We will use at least the following criteria:

- size of each natural landscape block associated with the essential connectivity area
- ecological integrity of the essential connectivity areas
- fraction or area of the natural landscape blocks and essential connectivity areas in protected status
- a metric derived from graph theory called the "integral index of connectivity" that integrates landscape value (e.g., ecological integrity) and graph connectedness into a single measure (Pascual-Hortal and Suarta 2008).

Several additional metrics for biological value of an essential connectivity area were proposed by members of the TAG. Any metric must meet the following two criteria (1) it must be calculated from *unambiguous, existing* data, and (2) the appropriate data must be available *for the entire analysis area* (State of California plus buffer). We will attempt to find data layers meeting these standards for the following proposed metrics:

- Presence of aquatic features (streams, lakes, wetlands, etc.)
- Irreplaceability (e.g., rarity hotspots from CNDDB)
- Number of life zones (or magnitude of elevation gradients)
- Number of taxa potentially supported (from previous strategic action)
- Importance as migration route (existing or restorable)

Rather than assign relative weights to each metric, we will provide a matrix of scores for each metric by essential connectivity area. The matrix will also identify which ecoregion(s) and which county(s) the essential connectivity area falls within. Subject to input from the TAG, we may classify the relative importance of each area to biodiversity protection in two or more classes (e.g., truly essential vs. important) and if possible, further identify conservation potential (e.g., contribution to existing conservation investments, land condition, restoration opportunities) to assist agencies in prioritizing actions.

Action Step 5.2: Provide Draft Results to the TAG. Provide results of draft analyses for Assigning Biological Value to Connectivity Areas via Data Basin for TAG review and input. Include summary document.

Action Step 5.3: Hold Second Meeting with the TAG to discuss results of analyses for natural landscape blocks, essential connectivity areas, and biological value of connectivity areas (anticipated for October 14 or 15, 2009).

Action Step 5.4: Revise Analyses based on input from the TAG and provide results to the TAG for final review and input.

Action Step 5.5: Address Final Revisions.

Strategic Action #6: Strategic Plan Development (December 2009 targeted completion date)

The goal of this strategic action is to produce a strategic plan that will guide future regional and fine scale connectivity analyses, planning, and implementation.

Action Step 6.1: Circulate strategic plan outline. Provide detailed outline for Strategic Plan to MDT for review and input. Topics likely addressed include:

- Describe goals of the Strategic Plan.
- Summarize methods and results of the preceding analyses, including their limitations.
- Describe steps required to complete ecoregional level analyses.
- Describe steps required to complete local-scale analyses.
- Describe strategies for integrating essential connectivity areas into other planning and implementation strategies (e.g., General Plans, transportation plans, NCCP plans).
- Compare this approach with that of other plans.
- Describe necessary coordination and collaboration efforts.
- Describe threats and opportunities for implementation, including strategies for rating threats (e.g., development, climate change, fires, pests) and opportunities (e.g., state and regional transportation plans).
- Describe climate change assumptions and recommend future scenario analyses.
- Describe how to integrate results into transportation and land use models.

Action Step 6.2: Draft strategic plan. Develop full draft of Strategic Plan based on input received from MDT.

Strategic Action #7: Project Wrap-up (February 2010 targeted completion date)

Action Step 7.1: Develop presentation(s) summarizing the project and how to use the products.

Action Step 7.2: Obtain input from MDT on distribution list for final products.

Action Step 7.3: Hold final meeting with full MDT. Provide all products produced to date. Use meeting to get input on strategic plan (e.g., framework to use products) before finalizing.

Action Step 7.4: Circulate draft strategic plan to full MDT for review and input.

Action Step 7.5: Revise draft strategic plan based on input from MDT.

Action Step 7.6: Circulate final strategic plan to full MDT.

Action Step 7.7: Distribute final products. Compile and distribute final products to comprehensive distribution list.

Literature Cited

Beier, P., D.R. Majka, and W.D. Spencer. 2008. Forks in the road: Choices in GIS procedures for designing wildland linkages. Conservation Biology 22:836-851.

Beier, PB, KL Penrod, CL Luke, WD Spencer, and CR Cabanero. 2006. South Coast Missing Linkages: restoring connectivity to wildlands in the largest metropolitan area in the United States. pp. 555-586 *In* KR Crooks and MA Sanjayan, editors. Connectivity and Conservation. Oxford University Press.

Bunn, D., A. Mummert, M. Hoshovsky, K. Gilardi, and S. Shanks. 2007. California Wildlife: Conservation Challenges California's Wildlife Action Plan. Prepared by UC Davis Wildlife Health Center for California Department of Fish and Game. Pp. 597.

Davis, J., and J. Cohen. 2008. California Habitat Connectivity and Wildlife Movement Studies Synthesis of Baseline Information and Data Aggregate Compilation. Prepared by Institute for Geographic Information Science, San Francisco State University; report to Caltrans. Pp. 26.

Pascual-Hortal, L, and S Saura. 2008. Integrating landscape connectivity in broad-scale forest planning through a new graph-based habitat availability methodology: application to capercaillie (Tetrao urogallus) in Catalonia (NE Spain). European Journal of Forest Resources 127:23-31.

Penrod, K., C. Cabañero, P. Beier, C. Luke, W. Spencer, E. Rubin, and C. Paulman. 2008. A Linkage Design for the Joshua Tree-Twentynine Palms Connection. South Coast Wildlands, Fair Oaks, CA. www.scwildlands.org.

Penrod, K., C. Cabañero, P. Beier, C. Luke, W. Spencer, E. Rubin, R. Sauvajot, S. Riley, and D. Kamradt. 2006. South Coast Missing Linkages Project: A Linkage Design for the Santa Monica-Sierra Madre Connection. South Coast Wildlands, Idyllwild, CA. www.scwildlands.org.

Penrod, K., C. Cabañero, P. Beier, C. Luke, W. Spencer, and E. Rubin. 2006. South Coast Missing Linkages Project: A Linkage Design for the Palomar-San Jacinto/Santa Rosa Connection. South Coast Wildlands, Idyllwild, CA. www.scwildlands.org.

Penrod, K., C. Cabañero, P. Beier, C. Luke, W. Spencer, and E. Rubin. 2005. South Coast Missing Linkages Project: A Linkage Design for the San Bernardino-Little San Bernardino Connection. South Coast Wildlands, Idyllwild, CA. www.scwildlands.org.

Penrod, K., C. Cabañero, P. Beier, C. Luke, W. Spencer, and E. Rubin. 2004. South Coast Missing Linkages Project: A Linkage Design for the San Gabriel-Castaic Connection. South Coast Wildlands, Idyllwild, CA. www.scwildlands.org.

Penrod, K., C. Cabanero, C. Luke, P. Beier, W. Spencer, and E. Rubin. 2003. South Coast Missing Linkages Project: A Linkage Design for the Tehachapi Connection. South Coast Wildlands Project, Idyllwild, CA. www.scwildlands.org.

Penrod, K, R Hunter, and M Merrifield. 2001. Missing Linkages: Restoring connectivity to the California landscape. California Wilderness Coalition, The Nature Conservancy, US Geological Survey, Center for Reproduction of Endangered Species, and California State Parks.

Vandergast, A.G., A.J. Bohonak, S.A. Hathaway, J. Boys, and R.N. Fisher. 2008. Are hotspots of evolutionary potential adequately protected in southern California? Biological Conservation 141:1648-1664.

Identifier		Landform					ECI		Area		Essential Connectivity Area					Protection Status				Species Diversity					Listed Species					
ID	ECA_Name	elev_mean	elev_min	elev_max	elev_std	elev_range	mn_integ	std_integ	AREA_ac	AREA_km	pointA	pointB	NLB_In	min_length	lcp_length	pc_protect	pc_gap12e	pc_gap3	pc_privunprp	mn_sprich	std_sprich	CNDDB_plant_count	CNDDB_animal_count	pc_hotspt	pc_crithab	crithab_sp_count	pc_esshab	esshab_sp_count	pc_wtvp	mjrd_cross
1	Rand Mountains - Piute Mountains/ Scodie Mountains	750	576	1,329	192	753	74	37	12,733	52	183	201	172, 186	100	1,097	78	19	58	22	166	2	3	6	0	14	1	0	0	0	0
2	Rand Mountains - Piute Mountains/ Scodie Mountains	932	692	1,101	71	409	74	31	16,485	67	176	183	170, 171, 172, 186, 190	100	125	92	92	0	8	160	2	0	2	0	13	1	0	0	0	1
3	Rand Mountains - Piute Mountains/ Scodie Mountains	946	681	1,061	48	380	65	39	7,438	30	201	214		108	156	89	14	76	11	172	5	6	10	15	0	0	0	0	0	1
4	North Table Mountain - Ishi Wilderness	399	58	1,016	192	958	51	37	244,242	988	625	695	620, 622, 627, 628, 636, 638, 648, 655, 656, 682, 691	32,324	53,109	15	10	4	85	269	11	22	15	0	3	2	5	1	3	2
5	Martin Hill - Butte Valley	1,685	858	2,521	290	1,663	59	32	91,572	371	827	834	828, 830	20,613	30,585	62	3	59	38	257	13	9	6	0	39	1	0	0	4	1
6	Grizzly Mountain - Cottonwood Peak	1,681	1,106	2,545	228	1,439	67	27	113,385	459	654	662	666	23,101	29,296	95	1	94	5	228	5	6	5	0	0	0	0	0	2	0
7	Big Cliff Mine - McConaughy Gulch	1,313	737	2,284	350	1,547	57	30	21,769	88	811	818	843	8,461	9,383	31	12	19	69	230	9	10	6	0	29	1	0	0	2	0
8	Cinder Butte - Popcorn Cave	1,184	974	1,571	115	597	62	34	15,025	61	736	746	745	2,700	4,559	81	0	81	19	263	13	3	4	0	5	1	5	1	2	1
9	Las Colinas/ South Dome - Kettleman Hills	141	89	225	33	136	80	34	47,399	192	248	273	255, 263	15,328	29,631	0	0	0	100	197	6	2	11	0	0	0	0	0	0	2
10	Kern National Wildlife Refuge - Dudley Ridge	60	58	67	2	9	37	44	26,147	106	238	256	235, 243, 251	18,553	23,707	0	0	0	100	200	7	1	12	0	0	0	0	0	5	0
11	McKittrick Valley - Pixley National Wildlife Refuge	64	58	69	2	11	3	12	13,523	55	254	265		2,968	5,655	1	1	0	99	198	2	0	8	0	2	1	2	1	5	0
12	McKittrick Valley - Pixley National Wildlife Refuge	64	60	69	2	9	54	44	30,203	122	238	254	235, 243, 251	11,012	16,226	16	1	15	84	200	3	2	12	0	0	0	0	0	5	0
13	Gravelly Ford Canal - Lone Willow	48	41	62	3	21	34	40	23,112	94	320	329	324	10,072	13,680	0	0	0	100	211	3	6	2	0	0	0	0	0	54	0
14	Eastman Lake NRA - Bear Creek	65	27	218	30	191	34	41	86,695	351	336	346	335, 338, 341, 343	35,461	48,768	19	11	8	81	217	9	14	17	0	36	8	38	1	39	1
15	Ortigalita Ridge/ San Luis Reservoir - Kesterson National Wildlife Refuge	122	22	1,026	116	1,004	43	40	75,196	304	340	348	401	9,330	14,926	46	33	13	54	223	9	8	24	0	2	2	46	3	14	3
16	Bear Slough - Browns Creek	21	0	61	12	61	34	32	30,686	124	466	494	473, 476, 484	21,708	26,577	34	33	1	66	225	2	3	12	0	19	4	16	1	36	1
17	Colusa National Wildlife Refuge - Sacramento National Wildlife Refuge/ Provident Main Canal	19	11	31	3	20	41	41	33,752	137	588	621	601, 610, 616	25,515	29,104	73	72	1	27	220	3	9	6	0	0	0	6	1	43	2
18	Orland Buttes/ Stone Valley/ Julian Rocks - Ishi Wilderness	105	43	362	49	319	51	38	145,800	590	660	695	657, 661, 663, 664, 668, 672, 678, 682, 684, 692	31,107	37,997	12	6	6	88	219	8	19	30	0	12	7	23	1	37	2
19	McClure Creek - Table Mountain	132	77	300	31	223	58	38	68,336	277	681	706	684, 688, 690, 693, 698, 705	24,486	26,106	6	5	1	94	224	8	7	9	0	40	3	40	1	21	2
20	Mt Shasta - Wadsworth Flat	1,471	868	2,458	360	1,590	60	29	38,089	154	808	827	828	2,233	10,793	48	0	47	52	270	17	9	8	0	0	1	0	0	0	1
21	Mt Shasta - Wadsworth Flat	1,113	644	2,459	313	1,815	71	29	70,044	283	827	844	828, 832, 836	13,010	18,068	17	0	17	83	261	10	7	7	0	11	1	0	0	0	0

Characteristics of Essential Connectivity Areas

	Paved Roads				Ecoregions				Watershed		ACEC	Counties		Land Cover								
ID	mjrd_km	mjrd_dens	secrd_km	secrd_dens	n_ecoreg	Ecoregs	n_subsect	Subsect	HU_num	HU_name	pc_blmacec	n_counties	counties	pc_forest	pc_shrub	pc_herb	pc_wetrip	pc_water	pc_dev	pc_crop	pc_pasture	pc_other
1	0	0.0	22	0.4	1	MOJAVE DESERT	2	Searles Valley-Owlshead Mountains, High Desert Plains and Hills	1	FREMONT	17	1	Kern	0	60	0	4	0	3	0	0	33
2	1	0.0	51	0.8	1	MOJAVE DESERT	1	High Desert Plains and Hills	3	ANTELOPE, CUDDEBACK, FREMONT	84	2	San Bernardino, Kern	0	90	0	0	0	3	0	0	7
3	37	1.2	10	0.4	2	MOJAVE DESERT, SIERRA NEVADA	3	Eastern Slopes, Searles Valley-Owlshead Mountains, High Desert Plains and Hills	3	FREMONT, INDIAN WELLS, KERN RIVER	2	1	Kern	0	88	0	1	0	9	0	0	3
4	32	0.0	309	0.3	3	SIERRA NEVADA, GREAT CENTRAL VALLEY, MODOC PLATEAU	6	North Valley Alluvium, Hardpan Terraces, Shignletown-Paradise, Granitic and Metamorphic Foothills, Tuscan Flows, Lower Foothills Metamorphic Belt	5	BUTTE CREEK, COLUSA BASIN, EASTERN TEHAMA, FEATHER RIVER, TEHAMA	3	2	Tehama, Butte	19	63	3	7	2	6	1	0	0
5	8	0.0	0	0.0	1	MODOC PLATEAU	4	Old Cascades, Shasta Valley, High Cascade, Medicine Lake Lava Flows	1	KLAMATH RIVER	0	1	Siskiyou	75	7	1	4	0	1	5	2	4
6	0	0.0	41	0.1	1	SIERRA NEVADA	4	Diamond Mountains-Crystal Peak, Fredonyer Butte-Grizzly Peak, Frenchman, Greenville-Graeagle	1	FEATHER RIVER	0	1	Plumas	88	6	0	4	0	0	0	0	1
7	0	0.0	22	0.3	1	NORTH COAST	4	Scott Bar Mountain, Upper Salmon Mountains, Scott Valley, Forks of Salmon	1	KLAMATH RIVER	0	1	Siskiyou	77	3	4	1	0	5	3	0	7
8	1	0.0	11	0.2	1	MODOC PLATEAU	2	Hat Creek Rim, Bald Mountain-Dixie Valley	1	PIT RIVER	0	1	Shasta	32	55	0	1	0	1	6	4	1
9	9	0.1	24	0.1	1	GREAT CENTRAL VALLEY	2	Antelope Plain, Kettleman Hills and Valleys	1	SOUTH VALLEY FLOOR	0	2	Kings, Kern	0	0	88	0	1	4	5	0	2
10	0	0.0	9	0.1	1	GREAT CENTRAL VALLEY	2	Tulare Basin, South Valley Alluvium and Basins	1	SOUTH VALLEY FLOOR	0	2	Kings, Kern	0	0	3	5	7	3	69	13	0
11	0	0.0	8	0.2	1	GREAT CENTRAL VALLEY	2	Granitic Alluvial Fans and Terraces, Tulare Basin	1	SOUTH VALLEY FLOOR	0	1	Tulare	0	0	4	0	1	5	49	42	0
12	0	0.0	24	0.2	1	GREAT CENTRAL VALLEY	2	Tulare Basin, South Valley Alluvium and Basins	1	SOUTH VALLEY FLOOR	0	3	Tulare, Kings, Kern	0	0	2	0	3	4	48	42	0
13	0	0.0	23	0.3	1	GREAT CENTRAL VALLEY	1	Granitic Alluvial Fans and Terraces	1	SAN JOAQUIN VALLEY FLOOR	0	1	Madera	0	0	37	3	0	6	23	30	0
14	14	0.0	81	0.2	1	GREAT CENTRAL VALLEY	5	Hardpan Terraces, Manteca-Merced Alluvium, San Joaquin Basin, Granitic Alluvial Fans and Terraces, Lower Foothills Metamorphic Belt	3	AHWAHNEE, MARIPOSA, SAN JOAQUIN VALLEY FLOOR	0	3	Mariposa, Madera, Merced	0	1	32	8	0	4	43	11	0
15	82	0.3	36	0.1	2	CENTRAL COAST, GREAT CENTRAL VALLEY	5	Westside Alluvial Fans and Terraces, San Joaquin Basin, Western Diablo Range, Diablo Range, Eastern Hills	2	DELTA-MENDOTA CANAL, MIDDLE WEST SIDE	0	1	Merced	1	6	32	11	8	7	25	10	0
16	9	0.1	53	0.4	1	GREAT CENTRAL VALLEY	3	Hardpan Terraces, Sodic Claypan Terraces, Camanche Terraces	3	NORTH VALLEY FLOOR, SACRAMENTO DELTA, SAN JOAQUIN DELTA	2	2	Sacramento, San Joaquin	0	1	52	7	0	7	20	14	0
17	18	0.1	39	0.3	1	GREAT CENTRAL VALLEY	2	North Valley Alluvium, Colusa Basin	1	COLUSA BASIN	0	2	Glenn, Colusa	0	5	22	24	1	4	44	0	0
18	37	0.1	146	0.3	3	GREAT CENTRAL VALLEY, MODOC PLATEAU, NORTH COAST	5	North Valley Alluvium, Western Foothills, Tehama Terraces, Shignletown-Paradise, Tuscan Flows	5	COLUSA BASIN, CORTINA, EASTERN TEHAMA, STONY CREEK, TEHAMA	0	3	Tehama, Butte, Glenn	0	11	56	4	2	4	14	9	0
19	23	0.1	105	0.4	3	GREAT CENTRAL VALLEY, MODOC PLATEAU, NORTH COAST	3	North Valley Alluvium, Tehama Terraces, Tuscan Flows	2	REDDING, TEHAMA	3	1	Tehama	0	29	59	2	1	8	1	1	0
20	9	0.1	8	0.1	1	MODOC PLATEAU	3	Old Cascades, Shasta Valley, High Cascade	3	KLAMATH RIVER, MC CLOUD RIVER, UPPER SACRAMENTO	0	1	Siskiyou	81	11	0	2	0	2	0	0	3
21	0	0.0	24	0.1	2	MODOC PLATEAU, NORTH COAST	4	Scott Bar Mountain, Old Cascades, Shasta Valley, High Cascade	1	KLAMATH RIVER	0	1	Siskiyou	51	41	0	5	0	1	1	1	0

Characteristics of Essential Connectivity Areas

Identifier		Landform					ECI		Area		Essential Connectivity Area					Protection Status				Species Diversity					Listed Species					
ID	ECA_Name	elev_mean	elev_min	elev_max	elev_std	elev_range	mn_integ	std_integ	AREA_ac	AREA_km	pointA	pointB	NLB_In	min_length	lcp_length	pc_protect	pc_gap12e	pc_gap3	pc_privunprp	mn_sprich	std_sprich	CNDDB_plant_count	CNDDB_animal_count	pc_hotspt	pc_crithab	crithab_sp_count	pc_esshab	esshab_sp_count	pc_wtvp	mjrd_cross
22	Gold Bluffs - Siskiyou Mountains	330	0	1,564	257	1,564	61	31	112,221	454	840	848	825, 831, 846, 850	100	108	22	14	8	78	250	16	36	21	7	14	2	0	0	1	2
23	Gold Bluffs - Siskiyou Mountains	878	1	1,873	355	1,872	64	29	91,527	370	847	848	850	5,908	7,691	84	24	60	16	225	3	39	14	29	22	2	0	0	0	2
24	Bald Hills - Castle Crags	818	718	986	67	268	77	11	19,339	78	795	795	789	3,863	5,122	0	0	0	100	242	0	8	10	0	0	1	0	0	0	1
25	Bald Hills - Castle Crags	575	177	1,562	268	1,385	65	31	37,675	152	734	792	735, 737	9,486	12,415	57	28	29	43	256	3	2	12	0	0	0	0	0	0	1
26	Bald Hills - Castle Crags	431	174	1,567	200	1,393	69	24	40,669	165	719	734		8,907	9,776	13	1	12	87	243	14	0	1	0	0	0	12	1	0	0
27	Bald Hills - Castle Crags	517	313	1,312	189	999	81	31	52,147	211	785	792	737, 753, 760, 766, 769	2,892	7,475	89	83	6	11	260	6	3	15	0	0	1	0	0	0	1
28	Noble Ridge/ Beegum Gorge - Salmon Mountains	1,079	417	2,111	242	1,694	68	30	238,867	967	714	815	711, 717, 732, 747, 764, 772	45,045	50,374	73	18	55	27	233	4	15	20	0	24	1	0	0	0	1
29	South Fork Mountain/ Chinquapin Butte - Dairy Ridge/ Pilot Ridge/ South Fork	1,280	758	1,787	261	1,029	62	22	31,743	128	744	783		2,138	2,299	46	0	46	54	235	2	10	13	0	0	2	0	0	0	0
30	South Fork Mountain/ Chinquapin Butte - Dairy Ridge/ Pilot Ridge/ South Fork	1,194	692	1,758	246	1,066	61	30	30,829	125	724	744		1,709	2,210	91	0	91	9	227	1	8	7	0	32	1	0	0	0	0
31	Dairy Ridge/ Pilot Ridge/ South Fork - Redwood Creek/ Bald Hills	809	112	1,788	310	1,676	70	29	177,233	717	783	820	782, 791, 801, 815, 825	37,594	50,481	41	5	36	59	241	6	17	18	0	27	2	0	0	0	2
32	Charles Mountain - Salmon Mountains	1,014	201	1,914	290	1,713	70	29	326,525	1,321	731	815	724, 744, 764, 772, 783	44,241	59,175	82	23	59	18	232	4	24	26	0	34	2	0	0	0	1
33	Sinkyone - Island Mountain	542	4	1,244	241	1,240	69	28	164,191	664	709	715	679, 699	28,795	39,734	15	10	5	85	252	13	20	9	0	17	2	0	0	0	2
34	Charles Mountain - King Range	627	20	1,753	252	1,733	69	23	14,263	58	725	731		260	2,949	10	0	9	91	238	2	3	0	0	9	2	0	0	0	0
35	Charles Mountain - King Range	370	34	925	175	891	65	26	76,436	309	725	733	726, 730	33,247	782	40	31	8	60	243	6	9	9	0	37	2	0	0	0	1
36	Gube Mountain - Snow Mountain	431	141	1,065	234	924	61	35	56,629	229	600	615		7,295	14,161	27	0	27	73	238	4	10	6	0	0	0	0	0	0	1
37	Gube Mountain - Snow Mountain	438	149	995	119	846	72	28	30,568	124	587	600	580	4,880	7,150	2	2	0	98	248	6	2	4	0	1	1	0	0	0	1
38	Gube Mountain - Snow Mountain	782	294	2,049	277	1,755	70	32	116,492	471	615	642	634, 679	11,930	19,741	55	4	52	45	246	9	12	8	0	7	1	0	0	0	2
39	Lake Marie - The Cedars/ Adams Ridge	364	26	807	137	781	71	30	87,269	353	510	566	529, 541, 548	36,261	40,114	25	17	8	75	252	7	24	12	0	2	2	17	2	0	0
40	Chileno Valley - Sanel Mountain	426	224	956	176	732	50	33	6,132	25	580	600		100	1,361	0	0	0	100	249	7	2	1	0	0	0	0	0	0	1
41	Chileno Valley - Sanel Mountain	214	-2	776	146	778	56	35	195,625	792	527	580	530, 534, 536, 538, 546, 565, 574	69,350	79,538	28	23	4	72	263	19	56	26	29	5	5	7	1	1	1
42	Grizzly Island - Lake Marie	105	0	682	111	682	19	24	58,437	236	482	510	474, 489	4,904	10,533	22	16	6	78	259	8	18	18	17	17	8	49	2	17	3

	Paved Roads				Ecoregions				Watershed		ACEC	Counties		Land Cover								
ID	mjrd_km	mjrd_dens	secrd_km	secrd_dens	n_ecoreg	Ecoregs	n_subsect	Subsect	HU_num	HU_name	pc_blmacec	n_counties	counties	pc_forest	pc_shrub	pc_herb	pc_wetrip	pc_water	pc_dev	pc_crop	pc_pasture	pc_other
22	94	0.2	20	0.0	1	NORTH COAST	6	Northern Franciscan, Western Jurassic, Gasquet Mountain Ultramafics, Siskiyou Mountains, Eastern Franciscan, Central Franciscan	3	KLAMATH RIVER, REDWOOD CREEK, SMITH RIVER	0	3	Del Norte, Siskiyou, Humboldt	82	5	1	2	1	6	0	0	3
23	45	0.1	0	0.0	1	NORTH COAST	7	Northern Franciscan, Western Jurassic, Gasquet Mountain Ultramafics, Siskiyou Mountains, Scott Bar Mountain, Lower Salmon Mountains, Windy Peak	3	KLAMATH RIVER, ROGUE RIVER, SMITH RIVER	0	2	Del Norte, Siskiyou	88	4	0	1	0	5	0	0	2
24	15	0.2	15	0.2	2	MODOC PLATEAU, NORTH COAST	2	Eastern Klamath Mountains, Upper Scott Mountains	2	MC CLOUD RIVER, UPPER SACRAMENTO	0	2	Siskiyou, Shasta	71	0	0	0	0	0	0	0	29
25	9	0.1	9	0.1	2	MODOC PLATEAU, NORTH COAST	2	Oregon Mountain, Eastern Klamath Mountains	3	MOUNTAIN GATE, SHASTA BALLY, SHASTA DAM	0	1	Shasta	44	42	1	1	7	4	0	0	1
26	0	0.0	38	0.2	1	NORTH COAST	4	Oregon Mountain, Eastern Klamath Mountains, Western Foothills, Tehama Terraces	2	REDDING, SHASTA BALLY	0	1	Shasta	19	57	16	1	0	4	0	0	2
27	39	0.2	45	0.2	2	MODOC PLATEAU, NORTH COAST	1	Eastern Klamath Mountains	4	MC CLOUD RIVER, MOUNTAIN GATE, SHASTA DAM, UPPER SACRAMENTO	0	1	Shasta	78	5	0	2	12	3	0	0	0
28	36	0.0	87	0.1	1	NORTH COAST	8	Oregon Mountain, Eastern Klamath Mountains, Upper Scott Mountains, Forks of Salmon, North Trinity Mountain, Trinity Mountain-Hayfork, Rattlesnake Creek, Western Foothills	3	KLAMATH RIVER, SHASTA BALLY, TRINITY RIVER	0	4	Siskiyou, Trinity, Shasta, Tehama	76	16	1	0	0	4	0	0	3
29	0	0.0	0	0.0	1	NORTH COAST	3	Rattlesnake Creek, Eastern Franciscan, Central Franciscan	2	MAD RIVER, TRINITY RIVER	0	2	Humboldt, Trinity	93	1	0	0	0	1	0	0	4
30	0	0.0	13	0.1	1	NORTH COAST	2	Rattlesnake Creek, Eastern Franciscan	2	MAD RIVER, TRINITY RIVER	0	1	Trinity	85	5	0	0	0	4	0	0	7
31	34	0.1	37	0.1	1	NORTH COAST	5	Northern Franciscan, Central Franciscan, Western Jurassic, Rattlesnake Creek, Eastern Franciscan	5	KLAMATH RIVER, MAD RIVER, REDWOOD CREEK, TRINIDAD, TRINITY RIVER	4	2	Humboldt, Trinity	89	5	1	0	0	2	0	0	2
32	40	0.0	50	0.0	1	NORTH COAST	8	Central Franciscan, Oregon Mountain, Upper Scott Mountains, Forks of Salmon, North Trinity Mountain, Trinity Mountain-Hayfork, Rattlesnake Creek, Eastern Franciscan	4	EEL RIVER, KLAMATH RIVER, MAD RIVER, TRINITY RIVER	0	3	Siskiyou, Humboldt, Trinity	88	5	0	0	0	3	0	0	3
33	42	0.1	67	0.1	1	NORTH COAST	2	Central Franciscan, Coastal Franciscan	3	CAPE MENDOCINO, EEL RIVER, MENDOCINO COAST	4	3	Humboldt, Trinity, Mendocino	77	8	1	0	0	5	0	0	9
34	0	0.0	11	0.2	1	NORTH COAST	2	Central Franciscan, Coastal Franciscan	2	CAPE MENDOCINO, EEL RIVER	0	2	Humboldt, Trinity	77	12	3	0	0	1	0	0	8
35	28	0.1	42	0.1	1	NORTH COAST	2	Central Franciscan, Coastal Franciscan	2	CAPE MENDOCINO, EEL RIVER	3	1	Humboldt	87	4	2	0	1	3	0	0	2
36	18	0.1	21	0.1	1	NORTH COAST	2	Central Franciscan, Clear Lake Hills and Valleys	2	CACHE CREEK, RUSSIAN RIVER	0	2	Mendocino, Lake	20	51	18	0	0	6	3	0	2
37	14	0.1	4	0.0	1	NORTH COAST	2	Coastal Franciscan, Central Franciscan	2	MENDOCINO COAST, RUSSIAN RIVER	0	1	Mendocino	59	27	8	0	0	4	0	0	2
38	24	0.1	87	0.2	1	NORTH COAST	3	Eastern Franciscan, Central Franciscan, Clear Lake Hills and Valleys	4	CACHE CREEK, EEL RIVER, RUSSIAN RIVER, STONY CREEK	0	4	Mendocino, Glenn, Lake, Colusa	42	45	5	1	0	5	1	0	2
39	0	0.0	63	0.2	2	CENTRAL COAST, NORTH COAST	5	Suisun Hills and Valleys, Mount St. Helena Flows and Valleys, Central Franciscan, Ultramafic Complex, Western Foothills	3	PUTAH CREEK, SAN PABLO, SUISUN	8	2	Napa, Solano	18	67	9	1	1	2	1	0	1
40	10	0.4	0	0.0	1	NORTH COAST	2	Coastal Franciscan, Central Franciscan	2	MENDOCINO COAST, RUSSIAN RIVER	0	1	Mendocino	38	31	18	0	0	9	0	0	3
41	32	0.0	176	0.2	2	CENTRAL COAST, NORTH COAST	4	Coastal Franciscan, Coastal Hills-Santa Rosa Plain, Marin Hills and Valleys, Central Franciscan	4	BODEGA, MARIN COASTAL, MENDOCINO COAST, RUSSIAN RIVER	1	3	Mendocino, Sonoma, Marin	41	25	26	1	1	4	0	0	3
42	55	0.2	74	0.3	3	CENTRAL COAST, GREAT CENTRAL VALLEY, NORTH COAST	4	Suisun Hills and Valleys, Delta, Mount St. Helena Flows and Valleys, Ultramafic Complex	2	SAN PABLO, SUISUN	0	2	Napa, Solano	1	15	48	14	1	12	5	1	1

Characteristics of Essential Connectivity Areas

	Identifier	Landform					ECI		Area		Essential Connectivity Area					Protection Status				Species Diversity					Listed Species					
ID	ECA_Name	elev_mean	elev_min	elev_max	elev_std	elev_range	mn_integ	std_integ	AREA_ac	AREA_km	pointA	pointB	NLB_In	min_length	lcp_length	pc_protect	pc_gap12e	pc_gap3	pc_privunprp	mn_sprich	std_sprich	CNDDB_plant_count	CNDDB_animal_count	pc_hotspt	pc_crithab	crithab_sp_count	pc_esshab	esshab_sp_count	pc_wtvp	mjrd_cross
43	Tolay Creek - Lake Marie	25	0	504	63	504	27	30	32,618	132	504	510	486, 498	19,228	22,301	47	35	12	53	258	7	15	22	0	3	3	18	2	23	3
44	Sugarloaf Mountain - Bonny Doon	163	5	442	86	437	9	28	25,969	105	347	350	374	14,838	17,864	37	33	4	63	280	16	23	20	0	23	4	28	2	0	2
45	Sugarloaf Mountain - Montara Mountain	331	1	1,154	200	1,153	36	36	345,662	1,399	347	411	345,349,357,361,36 5,366,374,376,377, 378,385,395,3*	61,323	74,337	40	24	16	60	273	11	68	41	33	10	8	66	2	0	6
46	Pancho Rico Valley - Pinnacles National Monument	370	83	811	122	728	75	32	190,302	770	283	321	287, 291, 296, 297, 298, 300, 301, 316	38,928	42,717	1	1	0	99	223	11	7	18	0	26	3	25	2	0	1
47	San Geronimo - Weferling Canyon	370	139	892	120	753	70	31	110,849	449	242	281	247, 257, 262, 268, 271, 272, 314	50,085	55,629	30	12	18	70	241	11	23	8	0	1	1	9	3	0	0
48	Pancho Rico Valley - Los Padres National Forest	357	85	1,005	150	920	66	35	259,671	1,051	283	314	272, 281, 286, 287, 291, 294	34,227	37,862	30	0	30	70	234	13	38	23	0	0	1	5	3	0	3
49	Riverside Mountains - Pinto Basin/ Eagle Mountain	272	116	421	35	305	97	12	67,112	272	62	67	60	19,361	21,054	98	67	31	2	169	16	2	4	0	0	0	0	0	0	0
50	Riverside Mountains - Pinto Basin/ Eagle Mountain	245	153	687	66	534	85	30	33,766	137	67	80		5,869	8,622	96	0	96	4	155	2	3	2	0	0	1	0	0	0	0
51	Chocolate Mountains - Turtle Mountains/ Ward Valley	450	17	1,622	246	1,605	94	20	1,460,957	5,912	50	116	53, 57, 60, 67, 72, 80, 86, 90, 91, 92	61,120	130,534	93	63	30	7	157	9	27	22	0	16	1	0	0	0	2
52	San Bernardino Mountains - Calico Mountains	716	581	1,121	107	540	48	42	98,177	397	144	190	149	6,600	18,732	53	19	33	47	165	12	7	10	0	19	1	0	0	0	3
53	San Bernardino Mountains - Calico Mountains	1,265	839	3,029	517	2,190	68	36	146,248	592	101	144	93, 102	12,202	14,395	66	5	61	34	192	47	47	25	23	3	11	0	1	0	1
54	Contract Point - Santa Susana Mountains	608	317	1,138	167	821	14	24	29,349	119	129	136		3,081	3,545	17	7	10	83	263	10	8	10	0	45	1	0	0	0	3
55	Tehachapi Mountains - Piute Mountains/ Scodie Mountains	1,347	190	2,564	430	2,374	79	30	561,941	2,274	179	214	177, 178, 184, 189, 191, 193, 194, 196, 209, 220	42,559	72,157	49	24	25	51	230	26	35	42	36	0	1	0	0	0	2
56	Lone Oak Mountain - Tucker Mountain	371	128	967	163	839	74	33	50,393	204	285	292	290	16,595	18,505	0	0	0	100	247	6	2	6	0	18	2	19	1	2	0
57	Hunter Valley Mountain - Cardoza Ridge	294	108	673	102	565	76	29	28,718	116	367	371		11,148	15,517	8	0	8	92	251	3	1	3	2	1	3	6	2	0	0
58	Flat Top Mountain - Hunter Valley Mountain	407	137	947	153	810	78	32	53,854	218	341	367	343, 351, 359	27,288	29,150	2	0	2	98	247	7	4	2	42	0	0	0	0	0	0
59	Table Top Mountain - Gopher Ridge	120	31	458	69	427	76	32	215,316	871	360	409	358, 371, 372, 379, 380, 381, 382, 389, 390, 404	40,921	53,039	6	6	0	94	232	14	17	30	0	44	10	57	1	38	1

Characteristics of Essential Connectivity Areas

	Paved Roads				Ecoregions				Watershed		ACEC	Counties		Land Cover								
ID	mjrd_km	mjrd_dens	secrd_km	secrd_dens	n_ecoreg	Ecoregs	n_subsect	Subsect	HU_num	HU_name	pc_blmacec	n_counties	counties	pc_forest	pc_shrub	pc_herb	pc_wetrip	pc_water	pc_dev	pc_crop	pc_pasture	pc_other
43	17	0.1	34	0.3	2	CENTRAL COAST, NORTH COAST	3	Suisun Hills and Valleys, Coastal Hills-Santa Rosa Plain, Mount St. Helena Flows and Valleys	2	SAN PABLO, SUISUN	0	3	Sonoma, Napa, Solano	1	4	59	17	8	7	2	0	2
44	12	0.1	62	0.6	1	CENTRAL COAST	2	Santa Cruz Mountains, Watsonville Plain-Salinas Valley	1	BIG BASIN	0	1	Santa Cruz	43	30	2	1	0	23	1	0	0
45	264	0.2	416	0.3	1	CENTRAL COAST	4	Santa Clara Valley, Santa Cruz Mountains, Leeward Hills, Watsonville Plain-Salinas Valley	5	BIG BASIN, PAJARO RIVER, SAN MATEO, SANTA CLARA, SOUTH BAY	0	3	San Mateo, Santa Clara, Santa Cruz	40	37	4	1	0	16	0	0	0
46	20	0.0	45	0.1	1	CENTRAL COAST	4	Watsonville Plain-Salinas Valley, Diablo Range, Interior Santa Lucia Range, Gabilan Range	1	SALINAS	0	2	San Benito, Monterey	6	40	44	1	0	5	1	2	0
47	0	0.0	46	0.1	1	CENTRAL COAST	3	South Costal Santa Lucia Range, Interior Santa Lucia Range, Paso Robles Hills and Valleys	2	ESTERO BAY, SALINAS	7	2	Monterey, San Luis Obispo	18	43	26	2	5	5	1	0	0
48	62	0.1	94	0.1	1	CENTRAL COAST	6	Watsonville Plain-Salinas Valley, North Costal Santa Lucia Range, South Costal Santa Lucia Range, Interior Santa Lucia Range, Gabilan Range, Paso Robles Hills and Valleys	3	ESTERO BAY, SALINAS, SANTA LUCIA	0	1	Monterey	14	47	22	3	0	6	6	1	1
49	0	0.0	14	0.1	1	SONORAN DESERT	3	Cadiz-Vidal Valleys, Palen-Riverside Mountains, Palo Verde Valley and Mesa	4	CHUCKWALLA, COLORADO, RICE, WARD	0	1	Riverside	0	88	0	3	0	0	0	0	8
50	0	0.0	14	0.1	2	SONORAN DESERT, MOJAVE DESERT	4	Pinto Basin and Mountains, Cadiz-Vidal Valleys, Palen-Riverside Mountains, Chuckwalla Valley	4	CHUCKWALLA, COLORADO, RICE, WARD	0	1	Riverside	0	96	0	0	0	1	0	0	2
51	240	0.0	150	0.0	2	SONORAN DESERT, MOJAVE DESERT	10	Providence Mountains-Lanfair Valley, Lucerne-Johnson Valleys and Hills, Bullion Mountains-Bristol Lake, Pinto Basin and Mountains, Cadiz-Vidal Valleys, Palen-Riverside Mountains, Chuckwalla Valley, Chocolate Mountains and Valleys	12	CADIZ, CHEMEHUEVIS, CHUCKWALLA, COLORADO, DALE, EAST SALTON, HAYFIELD, IMPERIAL, RICE, ROUTE SIXTY SIX, WARD, WHITEWATER	8	3	San Bernardino, Riverside, Imperial	0	57	0	6	0	1	0	0	36
52	112	0.3	151	0.4	1	MOJAVE DESERT	3	High Desert Plains and Hills, Mojave Valley-Granite Mountains, Lucerne-Johnson Valleys and Hills	3	COYOTE, MOJAVE, SUPERIOR	19	1	San Bernardino	0	68	0	1	0	11	0	0	19
53	1	0.0	98	0.2	3	SONORAN DESERT, SOUTH COAST, MOJAVE DESERT	4	San Gorgonio Mountains, Upper San Gorgonio Mountains, Little San Bernardino-Bighorn Mountains, Lucerne-Johnson Valleys and Hills	8	EMERSON, JOHNSON, JOSHUA TREE, LUCERNE LAKE, MEANS, MOJAVE, SANTA ANA RIVER, WHITEWATER	1	2	San Bernardino, Riverside	18	61	4	0	0	3	0	0	13
54	40	0.3	32	0.3	1	SOUTH COAST	4	Simi Valley-Santa Susana Mountains, Los Angeles Plain, Sierra Pelona-Mint Canyon, San Gabriel Mountains	3	CALLEGUAS, LOS ANGELES RIVER, SANTA CLARA - CALLEGUAS	0	2	Ventura, Los Angeles	1	75	10	1	0	14	0	0	0
55	83	0.0	253	0.1	4	SOUTH COAST, MOJAVE DESERT, SIERRA NEVADA, GREAT CENTRAL VALLEY	9	Hardpan Terraces, South Valley Alluvium and Basins, Lower Batholith, Eastern Slopes, Tehachapi-Piute Mountains, Southern Granitic Foothills, San Emigdio Mountains, High Desert Plains and Hills	6	ANTELOPE, FREMONT, GRAPEVINE, KERN RIVER, SOUTH VALLEY FLOOR, SOUTHERN SIERRA	1	1	Kern	34	55	7	2	0	1	0	0	1
56	0	0.0	32	0.2	2	SIERRA NEVADA, GREAT CENTRAL VALLEY	2	Hardpan Terraces, Lower Granitic Foothills	2	KAWEAH RIVER, SOUTH VALLEY FLOOR	0	1	Tulare	0	41	49	3	0	2	4	1	0
57	0	0.0	11	0.1	2	SIERRA NEVADA, GREAT CENTRAL VALLEY	2	Camanche Terraces, Lower Foothills Metamorphic Belt	3	MARIPOSA, MERCED RIVER, SAN JOAQUIN VALLEY FLOOR	0	2	Mariposa, Merced	0	58	29	5	5	2	0	0	0
58	0	0.0	43	0.2	2	SIERRA NEVADA, GREAT CENTRAL VALLEY	2	Lower Foothills Metamorphic Belt, Lower Granitic Foothills	2	MARIPOSA, MERCED RIVER	0	1	Mariposa	1	56	35	6	0	1	0	0	1
59	32	0.0	164	0.2	2	SIERRA NEVADA, GREAT CENTRAL VALLEY	4	Hardpan Terraces, Camanche Terraces, Manteca-Merced Alluvium, Lower Foothills Metamorphic Belt	6	GOPHER RIDGE, MERCED RIVER, NORTH VALLEY FLOOR, SAN JOAQUIN VALLEY FLOOR, STANISLAUS RIVER, TUOLUMNE RIVER	0	4	Calaveras, Tuolumne, Stanislaus, Merced	0	10	69	7	3	3	6	3	0

Characteristics of Essential Connectivity Areas

Identifier		Landform					ECI		Area		Essential Connectivity Area					Protection Status				Species Diversity					Listed Species					
ID	ECA_Name	elev_mean	elev_min	elev_max	elev_std	elev_range	mn_integ	std_integ	AREA_ac	AREA_km	pointA	pointB	NLB_In	min_length	lcp_length	pc_protect	pc_gap12e	pc_gap3	pc_privunprp	mn_sprich	std_sprich	CNDDB_plant_count	CNDDB_animal_count	pc_hotspt	pc_crithab	crithab_sp_count	pc_esshab	esshab_sp_count	pc_wtvp	mjrd_cross
60	Pine Ridge - Irish Hill	464	77	943	240	866	49	33	142,325	576	454	479	445, 452, 455, 457, 463, 469, 477, 485	34,874	42,556	10	0	9	90	250	14	8	5	0	0	0	2	1	0	2
61	Bear Mountains - Middle Fork Cosumnes River	582	286	738	73	452	53	31	13,119	53	485	511	492, 493	2,583	3,321	0	0	0	100	269	7	0	0	0	0	0	68	1	2	0
62	Bear Mountains - Middle Fork Cosumnes River	433	169	808	125	639	45	30	88,346	358	435	485	439, 443, 445, 452, 455, 457	26,745	29,968	4	0	4	96	257	11	4	4	0	0	0	9	1	0	3
63	Duck Creek North Fork - Coyote Creek	71	46	148	16	102	52	35	1,362	6	471	494		100	106	19	19	0	81	226	1	2	4	0	52	4	81	1	65	0
64	Duck Creek North Fork - Coyote Creek	58	22	123	16	101	53	35	15,641	63	442	471	450, 461	4,963	7,473	1	1	0	99	232	4	2	9	0	20	4	0	1	22	1
65	Duck Creek North Fork - Coyote Creek	56	37	98	17	61	35	38	5,159	21	425	442	427	1,700	3,071	0	0	0	100	221	1	0	6	0	11	2	3	1	4	0
66	Duck Creek North Fork - Coyote Creek	71	28	160	27	132	41	32	27,301	110	494	522	491, 505, 523, 525	3,912	10,404	16	14	3	84	243	10	5	10	0	0	3	41	2	6	0
67	Coon Creek - Bear River	90	24	431	66	407	54	28	39,501	160	555	563	557, 562	13,113	18,090	8	8	0	92	244	8	3	6	0	6	1	25	1	25	1
68	Chaparral Hill/ Yuba River - Bald Mountain Range	1,052	159	2,074	474	1,915	50	29	69,755	282	590	595	577, 583, 602	16,603	21,930	42	8	33	58	221	21	9	7	0	3	1	0	1	0	1
69	Chaparral Hill/ Yuba River - Bald Mountain Range	1,957	1,232	2,690	234	1,458	59	31	185,076	749	595	613	597, 602	16,882	38,772	69	5	65	31	215	23	16	22	0	0	0	0	0	6	1
70	Fort Sage Mountains - Cottonwood Peak	1,619	1,214	2,184	271	970	67	33	96,094	389	647	662	649, 652	27,136	35,290	68	2	67	32	266	26	11	3	0	0	0	0	0	2	1
71	Grizzly Mountain - Deadwood Canyon	1,423	840	2,242	289	1,402	60	31	50,069	203	654	665	650, 658, 666	15,568	17,864	81	0	81	19	222	8	13	5	0	0	0	0	1	0	1
72	Big Bar Mountain/ Stevens Ridge - Ishi Wilderness	1,355	280	2,391	385	2,111	66	27	474,721	1,921	655	695	641, 645, 656, 665, 667, 682, 685, 691, 698	29,705	40,346	53	18	35	47	229	20	38	24	0	0	0	13	1	1	1
73	Table Mountain - Lassen Volcanic Wilderness	1,044	105	2,979	503	2,874	58	29	127,115	514	706	710	700, 705, 707	34,493	35,262	21	11	10	79	246	19	35	25	0	6	2	6	1	5	1
74	Pilot Butte - Knox Mountain	1,565	1,266	2,246	229	980	58	32	71,928	291	768	779	757, 770, 773	18,974	25,694	58	0	58	42	262	4	5	6	0	0	0	0	0	2	2
75	McCloud River/ Curl Ridge - McConaughy Gulch	1,503	350	2,747	455	2,397	70	28	189,891	768	785	818	789, 795, 799, 806	52,627	56,596	54	15	39	46	232	12	37	24	0	18	1	0	0	1	1
76	Beaver Creek Rim/ Indian Mountain - Little Hot Spring Valley	1,346	1,002	1,838	207	836	59	31	92,073	373	742	774	752	18,496	23,627	40	0	40	60	252	5	5	11	0	0	1	0	1	2	1
77	Warner Mountains - Mount Bidwell/ Larkspur Hills	1,754	1,354	2,571	300	1,217	59	34	300,061	1,214	786	813	738, 797	14,928	43,776	59	6	53	41	252	21	52	26	0	0	0	3	1	8	0

	Paved Roads				Ecoregions				Watershed		ACEC	Counties		Land Cover								
ID	mjrd_km	mjrd_dens	secrd_km	secrd_dens	n_ecoreg	Ecoregs	n_subsect	Subsect	HU_num	HU_name	pc_blmacec	n_counties	counties	pc_forest	pc_shrub	pc_herb	pc_wetrip	pc_water	pc_dev	pc_crop	pc_pasture	pc_other
60	54	0.1	154	0.3	1	SIERRA NEVADA	4	Camanche Terraces, Upper Foothills Metamorphic Belt, Batholith and Volcanic Flows, Lower Foothills Metamorphic Belt	3	MIDDLE SIERRA, NORTH VALLEY FLOOR, UPPER CALAVERAS	0	2	Amador, Calaveras	30	49	12	5	0	3	0	0	0
61	0	0.0	23	0.4	1	SIERRA NEVADA	2	Upper Foothills Metamorphic Belt, Lower Foothills Metamorphic Belt	1	MIDDLE SIERRA	0	2	El Dorado, Amador	8	76	0	6	0	3	1	5	0
62	39	0.1	94	0.3	1	SIERRA NEVADA	2	Upper Foothills Metamorphic Belt, Lower Foothills Metamorphic Belt	3	LOWER CALAVERAS, MIDDLE SIERRA, UPPER CALAVERAS	0	2	Amador, Calaveras	11	79	0	6	1	4	0	0	1
63	0	0.0	15	2.8	2	SIERRA NEVADA, GREAT CENTRAL VALLEY	2	Hardpan Terraces, Camanche Terraces	1	NORTH VALLEY FLOOR	0	2	Sacramento, Amador	0	1	74	1	0	24	0	0	0
64	11	0.2	15	0.2	2	SIERRA NEVADA, GREAT CENTRAL VALLEY	2	Hardpan Terraces, Camanche Terraces	1	NORTH VALLEY FLOOR	0	4	Sacramento, Amador, Calaveras, San Joaquin	0	7	70	5	2	6	6	3	0
65	0	0.0	15	0.7	2	SIERRA NEVADA, GREAT CENTRAL VALLEY	2	Hardpan Terraces, Camanche Terraces	1	NORTH VALLEY FLOOR	0	1	San Joaquin	0	3	38	5	3	8	33	9	0
66	0	0.0	44	0.4	2	SIERRA NEVADA, GREAT CENTRAL VALLEY	3	Hardpan Terraces, Camanche Terraces, Lower Foothills Metamorphic Belt	3	MIDDLE SIERRA, NORTH VALLEY FLOOR, VALLEY-AMERICAN	0	2	Sacramento, Amador	0	21	57	3	2	8	4	4	2
67	9	0.1	39	0.3	2	SIERRA NEVADA, GREAT CENTRAL VALLEY	2	Hardpan Terraces, Lower Foothills Metamorphic Belt	4	AMERICAN RIVER, BEAR RIVER, MARYSVILLE, VALLEY-AMERICAN	0	3	Yuba, Nevada, Placer	0	27	46	4	1	4	4	15	0
68	8	0.0	42	0.2	1	SIERRA NEVADA	4	Granitic and Metamorphic Foothills, Upper Foothills Metamorphic Belt, Upper Batholith and Volcanic Flows, Lower Foothills Metamorphic Belt	1	YUBA RIVER	0	3	Sierra, Yuba, Nevada	65	26	0	6	0	1	0	0	1
69	17	0.0	125	0.2	2	SIERRA NEVADA, MODOC PLATEAU	5	Frenchman, Upper Foothills Metamorphic Belt, Upper Batholith and Volcanic Flows, Sierra Valley, Tahoe-Truckee	5	FEATHER RIVER, LITTLE TRUCKEE RIVER, SUSANVILLE, TRUCKEE RIVER, YUBA RIVER	0	2	Sierra, Nevada	83	8	0	6	0	1	0	0	0
70	29	0.1	21	0.1	2	SIERRA NEVADA, MODOC PLATEAU	4	Diamond Mountains-Crystal Peak, Frenchman, Fort Sage Mountains-Lemmon Valley, Honey Lake Basin	2	FEATHER RIVER, SUSANVILLE	0	2	Lassen, Plumas	55	38	0	2	0	2	1	1	2
71	18	0.1	22	0.1	1	SIERRA NEVADA	2	Fredonyer Butte-Grizzly Peak, Greenville-Graeagle	1	FEATHER RIVER	0	1	Plumas	93	2	0	4	0	1	0	0	0
72	45	0.0	412	0.2	3	SIERRA NEVADA, GREAT CENTRAL VALLEY, MODOC PLATEAU	7	North Valley Alluvium, Shignletown-Paradise, Lassen-Almanor, Greenville-Graeagle, Bucks Lake, Granitic and Metamorphic Foothills, Tuscan Flows	4	BUTTE CREEK, EASTERN TEHAMA, FEATHER RIVER, TEHAMA	1	3	Tehama, Plumas, Butte	81	8	0	6	0	2	0	0	3
73	51	0.1	34	0.1	1	MODOC PLATEAU	4	Tehama Terraces, Shignletown-Paradise, Lassen-Almanor, Tuscan Flows	5	EASTERN TEHAMA, FEATHER RIVER, PIT RIVER, REDDING, WHITMORE	0	3	Shasta, Tehama, Plumas	58	32	3	5	0	1	0	0	1
74	14	0.1	29	0.1	1	MODOC PLATEAU	3	Mowitz Buttes, Likely Mountain, Adin Mountains and Valleys	1	PIT RIVER	0	2	Modoc, Lassen	53	36	1	3	0	1	3	3	1
75	21	0.0	40	0.1	2	MODOC PLATEAU, NORTH COAST	4	Scott Valley, Eastern Klamath Mountains, Upper Scott Mountains, Shasta Valley	6	KLAMATH RIVER, MC CLOUD RIVER, PIT RIVER, SHASTA DAM, TRINITY RIVER, UPPER SACRAMENTO	0	3	Siskiyou, Trinity, Shasta	82	12	0	3	0	1	0	0	1
76	17	0.1	21	0.1	1	MODOC PLATEAU	4	Medicine Lake Lava Flows, Hat Creek Rim, Mowitz Buttes, Bald Mountain-Dixie Valley	1	PIT RIVER	0	4	Siskiyou, Modoc, Shasta, Lassen	56	33	0	2	0	1	3	2	2
77	0	0.0	118	0.1	1	MODOC PLATEAU	7	Warner Mountains, Pit River Valley, Likely Mountain, Sheldon Range, Cottonwood-Skedaddle Mountains, Madeline Plain, Surprise Valley	5	DUCK FLAT, LAKEVIEW, MADELINE PLAINS, PIT RIVER, SUPRISE VALLEY	0	2	Modoc, Lassen	51	15	6	7	1	1	4	5	10

Characteristics of Essential Connectivity Areas

Identifier		Landform					ECI		Area		Essential Connectivity Area					Protection Status				Species Diversity					Listed Species					
ID	ECA_Name	elev_mean	elev_min	elev_max	elev_std	elev_range	mn_integ	std_integ	AREA_ac	AREA_km	pointA	pointB	NLB_In	min_length	lcp_length	pc_protect	pc_gap12e	pc_gap3	pc_privunprp	mn_sprich	std_sprich	CNDDB_plant_count	CNDDB_animal_count	pc_hotspt	pc_crithab	crithab_sp_count	pc_esshab	esshab_sp_count	pc_wtvp	mjrd_cross
78	Barber Ridge - Double Head Mountain/ Timbered Ridge	1,501	1,268	1,944	105	676	59	28	140,653	569	773	814	781, 788	23,763	34,777	91	6	86	9	264	5	10	9	0	0	0	8	1	3	1
79	Ord Mountains - Mid Hills/ Ivanpah Valley/ New York Mountains	701	381	1,934	192	1,553	91	23	529,767	2,144	144	159	130, 133, 154, 162	74,537	88,615	97	55	42	3	144	6	22	17	0	0	1	0	0	0	1
80	Mid Hills/ Ivanpah Valley/ New York Mountains - Calico Mountains	755	279	2,049	360	1,770	94	19	1,035,612	4,191	159	190	146, 149, 154, 162, 163, 203	56,196	62,966	95	76	18	5	151	10	39	28	4	32	1	0	0	0	1
81	Calico Mountains - Death Valley/ Black Mountains/ Amargosa Range	745	-57	1,664	360	1,721	96	14	478,764	1,937	190	253	269	68,645	88,376	99	53	46	1	142	5	3	8	0	1	1	0	0	0	0
82	Silver Mountain/ Rose Valley - Death Valley/ Panamint Range	1,339	-81	2,538	525	2,619	95	19	417,627	1,690	260	269	253, 258, 264, 267, 310	53,963	83,271	100	92	8	0	153	13	35	10	10	0	0	0	0	0	0
83	Silver Mountain/ Rose Valley - Inyo Mountains/ Saline Valley/ Death Valley	1,610	1,338	2,353	285	1,015	86	29	13,508	55	260	267		3,457	4,364	97	1	96	3	162	8	2	1	0	0	0	0	0	0	0
84	Silver Mountain/ Rose Valley - Inyo Mountains/ Saline Valley/ Death Valley	2,006	329	2,884	261	2,555	95	17	21,873	89	267	310		2,236	2,582	96	1	95	4	176	16	10	1	0	0	0	0	0	0	0
85	Lone Oak Mountain - Redwood Mountain/ Pine Ridge	620	150	2,446	318	2,296	87	22	41,566	168	285	293	375	16,677	17,398	17	13	4	83	250	8	5	14	0	4	2	5	1	0	1
86	Anticline Ridge - Joaquin Ridge	363	136	1,475	248	1,339	45	41	70,772	286	282	306	316	8,439	12,572	11	7	5	89	215	9	12	17	0	0	0	4	2	0	3
87	San Luis Canal - Kesterson National Wildlife Refuge	27	21	34	3	13	50	38	38,237	155	333	348	344	11,183	16,354	99	45	54	1	220	4	8	14	0	1	4	1	1	76	1
88	Cherokee Creek - Pine Ridge	538	281	967	133	686	59	26	37,817	153	426	454	422, 429, 436	16,424	18,493	13	0	13	87	263	14	2	3	0	0	0	98	1	0	1
89	Marble Valley - Sawtooth Ridge	723	110	2,155	448	2,045	43	37	217,268	879	528	572	525, 542, 543, 547, 549, 552, 554, 558, 559, 567	63,905	83,812	51	21	30	49	232	21	18	24	0	0	0	5	1	0	3
90	Sturdevant Ridge - Mosquito Ridge/ Crystal Ridge	1,661	766	2,701	329	1,935	52	27	171,457	694	517	567	518, 519, 524, 537	21,739	29,201	64	1	62	36	201	12	10	20	0	0	0	12	1	1	1
91	Bear River - Chaparral Hill/ Yuba River	260	67	674	103	607	67	30	46,438	188	563	590	573	19,000	21,878	26	4	21	74	248	3	2	6	0	0	0	0	0	0	1
92	Popcorn Cave - Curl Ridge	998	434	1,786	192	1,352	70	30	182,819	740	746	785	736, 745, 749, 754, 756, 758	49,155	51,269	54	9	45	47	244	10	19	34	0	21	3	1	1	1	2
93	Timbered Crater - Mt Dome	1,622	1,100	2,406	310	1,306	63	29	176,143	713	790	829	794, 796, 805, 810, 817, 819	39,409	44,245	96	20	76	4	242	11	12	11	0	0	0	0	0	0	0
94	Little Cottonwood Pk - Siskiyou Mountains	1,202	523	2,143	382	1,620	57	31	58,755	238	842	847	837	18,381	22,939	58	0	58	42	235	5	5	6	0	4	1	0	0	2	1
95	Big River/ Hi Chute Ridge - Black Oak Mountain	352	8	1,281	202	1,273	62	26	96,961	392	643	686		35,652	39,233	18	2	16	82	253	4	7	8	0	17	2	0	0	0	0

Characteristics of Essential Connectivity Areas

	Paved Roads				Ecoregions				Watershed		ACEC	Counties		Land Cover								
ID	mjrd_km	mjrd_dens	secrd_km	secrd_dens	n_ecoreg	Ecoregs	n_subsect	Subsect	HU_num	HU_name	pc_blmacec	n_counties	counties	pc_forest	pc_shrub	pc_herb	pc_wetrip	pc_water	pc_dev	pc_crop	pc_pasture	pc_other
78	16	0.0	0	0.0	1	MODOC PLATEAU	4	Devil's Garden, Mowitz Buttes, Pit River Valley, Adin Mountains and Valleys	2	KLAMATH RIVER, PIT RIVER	0	1	Modoc	66	28	2	3	0	0	0	0	1
79	99	0.1	100	0.1	1	MOJAVE DESERT	7	Mojave Valley-Granite Mountains, Silurian Valley-Devil's Playground, Kingston Range-Valley Wells, Ivanpah Valley, Providence Mountains-Lanfair Valley, Lucerne-Johnson Valleys and Hills, Bullion Mountains-Bristol Lake	6	BESSEMER, BROADWELL, LAVIC, LUCERNE LAKE, MOJAVE, ROUTE SIXTY SIX	10	1	San Bernardino	0	59	0	0	0	1	0	0	40
80	194	0.1	181	0.0	1	MOJAVE DESERT	6	Mojave Valley-Granite Mountains, Silurian Valley-Devil's Playground, Kingston Range-Valley Wells, Ivanpah Valley, Providence Mountains-Lanfair Valley, Bullion Mountains-Bristol Lake	8	AMARGOSA, BROADWELL, COYOTE, HOMER, IVANPAH, MOJAVE, ROUTE SIXTY SIX, SUPERIOR	2	1	San Bernardino	0	65	0	1	0	1	0	0	33
81	0	0.0	37	0.0	1	MOJAVE DESERT	5	Death Valley, Amargosa Desert-Pahrump Valley, Funeral Mountains-Greenwater Valley, Searles Valley-Owlshead Mountains, Mojave Valley-Granite Mountains	9	AMARGOSA, BALLARAT, GOLDSTONE, GRANITE, LEACH, MOJAVE, OWLSHEAD, SUPERIOR, TRONA	0	2	Inyo, San Bernardino	0	40	0	3	0	0	0	0	57
82	0	0.0	145	0.1	2	MOJAVE DESERT, SIERRA NEVADA	8	Owens Valley, Death Valley, Panamint Valley, Searles Valley-Owlshead Mountains, Inyo Mountains, Saline Valley Cottonwood Mountains, Cosa-Argus Ranges, Panamint Range	6	AMARGOSA, BALLARAT, INDIAN WELLS, OWENS, RACE TRACK, SALINE	1	1	Inyo	7	34	0	1	0	1	0	0	57
83	0	0.0	6	0.1	1	MOJAVE DESERT	2	Inyo Mountains, Cosa-Argus Ranges	3	BALLARAT, INDIAN WELLS, OWENS	0	1	Inyo	17	24	0	26	0	1	0	0	32
84	0	0.0	0	0.0	2	MOJAVE DESERT, SIERRA NEVADA	3	Inyo Mountains, Saline Valley-Cottonwood Mountains, Cosa-Argus Ranges	3	BALLARAT, OWENS, SALINE	1	1	Inyo	42	17	0	0	0	0	0	0	41
85	20	0.1	6	0.0	2	SIERRA NEVADA, GREAT CENTRAL VALLEY	4	Hardpan Terraces, Lower Batholith, Upper Batholith, Lower Granitic Foothills	2	KAWEAH RIVER, SOUTH VALLEY FLOOR	1	1	Tulare	12	52	31	5	0	0	0	0	0
86	39	0.1	29	0.1	2	CENTRAL COAST, GREAT CENTRAL VALLEY	5	Westside Alluvial Fans and Terraces, Panoche and Cantua Fans and Basins, Diablo Range, Eastern Hills, Kettleman Hills and Valleys	3	COAST RANGE, PAJARO RIVER, SOUTH VALLEY FLOOR	7	2	Fresno, San Benito	4	4	62	0	0	19	10	2	0
87	12	0.1	30	0.2	1	GREAT CENTRAL VALLEY	2	Westside Alluvial Fans and Terraces, San Joaquin Basin	1	DELTA-MENDOTA CANAL	0	1	Merced	0	3	5	63	1	6	12	8	0
88	8	0.1	64	0.4	1	SIERRA NEVADA	2	Upper Foothills Metamorphic Belt, Lower Foothills Metamorphic Belt	1	UPPER CALAVERAS	0	1	Calaveras	17	73	0	7	0	3	0	0	0
89	29	0.0	162	0.2	1	SIERRA NEVADA	4	Hardpan Terraces, Upper Foothills Metamorphic Belt, Upper Batholith and Volcanic Flows, Lower Foothills Metamorphic Belt	3	AMERICAN RIVER, MIDDLE SIERRA, VALLEY-AMERICAN	1	3	Placer, El Dorado, Sacramento	52	32	4	5	2	4	0	0	1
90	54	0.1	138	0.2	1	SIERRA NEVADA	6	Upper Foothills Metamorphic Belt, Upper Batholith and Volcanic Flows, Tahoe-Truckee, Glaciated Batholith and Volcanic Flows, Tahoe Valley, Batholith and Volcanic Flows	4	AMERICAN RIVER, LAKE TAHOE, MIDDLE SIERRA, TRUCKEE RIVER	0	2	Placer, El Dorado	84	6	0	5	1	2	0	0	2
91	9	0.1	24	0.1	2	SIERRA NEVADA, GREAT CENTRAL VALLEY	1	Lower Foothills Metamorphic Belt	2	BEAR RIVER, YUBA RIVER	0	3	Yuba, Nevada, Placer	1	85	5	7	1	2	0	0	0
92	42	0.1	81	0.1	1	MODOC PLATEAU	4	Eastern Klamath Mountains, Hat Creek Rim, Shignletown-Paradise, Bald Mountain-Dixie Valley	2	MC CLOUD RIVER, PIT RIVER	0	1	Shasta	75	17	0	3	1	1	1	0	2
93	0	0.0	71	0.1	1	MODOC PLATEAU	5	Medicine Lake Lava Flows, Medicine Lake Highlands, Hat Creek Rim, Mowitz Buttes, Bald Mountain-Dixie Valley	2	KLAMATH RIVER, PIT RIVER	0	1	Siskiyou	81	8	0	0	0	1	0	0	10
94	16	0.1	0	0.0	1	NORTH COAST	2	Scott Bar Mountain, Windy Peak	2	KLAMATH RIVER, ROGUE RIVER	0	1	Siskiyou	85	6	1	1	0	6	0	0	2
95	0	0.0	44	0.1	1	NORTH COAST	2	Coastal Franciscan, Central Franciscan	2	EEL RIVER, MENDOCINO COAST	0	1	Mendocino	86	4	1	0	0	5	0	0	5

Characteristics of Essential Connectivity Areas

Identifier		Landform					ECI		Area		Essential Connectivity Area					Protection Status				Species Diversity					Listed Species					
ID	ECA_Name	elev_mean	elev_min	elev_max	elev_std	elev_range	mn_integ	std_integ	AREA_ac	AREA_km	pointA	pointB	NLB_In	min_length	lcp_length	pc_protect	pc_gap12e	pc_gap3	pc_privunprp	mn_sprich	std_sprich	CNDDB_plant_count	CNDDB_animal_count	pc_hotspt	pc_crithab	crithab_sp_count	pc_esshab	esshab_sp_count	pc_wtvp	mjrd_cross
96	Bonny Doon - Castle Rock	407	73	981	184	908	19	26	60,468	245	350	366	355, 357, 365, 374	17,920	22,905	24	22	1	76	269	3	22	15	0	14	2	8	1	0	1
97	Los Padres National Forest - Pilarcitos Canyon	350	2	1,526	230	1,524	46	39	131,465	532	314	325	302, 304, 311, 317, 319	8,957	18,413	25	14	11	75	262	14	51	25	45	35	4	64	2	0	2
98	San Ynez Mountains West - Casmalia Hills	138	7	489	70	482	45	41	79,399	321	168	202	165, 169, 174, 185	25,416	33,798	10	9	1	90	260	6	24	22	0	3	3	85	5	3	1
99	Castro Peak/Santa Monica Mtns - Pine Mountain/Sespe Condor	402	62	1,304	161	1,242	23	35	119,050	482	107	160	106, 109, 111, 112, 114, 124, 136	36,200	42,675	38	36	2	62	258	8	23	37	0	23	9	27	5	1	4
100	The Badlands West - Box Springs Mountains	620	348	939	93	591	7	15	23,591	95	84	87		13,455	15,928	2	2	1	98	267	3	11	19	100	28	1	0	0	0	0
101	Santa Rosa Mountains - Cahuilla Moutain/Rouse Ridge	1,448	690	2,077	188	1,387	51	36	17,316	70	66	74	76	100	113	75	2	73	25	266	8	18	13	5	0	3	10	2	2	1
102	Santa Rosa Mountains - Cahuilla Moutain/Rouse Ridge	1,293	307	2,642	337	2,335	40	28	14,608	59	59	74	66	100	917	44	5	39	56	248	15	22	10	61	36	1	0	0	0	1
103	Lake Skinner - Cahuilla Moutain/Rouse Ridge	726	511	1,563	133	1,052	47	25	18,980	77	64	66	61	5,248	7,820	5	0	5	95	261	8	8	13	100	28	4	2	2	0	0
104	Canada de San Vicente/Iron Mountain - Black Mountain/Guejito Creek	451	136	872	79	736	24	25	27,102	110	33	46	35, 39	9,707	13,175	30	17	13	70	256	5	21	29	45	11	4	45	7	1	1
105	Palomar Mountains - Camp Pendleton/Santa Rosa	427	49	1,848	209	1,799	24	27	94,989	384	52	68	51, 54, 56, 58	14,566	20,060	21	9	11	79	272	7	52	41	90	20	6	77	9	1	2
106	East Mesa Sand Dunes - Chocolate Mountains South	81	48	515	21	467	100	0	6,560	27	3	6		1,000	1,124	100	0	100	0	163	1	6	1	0	3	1	0	0	0	0
107	East Mesa Sand Dunes - Chocolate Mountains South	157	42	667	76	625	94	19	96,435	390	6	18		18,546	28,706	96	0	96	4	165	5	10	16	0	0	3	0	1	0	0
108	Jacumba Peak - Campo Valley	1,080	832	1,236	61	404	54	31	27,307	111	4	7	5, 11, 31	10,486	14,914	3	0	3	97	245	5	6	6	0	9	2	6	1	1	2
109	McGinty Mountain/Lawson Valley - El Capitan	395	111	1,093	129	982	9	22	29,627	120	19	37	23	9,613	26,926	34	28	6	66	271	7	19	21	50	6	1	18	4	0	1
110	Noble Ridge/ Beegum Gorge - South Fork Mountain/ Chinquapin Butte	1,360	537	2,385	250	1,848	63	30	92,802	376	714	724	717, 720	10,734	15,846	96	19	77	4	229	3	7	8	0	20	1	0	0	0	0
111	Salmon Mountains - Redwood/ Williams Ridge/ Holter Ridge	712	17	1,811	361	1,794	64	30	99,062	401	815	825	809, 811, 848	12,200	22,807	52	2	50	48	232	6	14	17	0	26	2	0	0	0	1
112	Mill Creek Rim - Lassen Volcanic Wilderness	1,795	744	3,169	318	2,425	61	29	97,957	396	691	710	707	11,323	14,703	71	23	48	29	218	10	32	19	0	0	0	0	0	5	2
113	Pine Ridge - Lightning Mountain	1,652	798	2,733	291	1,935	46	34	65,625	266	454	470	437	14,957	22,696	52	8	45	48	212	18	5	7	0	0	0	4	1	0	1
114	Yokohl Valley/ Oat Canyon - Sierra Nevada	727	157	3,596	440	3,439	74	28	204,110	826	270	375	261, 293	5,248	5,807	12	3	10	88	254	14	32	23	0	55	2	0	0	0	2
115	Indio Hills - San Jacinto Mountains	222	54	492	84	438	22	35	28,944	117	73	74	65	13,927	16,458	30	17	13	70	203	20	17	22	20	9	2	34	1	0	2

	Paved Roads				Ecoregions				Watershed		ACEC	Counties		Land Cover								
ID	mjrd_km	mjrd_dens	secrd_km	secrd_dens	n_ecoreg	Ecoregs	n_subsect	Subsect	HU_num	HU_name	pc_blmacec	n_counties	counties	pc_forest	pc_shrub	pc_herb	pc_wetrip	pc_water	pc_dev	pc_crop	pc_pasture	pc_other
96	17	0.1	95	0.4	1	CENTRAL COAST	1	Santa Cruz Mountains	3	BIG BASIN, SAN MATEO, SANTA CLARA	0	3	San Mateo, Santa Clara, Santa Cruz	68	19	1	0	0	11	0	0	0
97	65	0.1	77	0.2	1	CENTRAL COAST	3	Watsonville Plain-Salinas Valley, North Costal Santa Lucia Range, Interior Santa Lucia Range	3	CARMEL RIVER, SALINAS, SANTA LUCIA	0	1	Monterey	15	69	5	1	0	10	0	0	0
98	56	0.2	68	0.2	1	CENTRAL COAST	3	Santa Maria Valley, Santa Ynez Valleys and Hills, Santa Ynez-Sulphur Mountains	4	SAN ANTONIO, SANTA MARIA, SANTA YNEZ, SOUTH COAST	0	1	Santa Barbara	1	71	4	4	0	13	5	1	0
99	67	0.1	143	0.3	1	SOUTH COAST	8	Santa Ynez-Sulphur Mountains, Oxnard Plain-Santa Paula Valley, Simi Valley-Santa Susana Mountains, Santa Monica Mountains, Los Angeles Plain, San Rafael-Topatopa Mountains, Northern Transverse Ranges, Sierra Pelona-Mint Canyon	4	CALLEGUAS, LOS ANGELES RIVER, SANTA CLARA - CALLEGUAS, SANTA MONICA BAY	0	2	Ventura, Los Angeles	0	66	13	1	0	15	2	1	1
100	0	0.0	40	0.4	1	SOUTH COAST	3	Fontana Plain-Calimesa Terraces, Perris Valley and Hills, San Jacinto Foothills-Cahuilla Mountains	2	SAN JACINTO VALLEY, SANTA ANA RIVER	0	2	San Bernardino, Riverside	3	58	22	1	0	15	0	1	0
101	24	0.3	6	0.1	1	SOUTH COAST	2	San Jacinto Foothills-Cahuilla Mountains, San Jacinto Mountains	2	SAN JACINTO VALLEY, SANTA MARGARITA	0	1	Riverside	45	35	8	0	2	9	0	0	0
102	21	0.4	0	0.0	2	SONORAN DESERT, SOUTH COAST	3	San Jacinto Foothills-Cahuilla Mountains, San Jacinto Mountains, Desert Slopes NA No Description	4	ANZA BORREGO, CLARK, SAN JACINTO VALLEY, WHITEWATER	0	1	Riverside	37	26	17	0	0	7	0	0	13
103	0	0.0	16	0.2	1	SOUTH COAST	3	Perris Valley and Hills, San Jacinto Foothills-Cahuilla Mountains, San Jacinto Mountains	2	SAN JACINTO VALLEY, SANTA MARGARITA	0	1	Riverside	7	71	14	0	0	7	0	0	2
104	8	0.1	26	0.2	1	SOUTH COAST	2	Coastal Hills, Western Granitic Foothills	3	PENASQUITOS, SAN DIEGO, SAN DIEGUITO	0	1	San Diego	1	64	23	0	0	10	1	0	1
105	41	0.1	155	0.4	1	SOUTH COAST	6	Coastal Hills, Santa Ana Mountains, Perris Valley and Hills, San Jacinto Foothills-Cahuilla Mountains, Western Granitic Foothills, Palomar-Cuyamaca Peak	4	SAN JACINTO VALLEY, SAN JUAN, SAN LUIS REY, SANTA MARGARITA	6	3	Riverside, Orange, San Diego	2	63	8	2	0	15	10	0	1
106	0	0.0	0	0.0	1	SONORAN DESERT	1	East Mesa-Sand Hills	2	IMPERIAL, YUMA	0	1	Imperial	0	1	0	1	0	0	0	0	98
107	0	0.0	19	0.1	1	SONORAN DESERT	3	Chocolate Mountains and Valleys, East Mesa-Sand Hills, Gila Bend Plain Desert Shrubland	4	AMOS-OGILBY, COLORADO, IMPERIAL, YUMA	0	1	Imperial	0	24	0	45	0	0	0	0	31
108	24	0.2	9	0.1	2	SONORAN DESERT, SOUTH COAST	2	Palomar-Cuyamaca Peak, Desert Slopes NA No Description	2	ANZA BORREGO, TIJUANA	0	1	San Diego	4	53	35	1	0	7	0	0	0
109	15	0.1	40	0.3	1	SOUTH COAST	3	Coastal Hills, Western Granitic Foothills, Palomar-Cuyamaca Peak	3	OTAY, SAN DIEGO, SWEETWATER	0	1	San Diego	0	71	5	2	2	19	1	0	0
110	0	0.0	51	0.1	1	NORTH COAST	4	Trinity Mountain-Hayfork, Rattlesnake Creek, Eastern Franciscan, Western Foothills	3	MAD RIVER, SHASTA BALLY, TRINITY RIVER	0	3	Trinity, Shasta, Tehama	76	15	2	0	0	4	0	0	2
111	9	0.0	46	0.1	1	NORTH COAST	9	Northern Franciscan, Western Jurassic, Gasquet Mountain Ultramafics, Lower Salmon Mountains, Forks of Salmon, North Trinity Mountain, Trinity Mountain-Hayfork, Eastern Franciscan	2	KLAMATH RIVER, TRINITY RIVER	0	3	Siskiyou, Humboldt, Trinity	90	3	0	1	1	3	0	0	2
112	67	0.2	25	0.1	1	MODOC PLATEAU	3	Shignletown-Paradise, Lassen-Almanor, Tuscan Flows	4	EASTERN TEHAMA, FEATHER RIVER, PIT RIVER, WHITMORE	0	4	Shasta, Lassen, Tehama, Plumas	86	2	0	6	0	2	0	0	4
113	31	0.1	6	0.0	1	SIERRA NEVADA	4	Upper Foothills Metamorphic Belt, Upper Batholith and Volcanic Flows, Glaciated Batholith and Volcanic Flows, Batholith and Volcanic Flows	3	MIDDLE SIERRA, STANISLAUS RIVER, UPPER CALAVERAS	0	3	Alpine, Calaveras, Tuolumne	85	1	0	6	1	2	0	0	5
114	95	0.1	78	0.1	2	SIERRA NEVADA, GREAT CENTRAL VALLEY	4	Hardpan Terraces, Lower Batholith, Upper Batholith, Lower Granitic Foothills	5	KAWEAH RIVER, KERN RIVER, KINGS RIVER, SOUTH VALLEY FLOOR, SOUTHERN SIERRA	0	2	Fresno, Tulare	24	33	37	4	0	1	0	0	0
115	31	0.3	28	0.2	2	SONORAN DESERT, SOUTH COAST	3	San Jacinto Mountains, Desert Slopes NA No Description, Coachella Valley	2	SAN JACINTO VALLEY, WHITEWATER	9	1	Riverside	0	62	1	10	0	7	0	0	20

Identifier		Landform					ECI		Area		Essential Connectivity Area					Protection Status				Species Diversity					Listed Species					
ID	ECA_Name	elev_mean	elev_min	elev_max	elev_std	elev_range	mn_integ	std_integ	AREA_ac	AREA_km	pointA	pointB	NLB_ln	min_length	lcp_length	pc_protect	pc_gap12e	pc_gap3	pc_privunprp	mn_sprich	std_sprich	CNDDB_plant_count	CNDDB_animal_count	pc_hotspt	pc_crithab	crithab_sp_count	pc_esshab	esshab_sp_count	pc_wtvp	mjrd_cross
116	East Mesa Sand Dunes - Chocolate Mountains	41	0	169	30	169	88	29	217,841	882	3	50	2, 12	18,433	19,884	84	4	79	16	174	23	9	15	0	0	2	2	1	0	2
117	Miramar - Canada de San Vicente/Iron Mountain	264	107	606	74	499	5	9	23,531	95	27	33	24	10,330	13,797	54	18	36	46	274	3	18	22	57	7	2	7	4	0	1
118	Burnt Mountain - Black Mountain/Guejito Creek	516	220	982	106	762	27	28	12,221	49	45	46		6,360	9,227	20	17	2	80	260	1	2	3	0	7	1	14	3	1	0
119	Lake Perris - The Badlands East	455	428	658	31	230	30	38	6,395	26	79	82		4,507	7,641	81	14	67	19	267	1	6	10	100	2	1	55	2	0	0
120	Estelle Mountain - Lake Matthews	496	316	837	100	521	21	19	4,428	18	75	81		1,302	2,369	19	7	12	81	269	3	3	8	0	40	3	54	2	0	0
121	Mooney Island - Ishi Wilderness	126	60	751	124	691	27	32	16,358	66	692	695		1,876	3,990	12	7	5	88	235	11	0	19	0	0	0	0	0	19	1
122	Poso Creek - Five Dog Creek	311	230	392	27	162	75	31	13,573	55	215	223		8,588	9,795	1	0	1	99	208	1	0	3	0	0	0	0	0	0	0
123	Ten Section Oil Field - Elk Hills	116	80	421	54	341	33	36	47,652	193	200	210	198	4,801	7,388	20	10	10	80	198	3	11	22	71	0	0	54	1	0	1
124	Kettleman Hills/ Las Alturas - Table Mountain/ Chino Canyon	263	89	1,128	125	1,039	52	40	142,471	577	255	284	263, 273, 277	8,543	12,903	17	16	0	83	197	10	9	14	0	0	0	5	1	0	3
125	Santa Cruz Mountains/ Pescadero Creek - Pigeon Point	108	36	448	92	412	32	35	6,325	26	337	342	401	11,915	14,428	10	9	1	90	247	8	3	8	0	12	1	25	1	1	2
126	Curry Creek - Coon Creek	28	18	39	3	21	45	38	15,002	61	545	555		12,076	13,400	14	10	4	86	222	1	2	6	0	0	0	53	1	50	0
127	Yolo Bypass - Sacramento Bypass	4	0	10	2	10	4	15	11,647	47	515	535		11,403	14,246	68	7	61	32	231	1	0	3	0	89	1	0	0	6	1
128	English Hills - Blue Ridge/ Rocky Ridge	206	32	863	166	831	66	35	34,622	140	532	570		7,494	12,310	37	24	13	63	251	9	3	8	0	0	0	16	1	2	0
129	Mandeville Island - Staten Island	-1	-3	4	1	7	5	16	16,976	69	441	464		5,689	13,661	14	13	0	86	232	1	7	5	0	100	1	0	0	6	0
130	Little Holland Tract/ Yolo Bypass - Yolo Bypass	3	0	10	2	10	14	21	5,082	21	501	515		1,432	3,488	5	4	1	95	231	2	0	1	0	100	1	0	0	11	0
131	Pixley National Wildlife Refuge - Cross Creek	66	63	69	1	6	10	24	14,192	57	265	274		6,984	9,852	1	1	0	99	198	1	0	4	0	6	1	6	1	26	0
132	Ash Slough - Merced National Wildlife Refuge	36	29	42	3	13	17	31	15,131	61	332	338	346	10,072	11,764	6	2	5	94	220	5	2	6	0	4	5	4	1	22	0
133	Fresno River - Lone Willow	45	42	53	1	11	7	17	7,152	29	327	329		6,589	8,014	0	0	0	100	211	1	1	2	0	0	0	0	0	13	0
134	Gravelly Ford Canal - Fresno River	52	46	61	3	15	39	42	19,671	80	320	327	324	6,907	7,722	4	4	0	96	209	2	5	3	0	0	0	0	0	50	0
135	Lone Willow - Ash Slough	41	37	45	2	8	20	31	8,635	35	329	332		2,563	3,148	0	0	0	100	213	4	2	3	0	0	0	0	0	23	0
136	Bald Mountain Range - Reconnaissance Peak	1,597	1,489	2,448	206	959	18	31	33,905	137	613	629		4,634	15,074	53	40	13	47	236	11	6	0	0	0	0	0	0	12	2
137	Allensworth - Pixley National Wildlife Refuge	74	61	82	4	21	3	11	4,849	20	241	249		1,200	2,149	2	2	0	98	200	4	3	10	0	16	1	17	1	19	0
138	Five Dog Creek - Gordon Gulch/ Sand Canyon	294	222	384	27	162	75	31	12,524	51	223	230		2,236	4,498	0	0	0	100	215	11	0	0	0	0	0	0	0	0	0
139	Mountain House - Brushy Peak	193	43	390	79	347	46	35	7,546	31	403	419		2,341	3,488	0	0	0	100	233	8	6	9	0	0	1	100	1	1	1

	Paved Roads				Ecoregions				Watershed		ACEC	Counties		Land Cover								
ID	mjrd_km	mjrd_dens	secrd_km	secrd_dens	n_ecoreg	Ecoregs	n_subsect	Subsect	HU_num	HU_name	pc_blmacec	n_counties	counties	pc_forest	pc_shrub	pc_herb	pc_wetrip	pc_water	pc_dev	pc_crop	pc_pasture	pc_other
116	66	0.1	7	0.0	1	SONORAN DESERT	3	Chocolate Mountains and Valleys, Imperial Valley, East Mesa-Sand Hills	4	AMOS-OGILBY, CHUCKWALLA, COLORADO, IMPERIAL	0	2	Riverside, Imperial	0	59	0	8	0	1	1	1	30
117	5	0.1	11	0.1	1	SOUTH COAST	3	Coastal Hills, Coastal Terraces, Western Granitic Foothills	2	PENASQUITOS, SAN DIEGO	0	1	San Diego	0	85	4	1	2	8	0	0	0
118	0	0.0	19	0.4	1	SOUTH COAST	2	Western Granitic Foothills, Palomar-Cuyamaca Peak	3	CARLSBAD, SAN DIEGUITO, SAN LUIS REY	0	1	San Diego	0	79	8	3	1	6	2	1	0
119	0	0.0	10	0.4	1	SOUTH COAST	2	Perris Valley and Hills, San Jacinto Foothills-Cahuilla Mountains	1	SAN JACINTO VALLEY	0	1	Riverside	0	30	41	0	4	14	7	3	0
120	0	0.0	9	0.5	1	SOUTH COAST	1	Perris Valley and Hills	1	SANTA ANA RIVER	0	1	Riverside	2	49	29	0	3	15	1	0	1
121	10	0.2	19	0.3	2	GREAT CENTRAL VALLEY, MODOC PLATEAU	2	North Valley Alluvium, Tuscan Flows	2	EASTERN TEHAMA, TEHAMA	0	1	Tehama	0	20	18	5	3	8	28	17	0
122	0	0.0	10	0.2	1	GREAT CENTRAL VALLEY	1	Hardpan Terraces	1	SOUTH VALLEY FLOOR	0	1	Kern	0	0	94	0	0	6	0	0	0
123	30	0.2	35	0.2	1	GREAT CENTRAL VALLEY	3	Antelope Plain, South Valley Alluvium and Basins, Elk Hills and South Valley Terraces	1	SOUTH VALLEY FLOOR	0	1	Kern	0	8	62	7	1	11	8	3	1
124	66	0.1	21	0.0	2	CENTRAL COAST, GREAT CENTRAL VALLEY	5	Panoche and Cantua Fans and Basins, Antelope Plain, Diablo Range, Eastern Hills, Kettleman Hills and Valleys	5	COAST RANGE, ESTRELLA RIVER, SALINAS, SOUTH VALLEY FLOOR, SUNFLOWER VALLEY	15	3	Fresno, Monterey, Kings	1	2	72	0	0	10	12	1	1
125	12	0.5	14	0.6	1	CENTRAL COAST	3	Santa Clara Valley, Leeward Hills, Western Diablo Range	2	PAJARO RIVER, SANTA CLARA	0	2	Santa Clara, San Benito	1	22	27	4	0	11	34	0	1
126	0	0.0	21	0.3	1	GREAT CENTRAL VALLEY	1	Hardpan Terraces	1	VALLEY-AMERICAN	0	1	Placer	0	1	52	4	0	5	26	11	0
127	6	0.1	9	0.2	1	GREAT CENTRAL VALLEY	2	Yolo Alluvial Fans, Yolo-American Basins	2	SACRAMENTO DELTA, VALLEY PUTAH-CACHE	0	1	Yolo	0	1	13	27	6	4	47	2	0
128	0	0.0	29	0.2	2	GREAT CENTRAL VALLEY, NORTH COAST	4	Suisun Hills and Valleys, Yolo Alluvial Fans, Sodic Claypan Terraces, Western Foothills	3	PUTAH CREEK, UPPER ELMIRA, VALLEY PUTAH-CACHE	0	3	Yolo, Napa, Solano	0	61	27	2	1	4	6	0	0
129	0	0.0	5	0.1	1	GREAT CENTRAL VALLEY	1	Delta	2	SACRAMENTO DELTA, SAN JOAQUIN DELTA	0	3	Sacramento, San Joaquin, Contra Costa	0	0	1	17	20	2	59	0	0
130	0	0.0	0	0.0	1	GREAT CENTRAL VALLEY	1	Yolo-American Basins	1	SACRAMENTO DELTA	0	1	Yolo	0	2	12	17	11	1	57	2	0
131	0	0.0	16	0.3	1	GREAT CENTRAL VALLEY	2	Granitic Alluvial Fans and Terraces, Tulare Basin	1	SOUTH VALLEY FLOOR	0	2	Tulare, Kings	0	0	19	1	2	5	51	22	0
132	0	0.0	13	0.2	1	GREAT CENTRAL VALLEY	3	Manteca-Merced Alluvium, San Joaquin Basin, Granitic Alluvial Fans and Terraces	2	DELTA-MENDOTA CANAL, SAN JOAQUIN VALLEY FLOOR	0	2	Madera, Merced	0	0	14	4	0	4	44	34	0
133	0	0.0	2	0.1	1	GREAT CENTRAL VALLEY	2	Hardpan Terraces, Granitic Alluvial Fans and Terraces	1	SAN JOAQUIN VALLEY FLOOR	0	1	Madera	0	0	8	4	0	2	63	23	0
134	0	0.0	17	0.2	1	GREAT CENTRAL VALLEY	2	Hardpan Terraces, Granitic Alluvial Fans and Terraces	1	SAN JOAQUIN VALLEY FLOOR	0	1	Madera	0	0	42	2	0	6	21	30	0
135	0	0.0	3	0.1	1	GREAT CENTRAL VALLEY	2	San Joaquin Basin, Granitic Alluvial Fans and Terraces	1	SAN JOAQUIN VALLEY FLOOR	0	1	Madera	0	0	19	2	0	3	32	44	0
136	20	0.1	9	0.1	2	SIERRA NEVADA, MODOC PLATEAU	3	Frenchman, Sierra Valley, Tahoe-Truckee	2	FEATHER RIVER, SUSANVILLE	0	3	Lassen, Plumas, Sierra	28	56	0	3	0	2	1	10	0
137	0	0.0	5	0.2	1	GREAT CENTRAL VALLEY	3	Granitic Alluvial Fans and Terraces, Tulare Basin, South Valley Alluvium and Basins	1	SOUTH VALLEY FLOOR	0	1	Tulare	0	0	20	0	0	4	43	33	0
138	0	0.0	0	0.0	1	GREAT CENTRAL VALLEY	2	Hardpan Terraces, Southern Granitic Foothills	2	SOUTH VALLEY FLOOR, SOUTHERN SIERRA	0	1	Kern	0	0	98	0	0	1	0	0	0
139	14	0.5	9	0.3	1	GREAT CENTRAL VALLEY	2	Westside Alluvial Fans and Terraces, Eastern Hills	3	NORTH DIABLO RANGE, SAN JOAQUIN DELTA, SOUTH BAY	0	1	Alameda	0	1	86	0	0	12	0	0	0

Characteristics of Essential Connectivity Areas

Identifier		Landform					ECI		Area		Essential Connectivity Area					Protection Status				Species Diversity					Listed Species					
ID	ECA_Name	elev_mean	elev_min	elev_max	elev_std	elev_range	mn_integ	std_integ	AREA_ac	AREA_km	pointA	pointB	NLB_In	min_length	lcp_length	pc_protect	pc_gap12e	pc_gap3	pc_privunprp	mn_sprich	std_sprich	CNDDB_plant_count	CNDDB_animal_count	pc_hotspt	pc_crithab	crithab_sp_count	pc_esshab	esshab_sp_count	pc_wtvp	mjrd_cross
140	Montezuma Hills - Hopkins Ravine	57	4	88	14	84	44	31	8,577	35	459	467		5,326	7,218	2	2	0	98	226	2	2	3	0	0	0	4	1	1	0
141	Santa Cruz Mountains/ Pescadero Creek - Santa Cruz Mountains	357	80	779	139	699	47	25	23,306	94	337	361	345, 349	3,612	4,974	9	9	0	91	272	6	9	3	0	0	0	0	1	0	0
142	Santa Cruz Mountains - Diablo Range	305	49	1,139	232	1,090	21	29	96,658	391	361	401	342, 345, 349	4,807	11,729	15	13	2	85	247	10	28	18	0	25	3	15	1	1	2
143	San Luis Island - Bear Creek	27	21	32	2	11	59	37	12,664	51	344	346		3,106	6,087	93	62	31	7	223	1	8	16	0	50	6	50	1	66	0
144	San Luis Canal - Ortigalita Ridge/ San Luis Reservoir	179	30	856	127	826	45	40	23,956	97	333	340		3,578	4,448	13	11	2	87	215	9	7	19	0	1	1	47	2	16	1
145	San Geronimo - Los Padres National Forest	381	0	1,341	233	1,341	65	37	145,571	589	242	314	247, 257, 262, 272	2,309	6,921	47	29	18	53	279	22	54	22	11	0	2	31	1	1	1
146	Stone Lake - Yolo Bypass	2	0	8	2	8	16	30	16,465	67	490	515	502, 507	13,286	18,617	50	32	18	50	231	1	4	17	0	79	1	0	0	30	1
147	Blue Ridge/ Rocky Ridge - Capay Hills	157	64	926	134	862	19	31	19,557	79	570	575		1,000	4,873	6	5	1	94	232	8	0	3	0	0	0	10	1	0	0
148	Dunnigan Hills/ Smith Creek - Dunnigan Hills	51	14	98	18	84	66	38	13,830	56	551	560		2,319	5,743	0	0	0	100	220	8	0	3	0	0	0	0	0	5	1
149	Sacramento National Wildlife Refuge - Clark Valley	40	19	276	32	257	37	42	17,231	70	616	644	621	5,053	5,991	46	46	0	54	219	5	12	4	0	0	0	11	1	35	1
150	Black Oak Mountain - Red Mountain	632	249	1,141	183	892	61	29	14,579	59	686	697		7,355	8,440	54	5	48	46	254	6	7	3	0	58	2	0	0	0	1
151	Sinkyone - King Range	486	4	948	164	944	60	29	15,293	62	709	733		3,276	3,770	63	11	53	37	272	21	6	2	0	63	2	0	0	0	0
152	Marble Mountains - Siskiyou Mountains	1,031	373	1,961	369	1,588	56	31	43,279	175	843	847		2,657	3,891	88	1	86	12	235	4	3	8	0	37	2	0	0	0	1
153	Little Cottonwood Pk - Wadsworth Flat	1,009	626	2,000	325	1,374	54	34	14,321	58	842	844		2,921	8,728	23	0	23	77	251	14	2	4	0	0	0	0	0	1	1
154	Butte Valley - Wadsworth Flat	1,189	662	1,886	277	1,224	66	31	75,118	304	834	844	830, 838, 839, 841	22,163	23,629	22	0	22	78	265	11	3	12	0	4	1	0	0	1	1
155	Double Head Mountain/ Timbered Ridge - Lava Beds Wilderness	1,350	1,231	1,579	66	348	76	31	126,203	511	814	817	802, 804, 810, 824	1,300	1,652	92	34	58	8	255	9	11	8	0	0	0	0	0	2	1
156	Timber Mountain - Double Head Mountain/ Timbered Ridge	1,474	1,277	1,613	58	336	54	26	75,788	307	802	814		1,574	22,215	100	0	100	0	256	6	5	3	0	0	0	0	0	4	1
157	Pilot Butte - Little Hot Spring Valley	1,372	1,007	1,928	210	921	52	33	33,036	134	768	774	765, 773, 776	18,736	19,883	26	4	22	74	252	6	8	8	0	1	1	1	1	6	0
158	Bald Hills - Beaver Creek Rim/ Indian Mountain	1,816	1,365	2,179	111	814	55	23	47,332	192	716	742	721	2,530	16,025	39	1	38	61	266	6	8	12	0	0	0	0	0	4	1
159	Thousand Lakes - Cinder Butte	1,333	987	1,876	227	889	50	28	17,493	71	722	736		3,860	4,846	29	0	28	71	233	4	3	3	0	1	1	1	1	1	1
160	Lassen Volcanic Wilderness - Thousand Lakes	1,934	1,563	3,122	270	1,559	68	28	37,983	154	710	722	707	7,300	7,411	95	48	47	5	217	8	13	15	0	0	0	0	0	1	2
161	Adams Peak - Fort Sage Mountains	1,406	1,298	2,260	129	962	59	35	17,915	73	624	647	633	5,571	6,574	35	0	35	65	262	17	6	1	0	0	0	0	0	10	1
162	Adams Peak - Reconnaissance Peak	1,771	1,485	2,363	135	878	54	30	20,052	81	624	629		5,295	7,198	80	4	76	20	255	10	8	1	0	0	0	0	0	2	0
163	Reconnaissance Peak - Diamond Mountains	1,968	1,640	2,522	157	882	63	22	46,434	188	629	652		5,954	7,571	93	0	93	7	234	13	10	2	0	0	0	0	0	2	0

	Paved Roads				Ecoregions				Watershed		ACEC	Counties		Land Cover								
ID	mjrd_km	mjrd_dens	secrd_km	secrd_dens	n_ecoreg	Ecoregs	n_subsect	Subsect	HU_num	HU_name	pc_blmacec	n_counties	counties	pc_forest	pc_shrub	pc_herb	pc_wetrip	pc_water	pc_dev	pc_crop	pc_pasture	pc_other
140	0	0.0	11	0.3	1	GREAT CENTRAL VALLEY	2	Sodic Claypan Terraces, Delta	2	SUISUN, VALLEY PUTAH-CACHE	0	1	Solano	0	2	48	1	0	3	1	45	0
141	0	0.0	44	0.5	1	CENTRAL COAST	4	Santa Clara Valley, Santa Cruz Mountains, Leeward Hills, Watsonville Plain-Salinas Valley	2	BIG BASIN, PAJARO RIVER	0	2	Santa Clara, Santa Cruz	32	56	5	0	0	6	1	0	0
142	41	0.1	171	0.4	1	CENTRAL COAST	6	Santa Clara Valley, Santa Cruz Mountains, Leeward Hills, Fremont-Livermore Hills and Valleys, Western Diablo Range, Diablo Range	5	BIG BASIN, MIDDLE WEST SIDE, PAJARO RIVER, SANTA CLARA, SOUTH BAY	0	3	Stanislaus, Santa Clara, Santa Cruz	13	34	22	2	1	23	4	1	0
143	0	0.0	0	0.0	1	GREAT CENTRAL VALLEY	2	Manteca-Merced Alluvium, San Joaquin Basin	2	DELTA-MENDOTA CANAL, SAN JOAQUIN VALLEY FLOOR	0	1	Merced	0	0	15	49	0	5	13	16	0
144	19	0.2	4	0.0	2	CENTRAL COAST, GREAT CENTRAL VALLEY	4	Westside Alluvial Fans and Terraces, San Joaquin Basin, Diablo Range, Eastern Hills	2	DELTA-MENDOTA CANAL, MIDDLE WEST SIDE	0	1	Merced	0	2	57	9	1	7	22	3	0
145	62	0.1	47	0.1	1	CENTRAL COAST	3	North Costal Santa Lucia Range, South Costal Santa Lucia Range, Interior Santa Lucia Range	3	ESTERO BAY, SALINAS, SANTA LUCIA	0	2	Monterey, San Luis Obispo	20	58	13	2	1	5	0	0	1
146	25	0.4	30	0.5	1	GREAT CENTRAL VALLEY	3	Hardpan Terraces, Yolo-American Basins, Sodic Claypan Terraces	2	SACRAMENTO DELTA, VALLEY-AMERICAN	0	2	Yolo, Sacramento	0	1	29	15	6	9	35	6	0
147	0	0.0	21	0.3	2	GREAT CENTRAL VALLEY, NORTH COAST	3	Yolo Alluvial Fans, Western Foothills, Dunnigan Hills	4	COLUSA BASIN, PUTAH CREEK, UPPER ELMIRA, VALLEY PUTAH-CACHE	0	2	Yolo, Napa	1	18	44	2	0	8	24	2	0
148	23	0.4	10	0.2	1	GREAT CENTRAL VALLEY	2	Yolo Alluvial Fans, Dunnigan Hills	2	COLUSA BASIN, VALLEY PUTAH-CACHE	0	1	Yolo	0	1	73	0	0	6	19	1	0
149	18	0.3	25	0.4	2	GREAT CENTRAL VALLEY, NORTH COAST	4	North Valley Alluvium, Colusa Basin, Western Foothills, Dunnigan Hills	2	COLUSA BASIN, CORTINA	0	2	Glenn, Colusa	0	2	26	19	1	6	44	1	0
150	11	0.2	4	0.1	1	NORTH COAST	2	Coastal Franciscan, Central Franciscan	1	EEL RIVER	32	1	Mendocino	85	7	0	0	0	4	0	0	3
151	0	0.0	37	0.6	1	NORTH COAST	1	Coastal Franciscan	3	CAPE MENDOCINO, EEL RIVER, MENDOCINO COAST	0	2	Humboldt, Mendocino	88	4	0	0	0	7	0	0	0
152	16	0.1	2	0.0	1	NORTH COAST	6	Western Jurassic, Siskiyou Mountains, Scott Bar Mountain, Lower Salmon Mountains, Upper Salmon Mountains, Windy Peak	2	KLAMATH RIVER, ROGUE RIVER	0	1	Siskiyou	86	5	1	1	0	6	0	0	2
153	18	0.3	8	0.1	2	MODOC PLATEAU, NORTH COAST	2	Scott Bar Mountain, Old Cascades	1	KLAMATH RIVER	0	1	Siskiyou	64	23	1	3	0	5	0	3	1
154	5	0.0	45	0.2	1	MODOC PLATEAU	3	Old Cascades, High Cascade, Medicine Lake Lava Flows	1	KLAMATH RIVER	0	1	Siskiyou	58	27	3	5	1	1	2	1	1
155	30	0.1	37	0.1	1	MODOC PLATEAU	4	Medicine Lake Lava Flows, Lower Klamath-Tule Lake Basins, Devil's Garden, Mowitz Buttes	2	KLAMATH RIVER, PIT RIVER	0	2	Siskiyou, Modoc	24	72	0	1	0	1	1	1	0
156	14	0.1	1	0.0	1	MODOC PLATEAU	3	Medicine Lake Lava Flows, Devil's Garden, Mowitz Buttes	2	KLAMATH RIVER, PIT RIVER	0	1	Modoc	74	24	1	1	0	0	0	0	0
157	0	0.0	23	0.2	1	MODOC PLATEAU	4	Medicine Lake Lava Flows, Hat Creek Rim, Mowitz Buttes, Bald Mountain-Dixie Valley	1	PIT RIVER	0	4	Siskiyou, Modoc, Shasta	60	17	0	6	0	1	8	5	3
158	4	0.0	0	0.0	1	MODOC PLATEAU	3	Blacks Mountain-Susanville Peak, Bald Mountain-Dixie Valley, Eagle Lake-Observation Peak	3	MADELINE PLAINS, PIT RIVER, SUSANVILLE	1	1	Lassen	85	8	0	5	1	0	0	0	0
159	11	0.2	0	0.0	1	MODOC PLATEAU	2	Hat Creek Rim, Lassen-Almanor	1	PIT RIVER	0	1	Shasta	75	9	0	5	0	2	6	1	3
160	38	0.3	7	0.1	1	MODOC PLATEAU	2	Hat Creek Rim, Lassen-Almanor	3	FEATHER RIVER, PIT RIVER, WHITMORE	0	2	Shasta, Plumas	80	4	0	4	0	2	0	0	10
161	10	0.1	9	0.1	2	SIERRA NEVADA, MODOC PLATEAU	4	Diamond Mountains-Crystal Peak, Frenchman, Fort Sage Mountains-Lemmon Valley, Honey Lake Basin	2	FEATHER RIVER, SUSANVILLE	0	2	Lassen, Plumas	24	60	0	7	0	2	2	4	0
162	0	0.0	0	0.0	2	SIERRA NEVADA, MODOC PLATEAU	4	Diamond Mountains-Crystal Peak, Frenchman, Sierra Valley, Fort Sage Mountains-Lemmon Valley	2	FEATHER RIVER, SUSANVILLE	0	2	Lassen, Plumas	74	21	0	3	0	1	0	0	0
163	0	0.0	0	0.0	1	SIERRA NEVADA	2	Diamond Mountains-Crystal Peak, Frenchman	2	FEATHER RIVER, SUSANVILLE	0	2	Lassen, Plumas	91	4	0	4	0	0	0	0	1

Characteristics of Essential Connectivity Areas

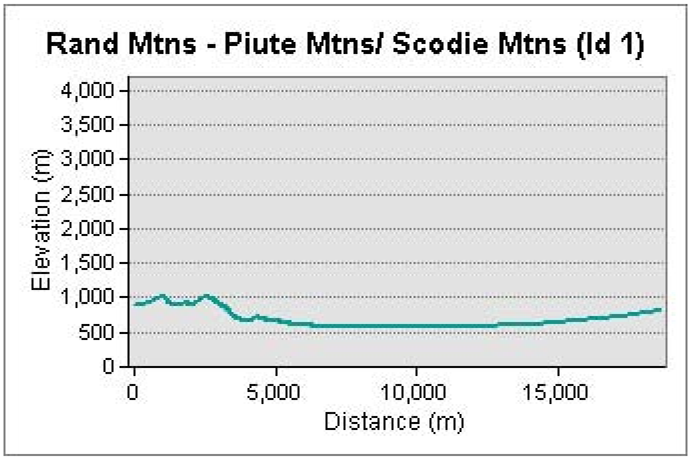
Identifier		Landform					ECI		Area		Essential Connectivity Area					Protection Status				Species Diversity					Listed Species					
ID	ECA_Name	elev_mean	elev_min	elev_max	elev_std	elev_range	mn_integ	std_integ	AREA_ac	AREA_km	pointA	pointB	NLB_ln	min_length	lcp_length	pc_protect	pc_gap12e	pc_gap3	pc_privunprp	mn_sprich	std_sprich	CNDDB_plant_count	CNDDB_animal_count	pc_hotspt	pc_crithab	crithab_sp_count	pc_esshab	esshab_sp_count	pc_wtvp	mjrd_cross
164	Mt Killmore - Grizzly Mountain	1,658	1,131	2,348	280	1,217	57	26	79,243	321	637	654	617, 631	3,890	14,218	63	5	58	37	223	11	12	11	0	0	0	0	0	1	1
165	Sawtooth Ridge - Lafayette Ridge/ Black Buttes	1,920	803	2,435	177	1,632	53	27	23,730	96	572	595		1,217	3,123	49	3	46	51	182	12	6	7	0	0	0	0	0	1	1
166	Middle Fork Cosumnes River - Big Mountain Ridge	734	371	1,127	144	756	46	26	21,912	89	511	512	493	1,640	7,946	5	0	5	95	249	23	2	1	0	0	0	100	1	2	0
167	Quartz Mountain - Logtown Ridge	395	125	573	70	448	43	33	8,619	35	485	516	487, 492, 511	942	4,926	1	0	0	99	253	6	0	2	0	0	0	91	1	1	1
168	Bear Mountains - Duck Creek	137	39	626	87	587	53	28	48,963	198	435	442	420, 425, 427	8,736	10,596	4	3	2	96	239	12	3	7	0	8	1	0	1	5	0
169	Calaveras Big Trees - Pine Ridge	1,211	700	1,594	131	894	33	35	18,170	74	437	454		2,944	3,648	32	4	29	68	228	3	1	1	0	0	0	41	1	0	1
170	Coyote Ridge - Owens Mountain	197	128	478	62	350	59	32	30,234	122	308	313		2,302	3,357	0	0	0	100	252	9	3	8	0	29	1	40	1	26	1
171	Coyote Ridge - Sierra Nevada	1,062	128	2,862	649	2,734	77	29	330,688	1,338	308	375	293, 303, 309	10,375	14,583	54	23	31	46	241	26	35	32	0	0	1	0	1	0	2
172	Tennessee Ridge - Frazier Valley/ Rocky Hill	237	152	498	66	346	45	40	12,603	51	252	261	270	2,933	6,261	27	1	26	73	255	6	5	4	0	17	2	0	0	1	0
173	Bluestone Ridge - Sand Ridge	136	59	824	58	765	51	44	58,942	239	250	251	248	19,576	21,473	1	0	1	99	200	8	6	12	0	0	0	0	0	2	2
174	Sulphur Mountain - Pine Mountain/Sespe Condor	528	272	1,136	255	864	31	23	18,465	75	141	160		3,311	10,320	1	0	1	99	262	6	2	8	0	15	4	0	2	0	0
175	Chocolate Mountains South - Chocolate Mountains	207	54	732	91	678	87	27	207,212	839	18	50	15, 26	1,887	2,073	93	1	92	7	200	37	12	32	2	27	2	1	1	0	1
176	San Jacinto Mountains - San Bernardino Mountains	810	133	2,759	675	2,626	43	32	24,512	99	74	101	86	1,204	1,840	31	3	27	69	274	20	36	38	71	8	5	7	3	0	3
177	Vail Lake - Lake Skinner	549	384	835	84	451	23	23	9,170	37	58	64		4,130	4,532	2	0	2	98	266	2	9	14	100	40	2	1	3	0	0
178	Vail Lake - Cahuilla Moutain/Rouse Ridge	806	410	1,659	226	1,249	47	29	19,950	81	58	66		100	8,866	10	1	10	90	262	8	10	26	91	54	4	2	4	1	0
179	Yuha Basin - Anza-Borrego Desert	420	-8	1,414	333	1,422	87	29	190,851	772	9	34	4, 8, 31	3,904	6,573	91	63	28	9	207	22	28	19	0	63	2	0	0	0	1
180	McKittrick Valley - Pixley National Wildlife Refuge	95	67	251	29	184	14	29	25,736	104	217	238	246	16,002	18,944	4	4	0	96	196	4	8	15	0	0	0	17	1	2	3

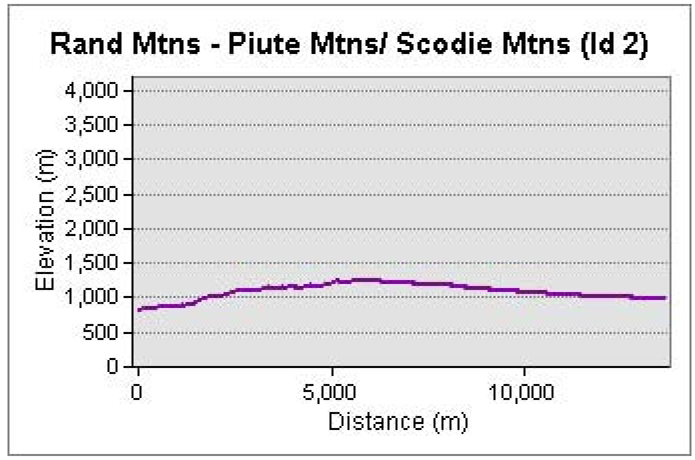
	Paved Roads				Ecoregions				Watershed		ACEC	Counties		Land Cover								
ID	mjrd_km	mjrd_dens	secrd_km	secrd_dens	n_ecoreg	Ecoregs	n_subsect	Subsect	HU_num	HU_name	pc_blmacec	n_counties	counties	pc_forest	pc_shrub	pc_herb	pc_wetrip	pc_water	pc_dev	pc_crop	pc_pasture	pc_other
164	22	0.1	26	0.1	1	SIERRA NEVADA	6	Fredonyer Butte-Grizzly Peak, Frenchman, Greenville-Graeagle, Granitic and Metamorphic Foothills, Upper Foothills Metamorphic Belt, Upper Batholith and Volcanic Flows	2	FEATHER RIVER, YUBA RIVER	0	2	Plumas, Sierra	91	2	0	5	0	1	0	0	0
165	26	0.3	3	0.0	1	SIERRA NEVADA	2	Upper Foothills Metamorphic Belt, Upper Batholith and Volcanic Flows	2	AMERICAN RIVER, YUBA RIVER	0	2	Nevada, Placer	84	5	0	6	2	3	0	0	0
166	0	0.0	44	0.5	1	SIERRA NEVADA	2	Upper Foothills Metamorphic Belt, Lower Foothills Metamorphic Belt	1	MIDDLE SIERRA	0	2	El Dorado, Amador	36	53	0	7	0	3	1	0	0
167	8	0.2	14	0.4	1	SIERRA NEVADA	1	Lower Foothills Metamorphic Belt	1	MIDDLE SIERRA	0	2	El Dorado, Amador	1	80	0	6	0	5	2	5	0
168	0	0.0	67	0.3	2	SIERRA NEVADA, GREAT CENTRAL VALLEY	3	Hardpan Terraces, Camanche Terraces, Lower Foothills Metamorphic Belt	3	GOPHER RIDGE, NORTH VALLEY FLOOR, UPPER CALAVERAS	0	3	Calaveras, San Joaquin, Stanislaus	0	18	66	5	1	6	3	1	0
169	13	0.2	9	0.1	1	SIERRA NEVADA	2	Upper Foothills Metamorphic Belt, Batholith and Volcanic Flows	3	MIDDLE SIERRA, STANISLAUS RIVER, UPPER CALAVERAS	0	2	Calaveras, Tuolumne	77	3	0	5	0	10	0	0	3
170	1	0.0	28	0.2	2	SIERRA NEVADA, GREAT CENTRAL VALLEY	2	Hardpan Terraces, Lower Granitic Foothills	3	KINGS RIVER, SAN JOAQUIN RIVER, SOUTH VALLEY FLOOR	0	1	Fresno	0	25	62	4	1	3	2	2	0
171	102	0.1	59	0.0	2	SIERRA NEVADA, GREAT CENTRAL VALLEY	5	Hardpan Terraces, Granitic Alluvial Fans and Terraces, Lower Batholith, Upper Batholith, Lower Granitic Foothills	3	KAWEAH RIVER, KINGS RIVER, SOUTH VALLEY FLOOR	0	2	Fresno, Tulare	43	35	12	5	2	1	1	0	1
172	0	0.0	13	0.3	2	SIERRA NEVADA, GREAT CENTRAL VALLEY	3	Hardpan Terraces, Granitic Alluvial Fans and Terraces, Lower Granitic Foothills	2	SOUTH VALLEY FLOOR, SOUTHERN SIERRA	0	1	Tulare	0	17	62	8	2	5	6	0	0
173	25	0.1	33	0.1	2	CENTRAL COAST, GREAT CENTRAL VALLEY	5	Tulare Basin, Antelope Plain, South Valley Alluvium and Basins, Eastern Hills, Kettleman Hills and Valleys	3	SOUTH VALLEY FLOOR, SUNFLOWER VALLEY, TEMBLOR	0	2	Kings, Kern	0	1	50	0	0	8	32	8	1
174	0	0.0	9	0.1	1	SOUTH COAST	3	Santa Ynez-Sulphur Mountains, San Rafael-Topatopa Mountains, Northern Transverse Ranges	2	SANTA CLARA - CALLEGUAS, VENTURA RIVER	0	1	Ventura	7	79	6	0	0	6	0	0	0
175	56	0.1	15	0.0	1	SONORAN DESERT	5	Chuckwalla Valley, Palo Verde Valley and Mesa, Chocolate Mountains and Valleys, East Mesa-Sand Hills, Gila Bend Plain Desert Shrubland	5	AMOS-OGILBY, CHUCKWALLA, COLORADO, IMPERIAL, YUMA	9	2	Riverside, Imperial	0	32	0	45	0	1	0	0	22
176	49	0.5	7	0.1	3	SONORAN DESERT, SOUTH COAST, MOJAVE DESERT	8	San Gorgonio Mountains, Upper San Gorgonio Mountains, Little San Bernardino-Bighorn Mountains, Fontana Plain-Calimesa Terraces, San Jacinto Foothills-Cahuilla Mountains, San Jacinto Mountains, Desert Slopes NA No Description, Coachella Valley	4	EMERSON, SAN JACINTO VALLEY, SANTA ANA RIVER, WHITEWATER	1	2	San Bernardino, Riverside	17	30	31	1	0	11	0	0	11
177	0	0.0	19	0.5	1	SOUTH COAST	2	Perris Valley and Hills, San Jacinto Foothills-Cahuilla Mountains	1	SANTA MARGARITA	0	1	Riverside	1	52	25	2	0	15	2	3	1
178	0	0.0	10	0.1	1	SOUTH COAST	3	Perris Valley and Hills, San Jacinto Foothills-Cahuilla Mountains, San Jacinto Mountains	2	SAN JACINTO VALLEY, SANTA MARGARITA	0	1	Riverside	12	45	29	1	1	6	0	1	5
179	97	0.1	86	0.1	2	SONORAN DESERT, SOUTH COAST	4	Palomar-Cuyamaca Peak, Desert Slopes NA No Description, Borrego Valley-West Mesa, Imperial Valley	3	ANZA BORREGO, DAVIES, IMPERIAL	15	2	Imperial, San Diego	2	56	6	5	0	3	0	0	28
180	31	0.3	21	0.2	1	SOUTH COAST	3	Antelope Plain, South Valley Alluvium and Basins, Elk Hills and South Valley Terraces	1	SOUTH VALLEY FLOOR	3	1	Kern	0	4	5	0	0	10	65	14	2

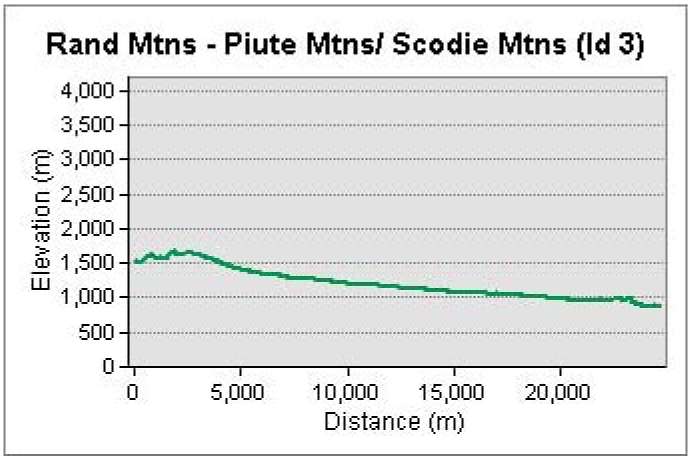
Characteristics of Essential Connectivity Areas

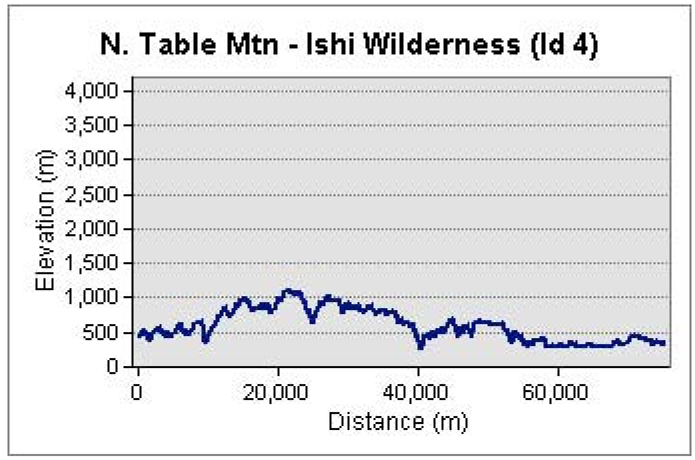
Identifier		Landform					ECI		Area		Essential Connectivity Area					Protection Status				Species Diversity					Listed Species					
ID	ECA_Name	elev_mean	elev_min	elev_max	elev_std	elev_range	mn_integ	std_integ	AREA_ac	AREA_km	pointA	pointB	NLB_In	min_length	lcp_length	pc_protect	pc_gap12e	pc_gap3	pc_privunprp	mn_sprich	std_sprich	CNDDB_plant_count	CNDDB_animal_count	pc_hotspt	pc_crithab	crithab_sp_count	pc_esshab	esshab_sp_count	pc_wtvp	mjrd_cross
181	Pine Mountain/Sespe Condor - Lucas Creek	1,101	123	2,689	544	2,566	78	30	580,266	2,348	160	209	164,173,178,179,184,189,191, 193, 194, 196	65,640	92,664	60	52	9	40	246	13	35	44	11	18	5	0	4	0	3
182	Lassen Volcanic Wilderness - Beaver Creek Rim/ Indian Mountain	1,754	1,270	2,472	171	1,202	52	25	156,814	635	710	742	708, 718	30,454	37,722	73	7	66	27	243	13	16	20	0	7	1	7	1	4	2
183	Poso Creek - Sequoia National Forest/ Greenhorn Mountains	510	177	1,315	243	1,138	72	33	47,337	192	215	220	212, 218, 222	5,967	6,504	3	0	3	97	230	18	12	8	13	5	1	0	0	1	0
184	Colusa Basin - Butte Sink	16	12	36	2	24	17	32	18,147	73	601	608	610	11,595	13,699	21	16	6	79	227	5	4	12	23	0	0	0	0	19	1
185	Sugarloaf Mountain/Keller Peak - San Gabriel/Cucamonga	1,295	281	2,860	526	2,579	51	42	289,348	1,171	93	120	94, 95, 97, 98, 99, 102, 103, 119, 132	23,406	34,224	72	26	46	28	270	14	72	53	12	6	9	14	5	0	5
186	Mt Allison - Briones Hills	239	14	805	108	791	9	23	162,438	657	392	446	396, 407, 408, 424, 430, 431, 449, 456	43,525	55,067	38	38	0	62	263	8	27	29	34	42	4	45	1	0	4
187	Rockefeller Redwood Forest - Dairy Ridge/ Pilot Ridge/ South Fork	543	20	1,442	300	1,422	66	29	140,664	569	740	783	755, 762	15,521	18,805	6	5	0	94	238	5	14	19	0	6	2	0	0	0	1
188	La Panza Range - San Geronimo	357	0	1,448	178	1,448	56	37	286,231	1,158	229	242	211, 221, 226, 233, 247, 314	30,438	33,377	18	5	13	82	263	24	58	48	6	2	6	56	4	1	2
189	Elk Hills - Carrizo Plain/ Temblor Range	380	79	1,089	137	1,010	53	37	56,760	230	210	211	217	3,547	4,553	42	12	30	58	205	12	13	18	7	0	0	100	1	0	1
190	San Gabriel Mountains West - San Francisquito	759	419	1,655	189	1,236	43	42	98,705	399	131	147	129, 140, 145	17,951	19,444	58	1	56	42	235	4	12	17	0	3	2	3	4	0	1
191	Sulphur Mountain - Sierra Madre Mountains	561	86	2,190	392	2,104	26	30	70,944	287	141	199	155	5,951	38,577	25	4	22	75	259	12	24	19	0	11	4	72	2	2	1
192	Mt Eddy - Mt Shasta	1,457	1,067	2,470	298	1,403	45	29	29,329	119	799	808		11,763	13,912	50	0	50	50	250	17	18	7	0	13	1	0	0	4	1

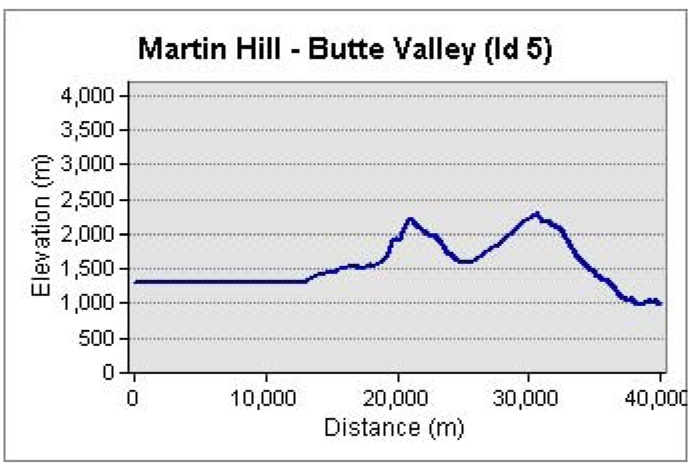
	Paved Roads				Ecoregions				Watershed		ACEC	Counties		Land Cover								
ID	mjrd_km	mjrd_dens	secrd_km	secrd_dens	n_ecoreg	Ecoregs	n_subsect	Subsect	HU_num	HU_name	pc_blmacec	n_counties	counties	pc_forest	pc_shrub	pc_herb	pc_wetrip	pc_water	pc_dev	pc_crop	pc_pasture	pc_other
181	84	0.0	244	0.1	4	SOUTH COAST, MOJAVE DESERT, SIERRA NEVADA, GREAT CENTRAL VALLEY	11	Hardpan Terraces, South Valley Alluvium and Basins, Elk Hills and South Valley Terraces, Tehachapi-Piute Mountains, Southern Granitic Foothills, San Emigdio Mountains, San Rafael-Topatopa Mountains, Northern Transverse Ranges	8	ANTELOPE, GRAPEVINE, KERN RIVER, SANTA CLARA - CALLEGUAS, SANTA MARIA, SOUTH VALLEY FLOOR, SOUTHERN SIERRA, VENTURA RIVER	0	3	Kern, Ventura, Los Angeles	35	28	31	1	0	3	2	0	0
182	28	0.0	19	0.0	1	MODOC PLATEAU	4	Blacks Mountain-Susanville Peak, Hat Creek Rim, Lassen-Almanor, Bald Mountain-Dixie Valley	3	FEATHER RIVER, PIT RIVER, SUSANVILLE	0	3	Shasta, Lassen, Plumas	84	8	0	3	0	1	0	0	3
183	0	0.0	49	0.3	2	SIERRA NEVADA, GREAT CENTRAL VALLEY	2	Hardpan Terraces, Southern Granitic Foothills	3	KERN RIVER, SOUTH VALLEY FLOOR, SOUTHERN SIERRA	0	1	Kern	1	38	55	1	0	5	0	0	0
184	2	0.0	30	0.4	1	GREAT CENTRAL VALLEY	3	Butte Sink-Sutter Basin, Colusa Basin, River Alluvium	1	COLUSA BASIN	0	3	Butte, Colusa, Sutter	0	1	11	13	2	6	66	1	0
185	94	0.1	466	0.4	2	SOUTH COAST, MOJAVE DESERT	7	Los Angeles Plain, San Gabriel Mountains, Upper San Gabriel Mountains, San Gorgonio Mountains, Upper San Gorgonio Mountains, Fontana Plain-Calimesa Terraces, High Desert Plains and Hills	5	ANTELOPE, LOS ANGELES RIVER, MOJAVE, SAN GABRIEL RIVER, SANTA ANA RIVER	0	2	San Bernardino, Los Angeles	41	35	6	1	0	13	0	0	2
186	106	0.2	315	0.5	2	CENTRAL COAST, GREAT CENTRAL VALLEY	5	Suisun Hills and Valleys, Bay Flats, East Bay Hills-Mt. Diablo, Fremont-Livermore Hills and Valleys, Western Diablo Range	5	BAY BRIDGES, SAN PABLO, SANTA CLARA, SOUTH BAY, SUISUN	0	3	Contra Costa, Alameda, Santa Clara	5	38	28	1	2	25	0	0	0
187	32	0.1	100	0.2	1	NORTH COAST	2	Central Franciscan, Coastal Franciscan	4	CAPE MENDOCINO, EEL RIVER, MAD RIVER, TRINITY RIVER	1	1	Humboldt	79	6	2	0	0	2	0	0	10
188	108	0.1	169	0.2	2	CENTRAL COAST, GREAT CENTRAL VALLEY	5	South Costal Santa Lucia Range, Interior Santa Lucia Range, Paso Robles Hills and Valleys, Carrizo Plain, Caliente Range-Cuyama Valley	5	CARRIZO PLAIN, ESTERO BAY, ESTRELLA RIVER, SALINAS, SANTA MARIA	1	2	San Luis Obispo, Santa Barbara	10	57	22	2	0	7	1	1	0
189	24	0.1	45	0.2	1	GREAT CENTRAL VALLEY	5	Antelope Plain, South Valley Alluvium and Basins, Elk Hills and South Valley Terraces, Carrizo Plain, Temblor Range	4	CARRIZO PLAIN, FELLOWS, SOUTH VALLEY FLOOR, TEMBLOR	12	2	Kern, San Luis Obispo	1	49	30	0	0	16	0	0	4
190	35	0.1	142	0.4	1	SOUTH COAST	3	Northern Transverse Ranges, Sierra Pelona-Mint Canyon, San Gabriel Mountains	2	LOS ANGELES RIVER, SANTA CLARA - CALLEGUAS	0	1	Los Angeles	14	61	11	1	0	12	0	0	1
191	86	0.3	90	0.3	2	SOUTH COAST, CENTRAL COAST	5	Santa Ynez-Sulphur Mountains, Interior Santa Lucia Range, Caliente Range-Cuyama Valley, San Rafael-Topatopa Mountains, Northern Transverse Ranges	6	BUENAVENTURA, SANTA CLARA - CALLEGUAS, SANTA MARIA, SANTA YNEZ, SOUTH COAST, VENTURA RIVER	0	2	Santa Barbara, Ventura	10	57	7	3	0	17	4	1	0
192	16	0.1	22	0.2	2	MODOC PLATEAU, NORTH COAST	3	Eastern Klamath Mountains, Upper Scott Mountains, High Cascade	4	KLAMATH RIVER, MC CLOUD RIVER, TRINITY RIVER, UPPER SACRAMENTO	0	2	Siskiyou, Trinity	81	5	0	2	0	7	0	0	4

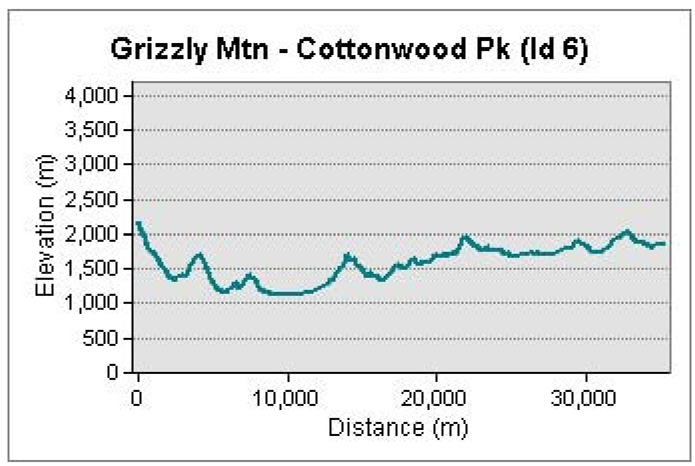

Rand Mtns - Piute Mtns/ Scodie Mtns (Id 1)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
5,000
10,000
15,000
Distance (m)

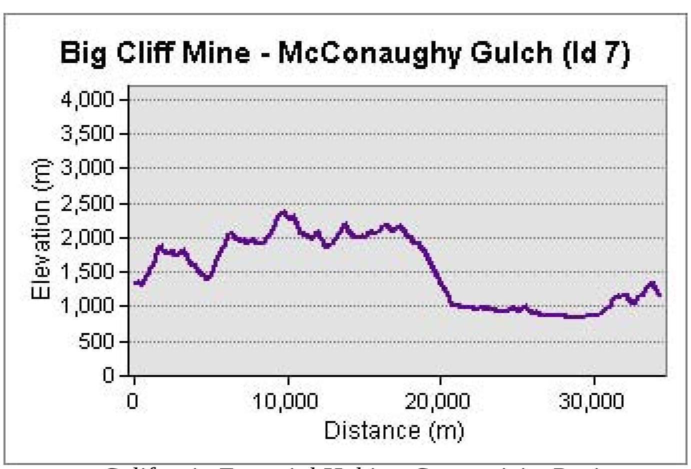

Rand Mtns - Piute Mtns/ Scodie Mtns (Id 2)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
5,000
10,000
Distance (m)

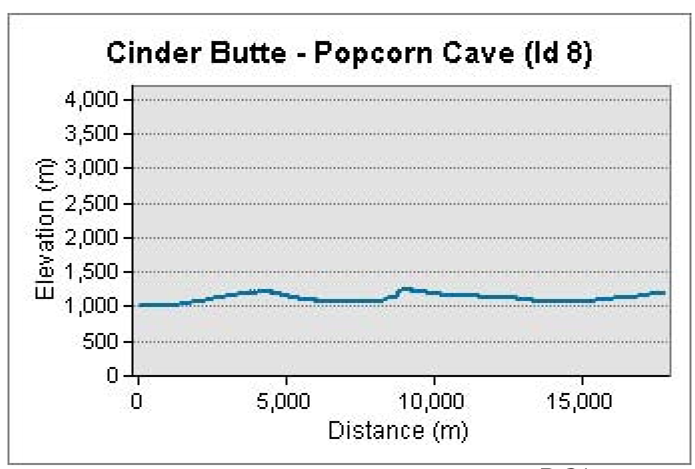

Rand Mtns - Piute Mtns/ Scodie Mtns (Id 3)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
5,000
10,000
15,000
20,000
Distance (m)

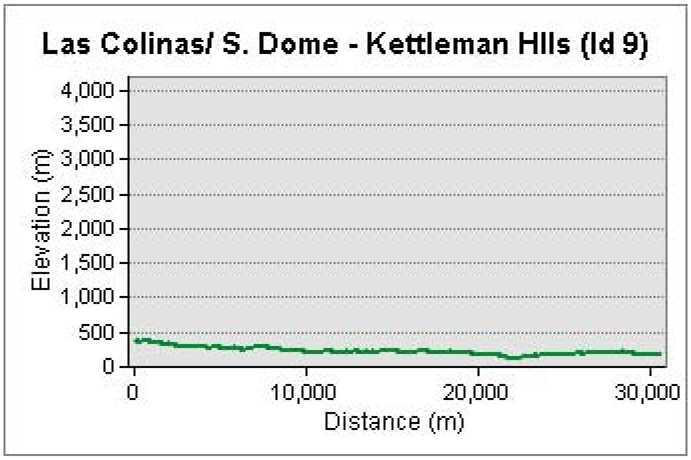

N. Table Mtn - Ishi Wilderness (Id 4)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
20,000
40,000
60,000
Distance (m)

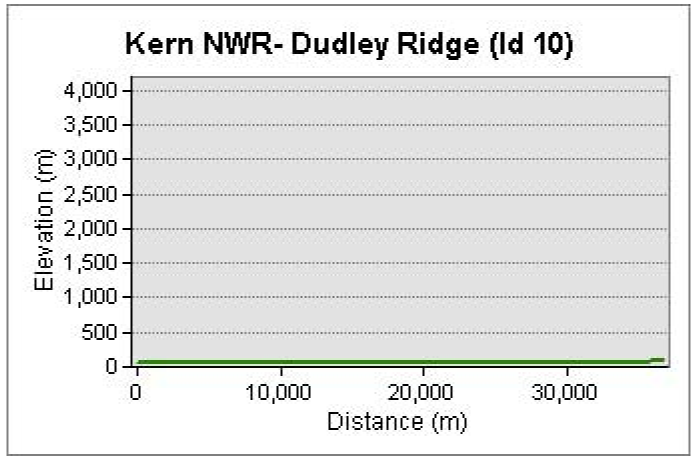

Martin Hill - Butte Valley (Id 5)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
30,000
40,000
Distance (m)

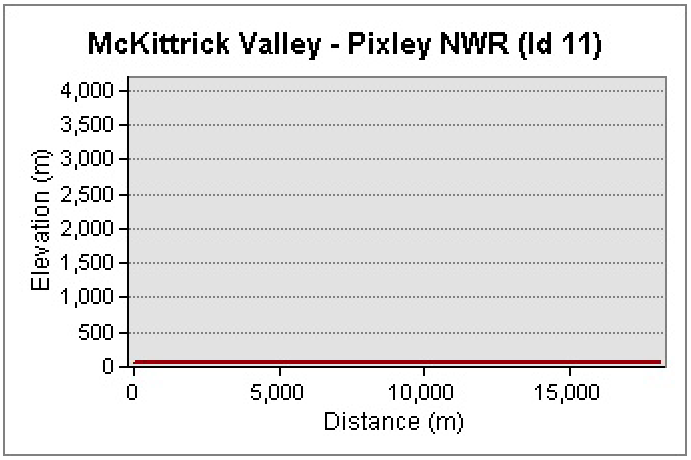

Grizzly Mtn - Cottonwood Pk (Id 6)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
30,000
Distance (m)

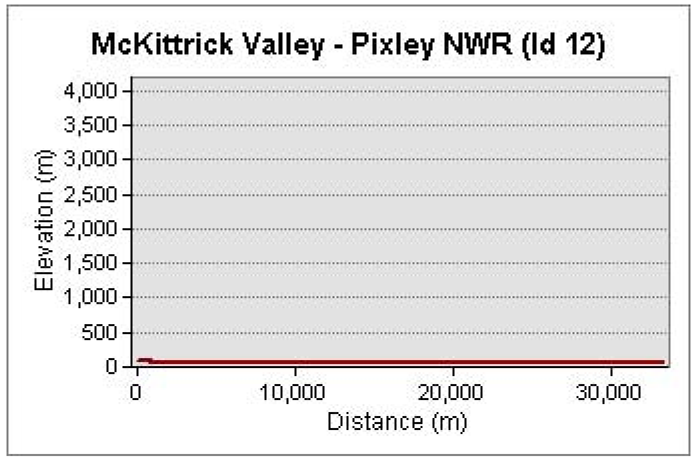

Big Cliff Mine - McConaughy Gulch (Id 7)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
30,000
Distance (m)

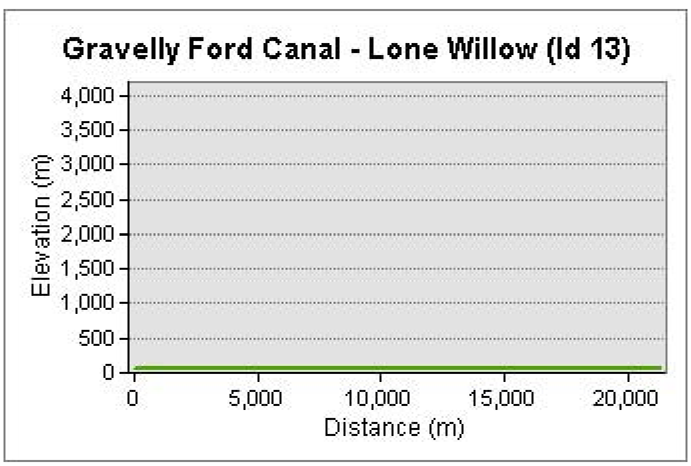

Cinder Butte - Popcorn Cave (Id 8)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
5,000
10,000
15,000
Distance (m)

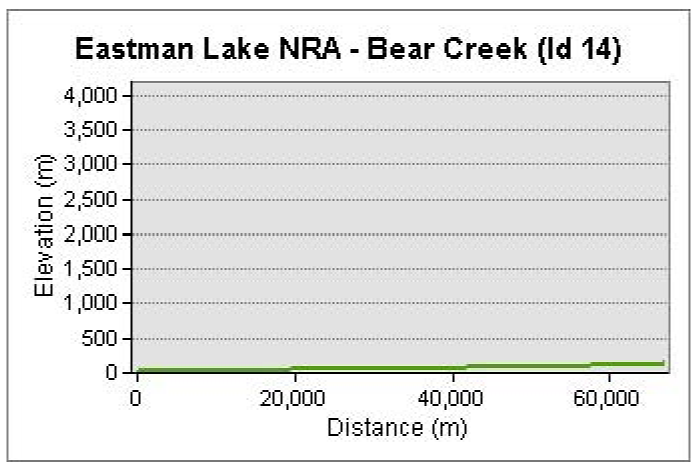

Las Colinas/ S. Dome - Kettleman Hlls (Id 9)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
30,000
Distance (m)

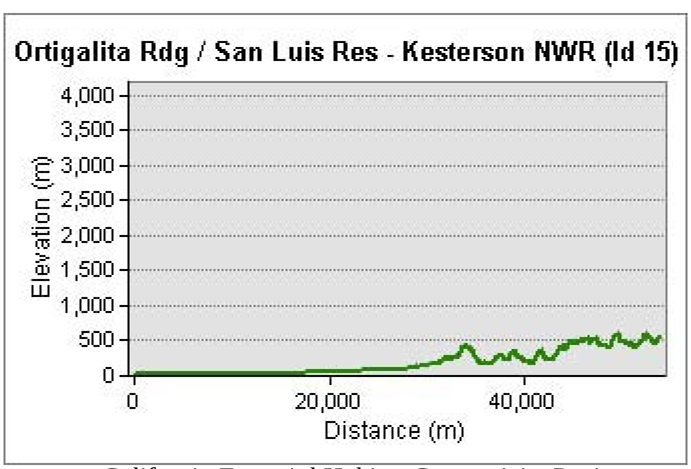

Kern NWR- Dudley Ridge (Id 10)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
30,000
Distance (m)

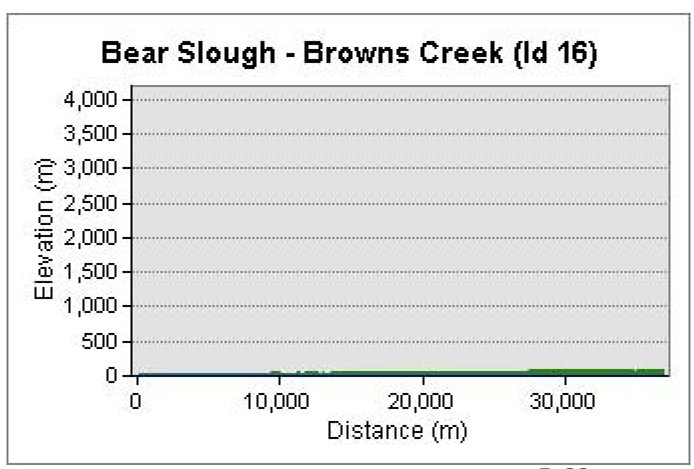

McKittrick Valley - Pixley NWR (Id 11)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
5,000
10,000
15,000
Distance (m)

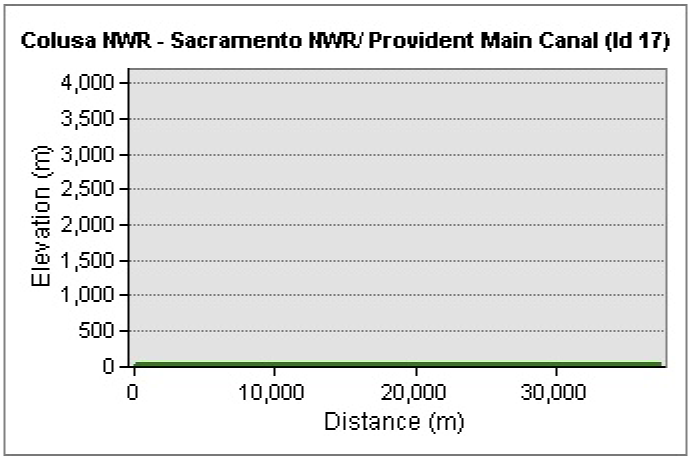

McKittrick Valley - Pixley NWR (Id 12)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
30,000
Distance (m)

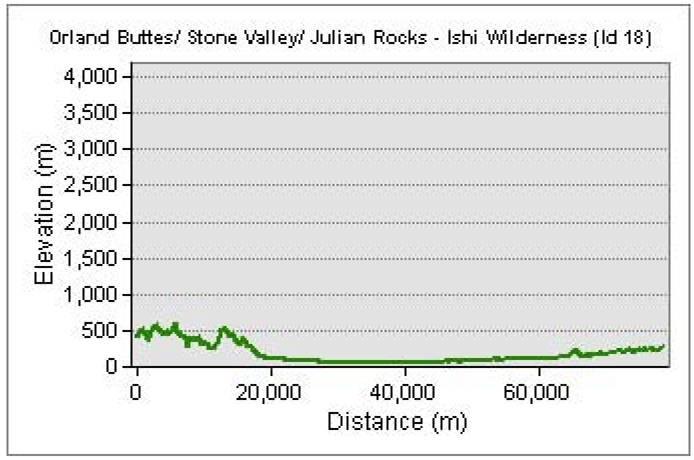

Gravelly Ford Canal - Lone Willow (Id 13)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
5,000
10,000
15,000
20,000
Distance (m)

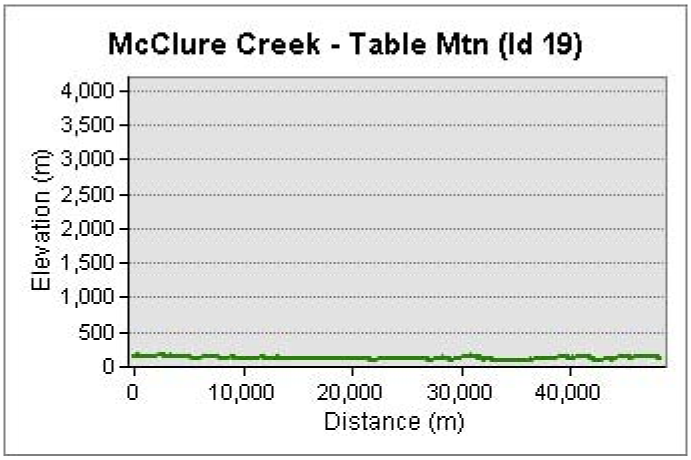

Eastman Lake NRA - Bear Creek (Id 14)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
20,000
40,000
60,000
Distance (m)

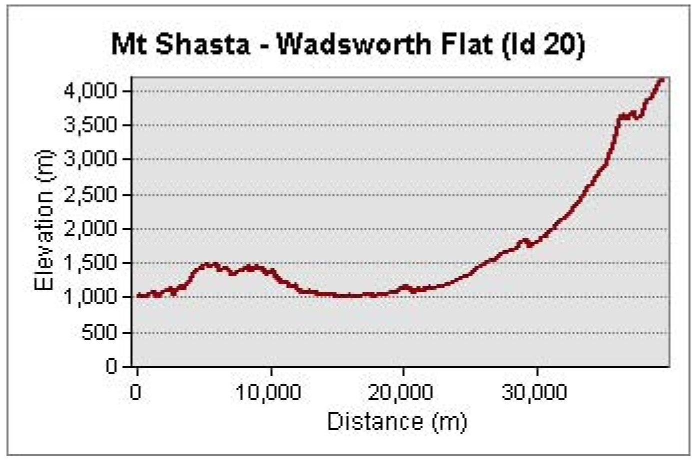

Ortigalita Rdg / San Luis Res - Kesterson NWR (Id 15)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
20,000
40,000
Distance (m)

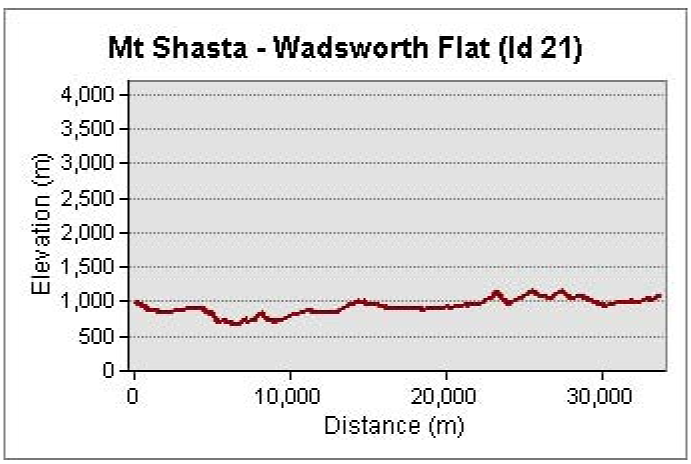

Bear Slough - Browns Creek (Id 16)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
30,000
Distance (m)

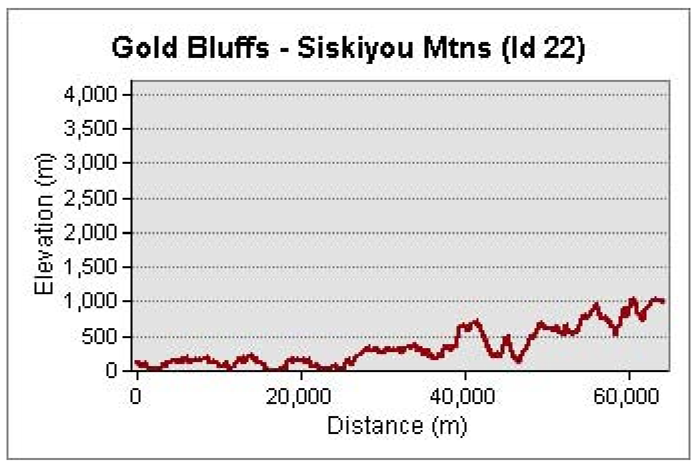

Colusa NWR - Sacramento NWR/ Provident Main Canal (Id 17)
Elevation (m)
Distance (m)

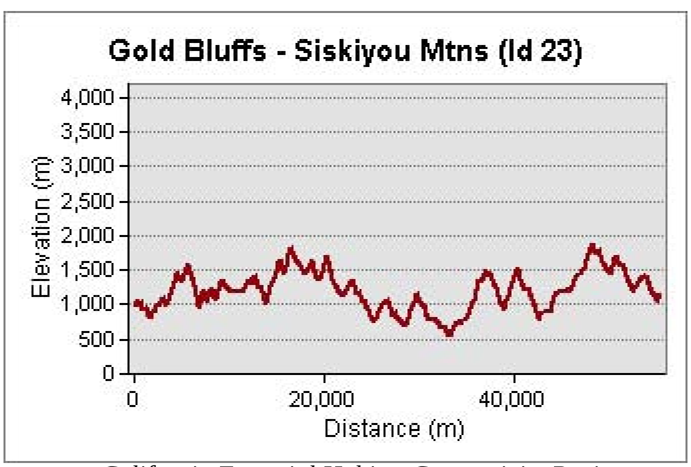

Orland Buttes/ Stone Valley/ Julian Rocks - Ishi Wilderness (Id 18)
Elevation (m)
Distance (m)

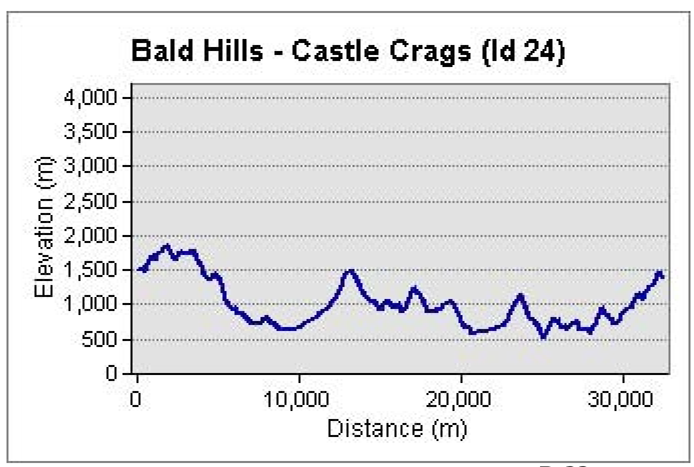

McClure Creek - Table Mtn (Id 19)
Elevation (m)
Distance (m)

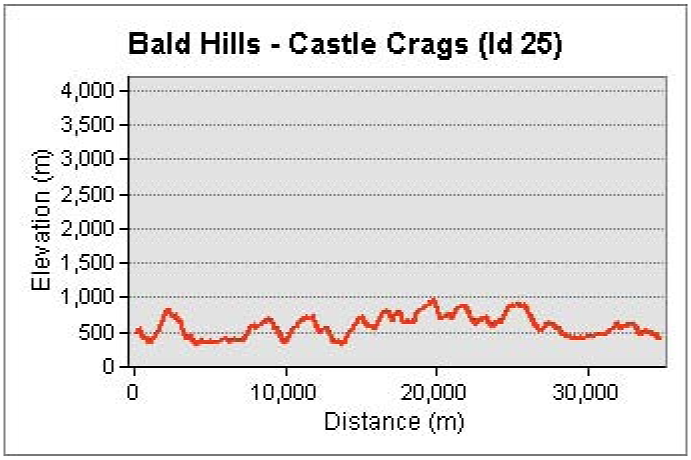

Mt Shasta - Wadsworth Flat (Id 20)
Elevation (m)
Distance (m)

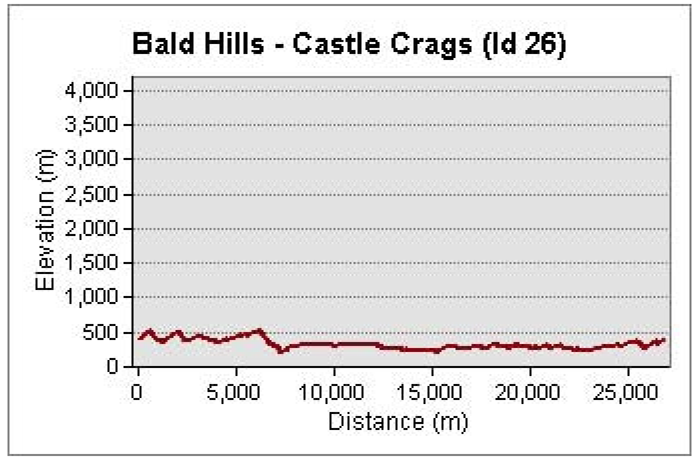

Mt Shasta - Wadsworth Flat (Id 21)
Elevation (m)
Distance (m)

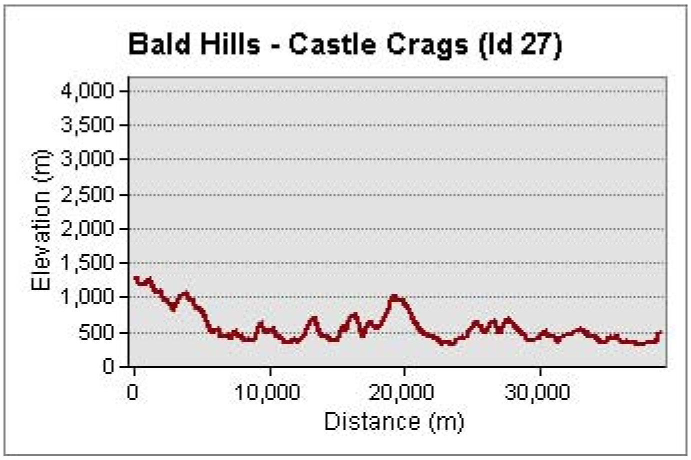

Gold Bluffs - Siskiyou Mtns (Id 22)
Elevation (m)
Distance (m)

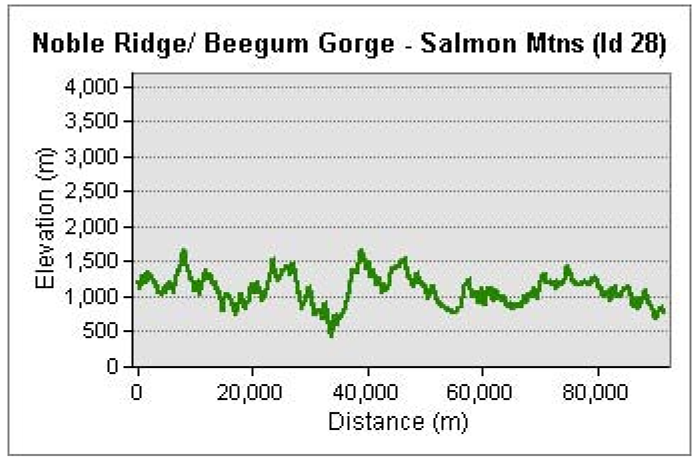

Gold Bluffs - Siskiyou Mtns (Id 23)
Elevation (m)
Distance (m)

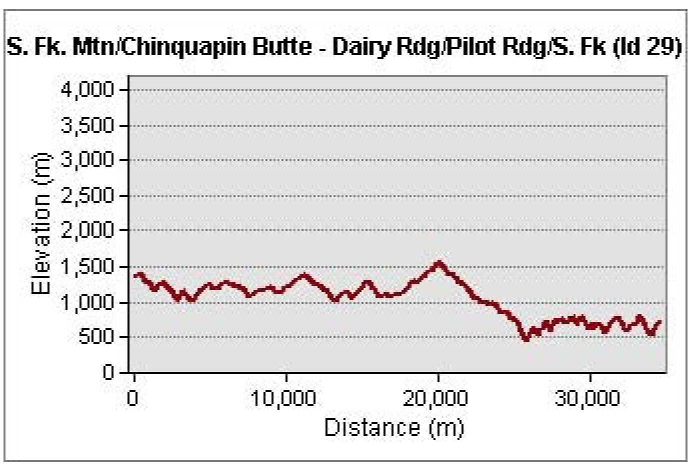

Bald Hills - Castle Crags (Id 24)
Elevation (m)
Distance (m)

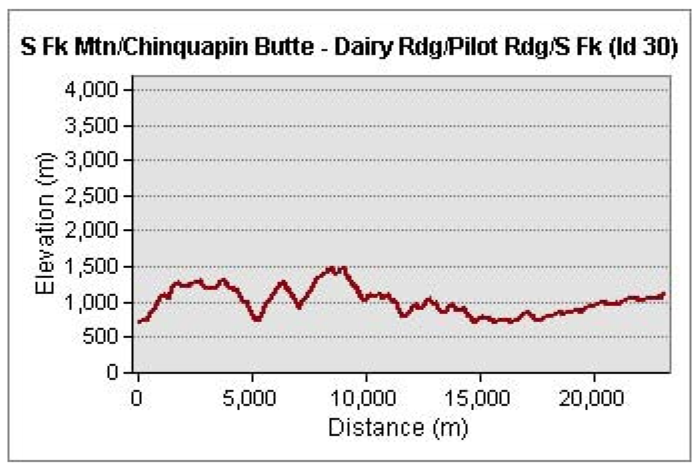

Bald Hills - Castle Crags (Id 25)
Elevation (m)
4,000 3,500 3,000 2,500 2,000 1,500 1,000 500 0
0 10,000 20,000 30,000
Distance (m)

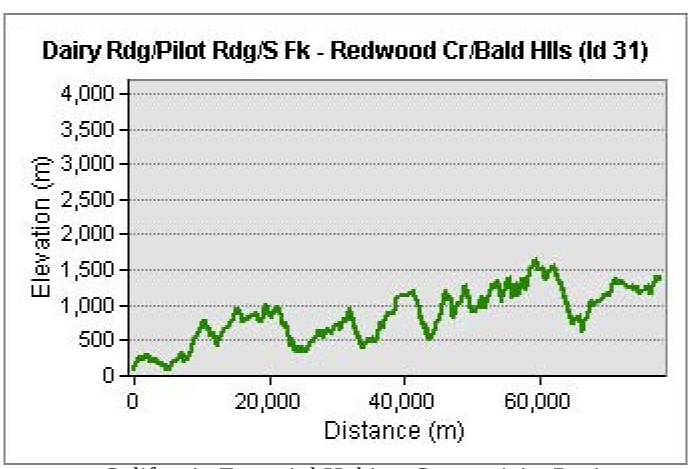

Bald Hills - Castle Crags (Id 26)
Elevation (m)
4,000 3,500 3,000 2,500 2,000 1,500 1,000 500 0
0 5,000 10,000 15,000 20,000 25,000
Distance (m)

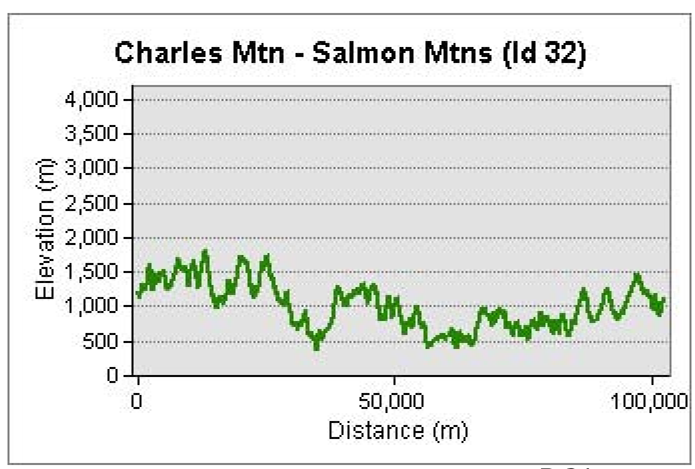

Bald Hills - Castle Crags (Id 27)
Elevation (m)
4,000 3,500 3,000 2,500 2,000 1,500 1,000 500 0
0 10,000 20,000 30,000
Distance (m)

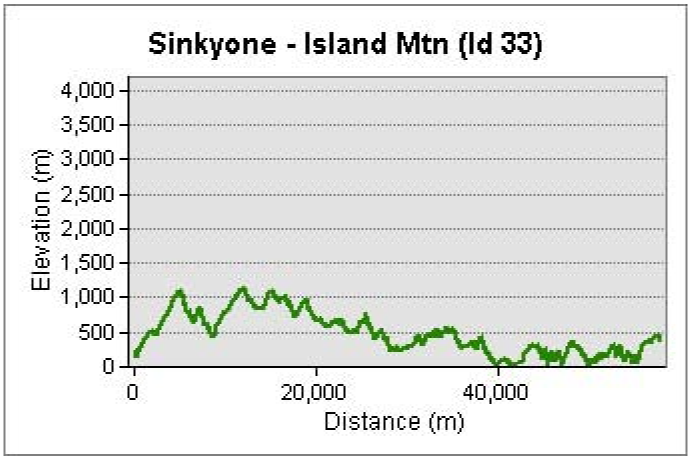

Noble Ridge/ Beegum Gorge - Salmon Mtns (Id 28)
Elevation (m)
4,000 3,500 3,000 2,500 2,000 1,500 1,000 500 0
0 20,000 40,000 60,000 80,000
Distance (m)

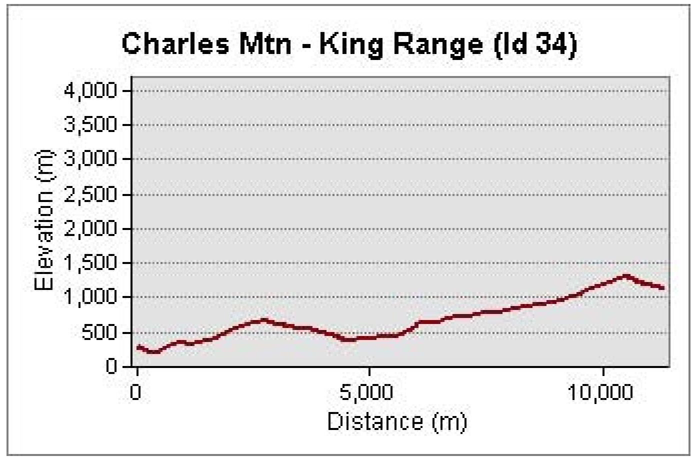

S. Fk. Mtn/Chinquapin Butte - Dairy Rdg/Pilot Rdg/S. Fk (Id 29)
Elevation (m)
4,000 3,500 3,000 2,500 2,000 1,500 1,000 500 0
0 10,000 20,000 30,000
Distance (m)

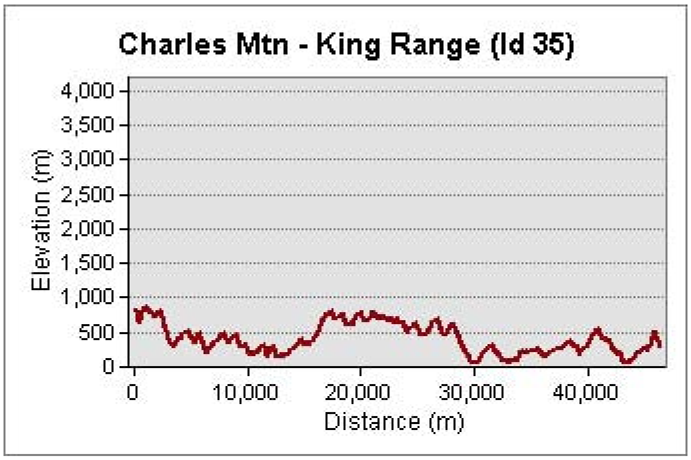

S Fk Mtn/Chinquapin Butte - Dairy Rdg/Pilot Rdg/S Fk (Id 30)
Elevation (m)
4,000 3,500 3,000 2,500 2,000 1,500 1,000 500 0
0 5,000 10,000 15,000 20,000
Distance (m)

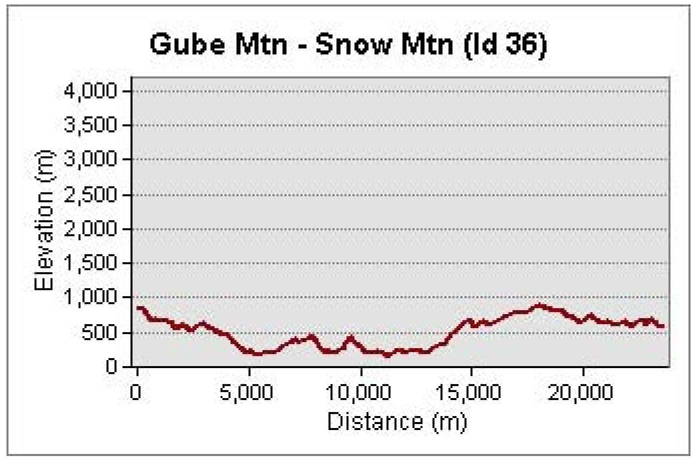

Dairy Rdg/Pilot Rdg/S Fk - Redwood Cr/Bald Hlls (Id 31)
Elevation (m)
4,000 3,500 3,000 2,500 2,000 1,500 1,000 500 0
0 20,000 40,000 60,000
Distance (m)

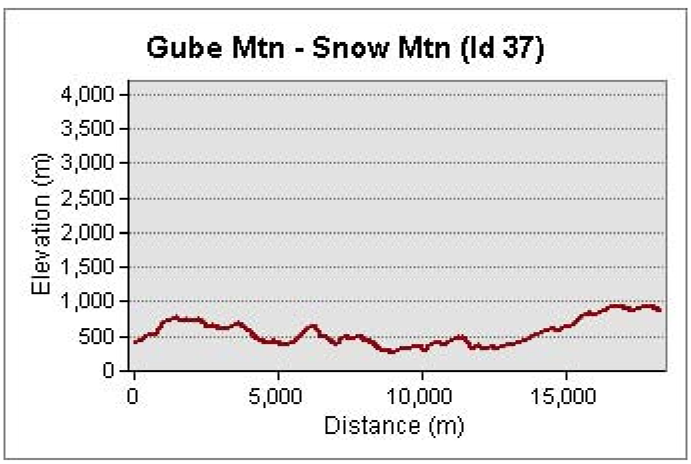

Charles Mtn - Salmon Mtns (Id 32)
Elevation (m)
4,000 3,500 3,000 2,500 2,000 1,500 1,000 500 0
0 50,000 100,000
Distance (m)

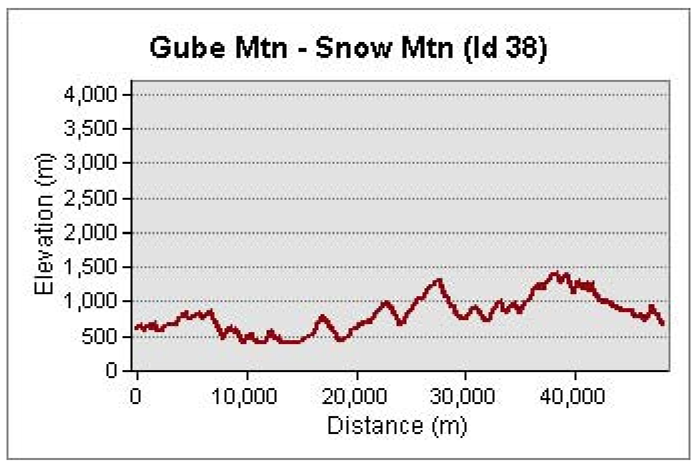

Sinkyone - Island Mtn (Id 33)
Elevation (m)
Distance (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
20,000
40,000

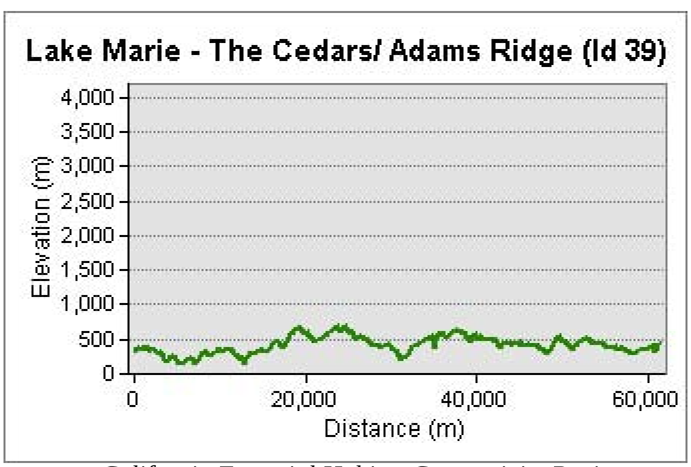

Charles Mtn - King Range (Id 34)
Elevation (m)
Distance (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
5,000
10,000

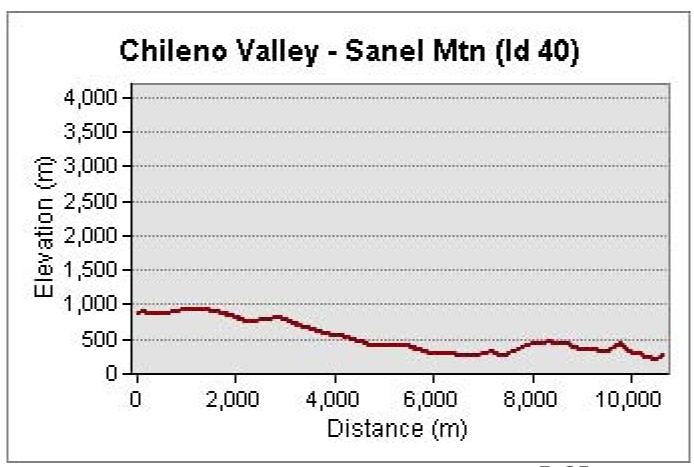

Charles Mtn - King Range (Id 35)
Elevation (m)
Distance (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
30,000
40,000

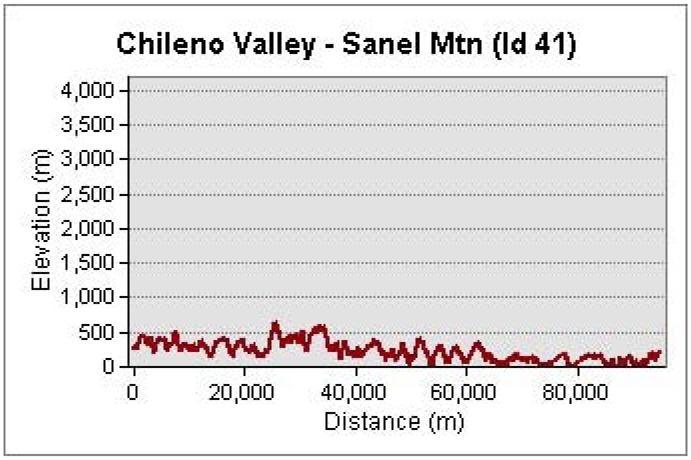

Gube Mtn - Snow Mtn (Id 36)
Elevation (m)
Distance (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
5,000
10,000
15,000
20,000

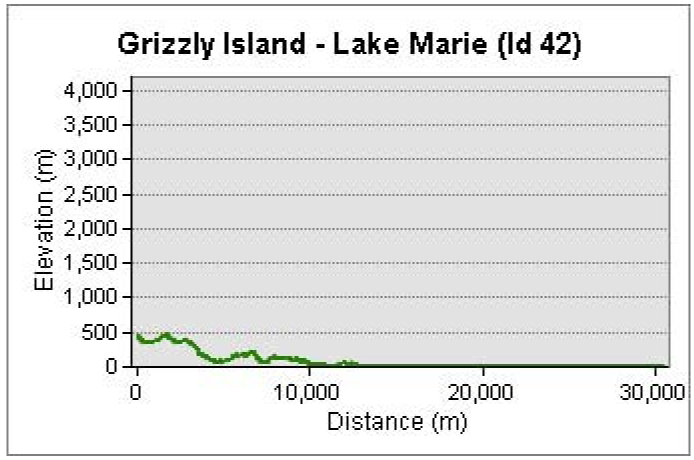

Gube Mtn - Snow Mtn (Id 37)
Elevation (m)
Distance (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
5,000
10,000
15,000

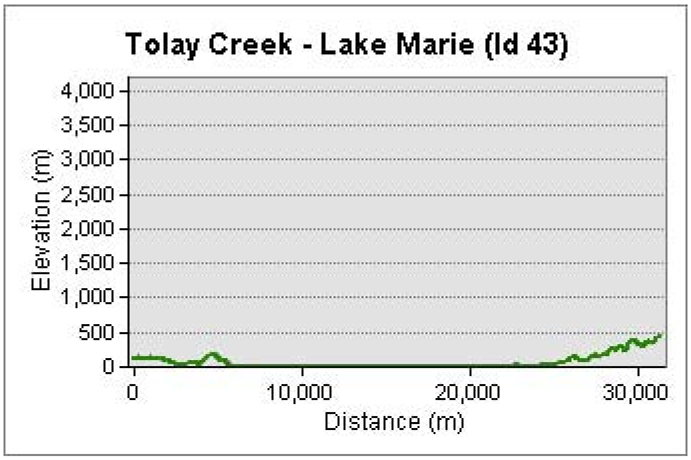

Gube Mtn - Snow Mtn (Id 38)
Elevation (m)
Distance (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
30,000
40,000

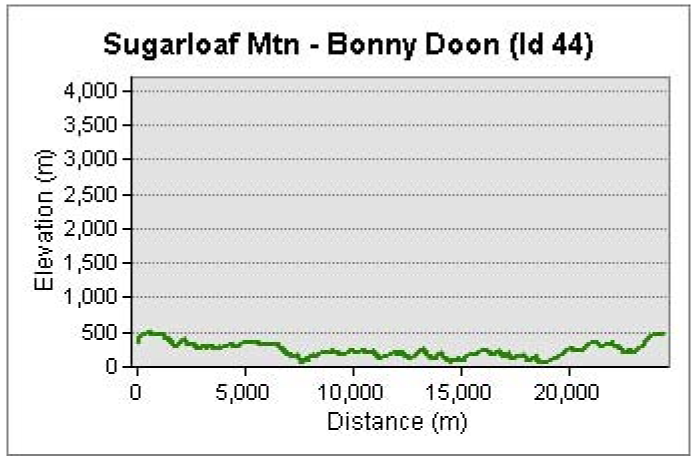

Lake Marie - The Cedars/ Adams Ridge (Id 39)
Elevation (m)
Distance (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
20,000
40,000
60,000

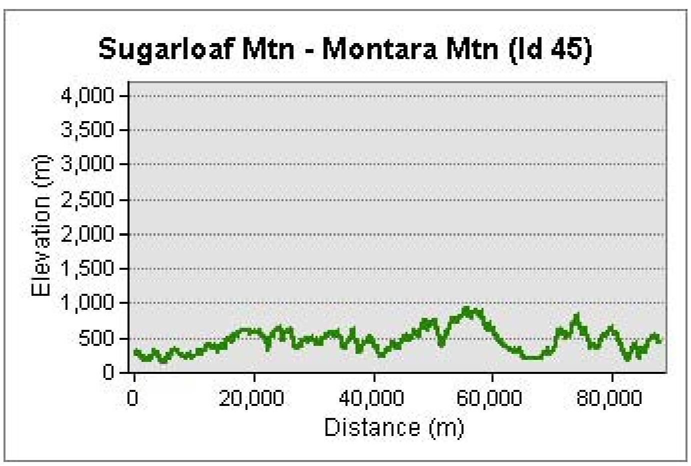

Chileno Valley - Sanel Mtn (Id 40)
Elevation (m)
Distance (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
2,000
4,000
6,000
8,000
10,000

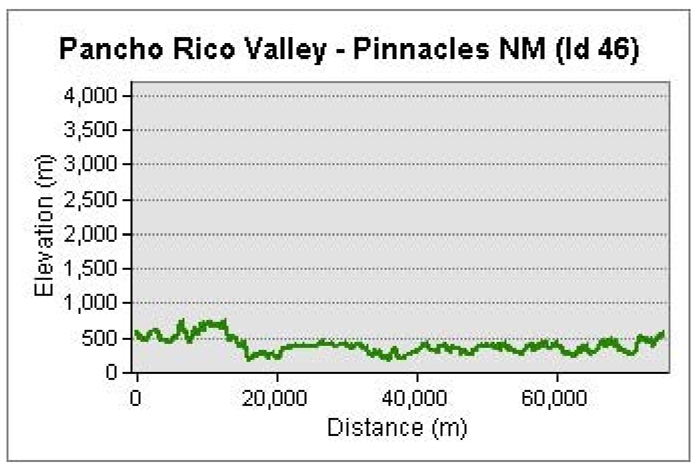

Chileno Valley - Sanel Mtn (Id 41)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
20,000
40,000
60,000
80,000
Distance (m)

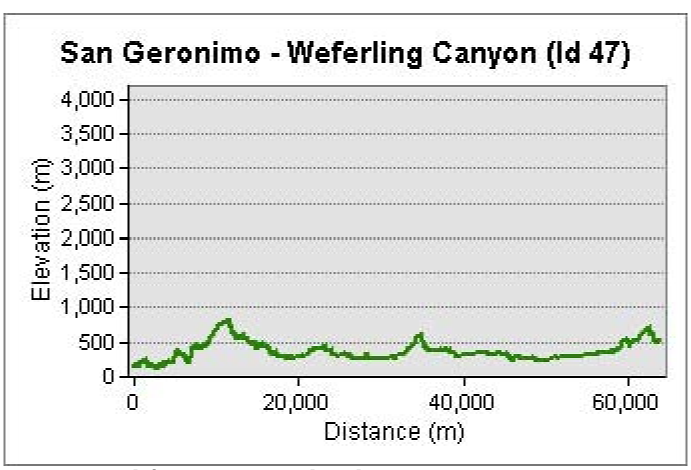

Grizzly Island - Lake Marie (Id 42)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
30,000
Distance (m)

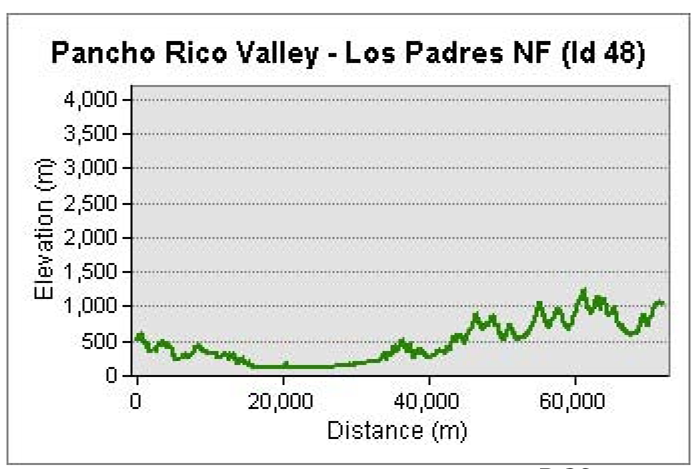

Tolay Creek - Lake Marie (Id 43)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
30,000
Distance (m)

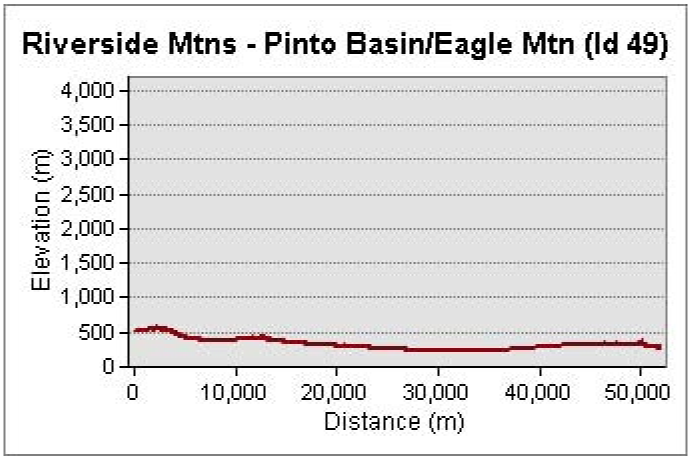

Sugarloaf Mtn - Bonny Doon (Id 44)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
5,000
10,000
15,000
20,000
Distance (m)

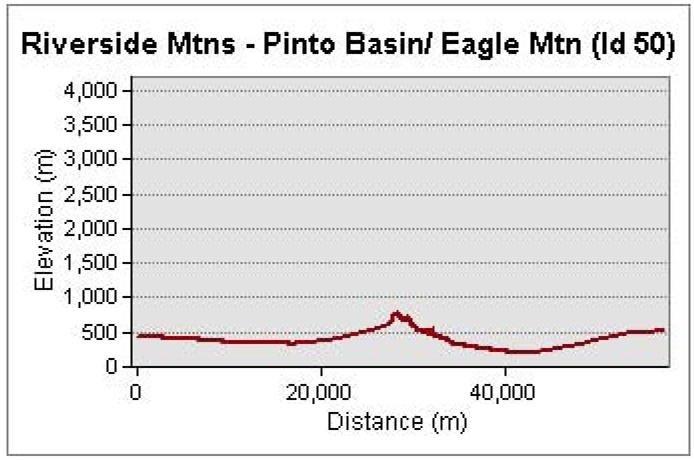

Sugarloaf Mtn - Montara Mtn (Id 45)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
20,000
40,000
60,000
80,000
Distance (m)

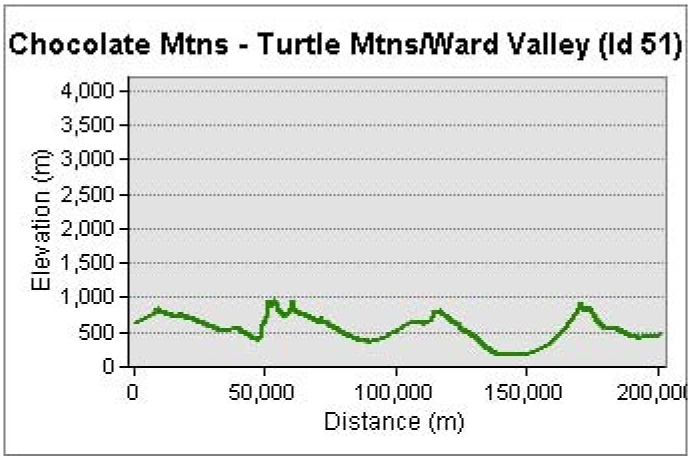

Pancho Rico Valley - Pinnacles NM (Id 46)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
20,000
40,000
60,000
Distance (m)

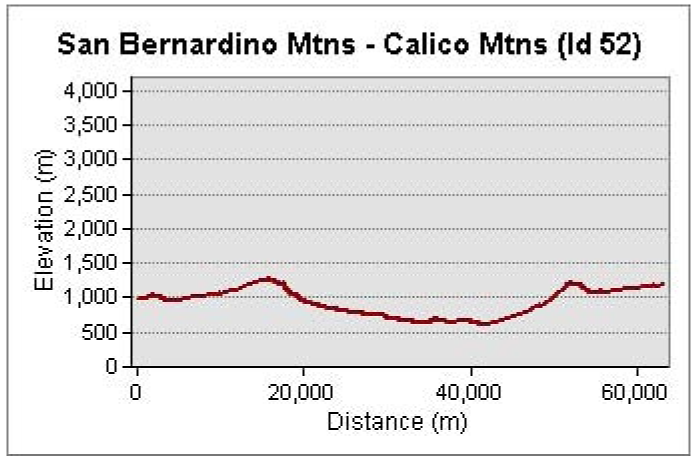

San Geronimo - Weferling Canyon (Id 47)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
20,000
40,000
60,000
Distance (m)

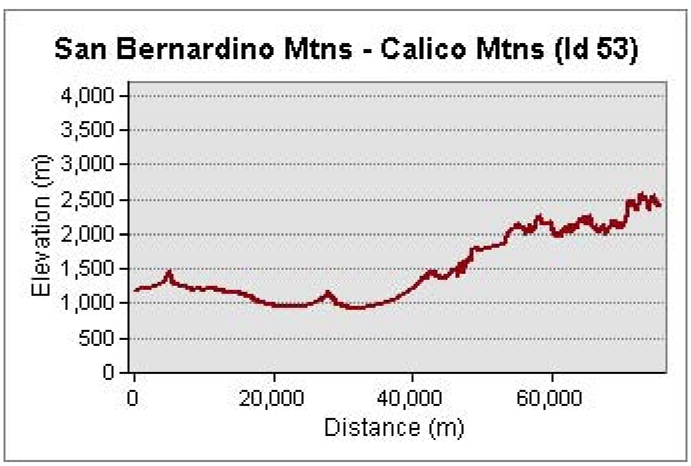

Pancho Rico Valley - Los Padres NF (Id 48)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
20,000
40,000
60,000
Distance (m)

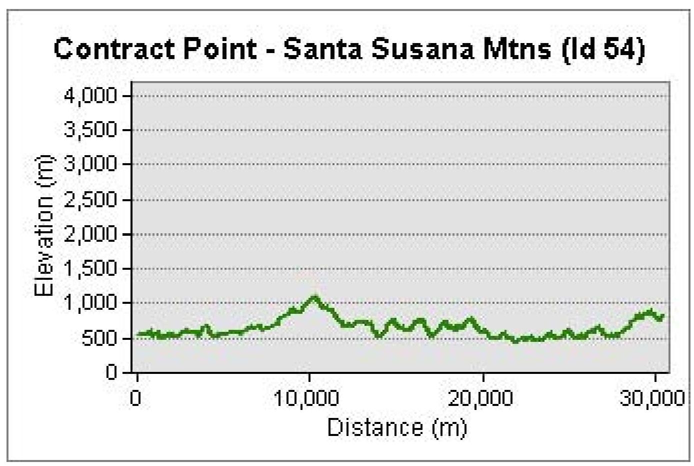

Riverside Mtns - Pinto Basin/Eagle Mtn (Id 49)
Elevation (m)
Distance (m)

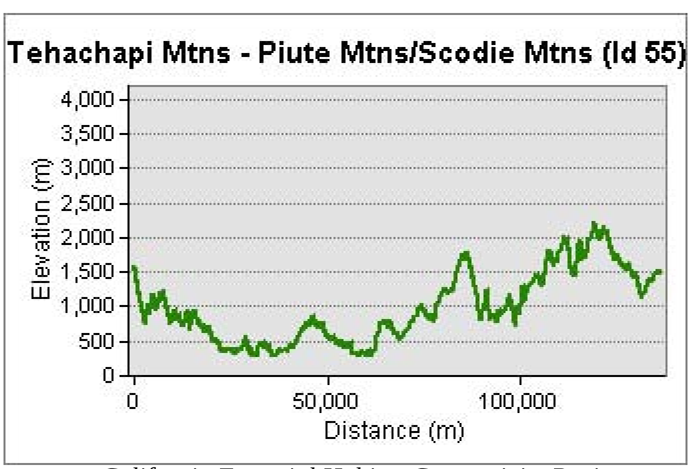

Riverside Mtns - Pinto Basin/ Eagle Mtn (Id 50)
Elevation (m)
Distance (m)

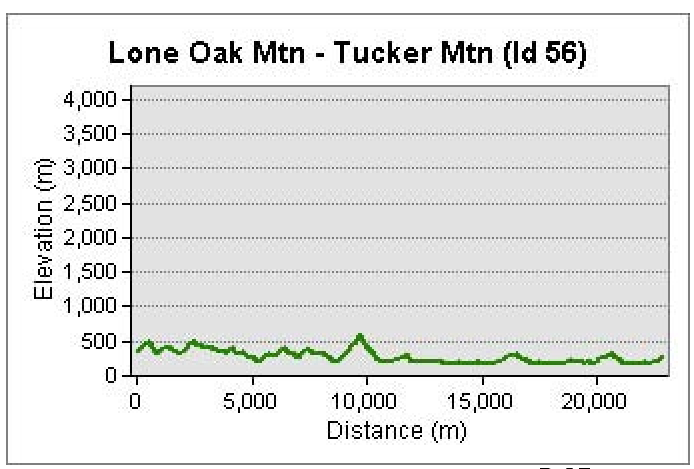

Chocolate Mtns - Turtle Mtns/Ward Valley (Id 51)
Elevation (m)
Distance (m)

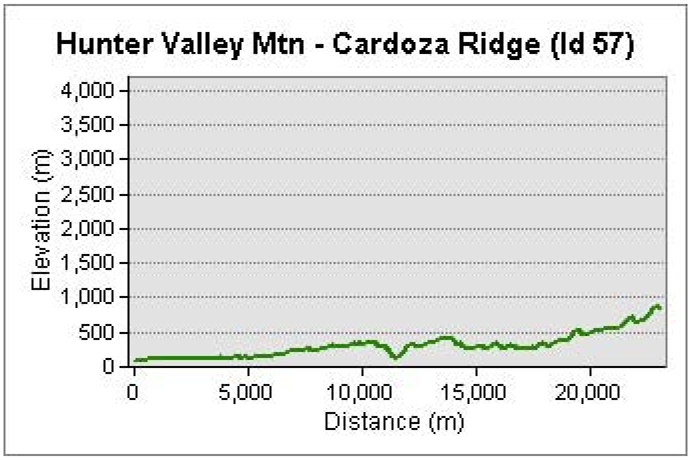

San Bernardino Mtns - Calico Mtns (Id 52)
Elevation (m)
Distance (m)

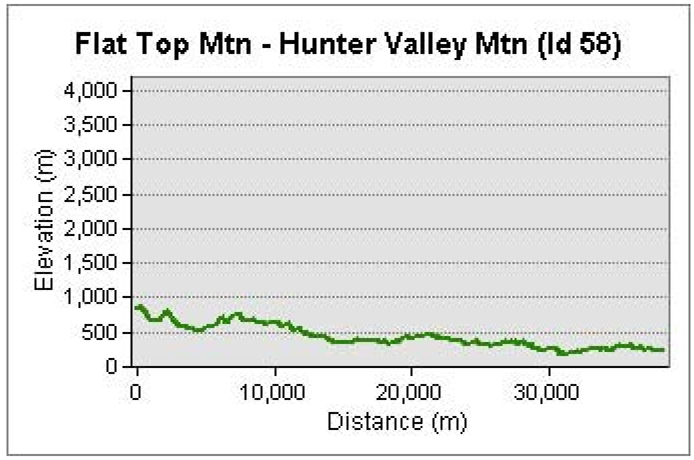

San Bernardino Mtns - Calico Mtns (Id 53)
Elevation (m)
Distance (m)


Contract Point - Santa Susana Mtns (Id 54)
Elevation (m)
Distance (m)


Tehachapi Mtns - Piute Mtns/Scodie Mtns (Id 55)
Elevation (m)
Distance (m)


Lone Oak Mtn - Tucker Mtn (Id 56)
Elevation (m)
Distance (m)


Hunter Valley Mtn - Cardoza Ridge (Id 57)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
5,000
10,000
15,000
20,000
Distance (m)


Flat Top Mtn - Hunter Valley Mtn (Id 58)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
30,000
Distance (m)

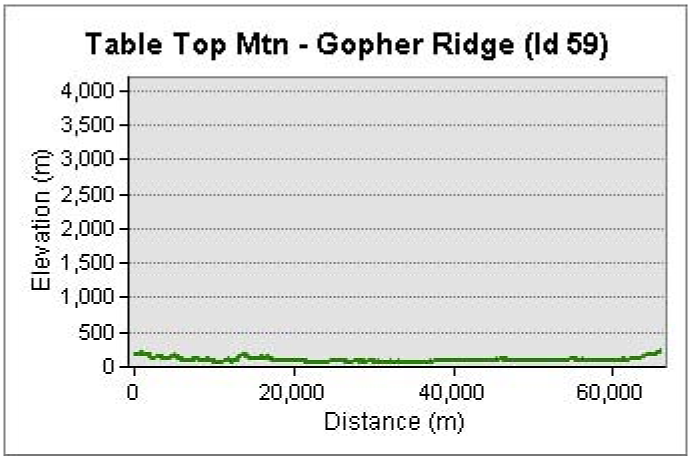
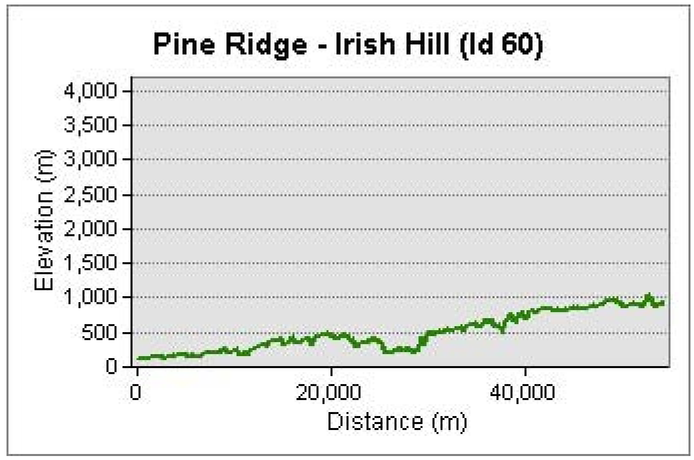
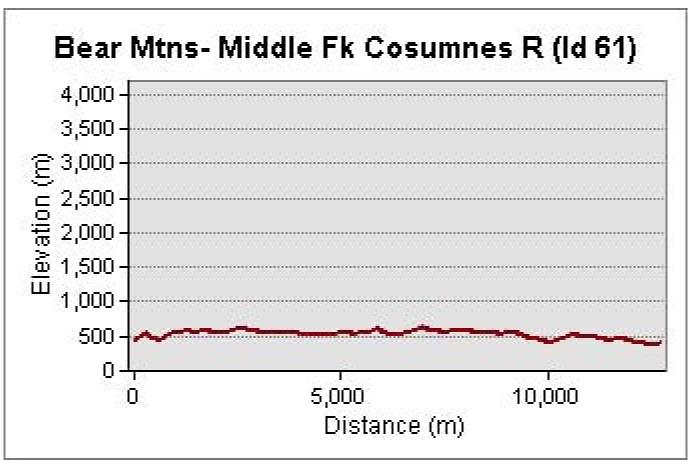
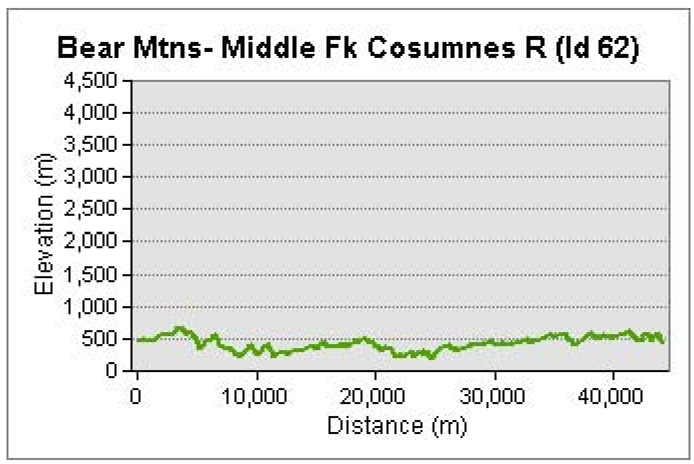
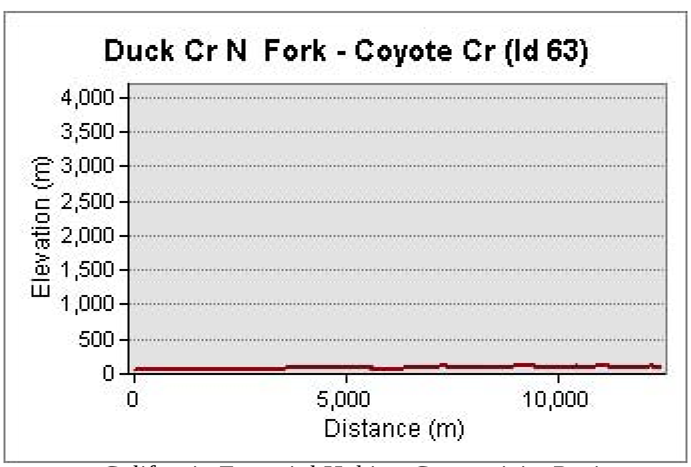


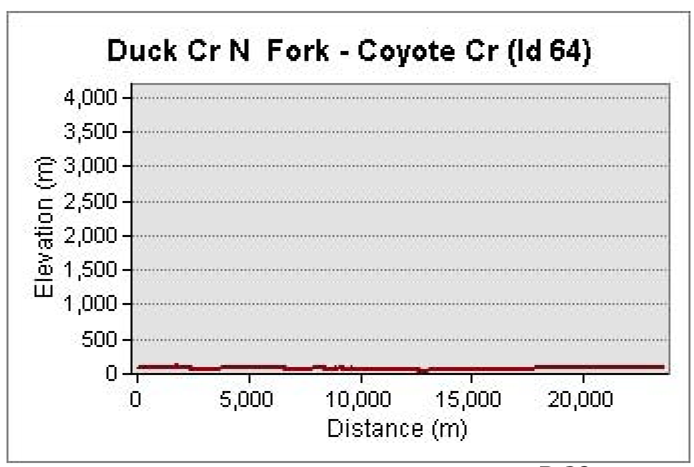
Table Top Mtn - Gopher Ridge (Id 59)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
20,000
40,000
60,000
Distance (m)

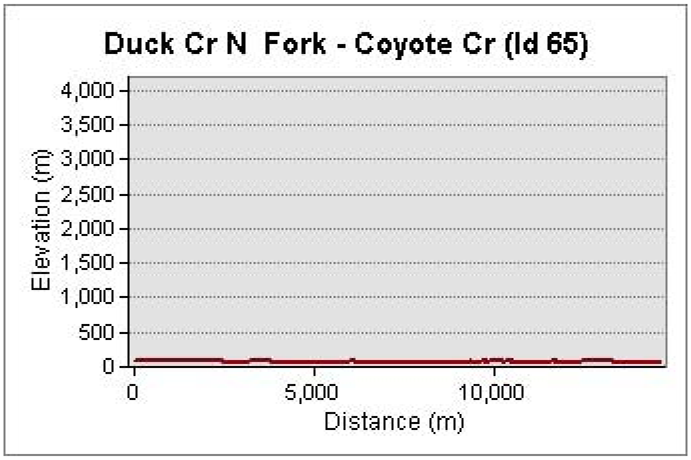

Pine Ridge - Irish Hill (Id 60)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
20,000
40,000
Distance (m)

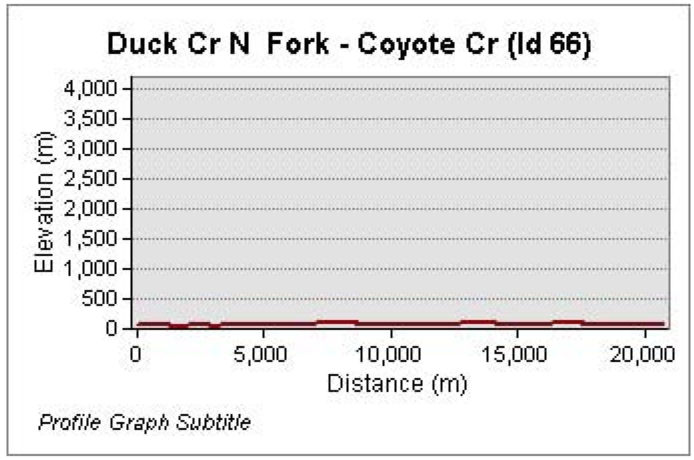

Bear Mtns- Middle Fk Cosumnes R (Id 61)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
5,000
10,000
Distance (m)

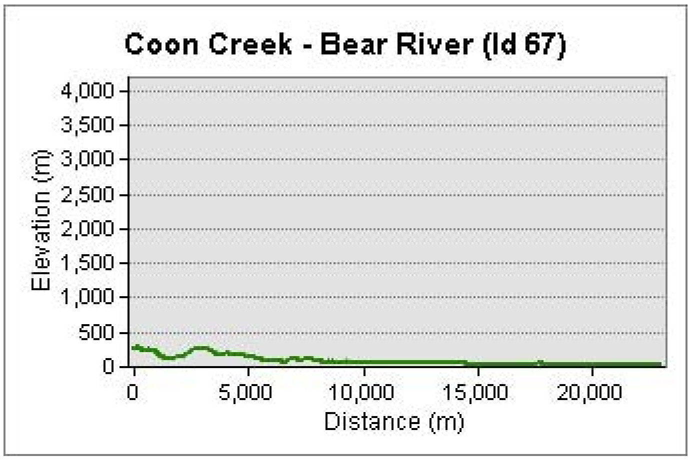

Bear Mtns- Middle Fk Cosumnes R (Id 62)
Elevation (m)
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
30,000
40,000
Distance (m)

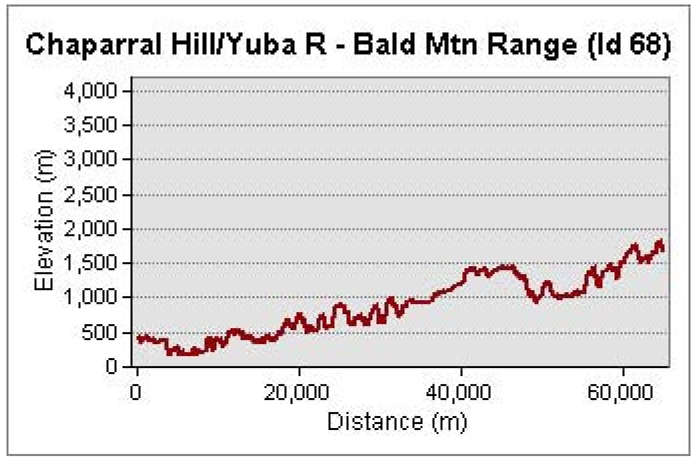

Duck Cr N Fork - Coyote Cr (Id 63)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
5,000
10,000
Distance (m)

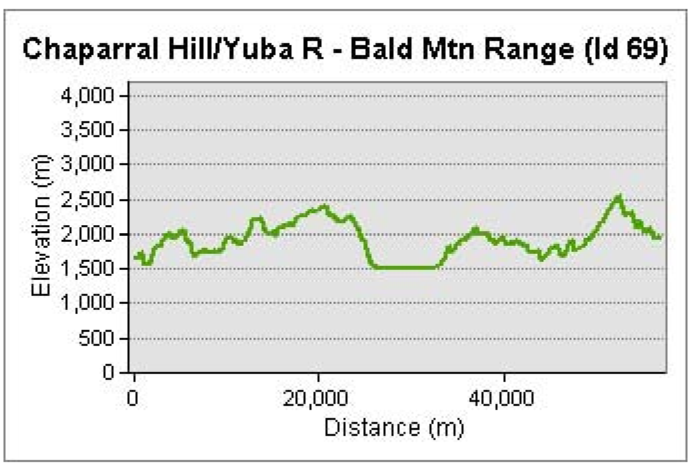

Duck Cr N Fork - Coyote Cr (Id 64)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
5,000
10,000
15,000
20,000
Distance (m)

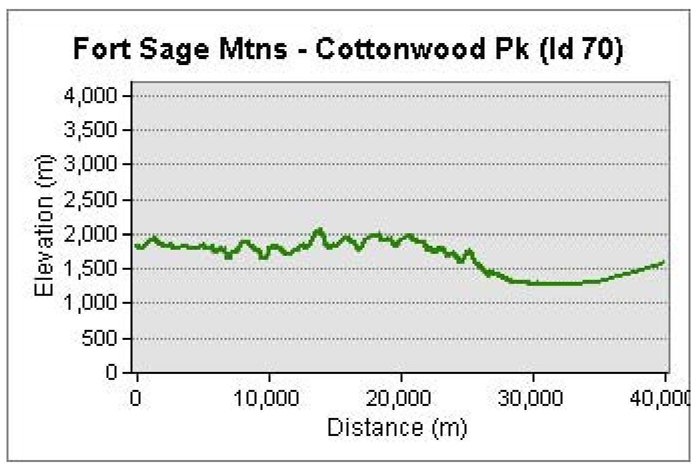

Duck Cr N Fork - Coyote Cr (Id 65)
Elevation (m)
Distance (m)

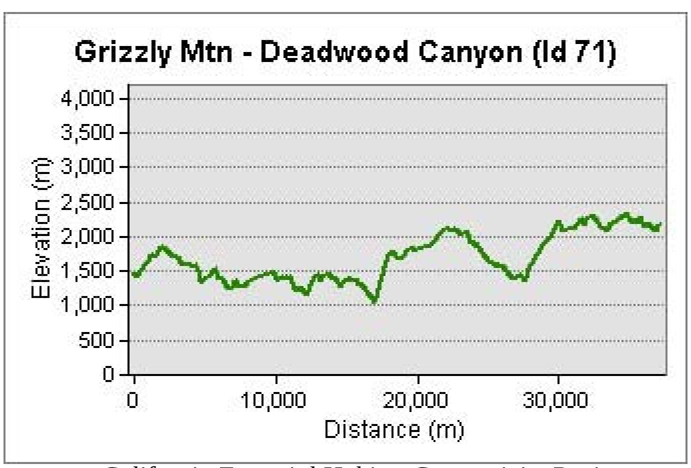

Duck Cr N Fork - Coyote Cr (Id 66)
Elevation (m)
Distance (m)
Profile Graph Subtitle

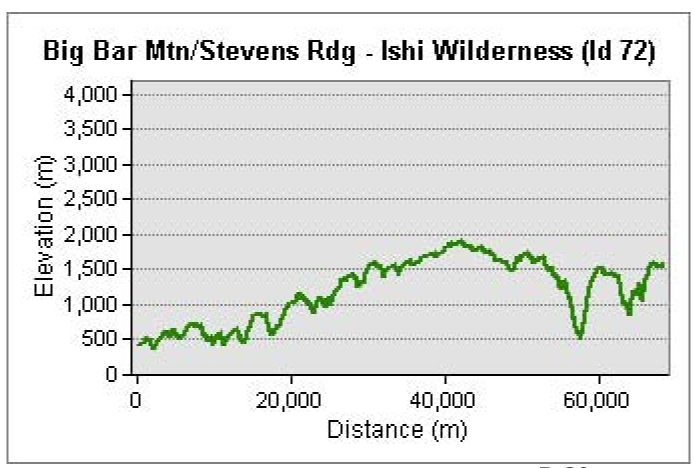

Coon Creek - Bear River (Id 67)
Elevation (m)
Distance (m)


Chaparral Hill/Yuba R - Bald Mtn Range (Id 68)
Elevation (m)
Distance (m)


Chaparral Hill/Yuba R - Bald Mtn Range (Id 69)
Elevation (m)
Distance (m)


Fort Sage Mtns - Cottonwood Pk (Id 70)
Elevation (m)
Distance (m)


Grizzly Mtn - Deadwood Canyon (Id 71)
Elevation (m)
Distance (m)


Big Bar Mtn/Stevens Rdg - Ishi Wilderness (Id 72)
Elevation (m)
Distance (m)

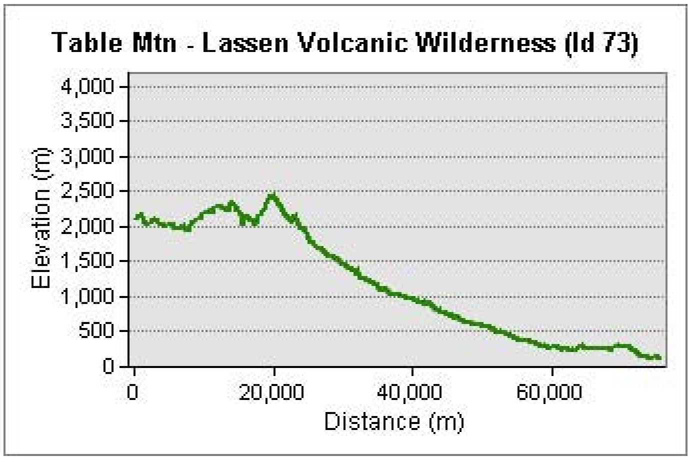
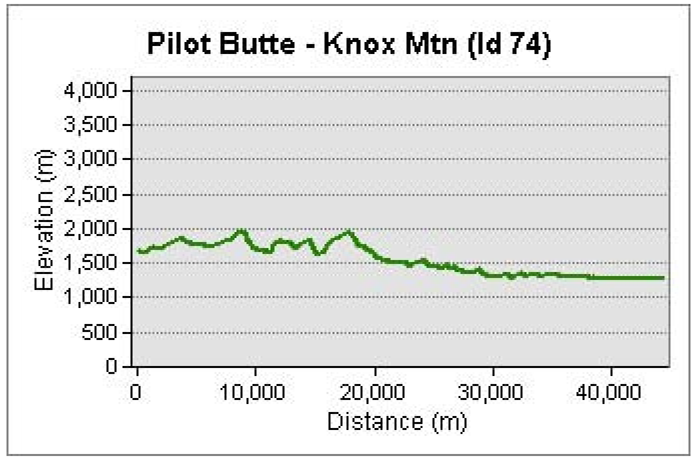
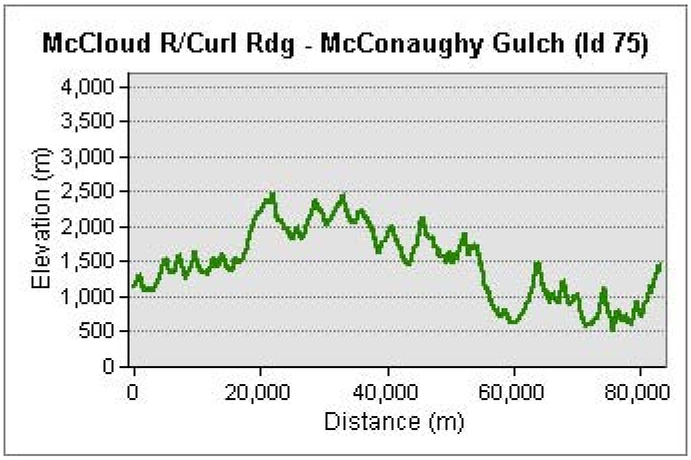


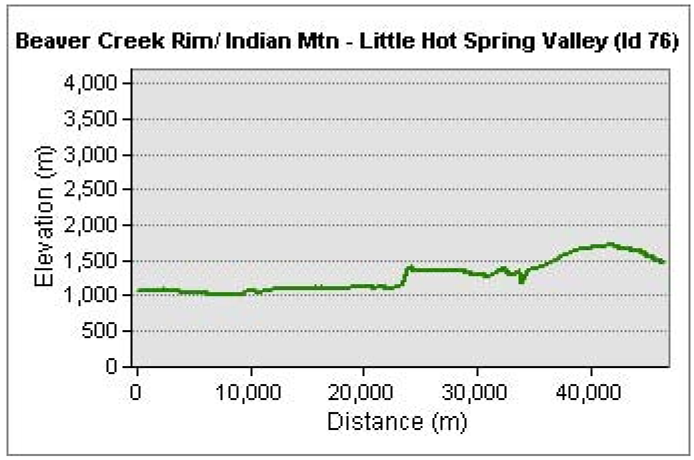
Table Mtn - Lassen Volcanic Wilderness (Id 73)
Elevation (m)
Distance (m)



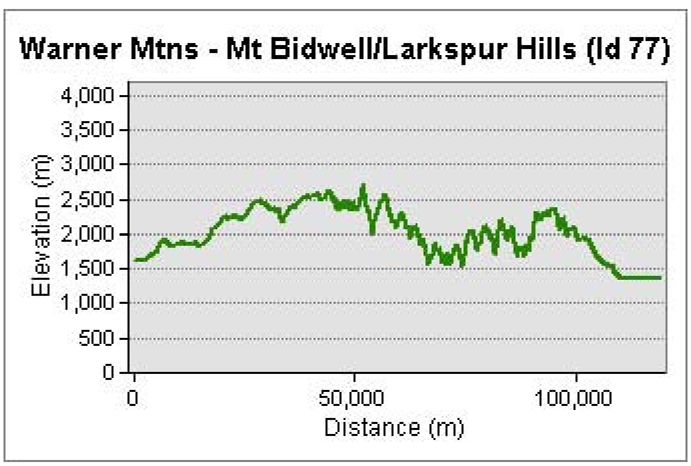
Pilot Butte - Knox Mtn (Id 74)
Elevation (m)
Distance (m)



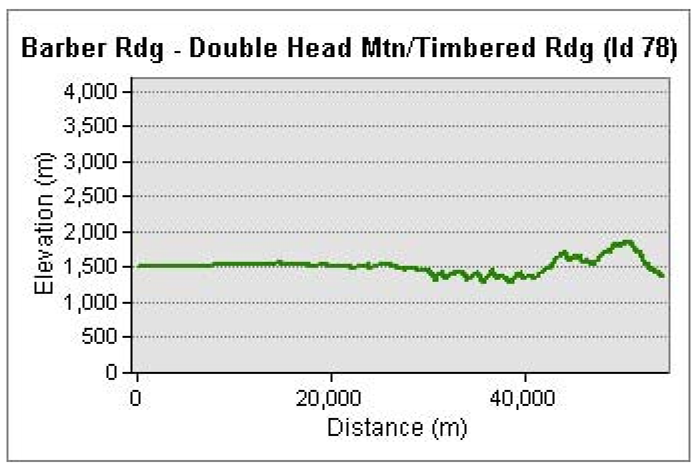
McCloud R/Curl Rdg - McConaughy Gulch (Id 75)
Elevation (m)
Distance (m)



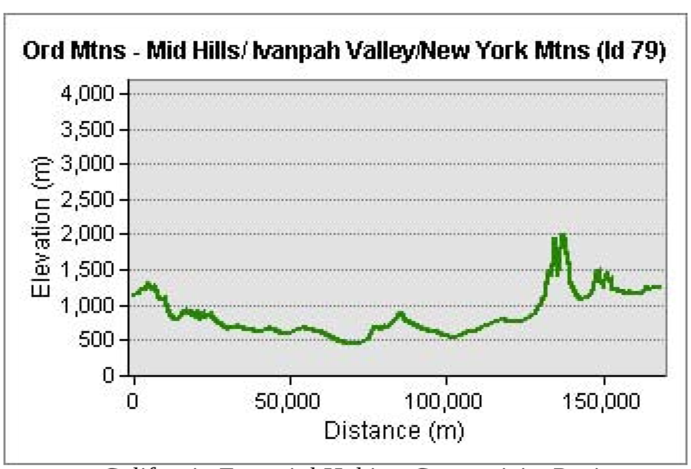
Beaver Creek Rim/ Indian Mtn - Little Hot Spring Valley (Id 76)
Elevation (m)
Distance (m)



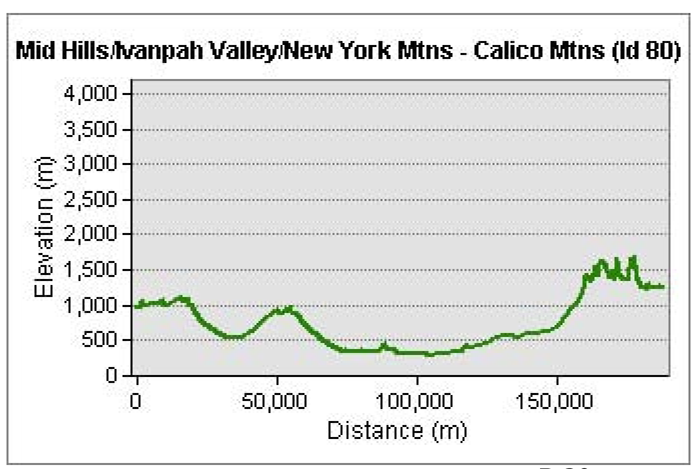
Warner Mtns - Mt Bidwell/Larkspur Hills (Id 77)
Elevation (m)
Distance (m)



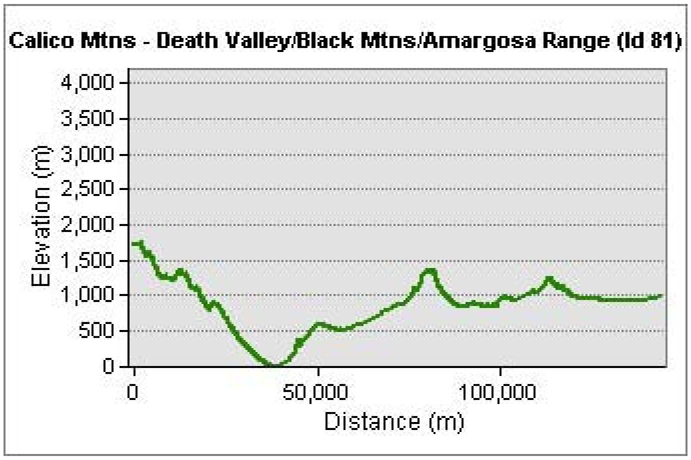
Barber Rdg - Double Head Mtn/Timbered Rdg (Id 78)
Elevation (m)
Distance (m)

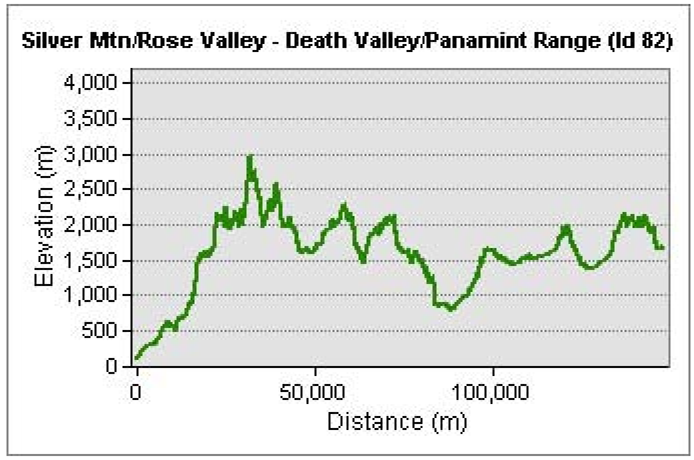


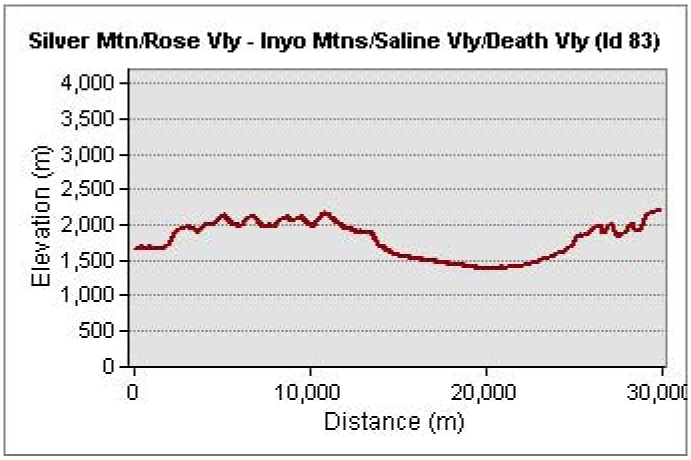
Ord Mtns - Mid Hills/ Ivanpah Valley/New York Mtns (Id 79)
Elevation (m)
Distance (m)

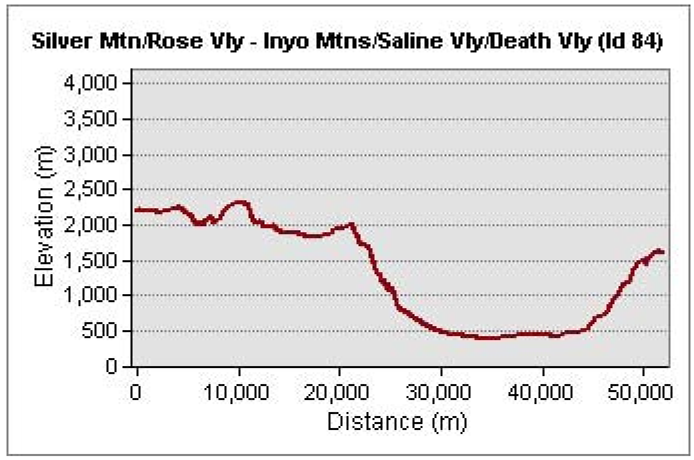


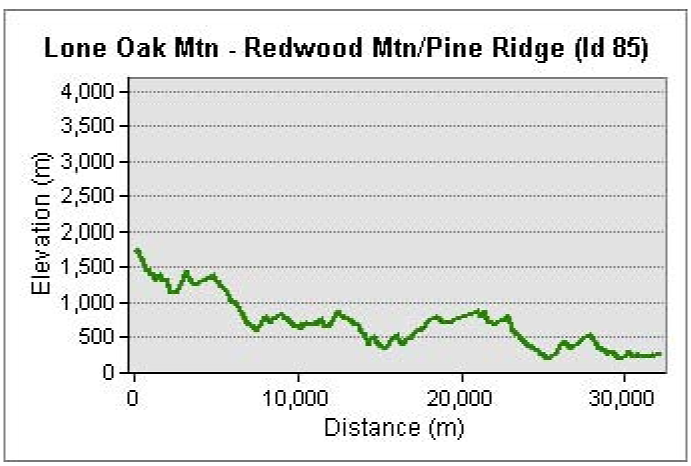
Mid Hills/Ivanpah Valley/New York Mtns - Calico Mtns (Id 80)
Elevation (m)
Distance (m)

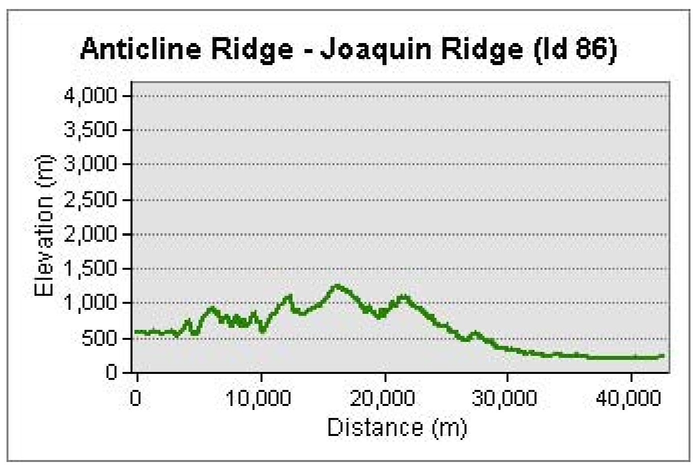

Calico Mtns - Death Valley/Black Mtns/Amargosa Range (Id 81)
Elevation (m)
Distance (m)
0
50,000
100,000
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000

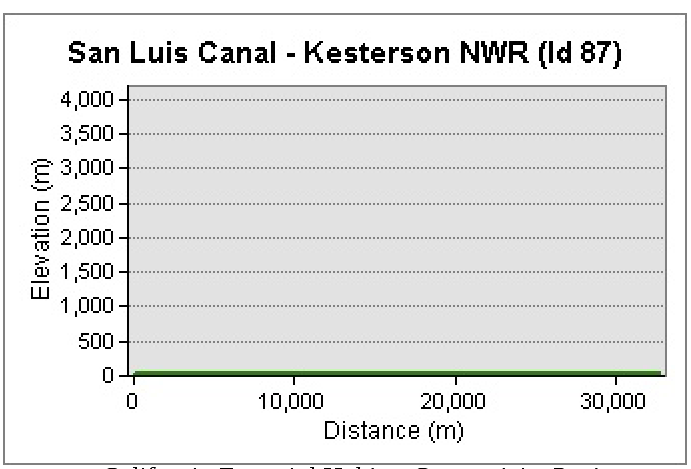

Silver Mtn/Rose Valley - Death Valley/Panamint Range (Id 82)
Elevation (m)
Distance (m)
0
50,000
100,000
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000

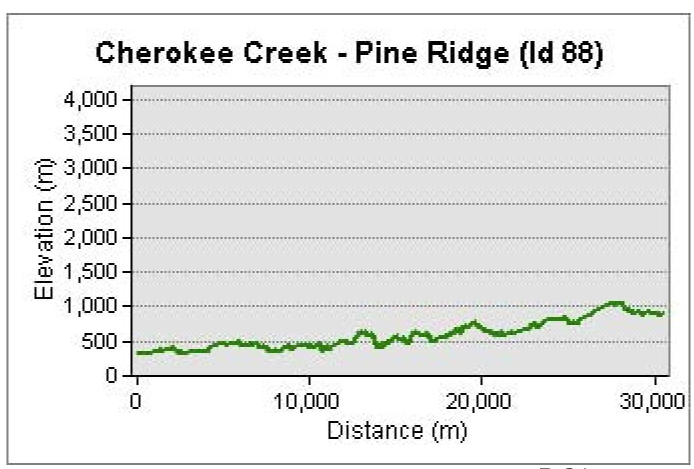

Silver Mtn/Rose Vly - Inyo Mtns/Saline Vly/Death Vly (Id 83)
Elevation (m)
Distance (m)
0
10,000
20,000
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000

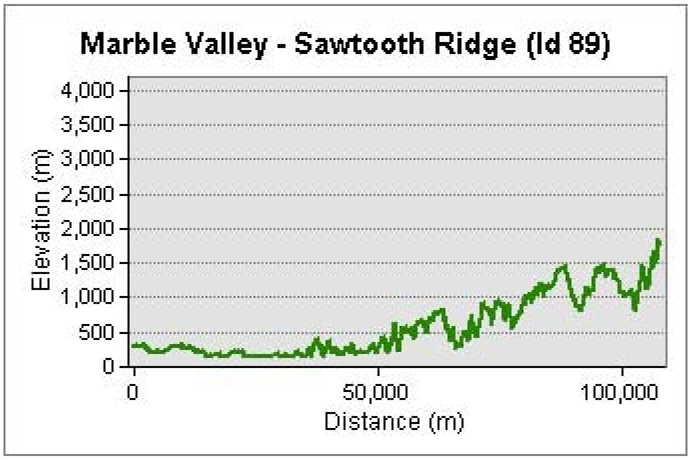

Silver Mtn/Rose Vly - Inyo Mtns/Saline Vly/Death Vly (Id 84)
Elevation (m)
Distance (m)
0
10,000
20,000
30,000
40,000
50,000
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000

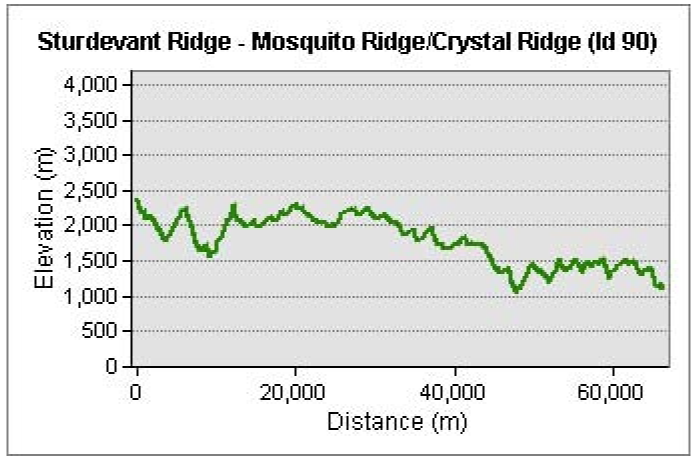

Lone Oak Mtn - Redwood Mtn/Pine Ridge (Id 85)
Elevation (m)
Distance (m)
0
10,000
20,000
30,000
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000

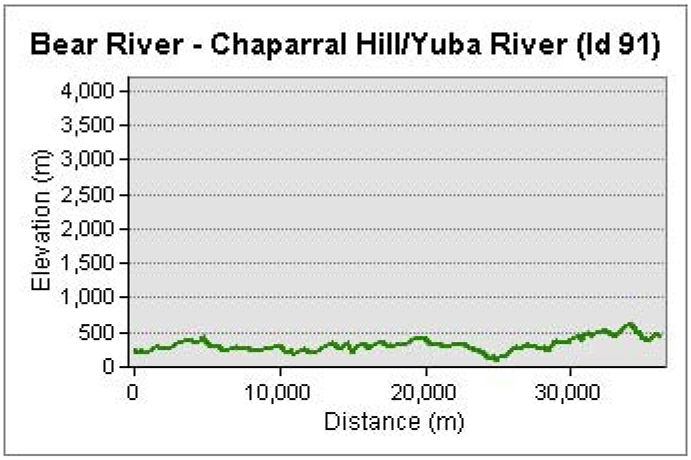

Anticline Ridge - Joaquin Ridge (Id 86)
Elevation (m)
Distance (m)
0
10,000
20,000
30,000
40,000
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000

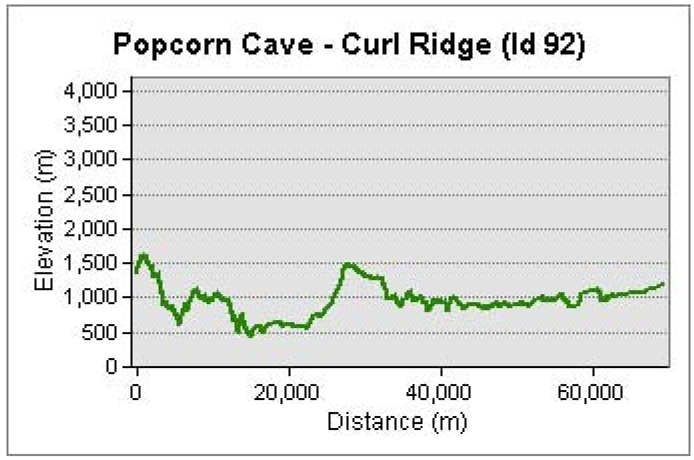

San Luis Canal - Kesterson NWR (Id 87)
Elevation (m)
Distance (m)
0
10,000
20,000
30,000
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000

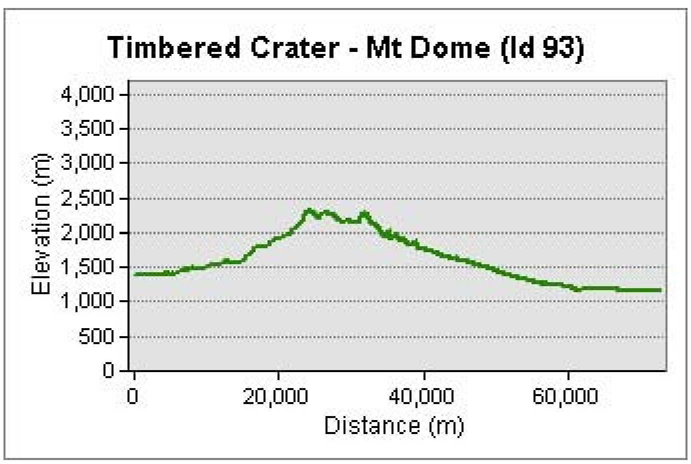

Cherokee Creek - Pine Ridge (Id 88)
Elevation (m)
Distance (m)
0
10,000
20,000
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000

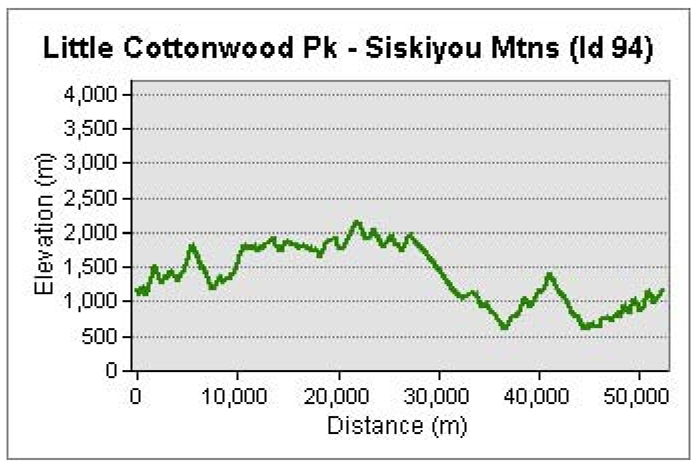

Marble Valley - Sawtooth Ridge (Id 89)
Elevation (m)
Distance (m)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
50,000
100,000

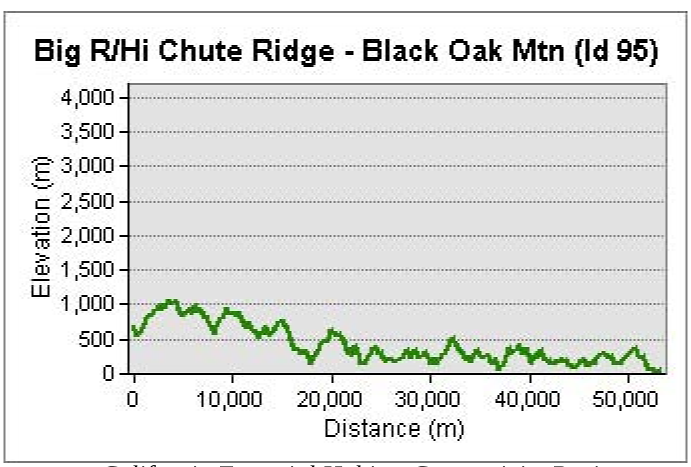

Sturdevant Ridge - Mosquito Ridge/Crystal Ridge (Id 90)
Elevation (m)
Distance (m)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
20,000
40,000
60,000

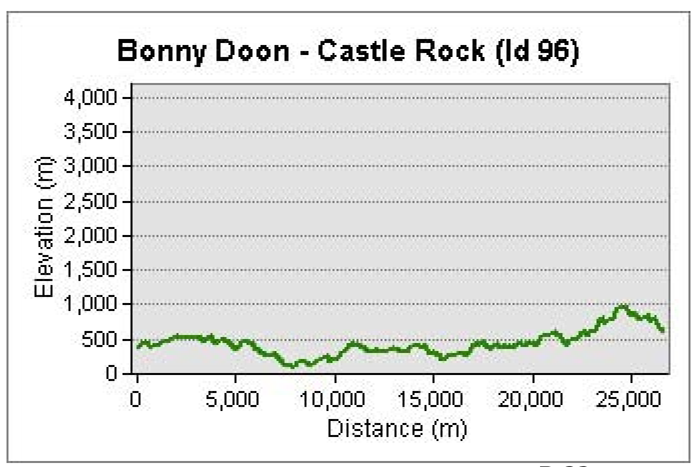

Bear River - Chaparral Hill/Yuba River (Id 91)
Elevation (m)
Distance (m)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
10,000
20,000
30,000

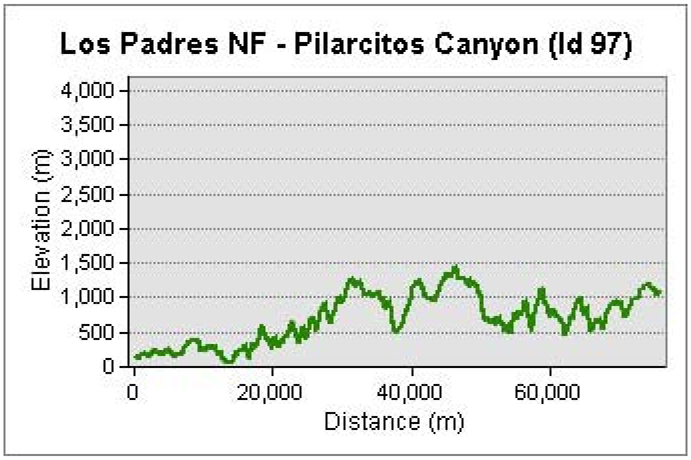

Popcorn Cave - Curl Ridge (Id 92)
Elevation (m)
Distance (m)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
20,000
40,000
60,000

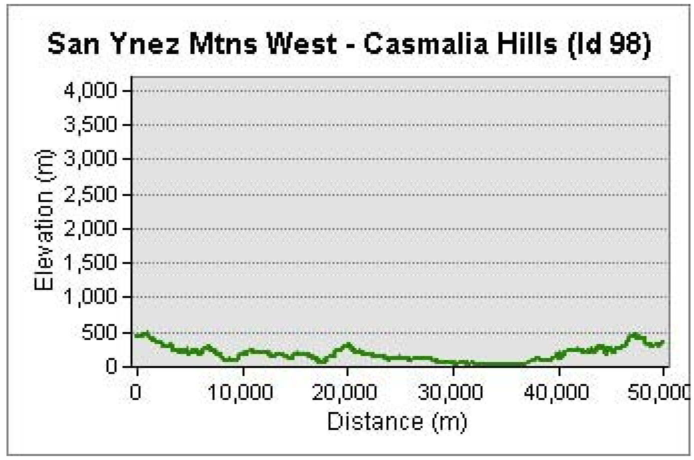

Timbered Crater - Mt Dome (Id 93)
Elevation (m)
Distance (m)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
20,000
40,000
60,000

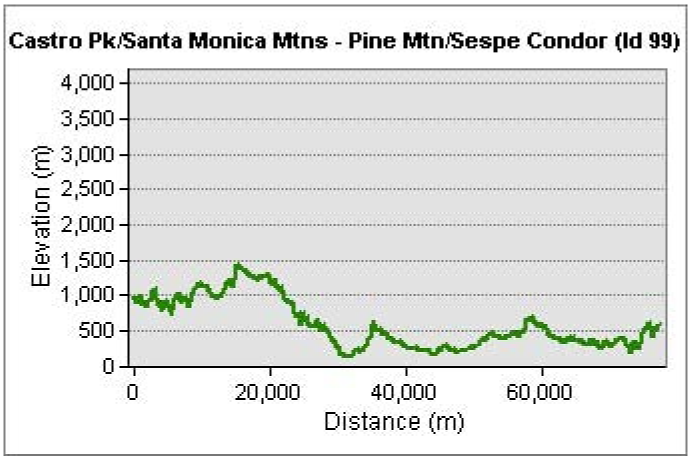

Little Cottonwood Pk - Siskiyou Mtns (Id 94)
Elevation (m)
Distance (m)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
10,000
20,000
30,000
40,000
50,000

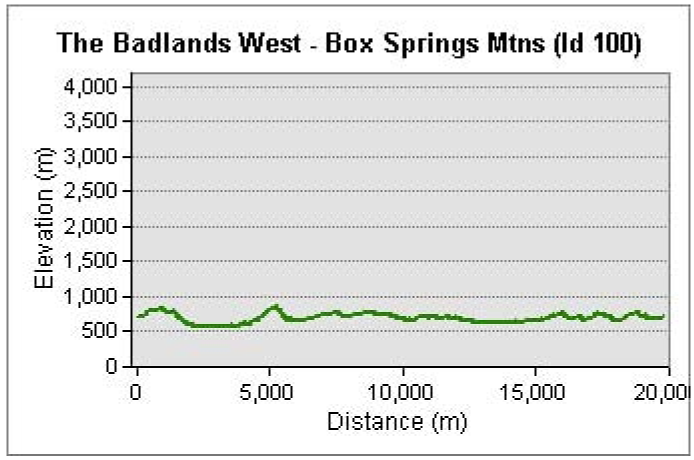

Big R/Hi Chute Ridge - Black Oak Mtn (Id 95)
Elevation (m)
Distance (m)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
10,000
20,000
30,000
40,000
50,000

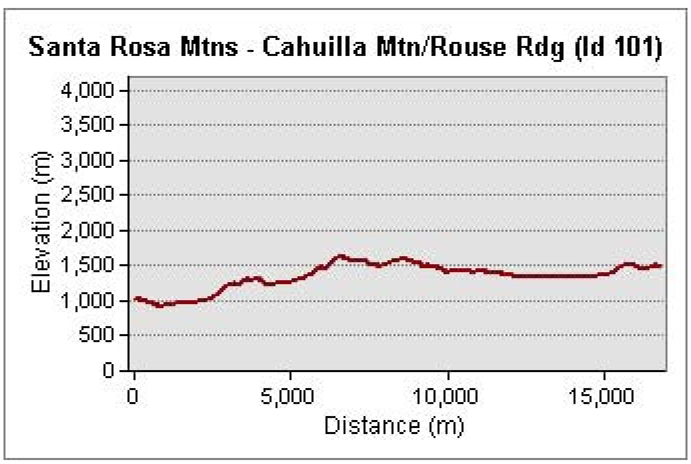

Bonny Doon - Castle Rock (Id 96)
Elevation (m)
Distance (m)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
5,000
10,000
15,000
20,000
25,000

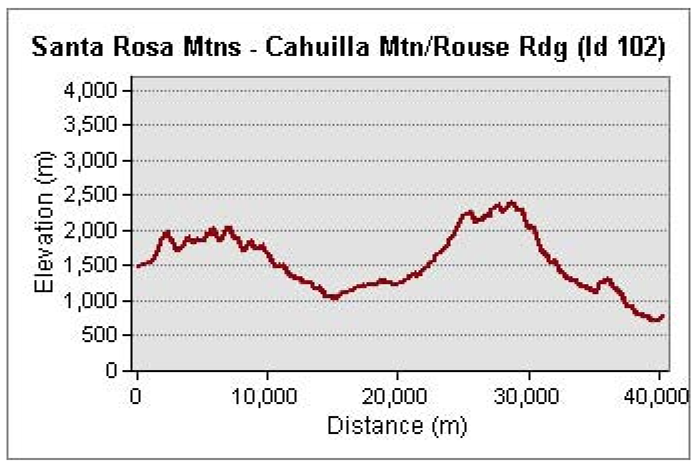

Los Padres NF - Pilarcitos Canyon (Id 97)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
20,000
40,000
60,000
Distance (m)

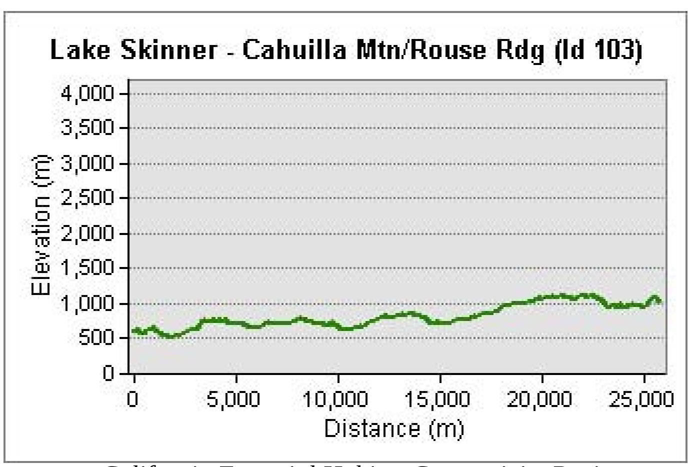

San Ynez Mtns West - Casmalia Hills (Id 98)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
10,000
20,000
30,000
40,000
Distance (m)

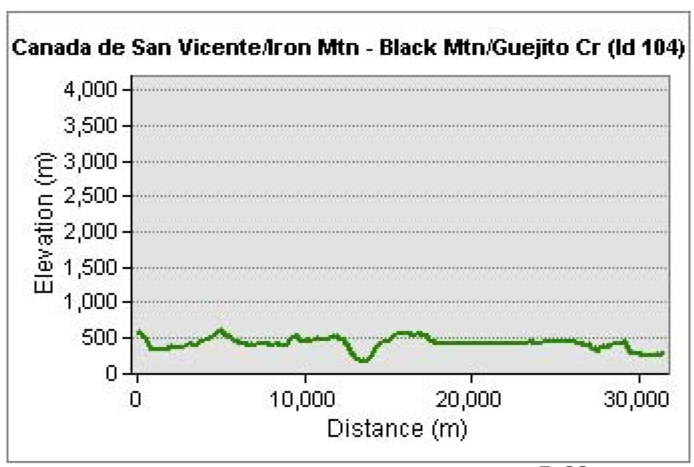

Castro Pk/Santa Monica Mtns - Pine Mtn/Sespe Condor (Id 99)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
20,000
40,000
60,000
Distance (m)

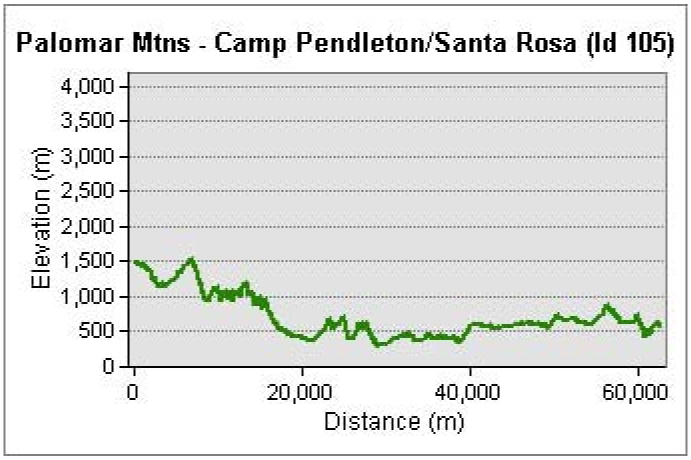

The Badlands West - Box Springs Mtns (Id 100)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
5,000
10,000
15,000
Distance (m)

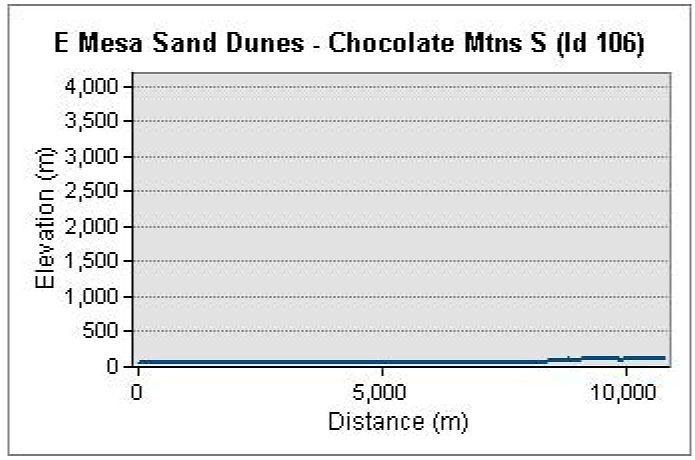

Santa Rosa Mtns - Cahuilla Mtn/Rouse Rdg (Id 101)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
5,000
10,000
15,000
Distance (m)

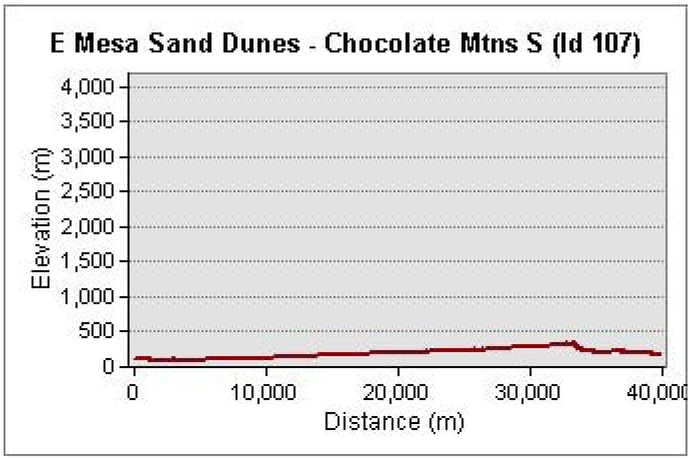

Santa Rosa Mtns - Cahuilla Mtn/Rouse Rdg (Id 102)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
10,000
20,000
30,000
40,000
Distance (m)

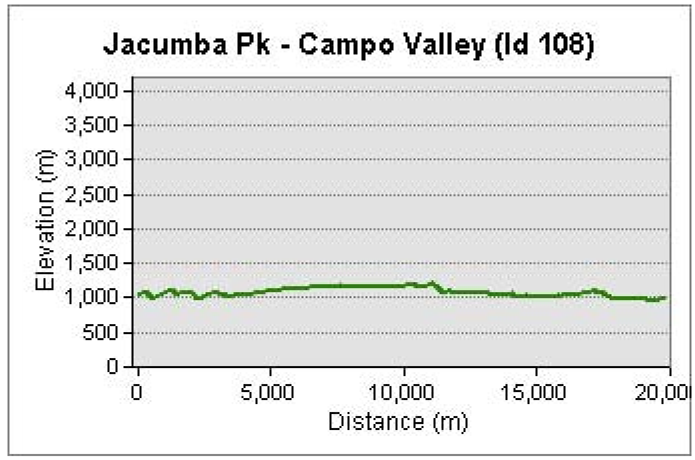

Lake Skinner - Cahuilla Mtn/Rouse Rdg (Id 103)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
5,000
10,000
15,000
20,000
25,000
Distance (m)

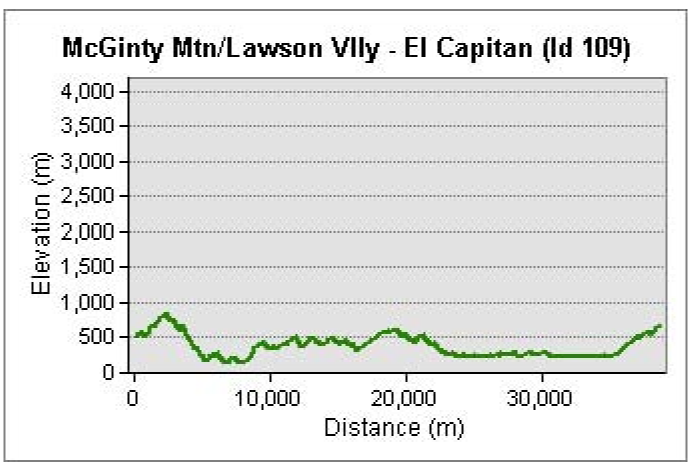

Canada de San Vicente/Iron Mtn - Black Mtn/Guejito Cr (Id 104)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
10,000
20,000
30,000
Distance (m)

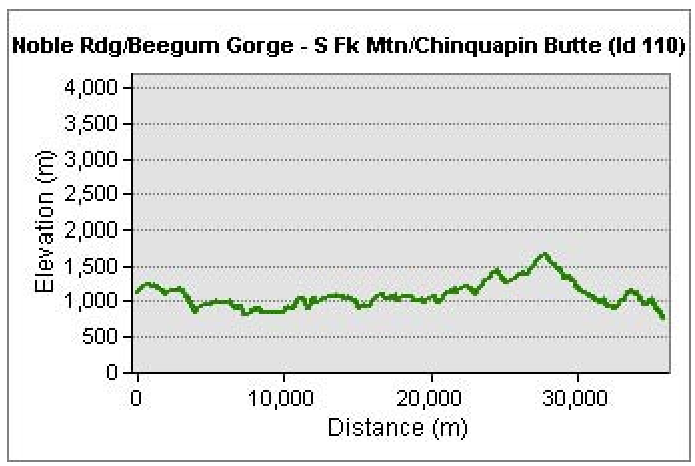

Palomar Mtns - Camp Pendleton/Santa Rosa (Id 105)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
20,000
40,000
60,000
Distance (m)

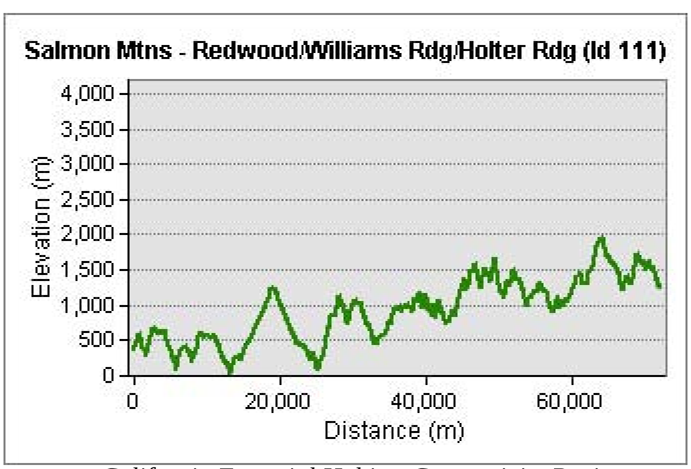

E Mesa Sand Dunes - Chocolate Mtns S (Id 106)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
5,000
10,000
Distance (m)

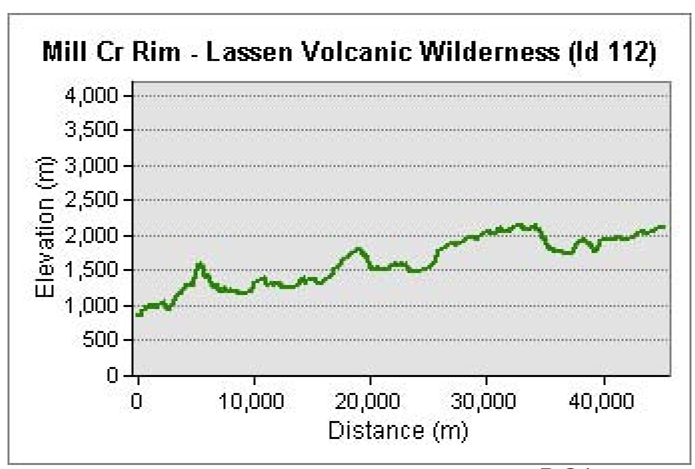

E Mesa Sand Dunes - Chocolate Mtns S (Id 107)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
30,000
Distance (m)

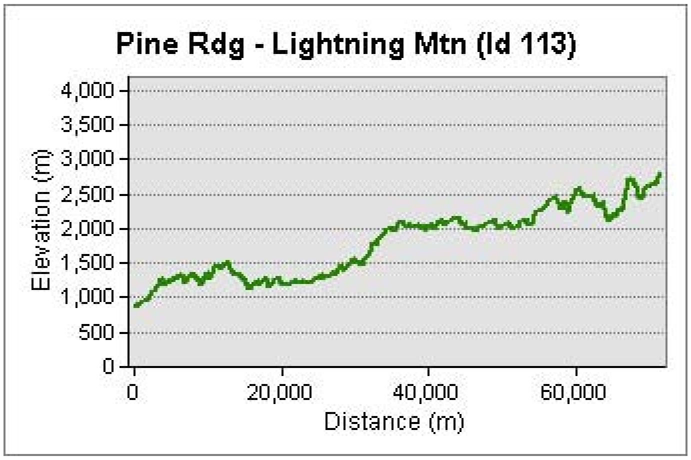

Jacumba Pk - Campo Valley (Id 108)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
5,000
10,000
15,000
Distance (m)

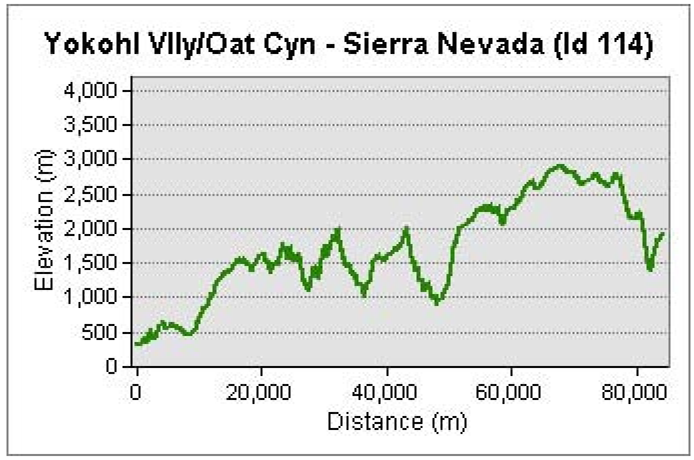

McGinty Mtn/Lawson Vlly - El Capitan (Id 109)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
30,000
Distance (m)

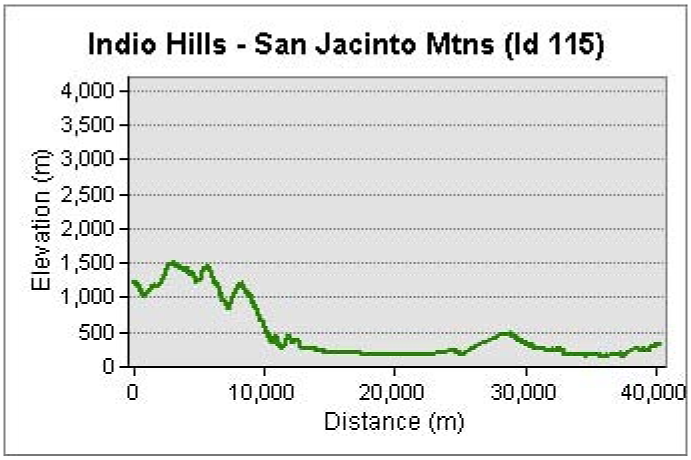

Noble Rdg/Beegum Gorge - S Fk Mtn/Chinquapin Butte (Id 110)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
30,000
Distance (m)

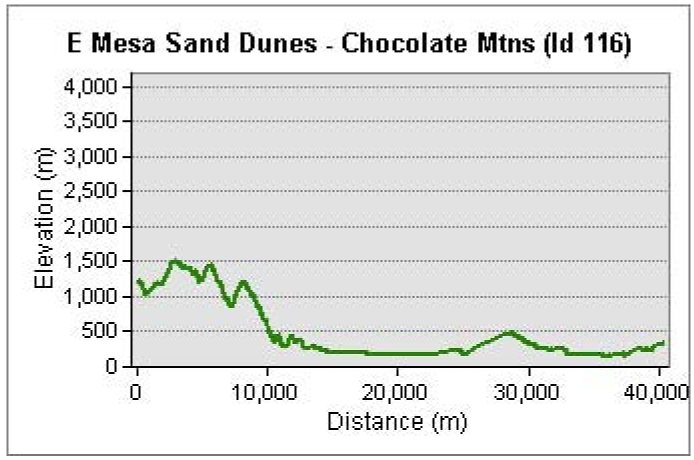

Salmon Mtns - Redwood/Williams Rdg/Holter Rdg (Id 111)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
20,000
40,000
60,000
Distance (m)

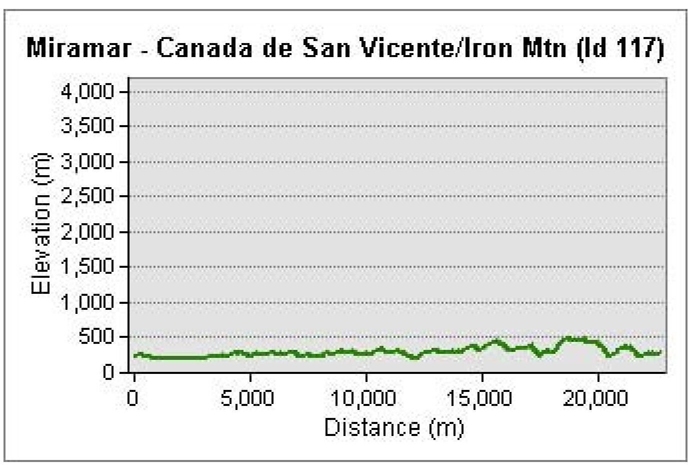

Mill Cr Rim - Lassen Volcanic Wilderness (Id 112)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
30,000
40,000
Distance (m)

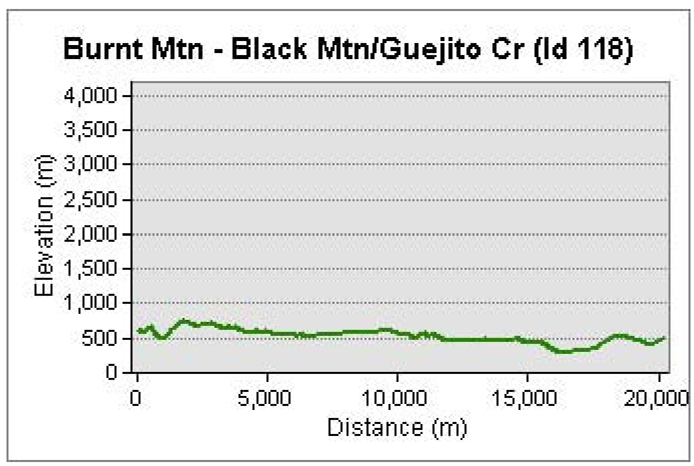

Pine Rdg - Lightning Mtn (Id 113)
Elevation (m)
Distance (m)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
20,000
40,000
60,000

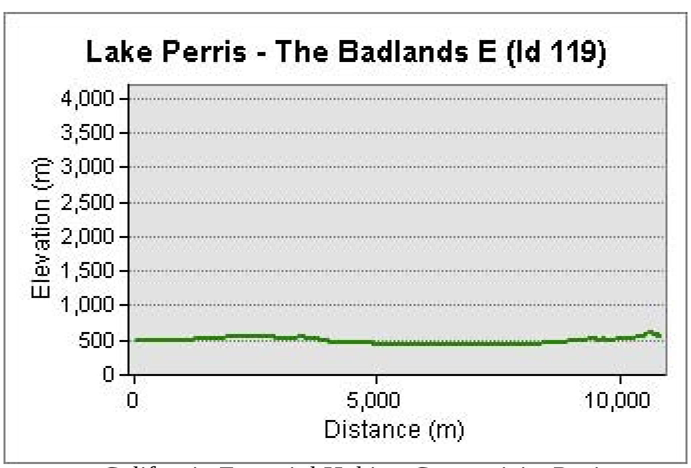

Yokohl Vlly/Oat Cyn - Sierra Nevada (Id 114)
Elevation (m)
Distance (m)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
20,000
40,000
60,000
80,000

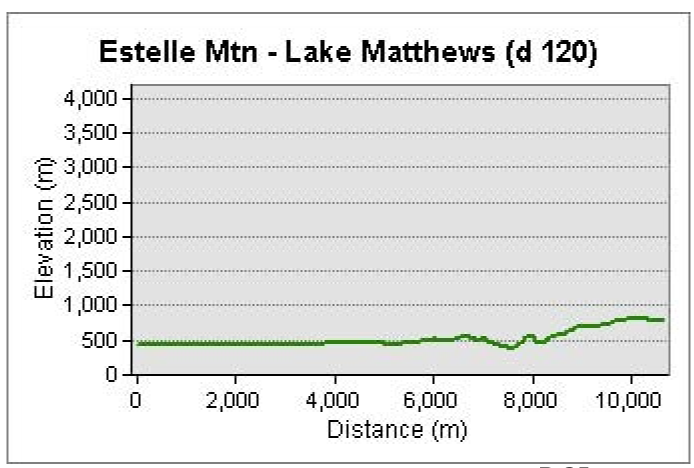

Indio Hills - San Jacinto Mtns (Id 115)
Elevation (m)
Distance (m)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
10,000
20,000
30,000
40,000

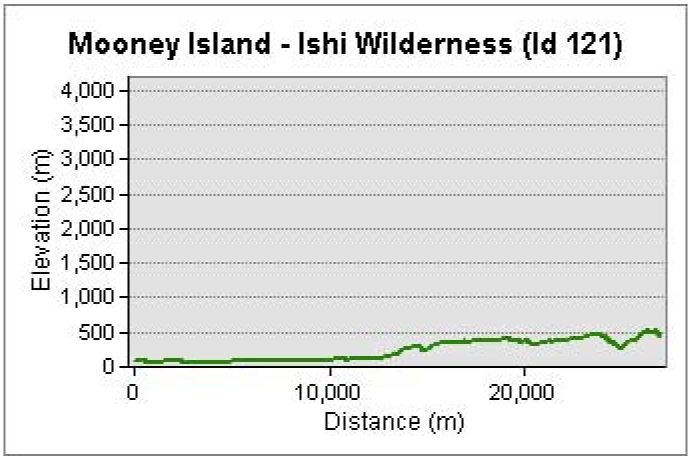

E Mesa Sand Dunes - Chocolate Mtns (Id 116)
Elevation (m)
Distance (m)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
10,000
20,000
30,000
40,000

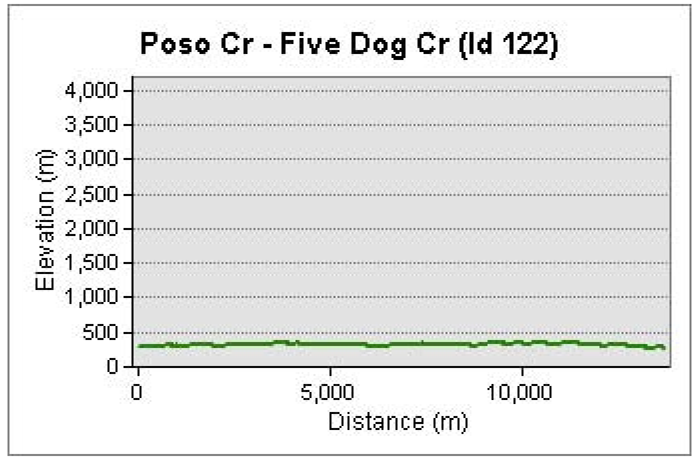

Miramar - Canada de San Vicente/Iron Mtn (Id 117)
Elevation (m)
Distance (m)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
5,000
10,000
15,000
20,000

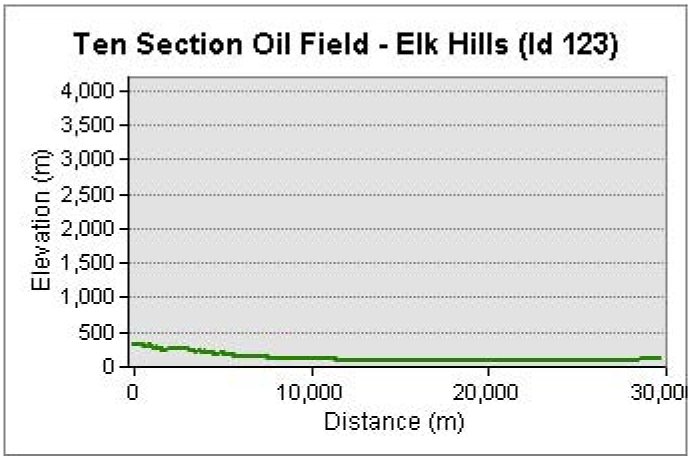

Burnt Mtn - Black Mtn/Guejito Cr (Id 118)
Elevation (m)
Distance (m)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
5,000
10,000
15,000
20,000

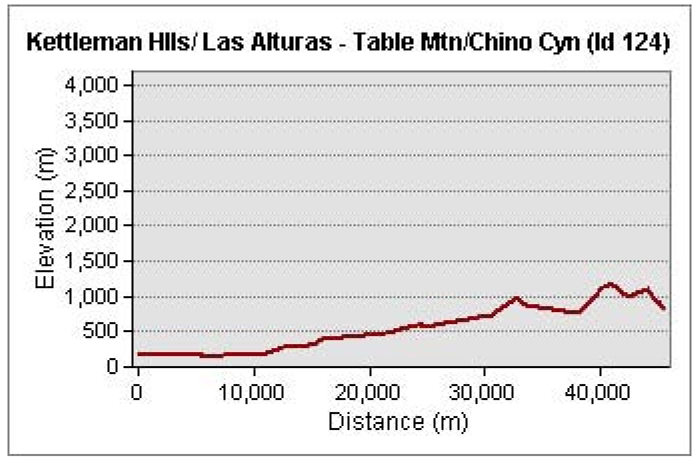

Lake Perris - The Badlands E (Id 119)
Elevation (m)
Distance (m)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
5,000
10,000

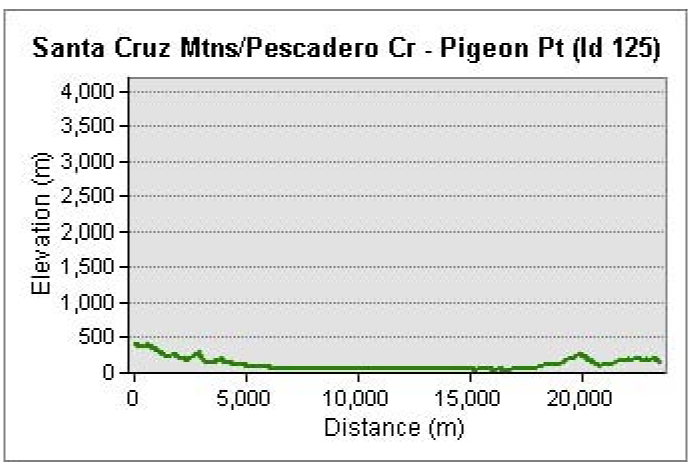

Estelle Mtn - Lake Matthews (d 120)
Elevation (m)
Distance (m)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
2,000
4,000
6,000
8,000
10,000

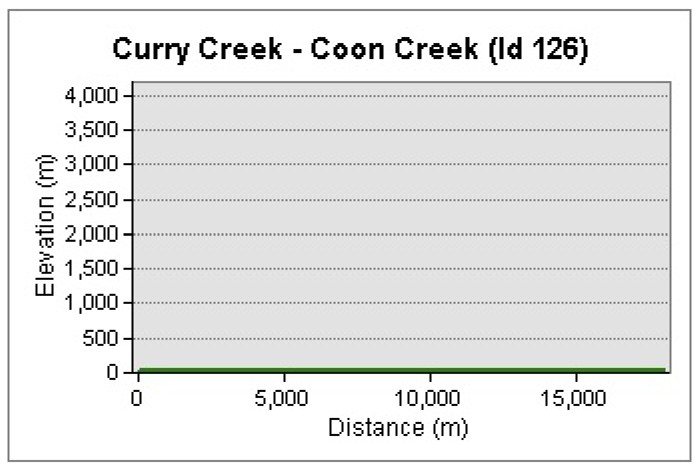

Mooney Island - Ishi Wilderness (Id 121)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
Distance (m)

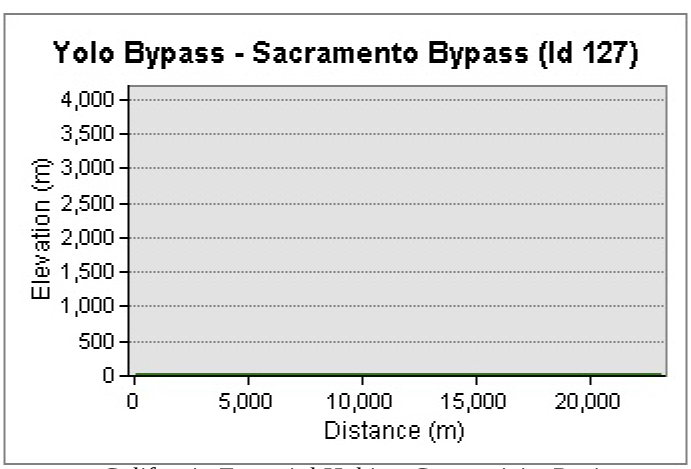

Poso Cr - Five Dog Cr (Id 122)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
5,000
10,000
Distance (m)

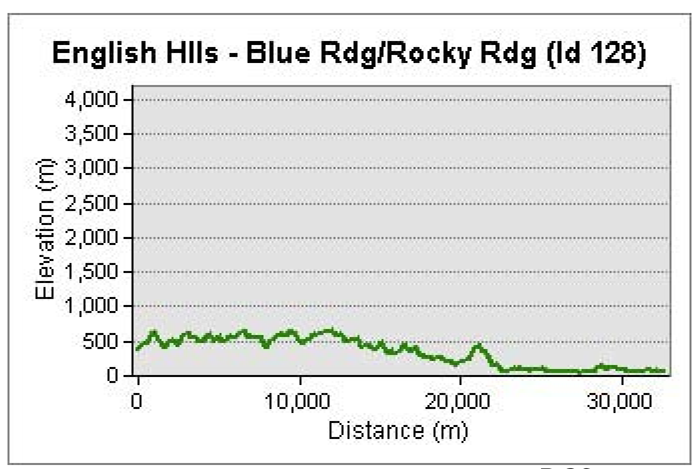

Ten Section Oil Field - Elk Hills (Id 123)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
30,00
Distance (m)

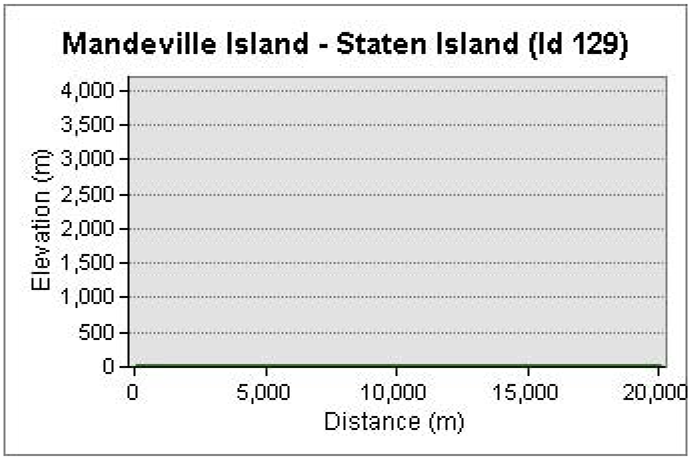

Kettleman Hlls/ Las Alturas - Table Mtn/Chino Cyn (Id 124)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
30,000
40,000
Distance (m)

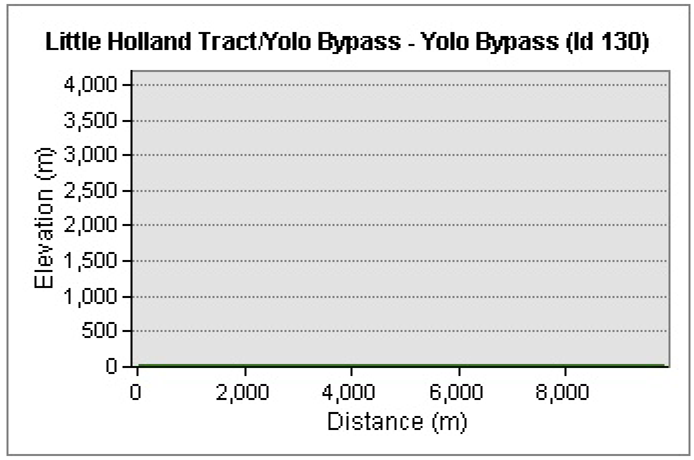

Santa Cruz Mtns/Pescadero Cr - Pigeon Pt (Id 125)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
5,000
10,000
15,000
20,000
Distance (m)

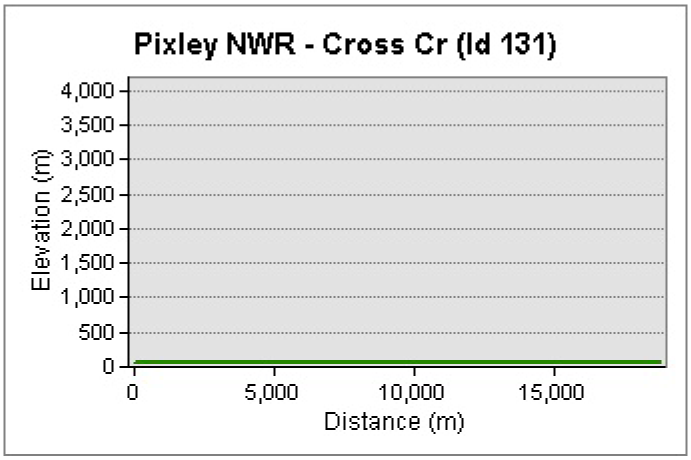

Curry Creek - Coon Creek (Id 126)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
5,000
10,000
15,000
Distance (m)

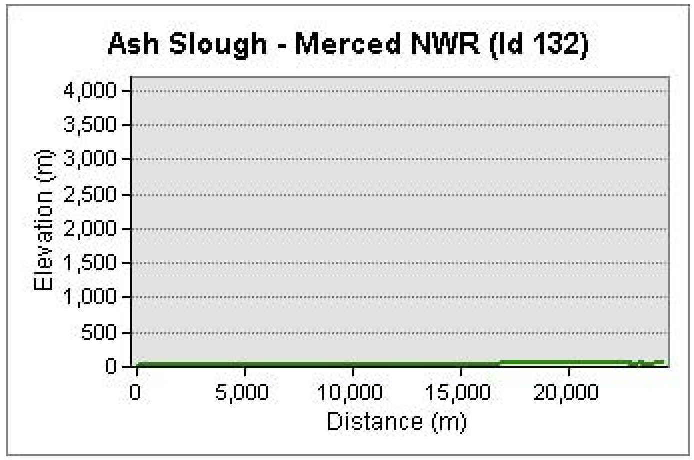

Yolo Bypass - Sacramento Bypass (Id 127)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
5,000
10,000
15,000
20,000
Distance (m)

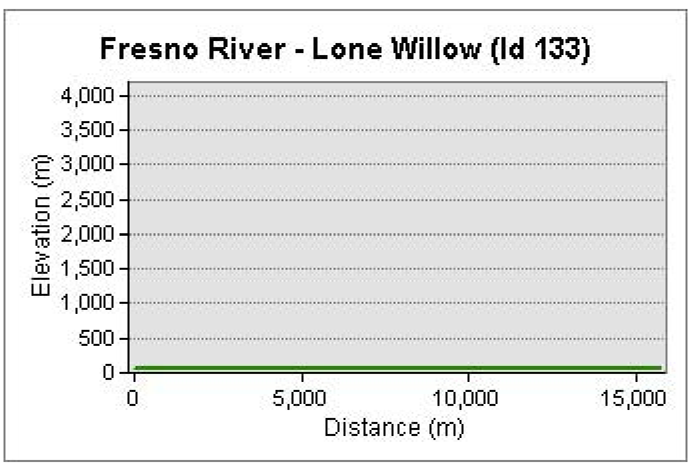

English Hlls - Blue Rdg/Rocky Rdg (Id 128)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
30,000
Distance (m)

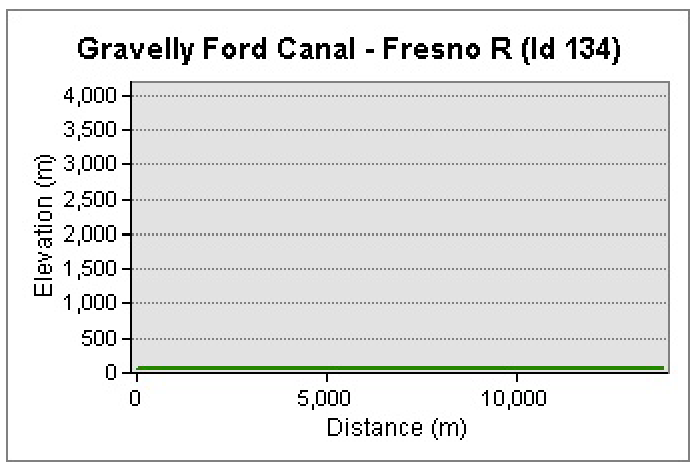

Mandeville Island - Staten Island (Id 129)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Elevation (m)
0
5,000
10,000
15,000
20,000
Distance (m)

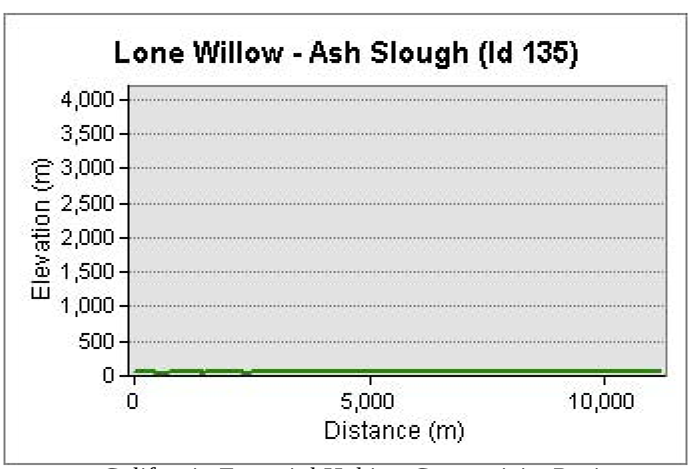

Little Holland Tract/Yolo Bypass - Yolo Bypass (Id 130)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Elevation (m)
0
2,000
4,000
6,000
8,000
Distance (m)

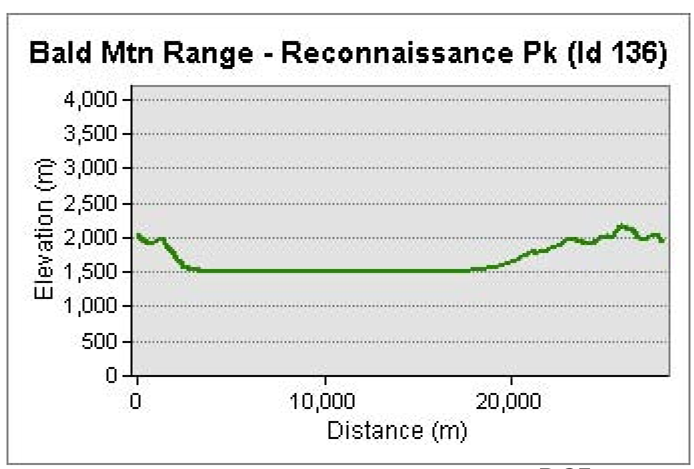

Pixley NWR - Cross Cr (Id 131)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Elevation (m)
0
5,000
10,000
15,000
Distance (m)

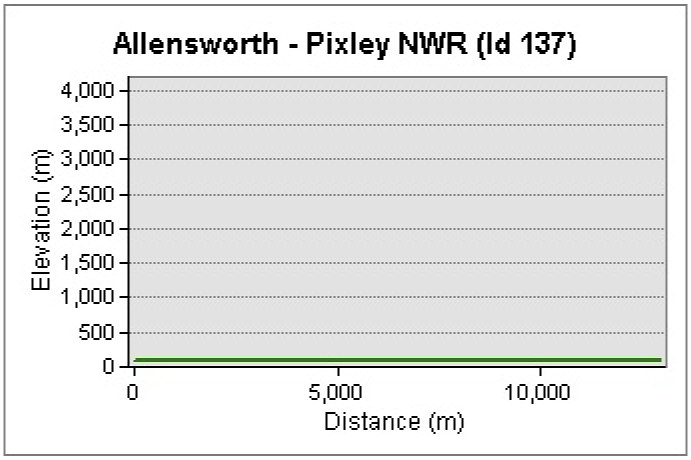

Ash Slough - Merced NWR (Id 132)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Elevation (m)
0
5,000
10,000
15,000
20,000
Distance (m)

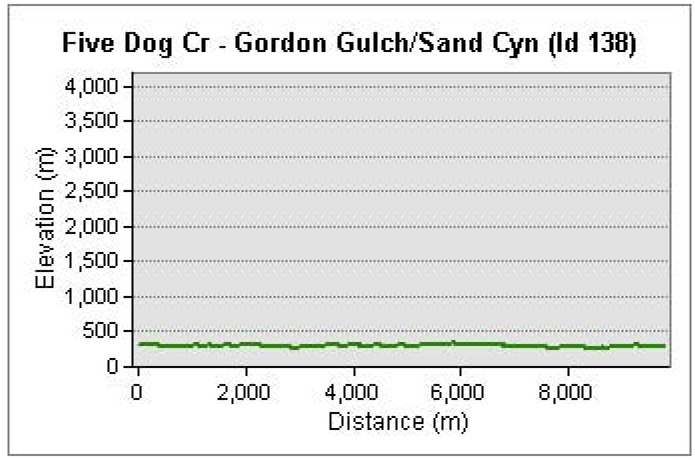

Fresno River - Lone Willow (Id 133)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Elevation (m)
0
5,000
10,000
15,000
Distance (m)

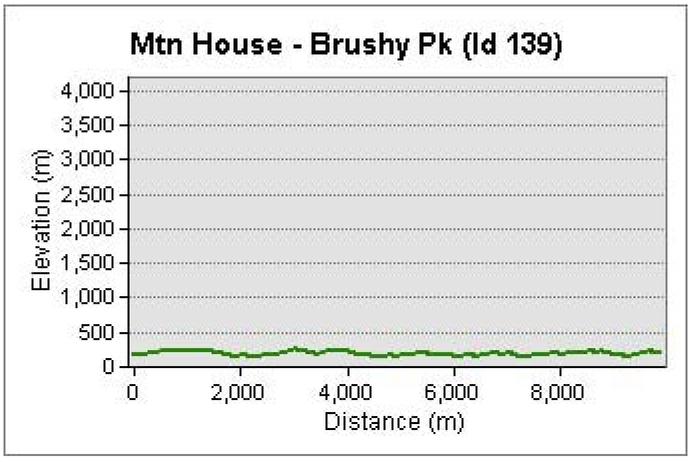

Gravelly Ford Canal - Fresno R (Id 134)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Elevation (m)
0
5,000
10,000
Distance (m)

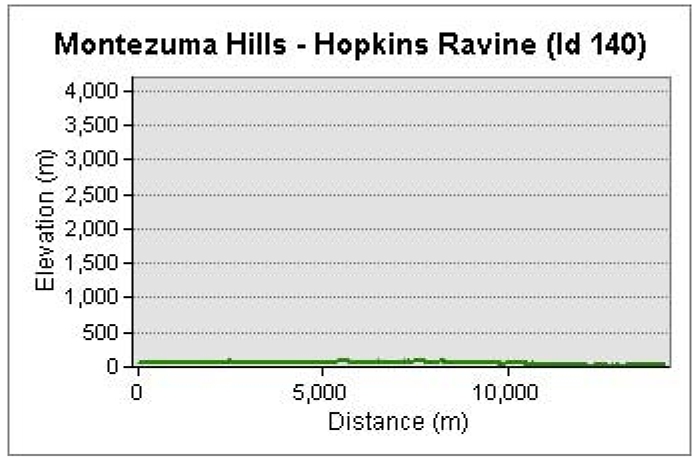

Lone Willow - Ash Slough (Id 135)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Elevation (m)
0
5,000
10,000
Distance (m)

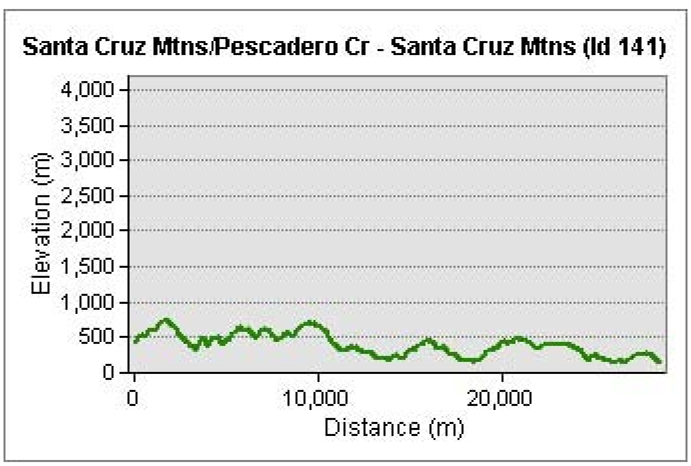

Bald Mtn Range - Reconnaissance Pk (Id 136)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Elevation (m)
0
10,000
20,000
Distance (m)

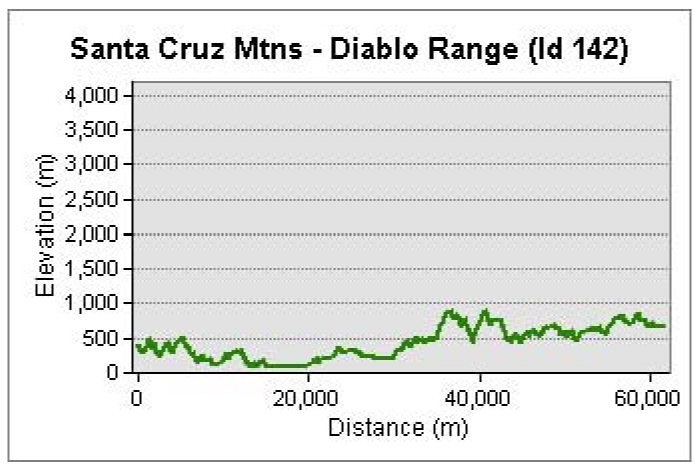

Allensworth - Pixley NWR (Id 137)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
5,000
10,000
Distance (m)

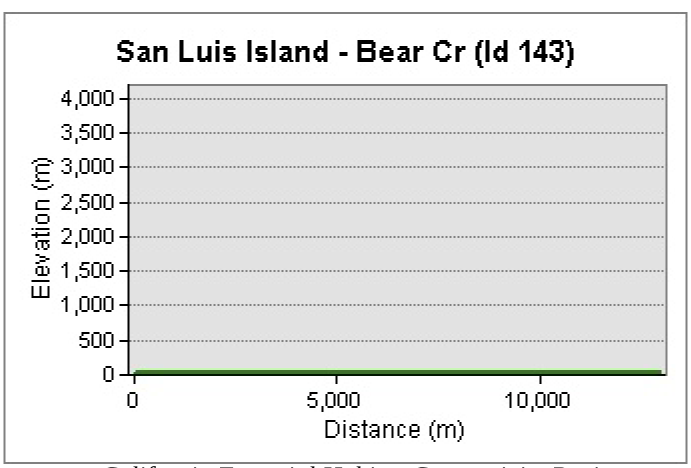

Five Dog Cr - Gordon Gulch/Sand Cyn (Id 138)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
2,000
4,000
6,000
8,000
Distance (m)

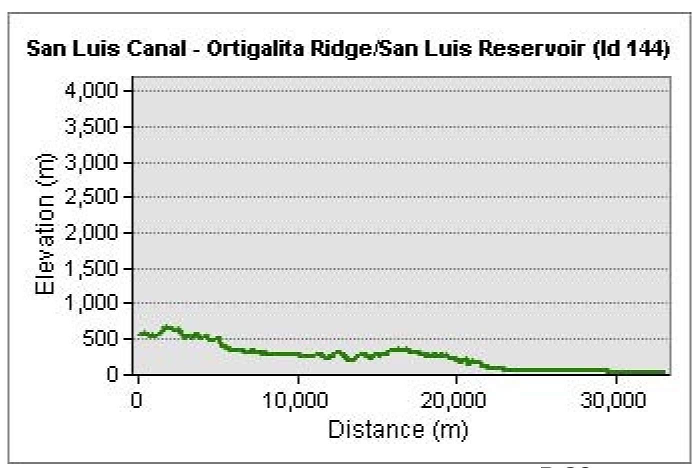

Mtn House - Brushy Pk (Id 139)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
2,000
4,000
6,000
8,000
Distance (m)


Montezuma Hills - Hopkins Ravine (Id 140)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
5,000
10,000
Distance (m)

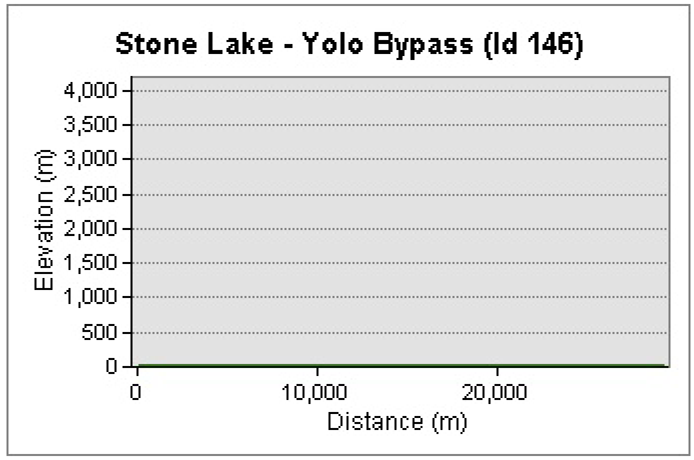

Santa Cruz Mtns/Pescadero Cr - Santa Cruz Mtns (Id 141)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
Distance (m)

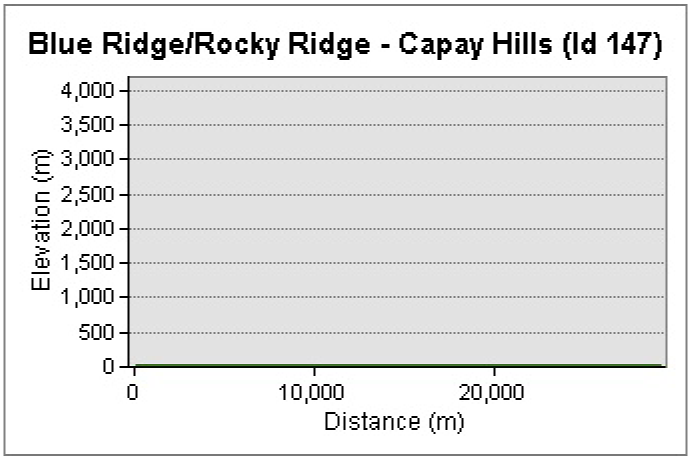

Santa Cruz Mtns - Diablo Range (Id 142)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
20,000
40,000
60,000
Distance (m)

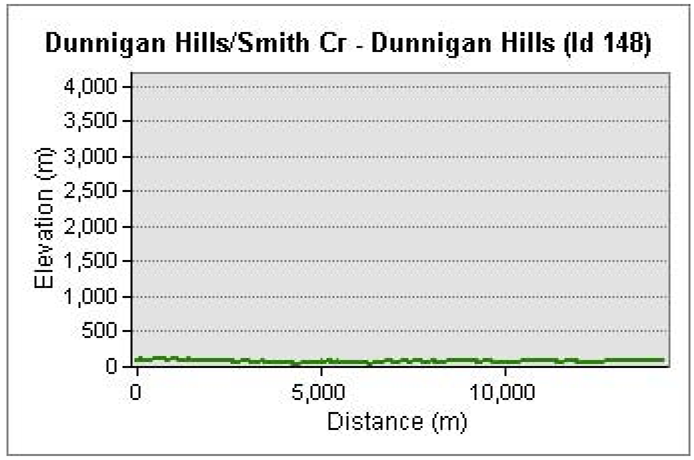

San Luis Island - Bear Cr (Id 143)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
5,000
10,000
Distance (m)

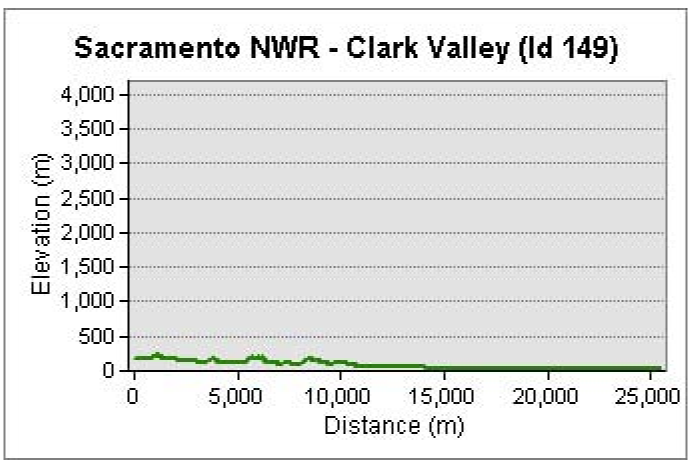

San Luis Canal - Ortigalita Ridge/San Luis Reservoir (Id 144)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
30,000
Distance (m)

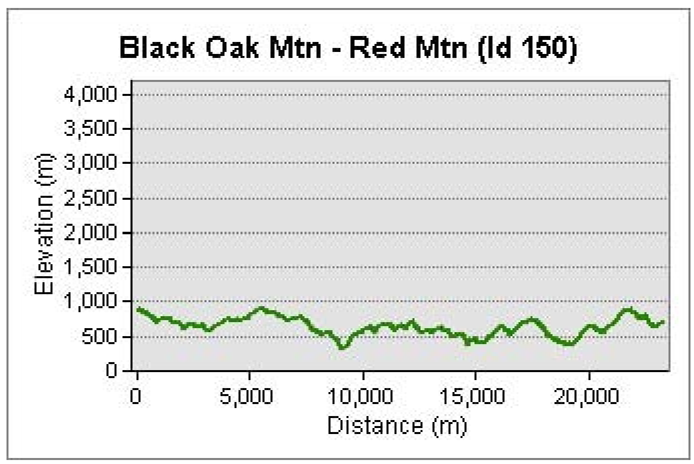

San Geronimo - Los Padres NF (Id 145)
Elevation (m)
Distance (m)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
0
20,000
40,000
60,000
80,000

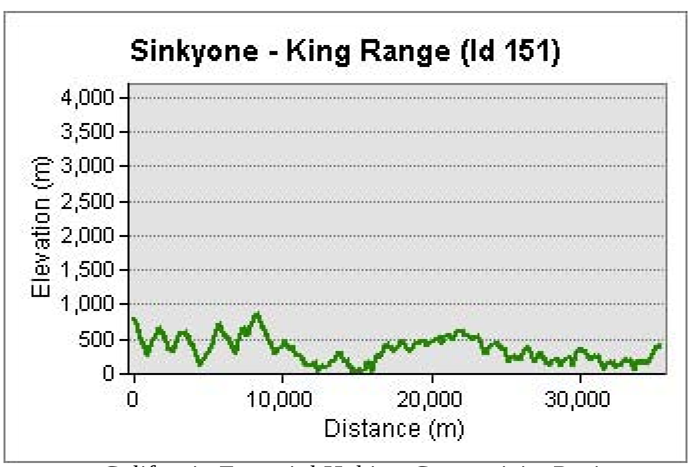

Stone Lake - Yolo Bypass (Id 146)
Elevation (m)
Distance (m)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
0
10,000
20,000

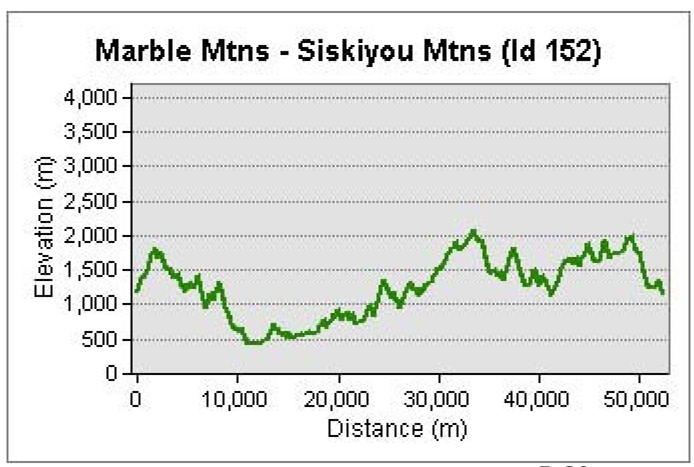

Blue Ridge/Rocky Ridge - Capay Hills (Id 147)
Elevation (m)
Distance (m)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
0
10,000
20,000

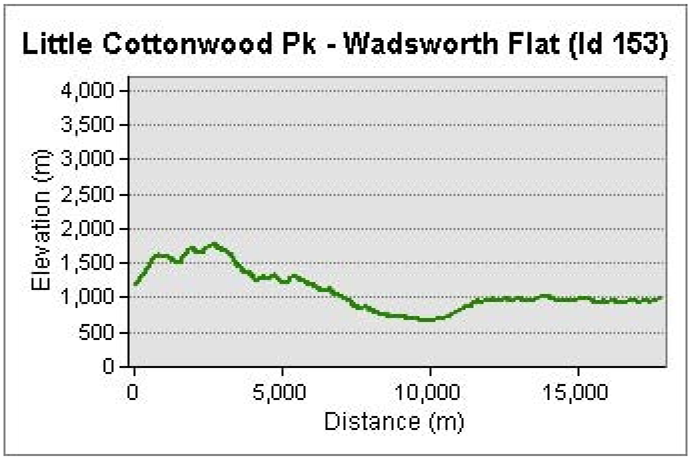

Dunnigan Hills/Smith Cr - Dunnigan Hills (Id 148)
Elevation (m)
Distance (m)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
0
5,000
10,000

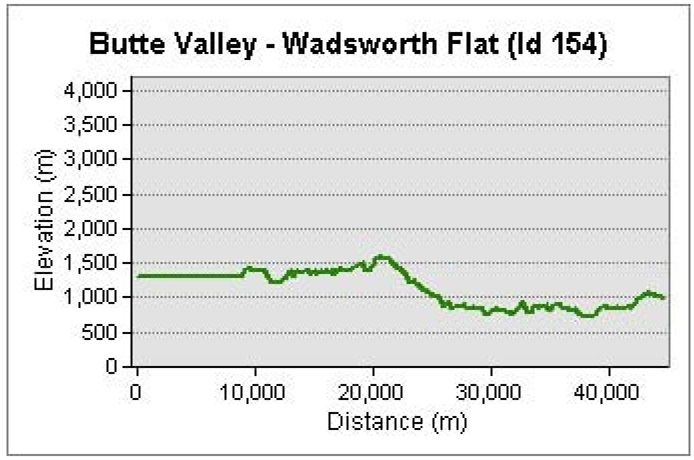

Sacramento NWR - Clark Valley (Id 149)
Elevation (m)
Distance (m)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
0
5,000
10,000
15,000
20,000
25,000

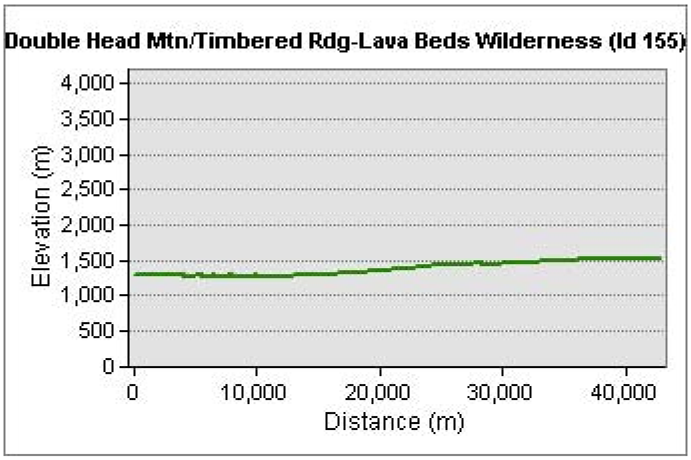

Black Oak Mtn - Red Mtn (Id 150)
Elevation (m)
Distance (m)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
0
5,000
10,000
15,000
20,000

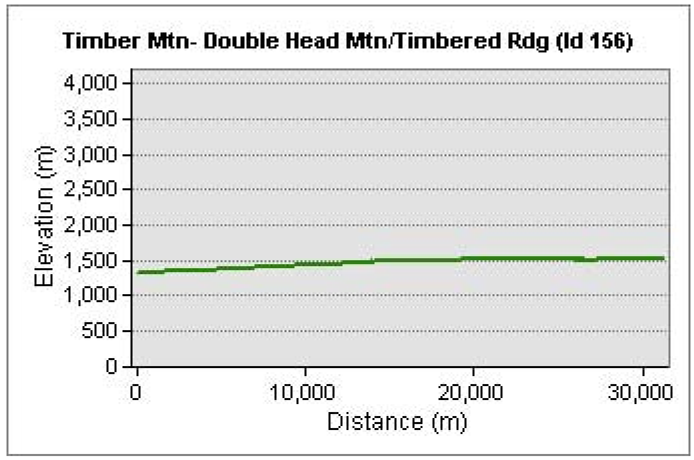

Sinkyone - King Range (Id 151)
Elevation (m)
Distance (m)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
0
10,000
20,000
30,000

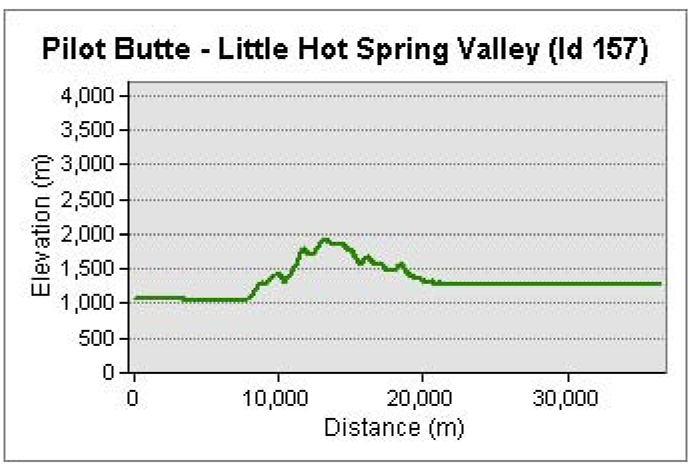

Marble Mtns - Siskiyou Mtns (Id 152)
Elevation (m)
Distance (m)
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
0
10,000
20,000
30,000
40,000
50,000

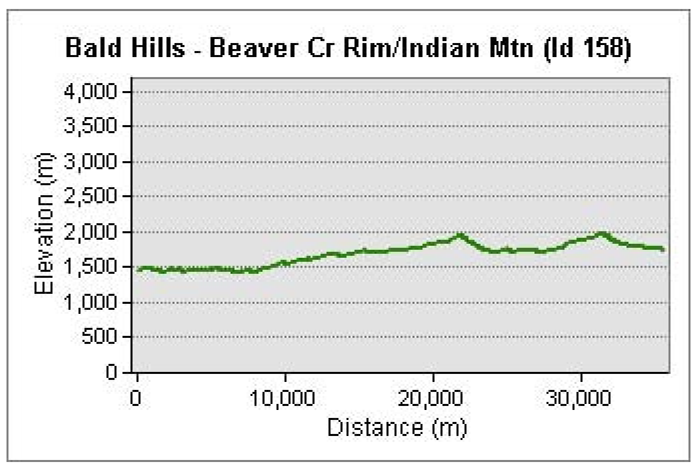

Little Cottonwood Pk - Wadsworth Flat (Id 153)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
5,000
10,000
15,000
Distance (m)

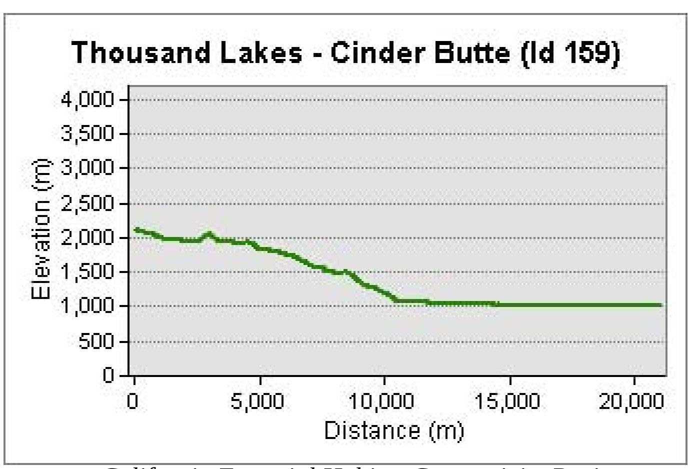

Butte Valley - Wadsworth Flat (Id 154)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
30,000
40,000
Distance (m)

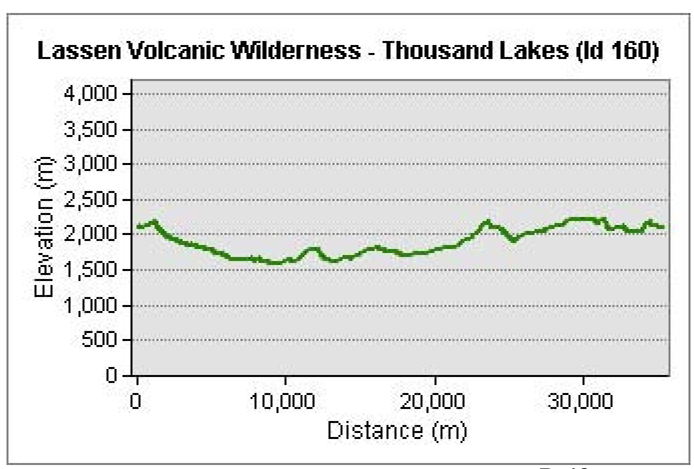

Double Head Mtn/Timbered Rdg-Lava Beds Wilderness (Id 155)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
30,000
40,000
Distance (m)

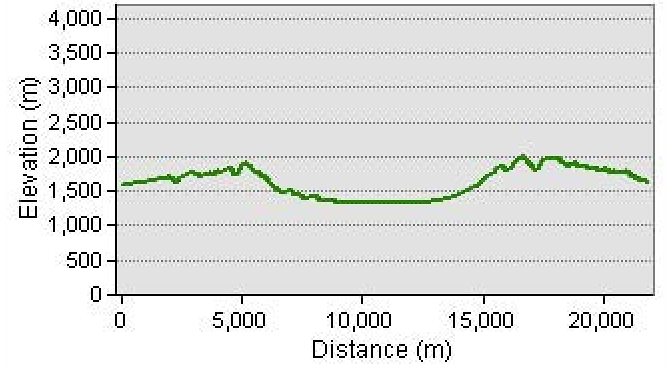

Timber Mtn- Double Head Mtn/Timbered Rdg (Id 156)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
30,000
Distance (m)


Pilot Butte - Little Hot Spring Valley (Id 157)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
30,000
Distance (m)

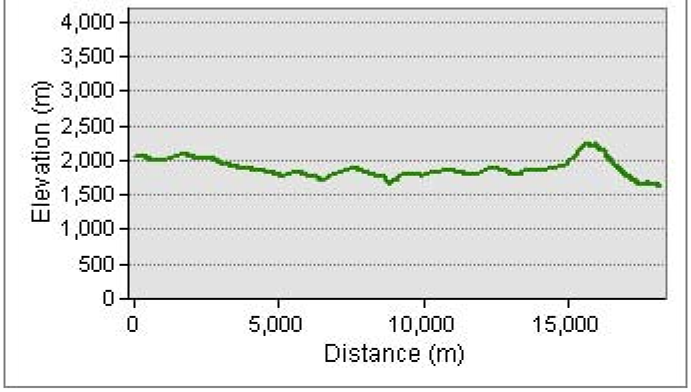

Bald Hills - Beaver Cr Rim/Indian Mtn (Id 158)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
30,000
Distance (m)


Thousand Lakes - Cinder Butte (Id 159)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
5,000
10,000
15,000
20,000
Distance (m)

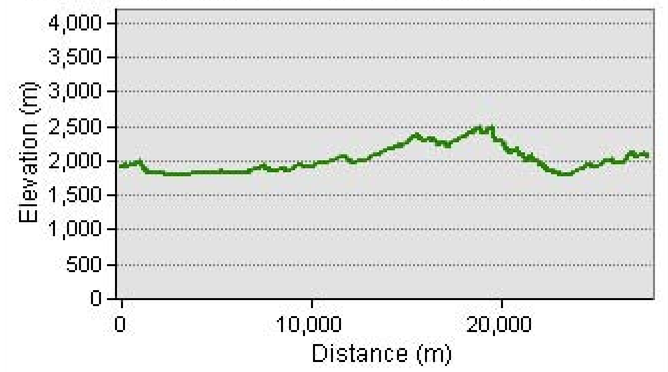

Lassen Volcanic Wilderness - Thousand Lakes (Id 160)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
30,000
Distance (m)



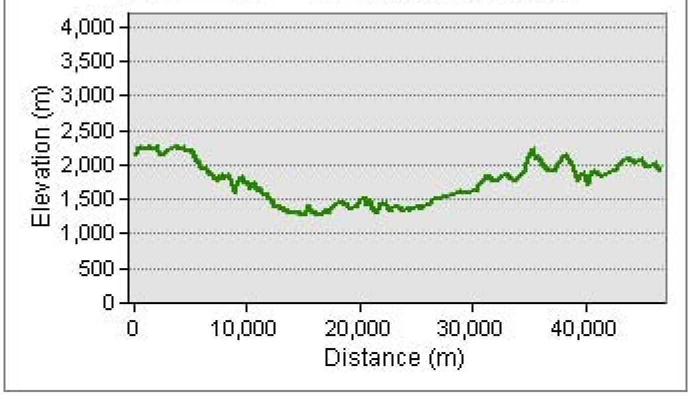
Adams Pk - Fort Sage Mtns (Id 161)



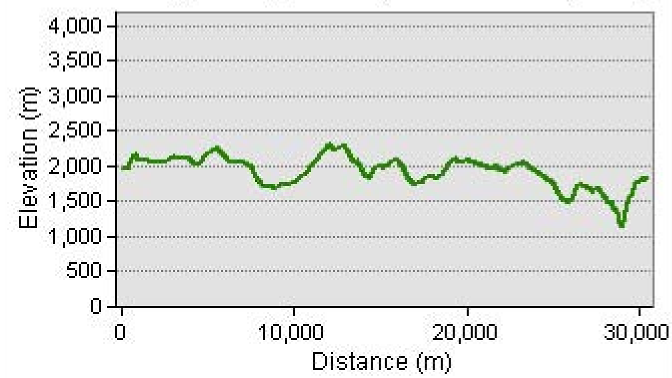
Adams Pk - Reconnaissance Pk (Id 162)



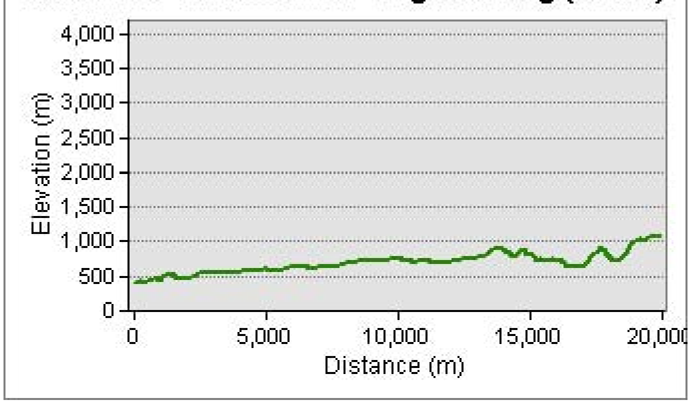
Reconnaissance Pk - Diamond Mtns (Id 163)



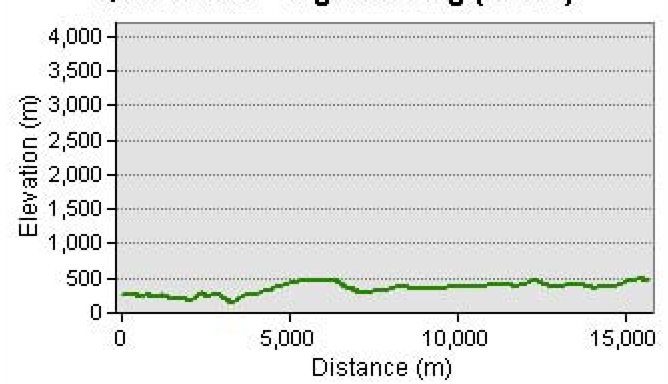
Mt Killmore - Grizzly Mtn (Id 164)



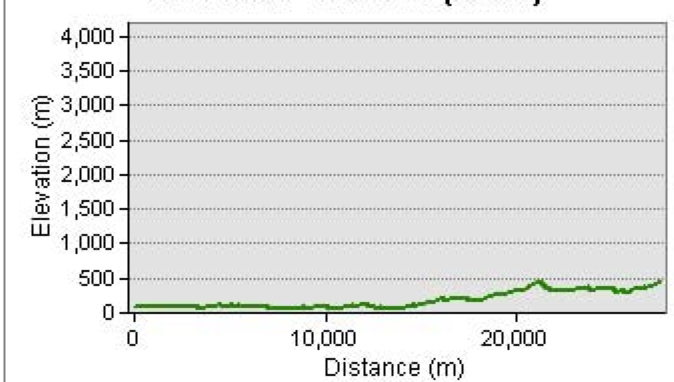
Sawtooth Rdg - Lafayette Rdg/Black Buttes (Id 165)



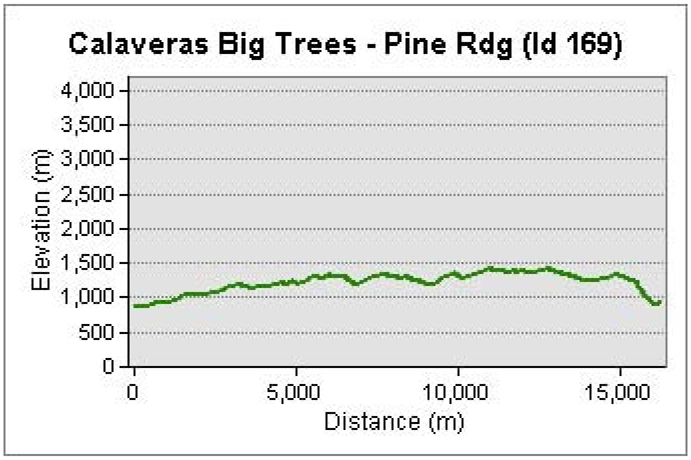
Middle Fk Cosumnes R - Big Mtn Rdg (Id 166)

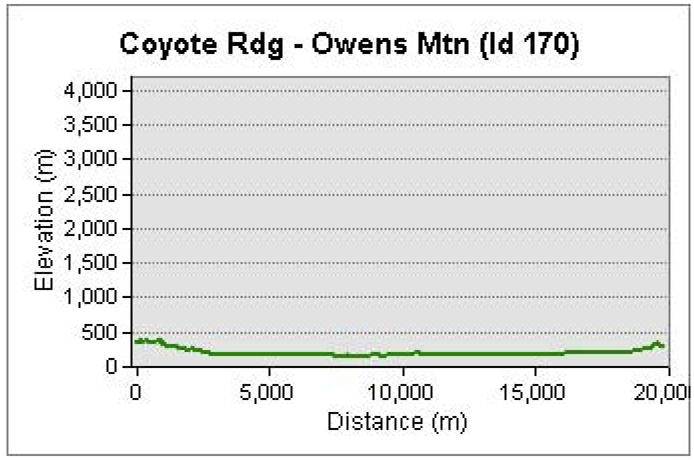


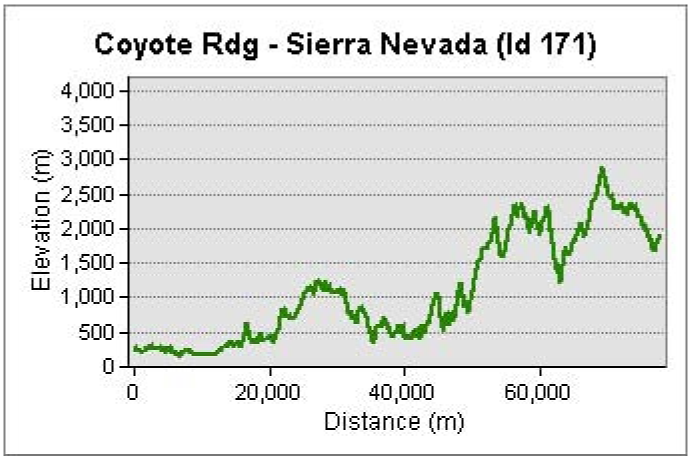
Quartz Mtn - Logtown Rdg (Id 167)

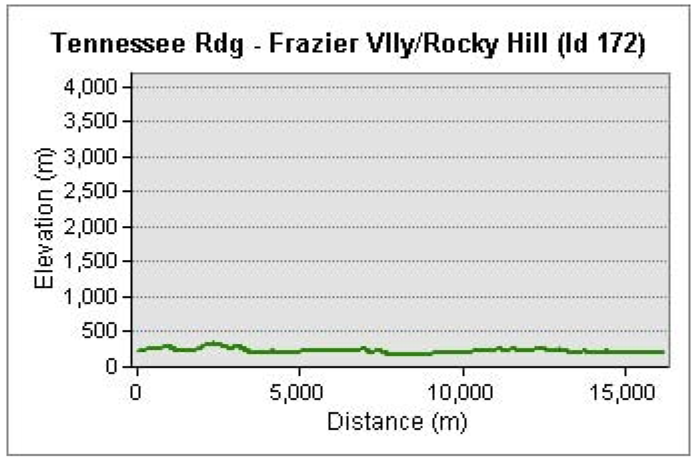


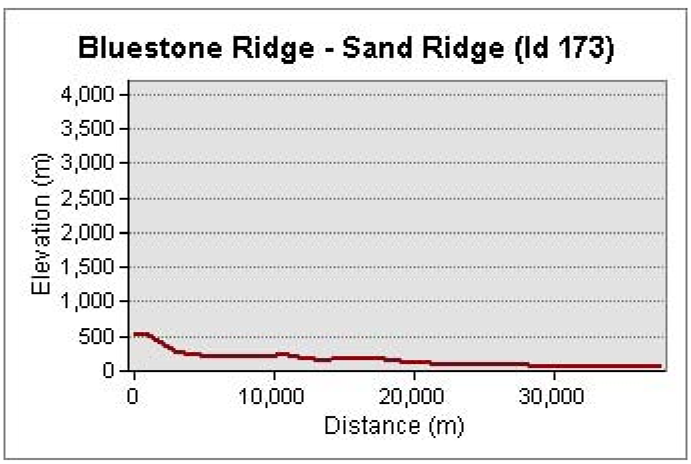
Bear Mtns - Duck Cr (Id 168)

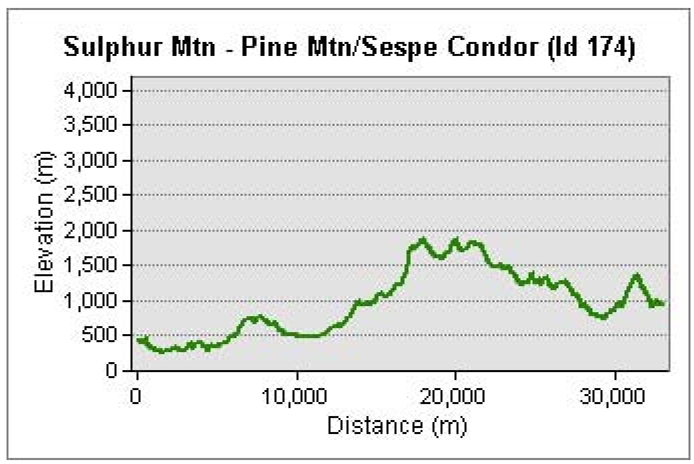

Calaveras Big Trees - Pine Rdg (Id 169)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
5,000
10,000
15,000
Distance (m)

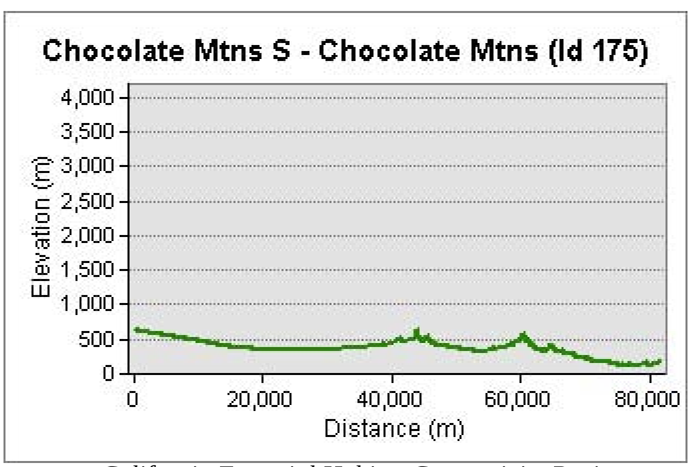

Coyote Rdg - Owens Mtn (Id 170)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
5,000
10,000
15,000
Distance (m)

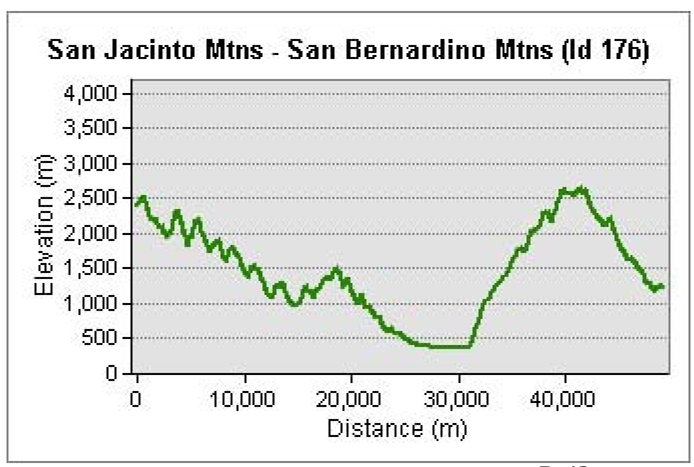

Coyote Rdg - Sierra Nevada (Id 171)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
20,000
40,000
60,000
Distance (m)

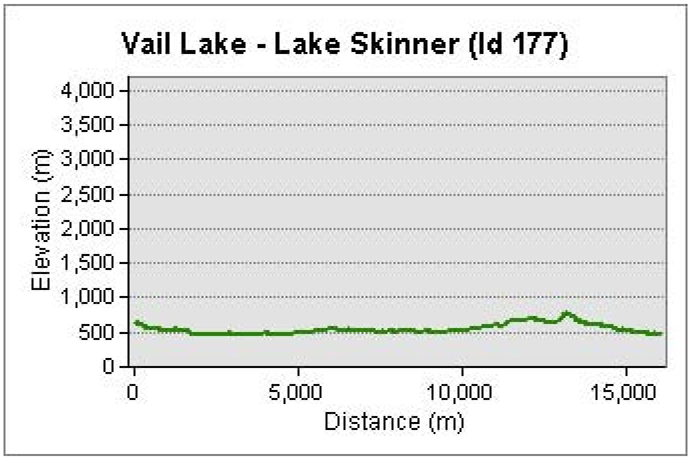

Tennessee Rdg - Frazier Vlly/Rocky Hill (Id 172)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
5,000
10,000
15,000
Distance (m)

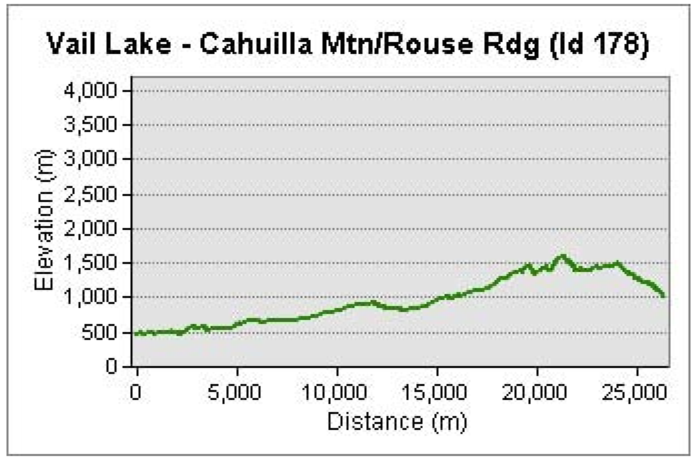

Bluestone Ridge - Sand Ridge (Id 173)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
30,000
Distance (m)

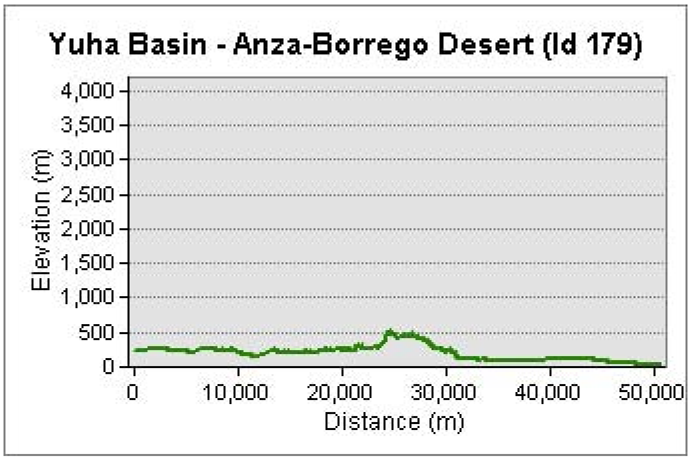

Sulphur Mtn - Pine Mtn/Sespe Condor (Id 174)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
30,000
Distance (m)

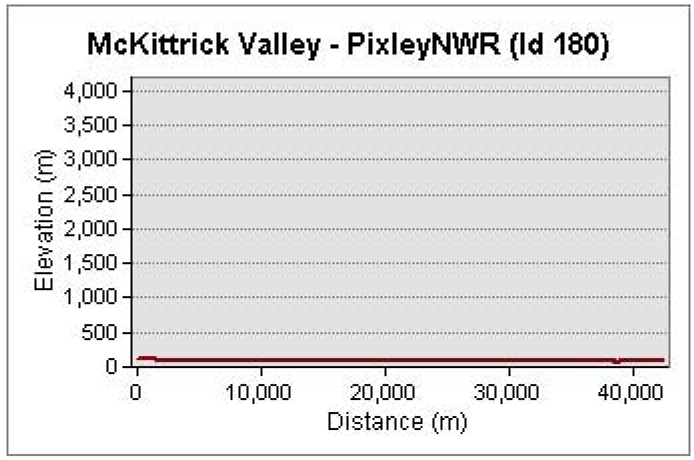

Chocolate Mtns S - Chocolate Mtns (Id 175)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
20,000
40,000
60,000
80,000
Distance (m)

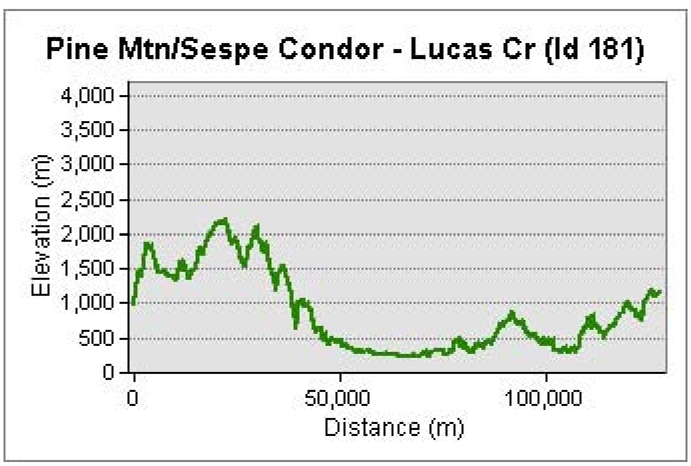

San Jacinto Mtns - San Bernardino Mtns (Id 176)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
30,000
40,000
Distance (m)

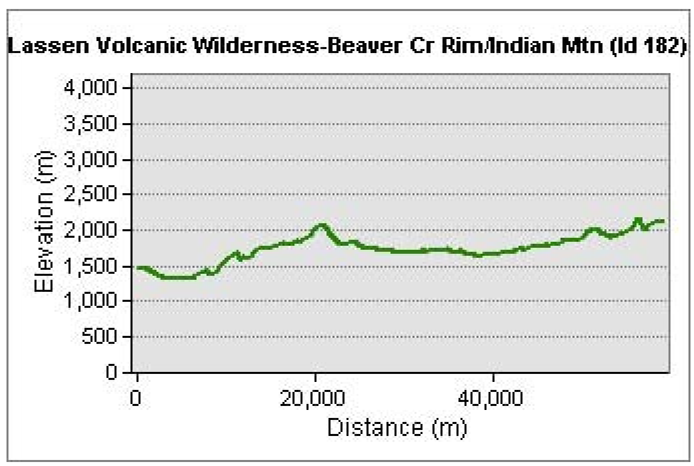

Vail Lake - Lake Skinner (Id 177)
Elevation (m)
Distance (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
5,000
10,000
15,000

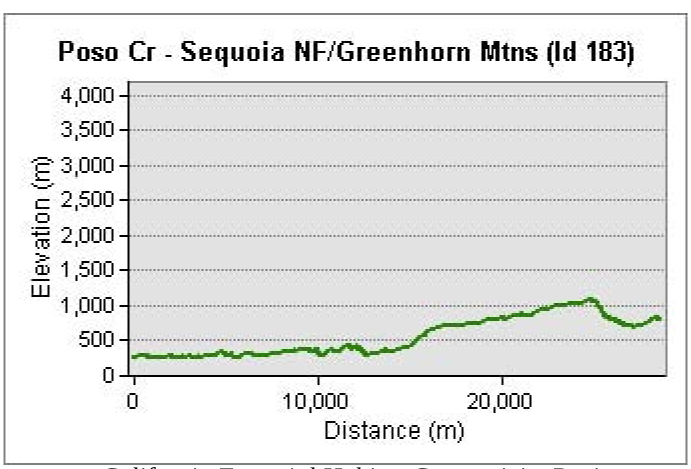

Vail Lake - Cahuilla Mtn/Rouse Rdg (Id 178)
Elevation (m)
Distance (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
5,000
10,000
15,000
20,000
25,000

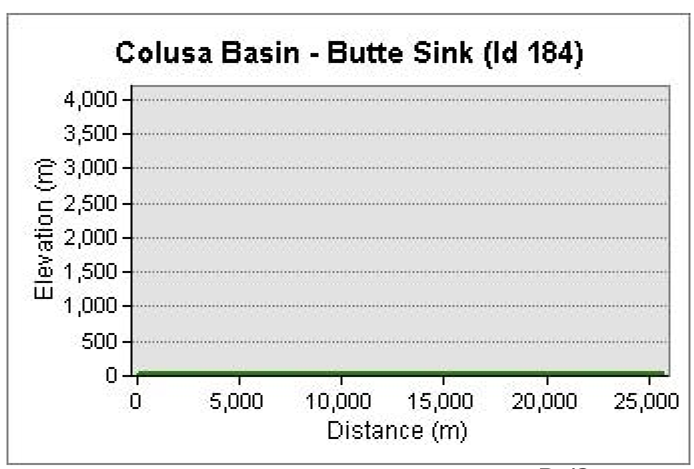

Yuha Basin - Anza-Borrego Desert (Id 179)
Elevation (m)
Distance (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
30,000
40,000
50,000

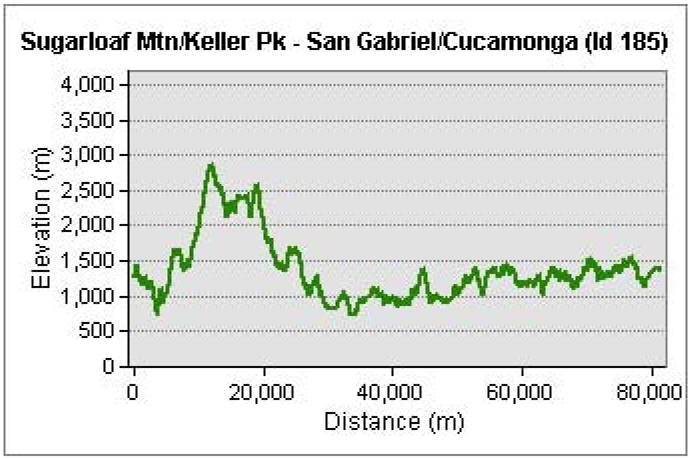

McKittrick Valley - PixleyNWR (Id 180)
Elevation (m)
Distance (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
30,000
40,000

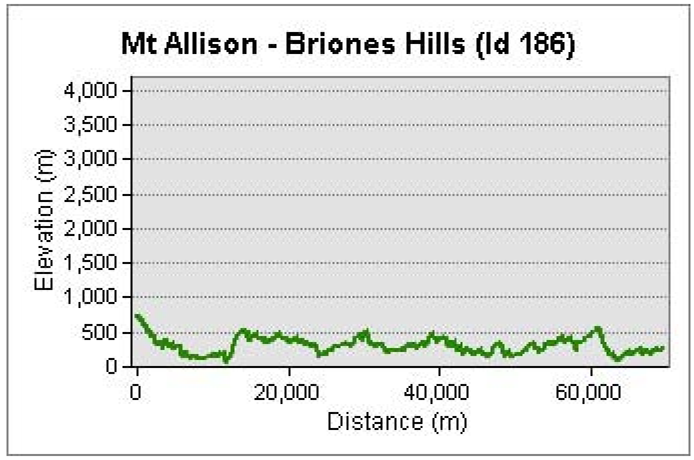

Pine Mtn/Sespe Condor - Lucas Cr (Id 181)
Elevation (m)
Distance (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
50,000
100,000

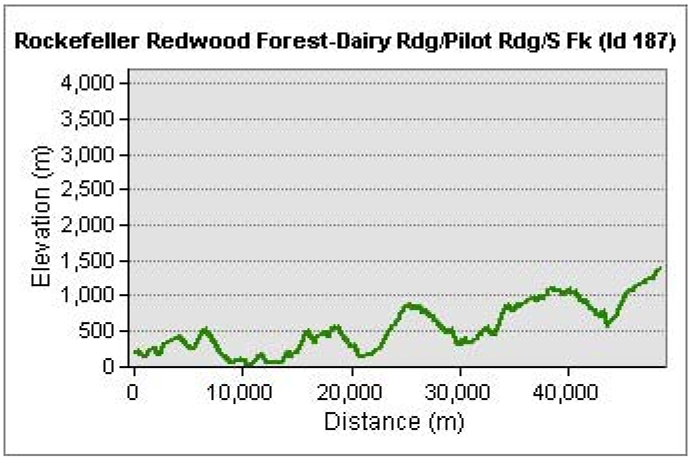

Lassen Volcanic Wilderness-Beaver Cr Rim/Indian Mtn (Id 182)
Elevation (m)
Distance (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
20,000
40,000

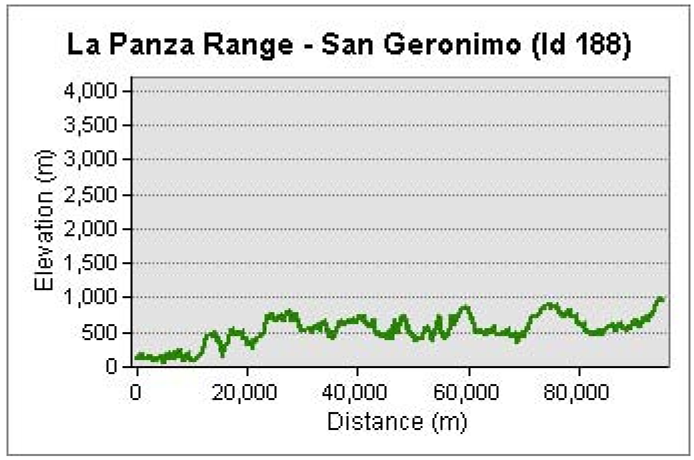

Poso Cr - Sequoia NF/Greenhorn Mtns (Id 183)
Elevation (m)
Distance (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000

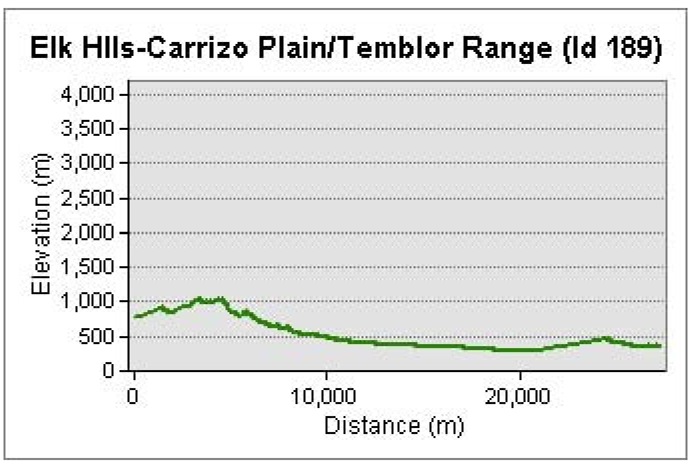

Colusa Basin - Butte Sink (Id 184)
Elevation (m)
Distance (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
5,000
10,000
15,000
20,000
25,000

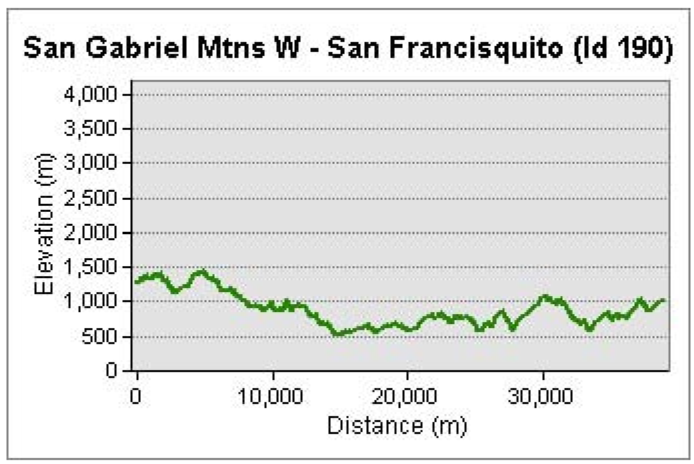

Sugarloaf Mtn/Keller Pk - San Gabriel/Cucamonga (Id 185)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
20,000
40,000
60,000
80,000
Distance (m)

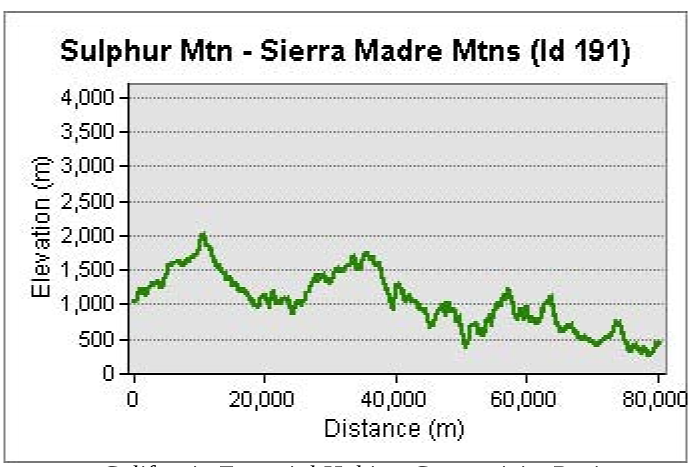

Mt Allison - Briones Hills (Id 186)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
20,000
40,000
60,000
Distance (m)

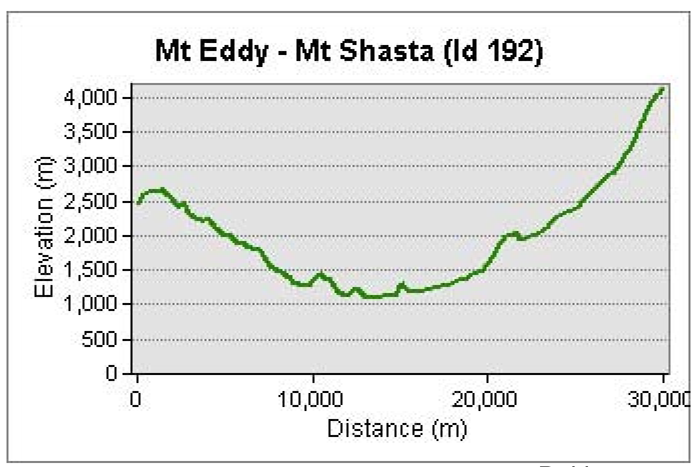

Rockefeller Redwood Forest-Dairy Rdg/Pilot Rdg/S Fk (Id 187)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
30,000
40,000
Distance (m)

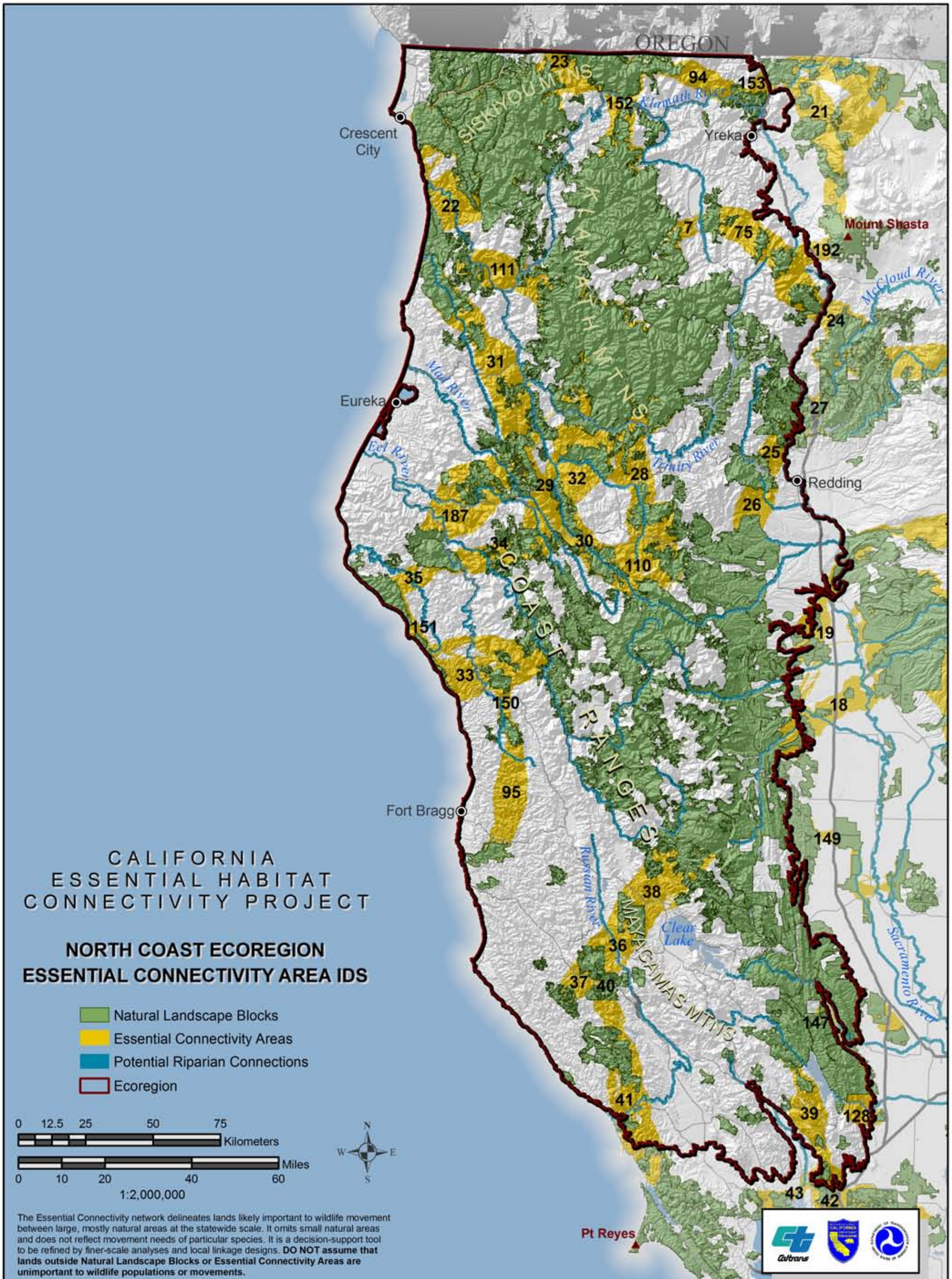

La Panza Range - San Geronimo (Id 188)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
20,000
40,000
60,000
80,000
Distance (m)

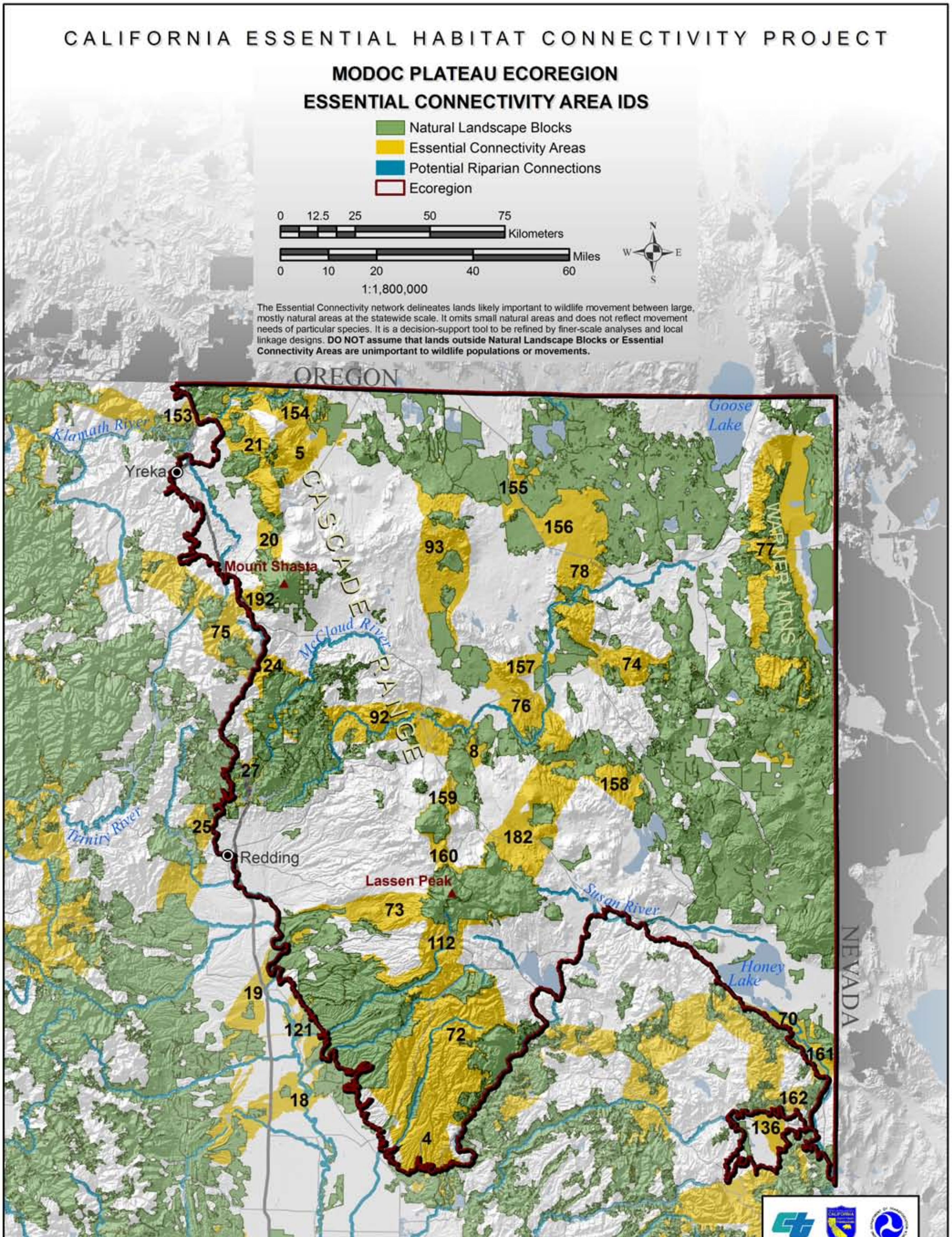

Elk Hlls-Carrizo Plain/Temblor Range (Id 189)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
Distance (m)

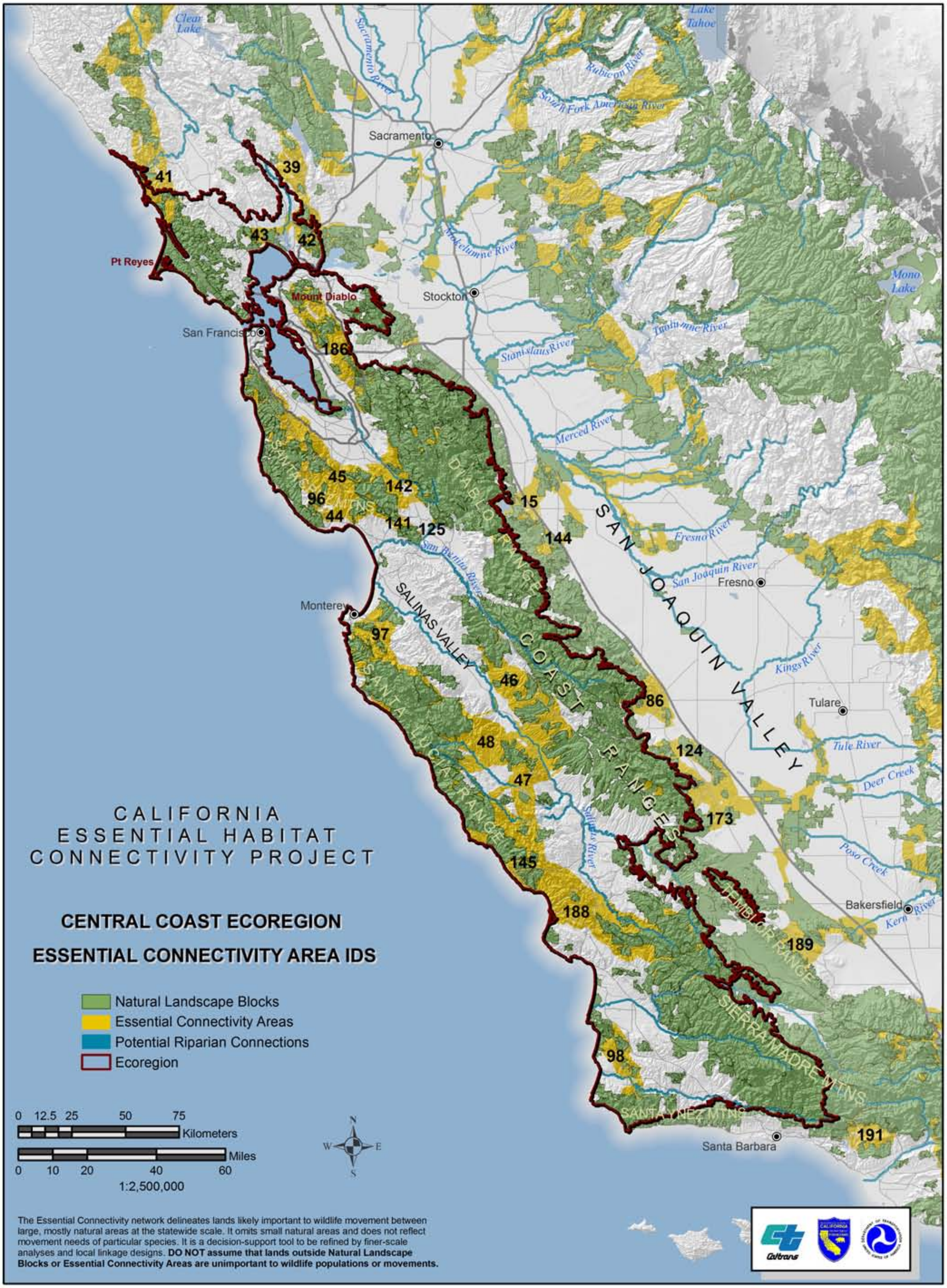

San Gabriel Mtns W - San Francisquito (Id 190)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
30,000
Distance (m)

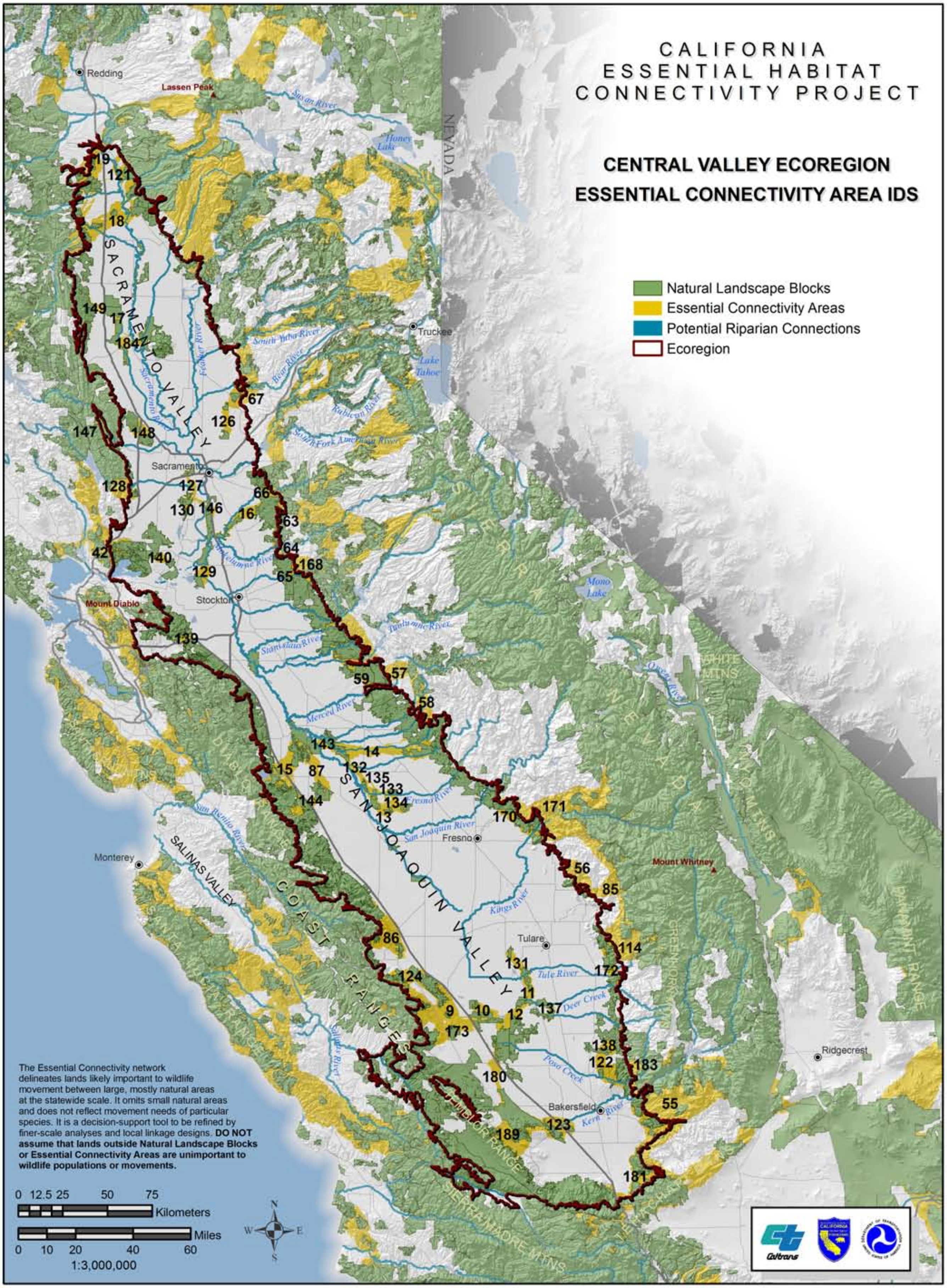

Sulphur Mtn - Sierra Madre Mtns (Id 191)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
20,000
40,000
60,000
80,000
Distance (m)

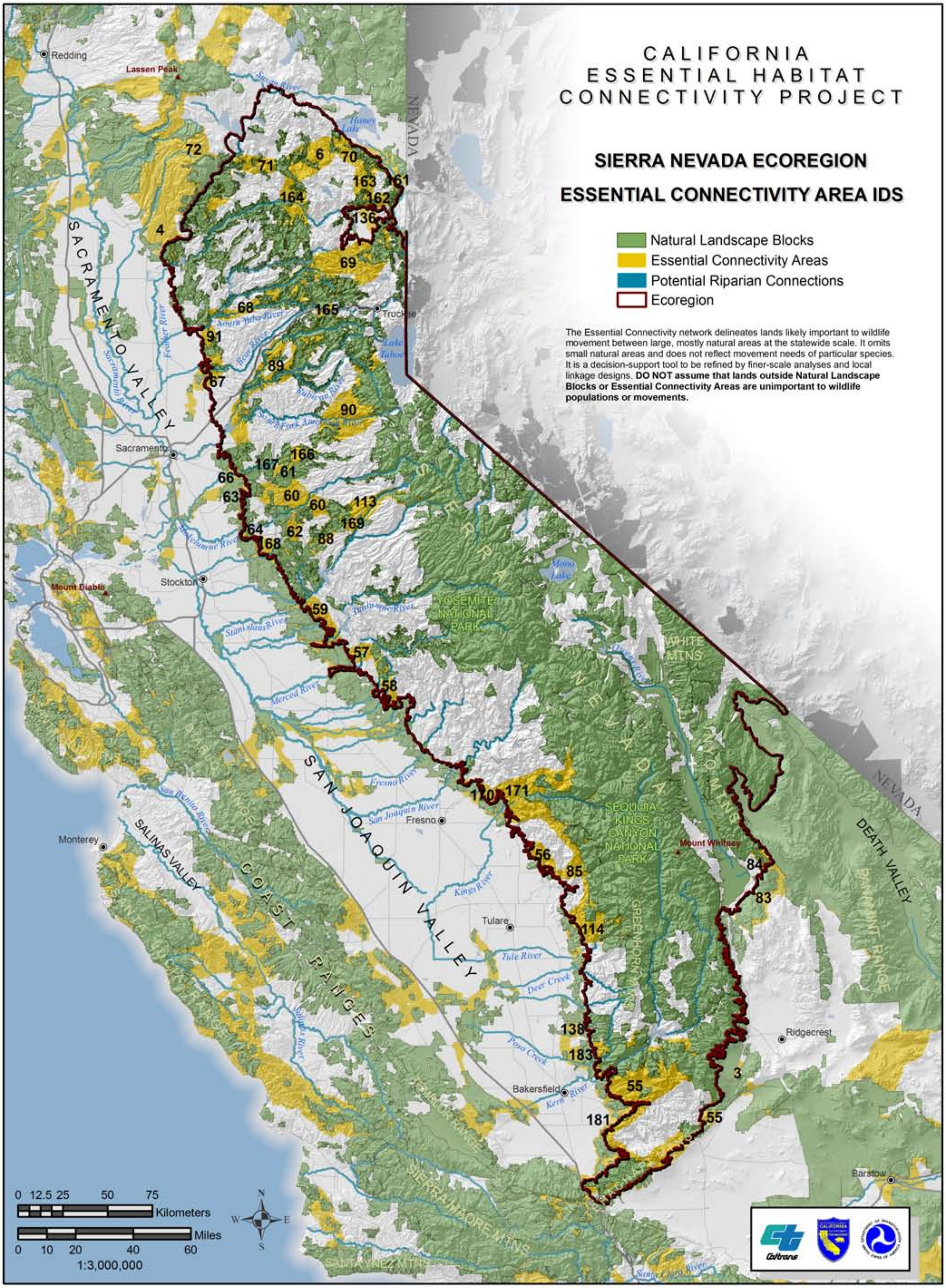

Mt Eddy - Mt Shasta (Id 192)
Elevation (m)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
0
10,000
20,000
30,000
Distance (m)

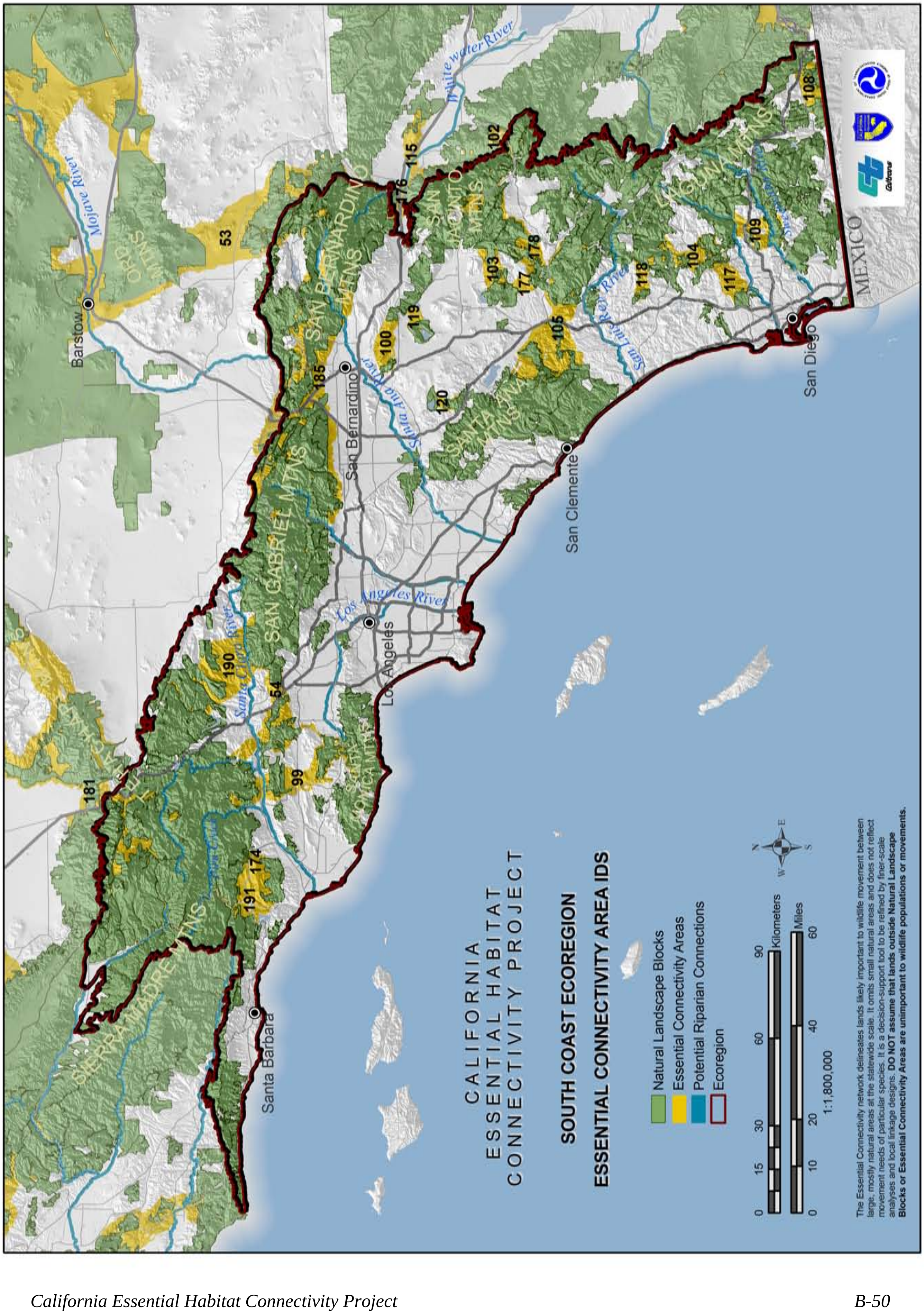

CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
NORTH COAST ECOREGION
ESSENTIAL CONNECTIVITY AREA IDS
Natural Landscape Blocks
Essential Connectivity Areas
Potential Riparian Connections
Ecoregion
0 12.5 25 50 75 Kilometers
0 10 20 40 60 Miles
1:2,000,000
N W E S
The Essential Connectivity network delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. **DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.**
OREGON
SISKIYOU MTNS
KLAMATH MTNS
COAST RANGES
MAYACAMAS MTNS
Klamath River
Mad River
Eel River
Trinity River
McCloud River
Russian River
Sacramento River
Clear Lake
Crescent City
Eureka
Yreka
Redding
Fort Bragg
Mount Shasta
Pt Reyes
Caltrans
23
94
153
152
21
22
7
75
192
111
24
31
27
25
28
32
29
26
187
34
30
110
35
151
19
33
150
18
95
149
38
36
37
40
147
41
39
128
43
42

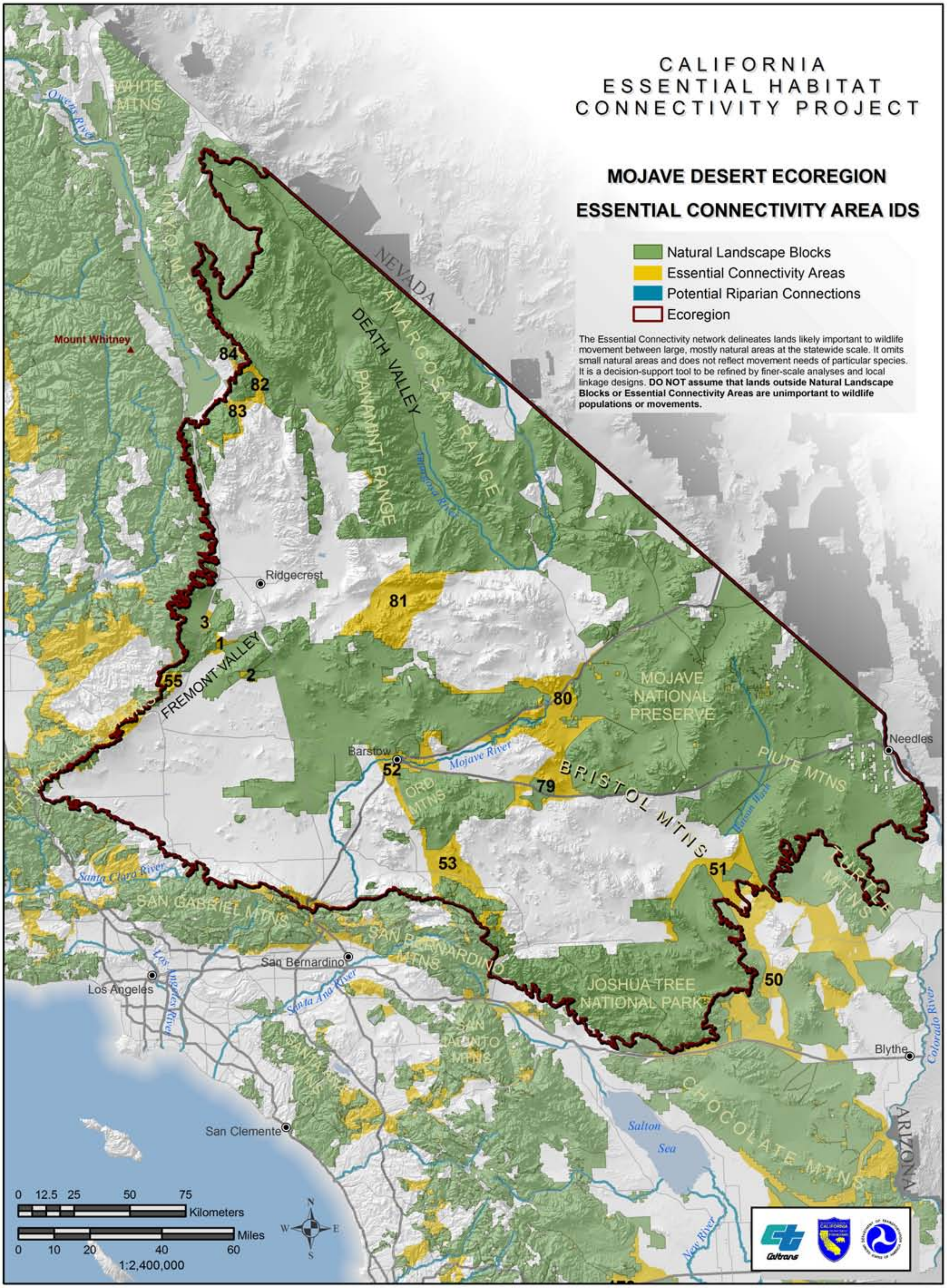

CALIFORNIA ESSENTIAL HABITAT CONNECTIVITY PROJECT
MODOC PLATEAU ECOREGION
ESSENTIAL CONNECTIVITY AREA IDS
Natural Landscape Blocks
Essential Connectivity Areas
Potential Riparian Connections
Ecoregion
0 12.5 25 50 75
Kilometers
Miles
0 10 20 40 60
1:1,800,000
The Essential Connectivity network delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.
OREGON
NEVADA
CASCADE RANGE
WARNER MTNS
Klamath River
McCloud River
Trinity River
Susan River
Goose Lake
Honey Lake
Yreka
Redding
Mount Shasta
Lassen Peak
153
154
21
5
155
156
20
93
77
78
192
75
24
157
74
76
92
8
27
158
159
25
182
160
73
112
19
121
72
70
161
18
162
136
4

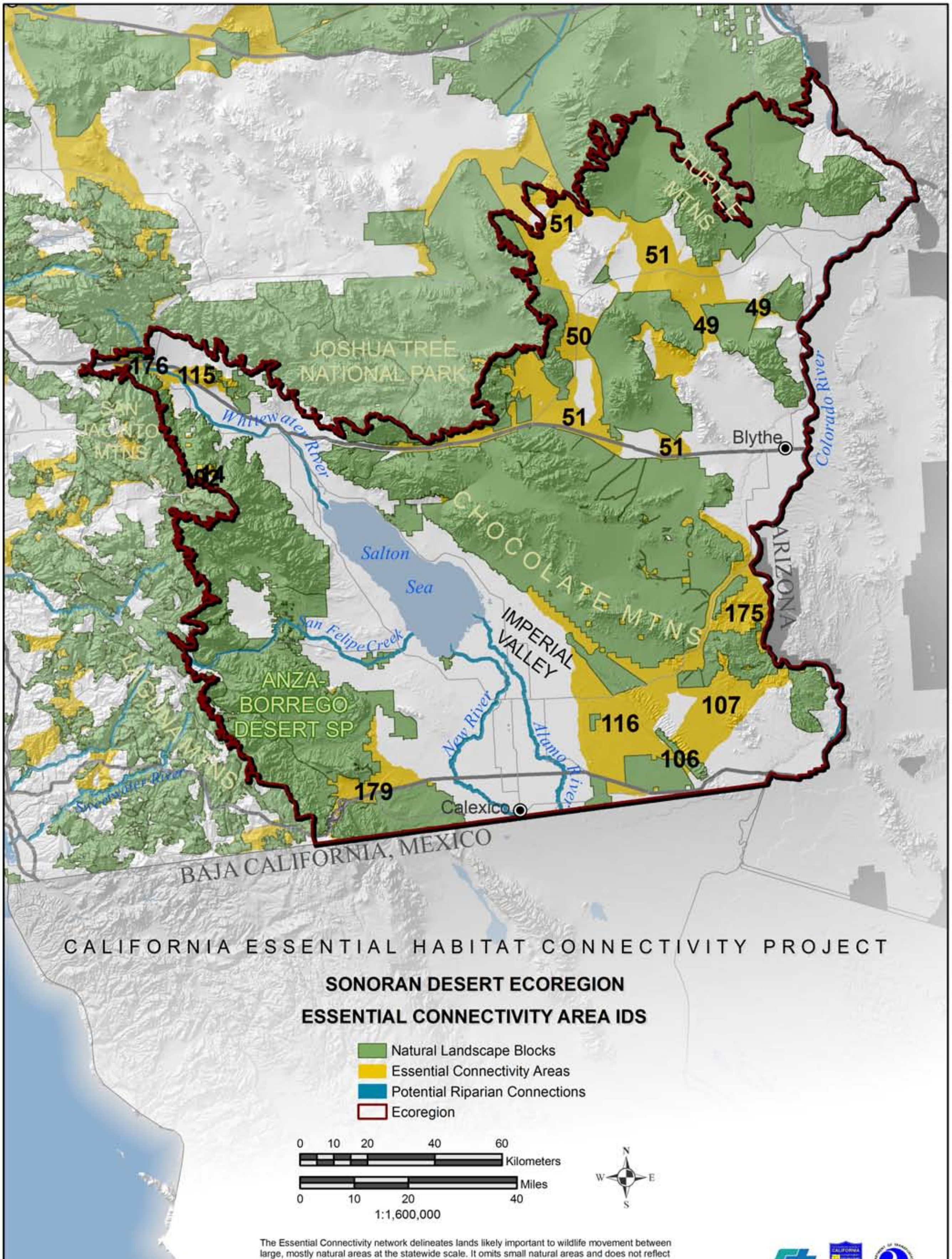

CALIFORNIA ESSENTIAL HABITAT CONNECTIVITY PROJECT
CENTRAL COAST ECOREGION
ESSENTIAL CONNECTIVITY AREA IDS
Natural Landscape Blocks
Essential Connectivity Areas
Potential Riparian Connections
Ecoregion
0 12.5 25 50 75 Kilometers
0 10 20 40 60 Miles
1:2,500,000
The Essential Connectivity network delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.
Sacramento
Stockton
San Francisco
Monterey
Fresno
Tulare
Bakersfield
Santa Barbara
Pt Reyes
Mount Diablo
SAN JOAQUIN VALLEY
SALINAS VALLEY
COAST RANGES
SANTA YNEZ MTNS
SIERRA MADRE MTNS
Clear Lake
Lake Tahoe
Mono Lake
Sacramento River
Rubicon River
South Fork American River
Mokelumne River
Tuolumne River
Stanislaus River
Merced River
Fresno River
San Joaquin River
Kings River
Tule River
Deer Creek
Poso Creek
Kern River
San Benito River
Salinas River
41
39
43
42
186
45
142
96
44
141
125
15
144
97
46
86
48
124
47
173
145
188
189
98
191


CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
CENTRAL VALLEY ECOREGION
ESSENTIAL CONNECTIVITY AREA IDS
Natural Landscape Blocks
Essential Connectivity Areas
Potential Riparian Connections
Ecoregion
The Essential Connectivity network delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.
0 12.5 25 50 75
Kilometers
Miles
0 10 20 40 60
1:3,000,000
Redding
Lassen Peak
Sacramento
Stockton
Fresno
Tulare
Bakersfield
Monterey
Truckee
Ridgecrest
Mount Diablo
Mount Whitney
SACRAMENTO VALLEY
SAN JOAQUIN VALLEY
SALINAS VALLEY
COAST RANGES
NEVADA
Caltrans


CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
SIERRA NEVADA ECOREGION
ESSENTIAL CONNECTIVITY AREA IDS
Natural Landscape Blocks
Essential Connectivity Areas
Potential Riparian Connections
Ecoregion
The Essential Connectivity network delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.
Redding
Lassen Peak
Sacramento
Stockton
Mount Diablo
Monterey
Fresno
Tulare
Bakersfield
Ridgecrest
Barstow
Truckee
Lake Tahoe
Mono Lake
Mount Whitney
NEVADA
SACRAMENTO VALLEY
SAN JOAQUIN VALLEY
SALINAS VALLEY
COAST RANGES
SIERRA NEVADA
YOSEMITE NATIONAL PARK
SEQUOIA KINGS CANYON NATIONAL PARK
WHITE MTNS
DEATH VALLEY
0 12.5 25 50 75 Kilometers
0 10 20 40 60 Miles
1:3,000,000
Caltrans


CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
SOUTH COAST ECOREGION
ESSENTIAL CONNECTIVITY AREA IDS
Natural Landscape Blocks
Essential Connectivity Areas
Potential Riparian Connections
Ecoregion
0 15 30 60 90 Kilometers
0 10 20 40 60 Miles
1:1,800,000
The Essential Connectivity network delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.
Barstow
San Bernardino
Los Angeles
San Clemente
San Diego
Santa Barbara
MEXICO
Mojave River
Whitewater River
Los Angeles River
Santa Ana River
Santa Clara River
San Luis Rey River
SAN GABRIEL MTNS
SAN BERNARDINO MTNS
SAN JACINTO MTNS
SANTA ANA MTNS
SIERRA MADRE MTNS
53
54
99
100
102
103
104
105
108
109
115
117
118
119
120
174
176
177
178
181
185
190
191


CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
MOJAVE DESERT ECOREGION
ESSENTIAL CONNECTIVITY AREA IDS
Natural Landscape Blocks
Essential Connectivity Areas
Potential Riparian Connections
Ecoregion
The Essential Connectivity network delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. **DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.**
NEVADA
AMARGOSA RANGE
DEATH VALLEY
PANAMINT RANGE
Mount Whitney
84
82
83
Ridgecrest
81
3
1
2
55
FREMONT VALLEY
MOJAVE NATIONAL PRESERVE
80
Needles
Barstow
52
Mojave River
BRISTOL MTNS
79
PIUTE MTNS
ORD MTNS
53
51
SAN GABRIEL MTNS
SAN BERNARDINO MTNS
San Bernardino
Los Angeles
JOSHUA TREE NATIONAL PARK
50
Blythe
Santa Clara River
Santa Ana River
Los Angeles River
SAN JACINTO MTNS
San Clemente
Salton Sea
CHOCOLATE MTNS
ARIZONA
Colorado River
New River
0 12.5 25 50 75
Kilometers
Miles
0 10 20 40 60
1:2,400,000


51
51
49
49
50
TURTLE MTNS
JOSHUA TREE NATIONAL PARK
176
115
51
51
Blythe
Colorado River
Whitewater River
SAN JACINTO MTNS
104
CHOCOLATE MTNS
Salton Sea
ARIZONA
175
San Felipe Creek
IMPERIAL VALLEY
ANZA-BORREGO DESERT SP
107
116
106
New River
Alamo River
LAGUNA MTNS
Sweetwater River
179
Calexico
BAJA CALIFORNIA, MEXICO
CALIFORNIA ESSENTIAL HABITAT CONNECTIVITY PROJECT
SONORAN DESERT ECOREGION
ESSENTIAL CONNECTIVITY AREA IDS
Natural Landscape Blocks
Essential Connectivity Areas
Potential Riparian Connections
Ecoregion
0 10 20 40 60 Kilometers
0 10 20 40 Miles
1:1,600,000
N
W
E
S
The Essential Connectivity network delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.
Caltrans

Characteristics of Natural Landscape Blocks

Identifier		Landform					ECI		Area		Protection Status				Species Diversity					Listed Species					Ecoregions	
ID	NLB_Name	elev_MEAN	elev_MIN	elev_MAX	elev_STD	elev_RANGE	mn_integ	std_integ	AREA_ac	AREA_km2	pc_protect	pc_gap12e	pc_gap3	pc_privunp	mn_sprich	std_sprich	CNDDB_plant_count	CNDDB_animal_count	pc_hotspt	pc_crithab	crithab_sp_count	pc_esshab	esshab_sp_count	pc_wtvp	n_ecoreg	Ecoregs
1	East Mesa/ All American Canal	20	11	30	4	19	80	33	4,831	20	99	92	7	1	206	25	0	2	0	0	0	0	0	2	1	SONORAN DESERT
2		14	8	26	4	18	67	42	5,516	22	98	97	1	2	215	22	0	1	0	0	0	0	0	1	1	SONORAN DESERT
3	East Mesa Sand Dunes	41	31	49	4	18	94	20	42,778	173	99	99	0	1	162	1	4	2	0	0	0	0	0	0	1	SONORAN DESERT
4	Jacumba Peak	960	827	1,159	67	332	72	17	3,576	14	15	13	2	85	241	13	8	5	0	95	1	0	0	0	1	SOUTH COAST
5	Rattlesnake Mountain	1,068	926	1,236	60	310	74	17	5,954	24	4	0	4	96	241	4	4	1	0	7	1	0	0	0	1	SOUTH COAST
6	Algodones Dunes	82	32	127	18	95	100	0	10,892	44	100	0	100	0	162	2	6	2	0	63	1	0	0	0	1	SONORAN DESERT
7	Campo Valley	991	801	1,133	86	332	79	19	8,172	33	36	0	36	64	248	1	6	2	0	0	0	29	1	0	1	SOUTH COAST
8		299	-1	1,226	257	1,227	92	21	54,857	222	99	97	2	1	197	17	12	9	0	65	1	0	0	0	1	SONORAN DESERT
9	Yuha Basin	55	-7	160	40	167	89	26	45,984	186	100	100	0	0	189	23	7	4	0	2	1	0	0	0	1	SONORAN DESERT
10	Tijuana River	17	1	130	30	129	NoData	NoData	2,937	12	99	99	0	1	292	18	26	26	100	12	2	0	1	42	1	SOUTH COAST
11	Clover Flat	1,048	866	1,261	89	395	78	17	7,805	32	23	3	20	77	248	1	3	1	0	0	0	28	1	1	1	SOUTH COAST
12		16	8	30	5	22	100	0	2,540	10	98	94	4	2	173	2	0	1	0	0	0	0	0	0	1	SONORAN DESERT
13	La Posta	1,023	865	1,168	69	303	79	21	5,621	23	74	7	66	26	249	1	1	0	0	0	0	41	2	0	1	SOUTH COAST
14	San Ysidro Mountains	439	61	1,072	215	1,011	78	17	34,202	138	87	78	9	13	273	5	45	28	56	72	7	34	6	1	1	SOUTH COAST
15	Gold Basin Rand Mine	205	163	280	19	117	94	19	8,653	35	92	21	71	8	162	2	1	1	0	84	1	0	0	0	1	SONORAN DESERT
16	San Miguel/Jamul Mountains	286	60	778	110	718	46	35	22,642	92	97	96	0	3	273	5	37	33	100	90	5	26	5	1	1	SOUTH COAST
17	Hauser Mountain	868	231	1,479	232	1,248	85	22	100,968	409	75	29	45	25	252	5	27	22	0	0	0	10	3	0	1	SOUTH COAST
18	Chocolate Mountains South	243	54	656	98	602	97	12	102,366	414	99	84	15	1	223	28	3	19	18	15	2	1	1	0	1	SONORAN DESERT
19	McGinty Mountain/Lawson Valley	576	112	1,155	235	1,043	58	36	23,823	96	72	42	30	28	263	11	18	24	35	8	2	84	3	0	1	SOUTH COAST
20	Guatay Mountain	1,251	1,047	1,482	81	435	50	41	3,156	13	79	41	38	21	255	2	9	1	0	0	0	2	1	0	1	SOUTH COAST
21	Sweetwater River/Peterson Canyon	785	416	1,131	148	715	80	27	12,176	49	53	3	50	47	255	2	5	8	0	0	0	89	2	0	1	SOUTH COAST
22	Chiquito Peak	1,021	742	1,271	151	529	83	30	2,963	12	62	0	62	38	259	3	7	3	0	4	1	23	1	0	1	SOUTH COAST
23	Flinn Springs	431	216	666	80	450	0	0	2,728	11	93	93	0	7	275	1	5	6	63	0	0	0	0	0	1	SOUTH COAST
24	Mission Gorge	162	40	356	66	316	0	1	2,536	10	98	92	6	2	276	7	10	17	100	16	1	56	2	4	1	SOUTH COAST
25		-65	-70	-56	3	14	0	0	2,115	9	93	93	0	7	255	2	0	6	0	0	0	0	0	0	1	SONORAN DESERT
26		225	95	478	87	383	96	14	9,684	39	100	0	100	0	224	17	1	2	0	100	1	0	0	0	1	SONORAN DESERT
27	Miramar	201	119	298	38	179	71	27	5,884	24	96	13	83	4	279	2	11	10	100	0	0	44	3	1	1	SOUTH COAST
28	East Mesa/Laguna Mountains	1,430	1,106	1,766	144	660	82	29	32,586	132	88	43	45	12	263	6	29	18	74	5	2	36	3	1	1	SOUTH COAST
29	San Felipe Creek	-27	-51	-2	9	49	100	0	7,203	29	95	94	1	5	169	6	1	5	0	7	1	0	0	1	1	SONORAN DESERT
30	Cuyamaca Mountains	1,314	818	1,972	211	1,154	75	34	23,691	96	91	82	9	9	265	2	26	15	73	0	0	4	1	0	1	SOUTH COAST
31	Inkopah/Tierra Blanca/Jacumba Mountains	937	206	1,936	393	1,730	92	20	227,851	922	91	67	24	9	243	20	51	25	23	57	2	4	2	0	2	SONORAN DESERT, SOUTH COAST
32	Los Penasquitos	82	10	138	32	128	0	0	3,665	15	90	90	0	10	275	2	18	17	100	5	1	2	1	7	1	SOUTH COAST
33	Canada de San Vicente/Iron Mountain	438	138	809	116	671	46	28	15,214	62	67	63	5	33	266	10	15	13	100	0	0	5	2	0	1	SOUTH COAST
34	Anza-Borrego Desert	410	-3	1,624	318	1,627	96	17	298,486	1,208	97	92	5	3	193	20	25	27	11	75	1	0	0	0	1	SONORAN DESERT
35	Woodson Mountain	451	167	872	165	705	32	33	2,865	12	78	78	0	22	267	9	5	6	59	0	0	7	1	1	1	SOUTH COAST
36	Black Mountain	240	54	474	93	420	0	0	2,690	11	88	88	0	12	281	1	6	5	58	0	0	0	0	1	1	SOUTH COAST
37	El Capitan	721	150	1,269	242	1,119	88	19	75,117	304	60	19	41	40	261	7	22	17	69	13	2	1	2	0	1	SOUTH COAST
38		355	197	621	92	424	78	35	7,682	31	100	100	0	0	207	17	4	4	0	77	1	0	0	0	1	SONORAN DESERT
39	Santa Maria	362	122	590	118	468	31	32	4,859	20	63	63	0	37	256	2	8	15	0	20	3	59	6	1	1	SOUTH COAST
40	San Pasqual Valley	129	90	354	44	264	1	6	3,575	14	98	98	0	2	260	7	3	17	0	0	1	59	2	9	1	SOUTH COAST
41	Santa Ysabel	844	514	1,142	126	628	77	24	22,425	91	29	19	10	71	261	4	11	16	100	0	0	15	3	0	1	SOUTH COAST
42	San Felipe Hills/Pinyon Ridge	878	195	1,413	295	1,218	87	28	46,425	188	94	81	13	6	238	17	17	19	68	59	1	0	0	0	2	SONORAN DESERT, SOUTH COAST
43	Borrego Badlands	187	56	390	70	334	92	20	45,737	185	97	97	0	3	172	13	7	3	0	3	1	0	0	0	1	SONORAN DESERT
44	Volcan Mountains	1,171	753	1,734	220	981	83	24	36,253	147	57	18	38	43	266	6	15	21	100	0	1	1	1	0	2	SONORAN DESERT, SOUTH COAST
45	Burnt Mountain	449	220	647	77	427	2	4	3,477	14	93	92	0	7	261	1	2	1	0	23	1	0	0	2	1	SOUTH COAST
46	Black Mountain/Guejito Creek	713	114	1,384	274	1,270	74	27	73,641	298	45	16	28	55	261	4	14	22	41	1	1	31	4	1	1	SOUTH COAST
47	Pine Hills	1,081	720	1,608	195	888	62	35	6,811	28	44	0	44	56	261	2	2	2	57	0	1	0	2	0	1	SOUTH COAST
48	Pala Mountain	314	126	642	110	516	65	15	5,065	20	14	14	0	86	264	1	6	1	87	6	1	100	2	1	1	SOUTH COAST
49	Couser Canyon	261	91	550	135	459	62	23	2,373	10	0	0	0	100	269	3	5	7	25	36	3	100	2	4	1	SOUTH COAST
50	Chocolate Mountains	394	-64	1,366	221	1,430	97	11	1,125,218	4,554	95	72	23	5	170	15	27	30	2	66	2	0	0	0	1	SONORAN DESERT
51	Tourmaline Queen Mountain	411	132	677	129	545	64	19	4,167	17	0	0	0	100	266	6	9	3	100	0	0	100	2	0	1	SOUTH COAST
52	Palomar Mountains	1,045	210	1,868	330	1,658	88	20	99,743	404	66	46	20	34	271	6	36	23	87	3	5	28	6	2	1	SOUTH COAST

Characteristics of Natural Landscape Blocks

	Ecoregions		Watershed		ACEC	Counties		Land Cover								
ID	n_subsect	Subsect	HU_num	HU_names	pc_blmacec	n_Counties	Counties	pc_forest	pc_shrub	pc_herb	pc_wetrip	pc_water	pc_dev	pc_crop	pc_pasture	pc_other
1	1	East Mesa-Sand Hills	1	IMPERIAL	0	1	Imperial	0	86	0	9	2	1	0	0	3
2	2	Imperial Valley, East Mesa-Sand Hills	1	IMPERIAL	0	1	Imperial	0	77	0	17	0	0	0	1	4
3	1	East Mesa-Sand Hills	1	IMPERIAL	99	1	Imperial	0	38	0	0	0	0	0	0	61
4	2	Palomar-Cuyamaca Peak, Desert Slopes NA No Description	1	ANZA BORREGO	0	1	San Diego	19	51	28	0	0	1	0	0	0
5	1	Palomar-Cuyamaca Peak	2	ANZA BORREGO, TIJUANA	0	1	San Diego	5	59	34	0	0	2	0	0	0
6	1	East Mesa-Sand Hills	2	AMOS-OGILBY, IMPERIAL	0	1	Imperial	0	1	0	0	0	0	0	0	99
7	1	Palomar-Cuyamaca Peak	1	TIJUANA	0	1	San Diego	6	76	16	0	0	2	0	0	0
8	3	Desert Slopes NA No Description, Borrego Valley-West Mesa, Imperial Valley	2	DAVIES, IMPERIAL	44	1	Imperial	1	59	1	15	0	0	0	0	24
9	2	Borrego Valley-West Mesa, Imperial Valley	1	IMPERIAL	100	1	Imperial	0	39	0	29	0	0	0	0	32
10	1	Coastal Terraces	1	TIJUANA	0	1	San Diego	0	13	13	31	4	18	19	0	2
11	1	Palomar-Cuyamaca Peak	1	TIJUANA	0	1	San Diego	4	79	15	1	0	1	0	0	0
12	1	East Mesa-Sand Hills	1	IMPERIAL	0	1	Imperial	0	92	0	8	0	0	0	0	0
13	1	Palomar-Cuyamaca Peak	1	TIJUANA	0	1	San Diego	4	82	11	0	0	3	0	0	0
14	3	Coastal Hills, Coastal Terraces, Western Granitic Foothills	2	OTAY, TIJUANA	3	1	San Diego	0	83	12	2	0	2	0	0	0
15	1	East Mesa-Sand Hills	1	AMOS-OGILBY	0	1	Imperial	0	28	0	69	0	0	0	0	3
16	2	Coastal Hills, Coastal Terraces	2	OTAY, SWEETWATER	0	1	San Diego	0	86	9	2	0	4	0	0	0
17	3	Coastal Hills, Western Granitic Foothills, Palomar-Cuyamaca Peak	3	OTAY, SWEETWATER, TIJUANA	0	1	San Diego	6	84	7	1	0	2	0	0	0
18	3	Chocolate Mountains and Valleys, East Mesa-Sand Hills, Gila Bend Plain Desert Shrubland	3	AMOS-OGILBY, COLORADO, YUMA	0	1	Imperial	0	25	0	15	0	0	0	0	60
19	3	Coastal Hills, Western Granitic Foothills, Palomar-Cuyamaca Peak	3	OTAY, SWEETWATER, TIJUANA	0	1	San Diego	2	87	6	2	0	4	0	0	0
20	1	Palomar-Cuyamaca Peak	2	SWEETWATER, TIJUANA	0	1	San Diego	18	72	6	2	0	1	0	0	0
21	2	Western Granitic Foothills, Palomar-Cuyamaca Peak	2	SWEETWATER, TIJUANA	0	1	San Diego	1	83	10	0	0	5	0	0	0
22	2	Western Granitic Foothills, Palomar-Cuyamaca Peak	2	SAN DIEGO, SWEETWATER	0	1	San Diego	3	87	6	1	0	4	0	0	0
23	2	Coastal Hills, Western Granitic Foothills	2	SAN DIEGO, SWEETWATER	0	1	San Diego	0	87	0	0	0	11	0	0	0
24	2	Coastal Hills, Coastal Terraces	1	SAN DIEGO	0	1	San Diego	0	70	17	4	0	9	0	0	0
25	2	Coachella Valley, Imperial Valley	2	IMPERIAL, SALTON SEA	0	1	Imperial	0	18	0	15	23	3	17	22	2
26	1	Chocolate Mountains and Valleys	1	COLORADO	0	1	Imperial	0	45	0	18	0	0	0	0	38
27	2	Coastal Hills, Coastal Terraces	2	PENASQUITOS, SAN DIEGO	0	1	San Diego	0	83	8	0	0	8	0	0	0
28	1	Palomar-Cuyamaca Peak	4	ANZA BORREGO, SAN DIEGO, SWEETWATER, TIJUANA	0	1	San Diego	32	55	7	1	0	3	0	0	2
29	1	Borrego Valley-West Mesa	1	ANZA BORREGO	67	1	Imperial	0	92	0	4	0	0	0	0	5
30	2	Western Granitic Foothills, Palomar-Cuyamaca Peak	3	ANZA BORREGO, SAN DIEGO, SWEETWATER	0	1	San Diego	39	53	3	2	0	3	0	0	0
31	3	Palomar-Cuyamaca Peak, Desert Slopes NA No Description, Borrego Valley-West Mesa	5	ANZA BORREGO, IMPERIAL, SAN DIEGO, SWEETWATER, TIJUANA	6	2	Imperial, San Diego	12	47	20	0	0	1	0	0	19
32	1	Coastal Terraces	1	PENASQUITOS	0	1	San Diego	1	57	14	13	0	14	0	0	0
33	2	Coastal Hills, Western Granitic Foothills	3	PENASQUITOS, SAN DIEGO, SAN DIEGUITO	0	1	San Diego	1	83	8	1	1	4	0	0	3
34	2	Desert Slopes NA No Description, Borrego Valley-West Mesa	2	ANZA BORREGO, IMPERIAL	7	2	Imperial, San Diego	2	59	4	2	0	1	0	0	32
35	1	Western Granitic Foothills	3	PENASQUITOS, SAN DIEGO, SAN DIEGUITO	0	1	San Diego	1	68	0	2	2	15	1	0	12
36	2	Coastal Hills, Coastal Terraces	2	PENASQUITOS, SAN DIEGUITO	0	1	San Diego	0	62	17	0	0	19	0	0	1
37	3	Coastal Hills, Western Granitic Foothills, Palomar-Cuyamaca Peak	3	SAN DIEGO, SAN DIEGUITO, SWEETWATER	0	1	San Diego	2	89	6	1	0	2	0	0	0
38	2	Desert Slopes NA No Description, Borrego Valley-West Mesa	1	ANZA BORREGO	0	1	San Diego	0	87	0	0	0	1	0	0	13
39	1	Western Granitic Foothills	1	SAN DIEGUITO	0	1	San Diego	1	62	29	0	0	2	6	1	0
40	2	Coastal Hills, Western Granitic Foothills	1	SAN DIEGUITO	0	1	San Diego	0	25	13	12	0	16	25	8	0
41	1	Western Granitic Foothills	1	SAN DIEGUITO	0	1	San Diego	1	74	22	2	0	2	0	0	0
42	3	Palomar-Cuyamaca Peak, Desert Slopes NA No Description, Borrego Valley-West Mesa	2	ANZA BORREGO, SAN LUIS REY	0	1	San Diego	15	63	15	0	0	1	0	0	7
43	1	Borrego Valley-West Mesa	3	ANZA BORREGO, CLARK, WEST SALTON	0	1	San Diego	0	79	0	0	0	1	0	0	20
44	3	Western Granitic Foothills, Palomar-Cuyamaca Peak, Desert Slopes NA No Description	4	ANZA BORREGO, SAN DIEGO, SAN DIEGUITO, SAN LUIS REY	0	1	San Diego	33	50	13	1	0	3	0	0	0
45	1	Western Granitic Foothills	2	CARLSBAD, SAN LUIS REY	0	1	San Diego	0	91	1	1	2	4	1	0	0
46	2	Western Granitic Foothills, Palomar-Cuyamaca Peak	3	CARLSBAD, SAN DIEGUITO, SAN LUIS REY	0	1	San Diego	4	78	13	2	0	2	0	0	0
47	1	Palomar-Cuyamaca Peak	1	SAN LUIS REY	0	1	San Diego	16	62	12	4	0	2	0	1	4
48	1	Western Granitic Foothills	1	SAN LUIS REY	0	1	San Diego	0	93	2	1	0	1	2	2	0
49	2	Santa Ana Mountains, Western Granitic Foothills	1	SAN LUIS REY	0	1	San Diego	0	82	3	1	0	1	13	0	0
50	6	Chuckwalla Valley, Palo Verde Valley and Mesa, Chocolate Mountains and Valleys, Coachella Valley, Imperial Valley, East Mesa-Sand Hills	7	AMOS-OGILBY, CHUCKWALLA, COLORADO, EAST SALTON, HAYFIELD, IMPERIAL, WHITEWATER	48	2	Riverside, Imperial	0	32	0	29	0	0	0	0	39
51	1	Western Granitic Foothills	1	SAN LUIS REY	0	1	San Diego	0	93	2	1	0	2	2	0	0
52	4	Perris Valley and Hills, San Jacinto Foothills-Cahuilla Mountains, Western Granitic Foothills, Palomar-Cuyamaca Peak	2	SAN LUIS REY, SANTA MARGARITA	0	2	Riverside, San Diego	24	62	11	2	0	1	0	0	1

Characteristics of Natural Landscape Blocks

ID	NLB_Name	elev_MEAN	elev_MIN	elev_MAX	elev_STD	elev_RANGE	mn_integ	std_integ	AREA_ac	AREA_km2	pc_protect	pc_gap12e	pc_gap3	pc_privunp	mn_sprich	std_sprich	CNDDB_plant_count	CNDDB_animal_count	pc_hotspt	pc_crithab	crithab_sp_count	pc_esshab	esshab_sp_count	pc_wtvp	n_ecoreg	Ecoregs
53		154	144	163	5	19	83	31	2,108	9	95	88	7	5	160	0	1	0	0	0	0	0	0	0	1	SONORAN DESERT
54	Sandia Canyon	294	85	441	85	356	66	23	2,053	8	58	7	51	42	273	8	4	4	100	15	3	100	3	1	1	SOUTH COAST
55		308	22	550	126	528	98	10	30,969	125	86	76	10	14	214	10	4	8	0	23	1	0	0	0	1	SONORAN DESERT
56	Temecula Canyon	390	145	710	120	565	27	20	6,444	26	87	87	0	13	272	5	9	16	100	96	3	88	2	1	1	SOUTH COAST
57		262	202	391	29	189	97	12	8,204	33	90	0	90	10	165	4	3	1	0	71	1	0	0	0	1	SONORAN DESERT
58	Vail Lake	554	375	838	93	463	71	20	10,987	44	7	0	7	93	271	4	12	16	100	78	3	14	5	2	1	SOUTH COAST
59	Santa Rosa Mountains	963	-18	2,644	500	2,662	94	17	466,607	1,888	88	78	10	12	241	21	63	34	15	60	4	1	2	0	2	SONORAN DESERT, SOUTH COAST
60	Big Maria Mountains	346	89	1,011	144	922	98	10	91,291	369	100	99	1	0	192	33	1	1	0	0	0	0	0	0	1	SONORAN DESERT
61	Magee Hills	714	590	822	49	232	71	18	2,845	12	0	0	0	100	260	8	0	5	100	17	2	1	1	0	1	SOUTH COAST
62	Riverside Mountains	296	117	674	91	557	NoData	NoData	25,360	103	100	98	1	0	229	22	1	7	0	0	0	0	0	0	1	SONORAN DESERT
63	Warm Springs Creek	443	390	494	21	104	1	4	2,378	10	95	95	0	5	264	1	5	4	0	76	3	3	1	0	1	SOUTH COAST
64	Lake Skinner	563	416	916	94	500	72	24	18,114	73	36	31	5	64	264	1	10	11	97	80	3	10	1	0	1	SOUTH COAST
65		58	33	101	13	68	16	27	4,649	19	96	96	0	4	189	2	2	4	0	98	1	99	1	0	1	SONORAN DESERT
66	Cahuilla Moutain/Rouse Ridge	1,147	583	2,068	286	1,485	86	22	76,219	308	74	50	23	26	256	6	16	24	61	13	4	6	2	0	1	SOUTH COAST
67	Palen Mountains	362	119	1,319	186	1,200	98	9	228,480	925	100	99	1	0	158	3	3	5	0	0	0	0	0	0	1	SONORAN DESERT
68	Camp Pendleton/Santa Rosa	401	7	1,085	253	1,078	84	22	173,747	703	86	32	55	14	282	15	35	42	92	2	6	55	9	1	1	SOUTH COAST
69	Aliso Creek	129	10	313	69	303	0	0	4,409	18	92	92	0	8	297	18	12	10	0	0	1	3	1	2	1	SOUTH COAST
70	San Joaquin Hills South	176	7	342	63	335	0	1	6,861	28	97	97	0	3	303	16	12	11	0	0	0	0	0	1	1	SOUTH COAST
71	San Joaquin Hills North	178	77	319	53	242	0	0	3,429	14	94	94	0	6	271	1	6	9	0	0	0	0	0	1	1	SOUTH COAST
72		339	282	448	34	166	92	22	3,706	15	98	95	3	2	151	1	0	0	0	0	0	0	0	0	1	SONORAN DESERT
73	Indio Hills	249	62	502	88	440	62	45	15,957	65	93	92	1	7	201	12	3	7	0	28	1	0	0	0	1	SONORAN DESERT
74	San Jacinto Mountains	1,290	69	3,290	656	3,221	74	35	177,816	720	90	80	10	10	271	19	49	39	76	39	2	2	3	0	2	SONORAN DESERT, SOUTH COAST
75	Estelle Mountain	510	298	841	118	543	42	21	7,367	30	80	64	16	20	274	8	5	11	0	96	3	2	2	0	1	SOUTH COAST
76	Indian Mountain/Gilman Springs	1,010	451	1,781	304	1,330	77	32	48,455	196	86	27	59	14	269	6	11	17	87	1	3	0	1	0	1	SOUTH COAST
77	Loma Ridge	362	168	537	71	369	41	42	9,369	38	52	52	0	48	273	4	2	15	0	0	1	45	2	0	1	SOUTH COAST
78	Mount Eden/Badlands	592	437	751	66	314	84	25	6,575	27	1	0	1	99	268	1	3	10	100	0	0	0	2	0	1	SOUTH COAST
79	Lake Perris	548	432	816	85	384	45	48	9,131	37	97	80	18	3	266	1	6	11	100	0	0	9	3	0	1	SOUTH COAST
80	Pinto Basin/ Eagle Mountain	654	154	1,622	224	1,468	96	15	551,784	2,233	99	98	1	1	163	8	18	15	0	43	1	0	0	0	2	SONORAN DESERT, MOJAVE DESERT
81	Lake Matthews	436	386	487	15	101	19	18	3,912	16	99	99	0	1	271	3	3	7	0	0	0	95	2	0	1	SOUTH COAST
82	The Badlands East	576	439	743	58	304	82	23	3,439	14	15	0	15	85	267	1	1	5	100	0	0	0	2	0	1	SOUTH COAST
83		1,198	633	1,721	192	1,088	96	15	55,546	225	100	100	0	0	184	6	7	14	0	0	0	0	0	0	1	MOJAVE DESERT
84	The Badlands West	676	578	803	44	225	72	16	3,324	13	34	1	33	66	266	2	3	3	100	0	0	0	0	0	1	SOUTH COAST
85	Santa Ana Mountains	694	74	1,712	287	1,638	89	26	109,570	443	89	58	31	11	276	7	33	30	6	7	3	59	6	0	1	SOUTH COAST
86	Little San Bernardino Mountains	1,060	327	1,769	268	1,442	95	18	368,619	1,492	98	97	2	2	203	23	15	23	0	20	1	0	0	0	2	SONORAN DESERT, MOJAVE DESERT
87	Box Springs Mountains	634	295	932	142	637	0	0	3,292	13	93	93	0	7	267	1	6	4	100	66	1	0	0	0	1	SOUTH COAST
88	Prado Basin	157	141	183	8	42	22	23	5,215	21	64	64	0	36	271	5	0	7	0	82	1	62	2	0	1	SOUTH COAST
89	Chino Hills	304	118	543	88	425	32	45	14,924	60	88	87	0	12	267	9	4	13	0	33	2	10	2	0	1	SOUTH COAST
90	Cleghorn Lakes	666	414	1,238	179	824	98	10	40,352	163	100	98	2	0	145	1	0	3	0	0	0	0	0	0	1	MOJAVE DESERT
91	Cadiz Valley	201	169	297	27	128	98	10	21,323	86	100	98	2	0	147	2	1	0	0	0	0	0	0	0	2	SONORAN DESERT, MOJAVE DESERT
92	Sheep Hole Mountains	481	172	1,398	192	1,226	97	14	196,742	796	100	100	0	0	147	4	4	5	0	1	1	0	0	0	2	SONORAN DESERT, MOJAVE DESERT
93	Sugarloaf Mountain/Keller Peak	1,673	468	3,029	597	2,561	86	25	73,431	297	94	31	62	6	267	10	38	12	79	2	8	0	2	0	1	SOUTH COAST
94	Glen Helen	549	475	699	36	224	66	14	2,215	9	0	0	0	100	273	3	2	4	99	93	1	100	1	0	1	SOUTH COAST
95	McKinley Mountain/Arrowhead Peak	1,174	503	1,909	270	1,406	70	42	15,646	63	98	62	35	2	272	5	7	8	0	6	2	0	0	0	1	SOUTH COAST
96		480	161	1,248	158	1,087	84	30	285,169	1,154	100	100	0	0	192	28	12	5	0	31	1	0	0	0	2	SONORAN DESERT, MOJAVE DESERT

Characteristics of Natural Landscape Blocks

ID	n_subsect	Subsect	HU_num	HU_names	pc_blmacec	n_Counties	Counties	pc_forest	pc_shrub	pc_herb	pc_wetrip	pc_water	pc_dev	pc_crop	pc_pasture	pc_other
53	1	Chuckwalla Valley	1	CHUCKWALLA	88	1	Riverside	0	55	0	1	0	0	1	0	43
54	1	Santa Ana Mountains	1	SANTA MARGARITA	0	1	San Diego	1	90	1	0	0	3	4	0	0
55	2	Chocolate Mountains and Valleys, Coachella Valley	1	WHITEWATER	28	1	Riverside	0	33	0	30	0	0	0	0	37
56	2	Santa Ana Mountains, Western Granitic Foothills	1	SANTA MARGARITA	84	2	Riverside, San Diego	1	92	2	1	0	2	1	0	0
57	1	Chuckwalla Valley	1	CHUCKWALLA	100	1	Riverside	0	67	0	25	0	0	0	0	8
58	2	Perris Valley and Hills, San Jacinto Foothills-Cahuilla Mountains	1	SANTA MARGARITA	0	1	Riverside	3	74	15	3	0	1	0	1	1
59	7	Perris Valley and Hills, San Jacinto Foothills-Cahuilla Mountains, San Jacinto Mountains, Palomar-Cuyamaca Peak, Desert Slopes NA No Description, Coachella Valley, Borrego Valley-West Mesa	7	ANZA BORREGO, CLARK, SAN JACINTO VALLEY, SAN LUIS REY, SANTA MARGARITA, WEST SALTON, WHITEWATER	2	3	Riverside, Imperial, San Diego	28	43	10	1	0	1	0	0	18
60	3	Cadiz-Vidal Valleys, Palen-Riverside Mountains, Palo Verde Valley and Mesa	2	COLORADO, RICE	0	1	Riverside	0	53	0	7	0	0	0	0	40
61	2	Perris Valley and Hills, San Jacinto Foothills-Cahuilla Mountains	2	SAN JACINTO VALLEY, SANTA MARGARITA	0	1	Riverside	7	75	14	0	0	2	0	0	2
62	3	Cadiz-Vidal Valleys, Palen-Riverside Mountains, Palo Verde Valley and Mesa	2	COLORADO, RICE	0	1	Riverside	0	57	0	10	0	0	0	0	33
63	1	Perris Valley and Hills	2	SAN JACINTO VALLEY, SANTA MARGARITA	0	1	Riverside	0	58	27	0	0	14	0	1	0
64	2	Perris Valley and Hills, San Jacinto Foothills-Cahuilla Mountains	1	SANTA MARGARITA	0	1	Riverside	1	76	9	1	7	5	0	0	1
65	1	Coachella Valley	1	WHITEWATER	0	1	Riverside	0	44	0	43	0	1	0	0	11
66	2	San Jacinto Foothills-Cahuilla Mountains, San Jacinto Mountains	2	SAN JACINTO VALLEY, SANTA MARGARITA	0	1	Riverside	28	62	7	0	0	2	0	0	1
67	3	Cadiz-Vidal Valleys, Palen-Riverside Mountains, Chuckwalla Valley	4	CHUCKWALLA, COLORADO, RICE, WARD	0	1	Riverside	0	36	0	5	0	0	0	0	60
68	4	Coastal Hills, Coastal Terraces, Santa Ana Mountains, Perris Valley and Hills	3	SAN JACINTO VALLEY, SAN JUAN, SANTA MARGARITA	0	3	Riverside, Orange, San Diego	0	80	11	2	0	4	0	0	3
69	2	Coastal Hills, Coastal Terraces	1	SAN JUAN	0	1	Orange	1	78	3	5	0	11	0	0	1
70	2	Coastal Hills, Coastal Terraces	2	SAN JUAN, SANTA ANA RIVER	0	1	Orange	0	91	2	1	0	6	0	0	0
71	1	Coastal Hills	2	SAN JUAN, SANTA ANA RIVER	0	1	Orange	0	83	5	3	0	9	0	0	0
72	1	Cadiz-Vidal Valleys	1	WARD	0	2	San Bernardino, Riverside	0	97	0	0	0	0	0	0	2
73	1	Coachella Valley	1	WHITEWATER	58	1	Riverside	0	56	0	24	0	1	0	0	19
74	5	Fontana Plain-Calimesa Terraces, San Jacinto Foothills-Cahuilla Mountains, San Jacinto Mountains, Desert Slopes NA No Description, Coachella Valley	2	SAN JACINTO VALLEY, WHITEWATER	0	1	Riverside	46	29	13	1	0	1	0	0	11
75	1	Perris Valley and Hills	1	SANTA ANA RIVER	0	1	Riverside	3	56	31	2	0	8	0	0	1
76	4	Fontana Plain-Calimesa Terraces, Perris Valley and Hills, San Jacinto Foothills-Cahuilla Mountains, San Jacinto Mountains	2	SAN JACINTO VALLEY, WHITEWATER	26	1	Riverside	19	59	18	0	0	2	0	0	1
77	2	Los Angeles Plain, Coastal Hills	2	SAN JUAN, SANTA ANA RIVER	0	1	Orange	0	87	6	0	0	7	0	0	0
78	2	Perris Valley and Hills, San Jacinto Foothills-Cahuilla Mountains	1	SAN JACINTO VALLEY	0	1	Riverside	1	66	30	0	0	1	0	0	2
79	1	Perris Valley and Hills	1	SAN JACINTO VALLEY	0	1	Riverside	6	49	31	1	2	10	0	0	1
80	6	Lucerne-Johnson Valleys and Hills, Bullion Mountains-Bristol Lake, Pinto Basin and Mountains, Cadiz-Vidal Valleys, Chuckwalla Valley, Chocolate Mountains and Valleys	6	CADIZ, CHUCKWALLA, DALE, HAYFIELD, ROUTE SIXTY SIX, WHITEWATER	23	2	San Bernardino, Riverside	0	40	0	4	0	0	0	0	56
81	1	Perris Valley and Hills	1	SANTA ANA RIVER	0	1	Riverside	1	34	42	0	11	10	1	0	0
82	2	Perris Valley and Hills, San Jacinto Foothills-Cahuilla Mountains	1	SAN JACINTO VALLEY	0	1	Riverside	1	66	30	1	0	1	0	0	1
83	2	Lucerne-Johnson Valleys and Hills, Pinto Basin and Mountains	2	DALE, JOSHUA TREE	0	2	San Bernardino, Riverside	0	44	0	1	0	0	0	0	55
84	2	Fontana Plain-Calimesa Terraces, San Jacinto Foothills-Cahuilla Mountains	2	SAN JACINTO VALLEY, SANTA ANA RIVER	0	1	Riverside	2	79	15	0	0	1	0	2	1
85	5	Los Angeles Plain, Coastal Hills, Santa Ana Mountains, Fontana Plain-Calimesa Terraces, Perris Valley and Hills	3	SAN JACINTO VALLEY, SAN JUAN, SANTA ANA RIVER	0	2	Riverside, Orange	5	88	2	1	0	3	0	0	1
86	5	Little San Bernardino-Bighorn Mountains, Lucerne-Johnson Valleys and Hills, Pinto Basin and Mountains, Chocolate Mountains and Valleys, Coachella Valley	4	CHUCKWALLA, DALE, JOSHUA TREE, WHITEWATER	8	2	San Bernardino, Riverside	0	36	0	2	0	0	0	0	62
87	2	Fontana Plain-Calimesa Terraces, Perris Valley and Hills	2	SAN JACINTO VALLEY, SANTA ANA RIVER	0	1	Riverside	10	53	30	0	0	7	0	0	1
88	2	Santa Ana Mountains, Fontana Plain-Calimesa Terraces	1	SANTA ANA RIVER	0	2	San Bernardino, Riverside	0	15	15	43	2	13	10	3	0
89	3	Los Angeles Plain, Santa Ana Mountains, Fontana Plain-Calimesa Terraces	1	SANTA ANA RIVER	0	3	San Bernardino, Riverside, Orange	2	75	14	2	0	6	0	0	0
90	2	Lucerne-Johnson Valleys and Hills, Bullion Mountains-Bristol Lake	2	DALE, ROUTE SIXTY SIX	0	1	San Bernardino	0	48	0	4	0	0	0	0	48
91	1	Cadiz-Vidal Valleys	1	CADIZ	0	1	San Bernardino	0	67	0	2	0	0	0	0	31
92	2	Bullion Mountains-Bristol Lake, Cadiz-Vidal Valleys	4	CADIZ, CHUCKWALLA, DALE, ROUTE SIXTY SIX	6	1	San Bernardino	0	75	0	2	0	0	0	0	23
93	2	San Gorgonio Mountains, Upper San Gorgonio Mountains	3	JOHNSON, MOJAVE, SANTA ANA RIVER	0	1	San Bernardino	59	33	3	1	0	4	0	0	0
94	2	San Gabriel Mountains, Fontana Plain-Calimesa Terraces	1	SANTA ANA RIVER	0	1	San Bernardino	0	43	22	2	0	32	0	0	2
95	2	San Gorgonio Mountains, Upper San Gorgonio Mountains	2	MOJAVE, SANTA ANA RIVER	0	1	San Bernardino	31	57	3	3	0	1	0	0	5
96	2	Piute Valley-Sacramento Mountains, Cadiz-Vidal Valleys	3	CHEMEHUEVIS, COLORADO, HOMER	41	1	San Bernardino	0	25	0	17	0	0	0	0	58

Characteristics of Natural Landscape Blocks

ID	NLB_Name	elev_MEAN	elev_MIN	elev_MAX	elev_STD	elev_RANGE	mn_integ	std_integ	AREA_ac	AREA_km2	pc_protect	pc_gap12e	pc_gap3	pc_privunp	mn_sprich	std_sprich	CNDDB_plant_count	CNDDB_animal_count	pc_hotspt	pc_crithab	crithab_sp_count	pc_esshab	esshab_sp_count	pc_wtvp	n_ecoreg	Ecoregs
97	Lytle Creek Ridge	843	604	1,162	137	558	90	18	4,318	17	79	0	79	21	278	10	3	4	4	15	2	3	1	0	1	SOUTH COAST
98	San Dimas	879	305	1,761	294	1,456	75	40	25,420	103	91	75	16	9	272	10	11	9	0	1	1	1	1	0	1	SOUTH COAST
99	The Pinnacles	1,339	942	1,772	184	830	88	26	15,838	64	92	7	85	8	282	15	6	11	0	0	0	82	2	0	2	SOUTH COAST, MOJAVE DESERT
100	Las Flores/Santa Monica Mtns	296	8	663	122	655	17	30	3,465	14	90	90	0	10	302	13	3	4	0	0	1	100	1	1	1	SOUTH COAST
101	San Bernardino Mountains	1,720	433	3,503	564	3,070	90	19	289,282	1,171	91	72	19	9	258	21	64	32	52	3	11	0	1	0	3	SONORAN DESERT, SOUTH COAST, MOJAVE DESERT
102	Butler Peak/White Mountains/Grapevine Canyon	1,787	917	2,588	320	1,671	86	25	75,173	304	96	33	63	4	270	11	43	18	58	4	10	18	2	0	2	SOUTH COAST, MOJAVE DESERT
103	Cleghorn Ridge	1,208	580	1,729	229	1,149	84	31	22,831	92	88	35	53	12	273	13	9	10	0	0	1	17	2	0	2	SOUTH COAST, MOJAVE DESERT
104	Mount Hollywood	271	130	537	79	407	0	0	3,947	16	94	94	0	6	244	3	4	3	0	0	0	0	0	0	1	SOUTH COAST
105		1,360	1,233	1,498	54	265	75	29	2,535	10	98	94	4	2	252	4	0	0	0	0	0	0	0	0	1	MOJAVE DESERT
106	Zuma/Trancas Canyons/Santa Monica Mtns	313	4	756	180	752	39	41	10,129	41	98	98	0	2	297	18	3	4	0	2	2	100	1	1	1	SOUTH COAST
107	Castro Peak/Santa Monica Mtns	362	9	856	175	847	24	39	19,846	80	100	100	0	0	277	17	11	14	0	0	1	100	1	2	1	SOUTH COAST
108	Alisos Canyon/Santa Monica Mtns	318	3	553	127	550	44	27	3,867	16	94	94	0	6	296	19	3	2	0	0	0	100	1	1	1	SOUTH COAST
109	Calabasas Peak/Santa Monica Mtns	382	1	855	148	854	6	20	13,100	53	97	97	0	3	276	15	10	12	0	0	1	88	1	1	1	SOUTH COAST
110	Topanga Canyon/Santa Monica Mtns	389	27	642	108	615	47	46	20,042	81	96	96	0	4	275	15	3	5	0	2	1	23	1	1	1	SOUTH COAST
111	Liberty Canyon/Santa Monica Mtns	291	168	445	57	277	0	0	3,567	14	97	97	0	3	269	1	1	4	0	0	0	100	1	2	1	SOUTH COAST
112	Las Virgenes Creek/Santa Monica Mtns	332	186	522	66	336	0	0	5,038	20	98	98	0	2	268	1	4	2	0	0	0	92	1	0	1	SOUTH COAST
113	Verdugo Mountains	558	236	950	145	714	0	0	7,265	29	93	93	0	7	230	2	6	1	0	0	0	0	0	0	1	SOUTH COAST
114	Lobo Canyon/Santa Monica Mtns	449	250	739	115	489	0	2	3,319	13	97	96	1	3	270	3	3	2	0	15	1	100	2	0	1	SOUTH COAST
115		673	555	831	58	276	85	29	7,850	32	100	100	0	0	145	1	0	1	0	100	1	0	0	0	1	MOJAVE DESERT
116	Turtle Mountains/ Ward Valley	600	155	1,607	212	1,452	98	11	1,030,509	4,170	99	96	4	1	154	13	5	6	0	67	1	0	0	0	2	SONORAN DESERT, MOJAVE DESERT
117		571	526	620	20	94	91	23	12,175	49	100	100	0	0	145	0	0	1	0	100	1	0	0	0	1	MOJAVE DESERT
118	Clipper Mountains	678	317	1,394	179	1,077	99	8	123,120	498	100	89	11	0	144	1	2	3	0	76	1	0	0	0	1	MOJAVE DESERT
119	Table Mountain	1,855	1,560	2,250	146	690	90	19	4,030	16	86	0	86	14	288	14	4	4	0	0	0	0	0	0	2	SOUTH COAST, MOJAVE DESERT
120	San Gabriel/Cucamonga	1,377	208	3,065	540	2,857	88	24	241,279	976	95	67	28	5	261	12	44	22	1	4	4	40	2	0	2	SOUTH COAST, MOJAVE DESERT
121	Point Mugu	356	2	924	184	922	54	37	31,975	129	91	91	0	9	280	17	9	8	0	2	1	92	2	0	1	SOUTH COAST
122	Big Tujunga Canyon	858	423	1,496	234	1,073	80	34	6,707	27	92	1	91	8	255	11	4	5	0	12	1	97	2	0	1	SOUTH COAST
123	Hope Nature	340	206	478	48	272	0	2	4,336	18	95	95	0	5	272	2	5	2	0	5	1	62	1	0	1	SOUTH COAST
124	Simi Hills	435	239	721	92	482	0	0	15,157	61	95	95	0	5	257	5	5	9	0	5	1	80	1	1	1	SOUTH COAST
125		688	360	1,075	134	715	90	24	38,361	155	100	99	0	0	148	9	2	2	0	92	1	0	0	0	1	MOJAVE DESERT
126		762	625	1,096	55	471	91	24	13,897	56	100	100	0	0	144	0	2	1	0	100	1	0	0	0	1	MOJAVE DESERT
127	Mount Clef Ridge	187	71	354	58	283	0	0	3,290	13	88	88	0	12	261	1	4	2	0	26	1	0	0	2	1	SOUTH COAST
128	Sidewinder Mountain	1,147	935	1,506	130	571	90	21	9,892	40	99	97	2	1	149	1	0	2	0	0	0	0	0	0	1	MOJAVE DESERT
129	Contract Point	805	431	1,224	174	793	86	30	9,714	39	81	13	69	19	268	13	6	3	0	0	1	5	1	0	1	SOUTH COAST
130	Lava	631	573	704	34	131	90	24	12,498	51	99	96	3	1	142	2	2	0	0	0	0	0	0	0	1	MOJAVE DESERT
131	San Gabriel Mountains West	1,119	369	1,983	303	1,614	91	24	94,584	383	95	17	79	5	247	8	8	11	0	1	1	38	2	0	1	SOUTH COAST
132	Pleasant View Ridge	1,544	826	2,555	303	1,729	86	26	97,425	394	98	36	63	2	257	13	19	11	0	2	2	23	2	0	2	SOUTH COAST, MOJAVE DESERT
133	Preston Mine	757	623	1,199	99	576	91	24	13,944	56	100	99	0	0	141	0	3	3	0	0	0	0	0	0	1	MOJAVE DESERT
134	South Mountain	231	46	660	119	614	77	18	4,196	17	25	25	0	75	254	3	0	3	0	0	0	0	0	4	1	SOUTH COAST
135	Long Canyon	333	140	563	81	423	77	14	3,373	14	0	0	0	100	252	1	1	0	0	0	0	0	0	0	1	SOUTH COAST
136	Santa Susana Mountains	579	169	1,022	142	853	57	39	40,875	165	40	39	1	60	256	7	7	15	0	61	2	0	0	1	1	SOUTH COAST
137	Eastern Sierra Pelona	1,356	1,077	1,588	121	511	55	15	2,419	10	96	95	0	4	240	16	0	0	0	0	0	0	0	0	1	SOUTH COAST
138		503	158	1,080	201	922	91	23	76,904	311	100	100	0	0	180	28	1	5	0	41	1	0	0	0	1	MOJAVE DESERT
139	Silver Mountain	997	751	1,282	103	531	89	22	11,648	47	97	97	0	3	178	3	1	1	0	0	0	0	0	0	1	MOJAVE DESERT
140	Big Oak Spring	1,087	652	1,513	202	861	96	13	9,158	37	99	0	99	1	233	2	2	0	0	0	0	0	0	0	1	SOUTH COAST
141	Sulphur Mountain	278	75	590	92	515	73	18	20,836	84	1	0	1	99	263	4	2	3	0	0	1	45	1	1	1	SOUTH COAST

Characteristics of Natural Landscape Blocks

ID	n_subsect	Subsect	HU_num	HU_names	pc_blmacec	n_Counties	Counties	pc_forest	pc_shrub	pc_herb	pc_wetrip	pc_water	pc_dev	pc_crop	pc_pasture	pc_other
97	3	San Gabriel Mountains, San Gorgonio Mountains, Fontana Plain-Calimesa Terraces	1	SANTA ANA RIVER	0	1	San Bernardino	5	89	4	0	0	1	0	0	2
98	3	Los Angeles Plain, San Gabriel Mountains, Upper San Gabriel Mountains	2	SAN GABRIEL RIVER, SANTA ANA RIVER	0	1	Los Angeles	13	80	2	1	0	3	0	0	0
99	4	San Gorgonio Mountains, Upper San Gorgonio Mountains, Little San Bernardino-Bighorn Mountains, High Desert Plains and Hills	1	MOJAVE	0	1	San Bernardino	51	34	11	0	1	2	0	0	0
100	1	Santa Monica Mountains	1	SANTA MONICA BAY	0	1	Los Angeles	2	87	1	0	0	10	0	0	0
101	6	San Gorgonio Mountains, Upper San Gorgonio Mountains, Little San Bernardino-Bighorn Mountains, Fontana Plain-Calimesa Terraces, Lucerne-Johnson Valleys and Hills, Coachella Valley	7	EMERSON, JOHNSON, JOSHUA TREE, LUCERNE LAKE, MEANS, SANTA ANA RIVER, WHITEWATER	8	2	San Bernardino, Riverside	59	23	13	1	0	1	0	0	4
102	5	San Gorgonio Mountains, Upper San Gorgonio Mountains, Little San Bernardino-Bighorn Mountains, High Desert Plains and Hills, Lucerne-Johnson Valleys and Hills	4	JOHNSON, LUCERNE LAKE, MOJAVE, SANTA ANA RIVER	0	1	San Bernardino	69	6	23	0	0	2	0	0	0
103	3	San Gorgonio Mountains, Fontana Plain-Calimesa Terraces, High Desert Plains and Hills	2	MOJAVE, SANTA ANA RIVER	0	1	San Bernardino	35	54	1	2	0	2	0	0	6
104	2	Santa Monica Mountains, Los Angeles Plain	2	LOS ANGELES RIVER, SANTA MONICA BAY	0	1	Los Angeles	0	66	2	1	2	30	0	0	0
105	1	Little San Bernardino-Bighorn Mountains	2	LUCERNE LAKE, MOJAVE	0	1	San Bernardino	1	83	2	5	0	0	0	0	9
106	1	Santa Monica Mountains	1	SANTA MONICA BAY	0	1	Los Angeles	1	79	1	1	0	19	0	0	0
107	1	Santa Monica Mountains	1	SANTA MONICA BAY	0	1	Los Angeles	1	81	1	1	0	15	0	0	0
108	1	Santa Monica Mountains	1	SANTA MONICA BAY	0	1	Los Angeles	1	90	2	0	0	7	0	0	0
109	2	Simi Valley-Santa Susana Mountains, Santa Monica Mountains	2	LOS ANGELES RIVER, SANTA MONICA BAY	0	1	Los Angeles	0	80	2	1	0	17	0	0	0
110	3	Simi Valley-Santa Susana Mountains, Santa Monica Mountains, Los Angeles Plain	2	LOS ANGELES RIVER, SANTA MONICA BAY	0	1	Los Angeles	1	86	1	0	1	12	0	0	0
111	2	Simi Valley-Santa Susana Mountains, Santa Monica Mountains	1	SANTA MONICA BAY	0	1	Los Angeles	0	77	7	2	0	14	0	0	0
112	2	Simi Valley-Santa Susana Mountains, Santa Monica Mountains	2	LOS ANGELES RIVER, SANTA MONICA BAY	0	1	Los Angeles	0	73	14	0	0	11	0	1	0
113	1	Los Angeles Plain	1	LOS ANGELES RIVER	0	1	Los Angeles	1	90	0	0	0	8	0	0	0
114	1	Santa Monica Mountains	1	SANTA MONICA BAY	0	2	Ventura, Los Angeles	0	84	2	1	4	9	0	0	0
115	2	Providence Mountains-Lanfair Valley, Bullion Mountains-Bristol Lake	1	ROUTE SIXTY SIX	99	1	San Bernardino	0	87	0	0	0	0	0	0	13
116	4	Providence Mountains-Lanfair Valley, Piute Valley-Sacramento Mountains, Bullion Mountains-Bristol Lake, Cadiz-Vidal Valleys	7	CADIZ, CHEMEHUEVIS, COLORADO, HOMER, RICE, ROUTE SIXTY SIX, WARD	64	1	San Bernardino	0	58	0	5	0	0	0	0	37
117	2	Providence Mountains-Lanfair Valley, Bullion Mountains-Bristol Lake	1	ROUTE SIXTY SIX	98	1	San Bernardino	0	100	0	0	0	0	0	0	0
118	2	Providence Mountains-Lanfair Valley, Bullion Mountains-Bristol Lake	1	ROUTE SIXTY SIX	57	1	San Bernardino	0	53	0	1	0	0	0	0	46
119	2	San Gabriel Mountains, High Desert Plains and Hills	2	ANTELOPE, MOJAVE	0	2	San Bernardino, Los Angeles	79	4	9	1	0	7	0	0	0
120	5	Los Angeles Plain, San Gabriel Mountains, Upper San Gabriel Mountains, Fontana Plain-Calimesa Terraces, High Desert Plains and Hills	5	ANTELOPE, LOS ANGELES RIVER, MOJAVE, SAN GABRIEL RIVER, SANTA ANA RIVER	0	2	San Bernardino, Los Angeles	47	46	2	1	0	1	0	0	1
121	3	Oxnard Plain-Santa Paula Valley, Simi Valley-Santa Susana Mountains, Santa Monica Mountains	3	CALLEGUAS, SANTA MONICA BAY, VENTURA COASTAL STREAMS	0	2	Ventura, Los Angeles	1	87	2	1	0	7	0	2	0
122	2	Los Angeles Plain, San Gabriel Mountains	1	LOS ANGELES RIVER	0	1	Los Angeles	11	78	1	2	0	7	0	0	0
123	2	Simi Valley-Santa Susana Mountains, Santa Monica Mountains	2	CALLEGUAS, SANTA MONICA BAY	0	1	Ventura	0	64	5	0	0	13	0	17	0
124	1	Simi Valley-Santa Susana Mountains	3	CALLEGUAS, LOS ANGELES RIVER, SANTA MONICA BAY	0	2	Ventura, Los Angeles	0	73	18	1	0	8	0	0	0
125	2	Providence Mountains-Lanfair Valley, Piute Valley-Sacramento Mountains	3	HOMER, ROUTE SIXTY SIX, WARD	92	1	San Bernardino	0	58	0	1	0	0	0	0	41
126	1	Providence Mountains-Lanfair Valley	1	ROUTE SIXTY SIX	100	1	San Bernardino	0	67	0	0	0	0	0	0	33
127	2	Oxnard Plain-Santa Paula Valley, Simi Valley-Santa Susana Mountains	1	CALLEGUAS	0	1	Ventura	0	75	2	5	0	18	0	0	0
128	1	Lucerne-Johnson Valleys and Hills	2	LUCERNE LAKE, MOJAVE	97	1	San Bernardino	0	59	0	1	0	0	0	0	40
129	3	Los Angeles Plain, Sierra Pelona-Mint Canyon, San Gabriel Mountains	2	LOS ANGELES RIVER, SANTA CLARA - CALLEGUAS	0	1	Los Angeles	3	89	1	1	0	6	0	0	0
130	2	Mojave Valley-Granite Mountains, Bullion Mountains-Bristol Lake	3	BROADWELL, LAVIC, MOJAVE	38	1	San Bernardino	0	33	0	0	0	0	0	0	67
131	4	Los Angeles Plain, Sierra Pelona-Mint Canyon, San Gabriel Mountains, Upper San Gabriel Mountains	2	LOS ANGELES RIVER, SANTA CLARA - CALLEGUAS	0	1	Los Angeles	30	63	4	1	0	2	0	0	0
132	4	Sierra Pelona-Mint Canyon, San Gabriel Mountains, Upper San Gabriel Mountains, High Desert Plains and Hills	4	ANTELOPE, LOS ANGELES RIVER, SAN GABRIEL RIVER, SANTA CLARA - CALLEGUAS	0	1	Los Angeles	62	25	12	0	0	1	0	0	0
133	1	Bullion Mountains-Bristol Lake	3	BROADWELL, LAVIC, MOJAVE	99	1	San Bernardino	0	74	0	1	0	0	0	0	25
134	2	Oxnard Plain-Santa Paula Valley, Simi Valley-Santa Susana Mountains	2	CALLEGUAS, SANTA CLARA - CALLEGUAS	0	1	Ventura	0	81	6	7	0	3	2	0	1
135	2	Oxnard Plain-Santa Paula Valley, Simi Valley-Santa Susana Mountains	2	CALLEGUAS, SANTA CLARA - CALLEGUAS	0	1	Ventura	0	86	10	0	0	4	0	0	0
136	4	Oxnard Plain-Santa Paula Valley, Simi Valley-Santa Susana Mountains, Los Angeles Plain, Sierra Pelona-Mint Canyon	3	CALLEGUAS, LOS ANGELES RIVER, SANTA CLARA - CALLEGUAS	0	2	Ventura, Los Angeles	1	83	12	1	0	3	0	0	0
137	1	Sierra Pelona-Mint Canyon	2	ANTELOPE, SANTA CLARA - CALLEGUAS	0	1	Los Angeles	63	27	5	0	0	6	0	0	0
138	1	Piute Valley-Sacramento Mountains	1	HOMER	41	1	San Bernardino	0	64	0	10	0	0	0	0	26
139	2	High Desert Plains and Hills, Lucerne-Johnson Valleys and Hills	1	MOJAVE	94	1	San Bernardino	0	49	0	0	0	0	0	0	51
140	2	Northern Transverse Ranges, Sierra Pelona-Mint Canyon	2	ANTELOPE, SANTA CLARA - CALLEGUAS	0	1	Los Angeles	16	79	4	0	0	1	0	0	0
141	2	Santa Ynez-Sulphur Mountains, Oxnard Plain-Santa Paula Valley	3	BUENAVENTURA, SANTA CLARA - CALLEGUAS, VENTURA RIVER	0	1	Ventura	1	91	3	1	0	2	2	1	0

Characteristics of Natural Landscape Blocks

ID	NLB_Name	elev_MEAN	elev_MIN	elev_MAX	elev_STD	elev_RANGE	mn_integ	std_integ	AREA_ac	AREA_km2	pc_protect	pc_gap12e	pc_gap3	pc_privunp	mn_sprich	std_sprich	CNDDB_plant_count	CNDDB_animal_count	pc_hotspt	pc_crithab	crithab_sp_count	pc_esshab	esshab_sp_count	pc_wtvp	n_ecoreg	Ecoregs
142	Saddleback Butte	887	783	1,101	62	318	72	34	3,059	12	96	96	0	4	174	1	0	3	0	0	0	0	0	0	1	MOJAVE DESERT
143	Rincon Mountain	326	35	652	114	617	72	10	3,786	15	0	0	0	100	266	11	3	0	0	0	0	0	0	0	1	SOUTH COAST
144	Ord Mountains	1,059	545	1,917	241	1,372	90	23	273,178	1,106	100	97	3	0	149	7	5	3	0	91	1	0	0	0	1	MOJAVE DESERT
145	Jupiter Mountain/Del Sur Ridge	908	503	1,374	174	871	89	26	15,542	63	94	0	94	6	236	7	2	2	0	0	0	0	0	0	1	SOUTH COAST
146		502	372	684	51	312	89	27	16,103	65	97	92	5	3	148	1	0	8	0	0	0	0	0	1	1	MOJAVE DESERT
147	San Francisquito	905	392	1,404	208	1,012	87	27	30,354	123	96	59	38	4	237	8	6	5	0	4	1	0	0	0	1	SOUTH COAST
148	Iron Mountain	747	677	927	39	250	80	28	31,114	126	100	100	0	0	174	3	1	3	0	40	1	0	0	0	1	MOJAVE DESERT
149		747	611	921	67	310	88	24	19,158	78	99	99	0	1	153	10	1	2	0	100	1	0	0	0	1	MOJAVE DESERT
150	Portal Ridge	1,132	901	1,363	90	462	80	25	10,747	43	23	5	18	77	267	12	3	3	0	0	0	0	0	0	2	SOUTH COAST, MOJAVE DESERT
151	Shadow Mountains	903	701	1,244	75	543	79	27	100,195	405	99	84	15	1	166	2	2	2	0	92	1	0	0	0	1	MOJAVE DESERT
152		810	697	1,019	49	322	83	28	99,959	405	100	100	0	0	168	4	3	3	0	100	1	0	0	0	1	MOJAVE DESERT
153	Spring Canyon	1,050	920	1,230	77	310	81	26	8,750	35	73	73	0	27	262	19	0	1	0	0	0	0	0	0	2	SOUTH COAST, MOJAVE DESERT
154	Bristol Mountains/ Devils Playground	674	283	2,049	284	1,766	97	13	591,582	2,394	100	99	0	0	150	10	11	19	0	6	1	0	0	0	1	MOJAVE DESERT
155	San Marcos Pass	550	276	1,086	165	810	88	26	9,851	40	83	0	83	17	287	4	4	2	0	34	1	100	1	0	2	SOUTH COAST, CENTRAL COAST
156	Liebre/Sawmill Mountains	1,051	350	1,763	286	1,413	92	21	93,328	378	95	48	46	5	242	15	5	11	0	0	0	14	2	0	2	SOUTH COAST, MOJAVE DESERT
157	Santa Ynez Mountains Central	372	10	865	207	855	80	22	21,197	86	54	17	37	46	278	19	8	7	0	9	2	100	2	0	2	SOUTH COAST, CENTRAL COAST
158	Santa Ynez Mountains East	492	20	1,306	260	1,286	89	20	45,342	183	65	61	5	35	277	12	10	6	0	0	0	99	1	0	2	SOUTH COAST, CENTRAL COAST
159	Mid Hills/ Ivanpah Valley/ New York Mountains	1,082	504	2,264	301	1,760	93	19	910,556	3,685	97	96	1	3	163	16	70	28	25	54	1	0	0	0	1	MOJAVE DESERT
160	Pine Mountain/Sespe Condor	1,243	193	2,422	421	2,229	93	16	437,040	1,769	92	79	13	8	246	9	16	19	0	50	5	56	3	0	1	SOUTH COAST
161	Oso Canyon	1,258	946	1,647	137	701	89	17	13,916	56	19	18	1	81	266	16	3	7	0	36	1	0	0	0	3	SOUTH COAST, MOJAVE DESERT, SIERRA NEVADA
162	Shaddow Valley	1,092	285	1,750	295	1,465	94	18	276,011	1,117	99	98	1	1	156	10	11	5	9	97	1	0	0	0	1	MOJAVE DESERT
163	Ivanpah Mountains	1,306	821	1,899	221	1,078	92	21	68,600	278	97	94	2	3	170	5	9	3	15	66	1	0	0	0	1	MOJAVE DESERT
164	Cuddy Creek	1,721	1,599	2,042	87	443	82	30	2,866	12	70	0	70	30	249	8	2	0	0	0	0	0	0	1	1	SOUTH COAST
165		295	56	585	97	529	90	19	25,446	103	13	13	0	87	259	3	6	1	0	23	1	100	1	0	2	SOUTH COAST, CENTRAL COAST
166		851	786	1,100	63	314	94	18	36,500	148	100	99	1	0	155	4	1	1	0	66	1	0	0	1	1	MOJAVE DESERT
167		333	170	563	82	393	90	16	5,765	23	19	19	0	81	255	2	2	1	0	0	0	27	1	0	1	CENTRAL COAST
168	San Ynez Mountains West	231	1	637	118	636	93	16	78,607	318	2	2	0	98	272	22	14	15	0	25	4	100	2	1	2	SOUTH COAST, CENTRAL COAST
169		122	38	294	41	256	72	35	2,945	12	97	97	0	3	255	5	10	2	0	0	0	100	1	0	1	CENTRAL COAST
170		929	882	1,004	21	122	76	28	6,159	25	98	98	0	2	158	0	0	1	0	5	1	0	0	0	1	MOJAVE DESERT
171		959	908	1,018	21	110	88	22	2,251	9	96	96	0	4	159	1	0	1	0	0	0	0	0	0	1	MOJAVE DESERT
172		928	871	1,048	38	177	80	28	5,056	20	99	99	0	1	163	2	0	1	0	0	0	0	0	0	1	MOJAVE DESERT
173	Apache Canyon	1,449	753	2,689	381	1,936	90	22	139,527	565	88	74	14	12	242	6	11	14	0	4	1	4	1	0	2	SOUTH COAST, GREAT CENTRAL VALLEY
174		150	64	323	46	259	71	37	2,475	10	88	84	4	12	258	3	8	4	0	0	0	99	1	0	1	CENTRAL COAST
175		324	204	429	40	225	88	19	6,368	26	0	0	0	100	255	0	1	1	0	0	0	0	0	0	1	CENTRAL COAST
176	Rand Mountains	1,007	911	1,141	44	230	78	32	12,374	50	100	100	0	0	158	0	0	1	0	88	1	0	0	0	1	MOJAVE DESERT
177		1,491	1,012	1,937	197	925	95	14	26,818	109	98	98	0	2	205	13	6	5	0	0	0	0	0	0	2	MOJAVE DESERT, SIERRA NEVADA
178	San Emigdio Mountains	1,006	192	2,275	477	2,083	87	22	186,367	754	86	80	7	14	239	21	7	17	0	2	1	17	1	0	3	SOUTH COAST, SIERRA NEVADA, GREAT CENTRAL VALLEY
179	Tehachapi Mountains	1,060	149	2,068	464	1,919	89	20	147,149	595	81	81	0	19	250	19	9	12	0	65	1	0	0	0	4	SOUTH COAST, MOJAVE DESERT, SIERRA NEVADA, GREAT CENTRAL VALLEY
180		254	167	390	42	223	95	5	5,441	22	0	0	0	100	252	2	2	3	0	35	2	3	1	0	1	CENTRAL COAST
181	Clark Mountain Range	1,217	774	2,399	286	1,625	94	18	117,344	475	99	93	6	1	171	13	45	10	76	22	1	0	0	0	1	MOJAVE DESERT
182		169	130	344	18	214	64	39	2,090	8	100	98	2	0	145	2	0	3	0	0	0	0	0	0	1	MOJAVE DESERT
183	Sidney Peak	839	576	1,438	200	862	82	28	86,495	350	99	99	0	1	164	2	2	10	0	48	1	0	0	0	1	MOJAVE DESERT
184		294	124	692	127	568	74	25	6,346	26	89	89	0	11	247	6	1	2	0	0	0	0	0	0	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
185		195	58	317	47	259	96	9	7,066	29	0	0	0	100	261	1	5	7	0	0	0	18	2	0	1	CENTRAL COAST
186		770	642	1,069	79	427	78	34	9,698	39	100	100	0	0	164	1	0	3	0	91	1	0	0	0	1	MOJAVE DESERT

Characteristics of Natural Landscape Blocks

ID	n_subsect	Subsect	HU_num	HU_names	pc_blmacec	n_Counties	Counties	pc_forest	pc_shrub	pc_herb	pc_wetrip	pc_water	pc_dev	pc_crop	pc_pasture	pc_other
142	1	High Desert Plains and Hills	1	ANTELOPE	4	1	Los Angeles	2	86	12	0	0	1	0	0	0
143	1	Santa Ynez-Sulphur Mountains	1	PITAS POINT	0	1	Ventura	4	93	2	0	0	1	0	0	0
144	4	High Desert Plains and Hills, Mojave Valley-Granite Mountains, Lucerne-Johnson Valleys and Hills, Bullion Mountains-Bristol Lake	3	BESSEMER, LUCERNE LAKE, MOJAVE	95	1	San Bernardino	0	53	0	1	0	0	0	0	46
145	2	Northern Transverse Ranges, Sierra Pelona-Mint Canyon	2	ANTELOPE, SANTA CLARA - CALLEGUAS	0	1	Los Angeles	5	89	2	0	0	4	0	0	0
146	2	Mojave Valley-Granite Mountains, Bullion Mountains-Bristol Lake	1	MOJAVE	79	1	San Bernardino	0	67	0	1	0	0	0	0	31
147	2	Northern Transverse Ranges, Sierra Pelona-Mint Canyon	1	SANTA CLARA - CALLEGUAS	0	1	Los Angeles	5	89	3	1	0	2	0	0	0
148	1	High Desert Plains and Hills	1	MOJAVE	100	1	San Bernardino	0	81	0	0	0	0	0	0	19
149	2	High Desert Plains and Hills, Mojave Valley-Granite Mountains	1	MOJAVE	99	1	San Bernardino	0	60	0	0	0	0	0	0	40
150	2	Northern Transverse Ranges, High Desert Plains and Hills	2	ANTELOPE, SANTA CLARA - CALLEGUAS	0	1	Los Angeles	19	62	17	0	0	1	0	0	0
151	1	High Desert Plains and Hills	2	ANTELOPE, MOJAVE	84	3	San Bernardino, Kern, Los Angeles	0	83	0	0	0	2	0	0	15
152	1	High Desert Plains and Hills	1	MOJAVE	100	1	San Bernardino	0	96	0	2	0	0	0	0	2
153	2	Northern Transverse Ranges, High Desert Plains and Hills	1	ANTELOPE	0	1	Los Angeles	18	49	33	0	0	0	0	0	0
154	6	Mojave Valley-Granite Mountains, Silurian Valley-Devil's Playground, Kingston Range-Valley Wells, Ivanpah Valley, Providence Mountains-Lanfair Valley, Bullion Mountains-Bristol Lake	3	BROADWELL, MOJAVE, ROUTE SIXTY SIX	0	1	San Bernardino	0	54	0	1	0	0	0	0	45
155	3	Santa Ynez Valleys and Hills, Santa Ynez-Sulphur Mountains, San Rafael-Topatopa Mountains	2	SANTA YNEZ, SOUTH COAST	0	1	Santa Barbara	2	95	1	1	0	1	0	0	0
156	3	Northern Transverse Ranges, Sierra Pelona-Mint Canyon, High Desert Plains and Hills	2	ANTELOPE, SANTA CLARA - CALLEGUAS	0	1	Los Angeles	20	69	8	0	0	1	0	0	0
157	1	Santa Ynez-Sulphur Mountains	2	SANTA YNEZ, SOUTH COAST	0	1	Santa Barbara	3	92	1	1	0	2	1	0	0
158	2	Santa Ynez Valleys and Hills, Santa Ynez-Sulphur Mountains	2	SANTA YNEZ, SOUTH COAST	0	1	Santa Barbara	4	93	1	1	0	1	1	0	0
159	5	Silurian Valley-Devil's Playground, Ivanpah Valley, Providence Mountains-Lanfair Valley, Piute Valley-Sacramento Mountains, Bullion Mountains-Bristol Lake	5	HOMER, IVANPAH, MOJAVE, ROUTE SIXTY SIX, WARD	10	1	San Bernardino	0	76	0	0	0	0	0	0	23
160	5	Santa Ynez-Sulphur Mountains, Oxnard Plain-Santa Paula Valley, San Rafael-Topatopa Mountains, Northern Transverse Ranges, Sierra Pelona-Mint Canyon	4	GRAPEVINE, SANTA CLARA - CALLEGUAS, SANTA MARIA, VENTURA RIVER	0	3	Kern, Ventura, Los Angeles	50	40	9	1	0	1	0	0	0
161	4	Eastern Slopes, San Emigdio Mountains, Northern Transverse Ranges, High Desert Plains and Hills	3	ANTELOPE, GRAPEVINE, SANTA CLARA - CALLEGUAS	0	2	Kern, Los Angeles	29	19	51	0	0	1	0	0	0
162	3	Silurian Valley-Devil's Playground, Kingston Range-Valley Wells, Ivanpah Valley	3	AMARGOSA, IVANPAH, MOJAVE	0	1	San Bernardino	0	72	0	0	0	0	0	0	27
163	2	Kingston Range-Valley Wells, Ivanpah Valley	2	AMARGOSA, IVANPAH	0	1	San Bernardino	0	74	0	0	0	0	0	0	26
164	2	San Emigdio Mountains, Northern Transverse Ranges	1	GRAPEVINE	0	2	Kern, Ventura	86	1	7	0	0	3	1	2	0
165	1	Santa Ynez-Sulphur Mountains	2	SANTA YNEZ, SOUTH COAST	0	1	Santa Barbara	4	78	14	1	0	2	0	0	0
166	2	Ivanpah Valley, Hualapai Mountains Coniferous Forest	1	IVANPAH	99	1	San Bernardino	0	73	0	0	0	0	0	0	27
167	1	Santa Ynez Valleys and Hills	2	SAN ANTONIO, SANTA YNEZ	0	1	Santa Barbara	6	78	11	0	0	4	0	0	0
168	1	Santa Ynez-Sulphur Mountains	2	SANTA YNEZ, SOUTH COAST	0	1	Santa Barbara	4	81	10	1	0	4	1	0	0
169	1	Santa Ynez Valleys and Hills	1	SANTA YNEZ	0	1	Santa Barbara	0	78	1	1	0	4	15	0	0
170	1	High Desert Plains and Hills	1	ANTELOPE	84	1	Kern	0	95	0	0	0	0	0	0	4
171	1	High Desert Plains and Hills	1	ANTELOPE	86	1	Kern	0	98	0	0	0	0	0	0	2
172	1	High Desert Plains and Hills	1	FREMONT	100	1	Kern	0	80	0	0	0	0	0	0	20
173	3	Caliente Range-Cuyama Valley, Temblor Range, Northern Transverse Ranges	4	CARRIZO PLAIN, GRAPEVINE, SANTA CLARA - CALLEGUAS, SANTA MARIA	0	4	Kern, San Luis Obispo, Santa Barbara, Ventura	61	16	21	0	0	1	0	0	0
174	1	Santa Ynez Valleys and Hills	2	SAN ANTONIO, SANTA YNEZ	0	1	Santa Barbara	1	81	3	1	0	7	7	0	0
175	1	Santa Ynez Valleys and Hills	2	SAN ANTONIO, SANTA MARIA	0	1	Santa Barbara	2	55	41	1	0	1	0	0	0
176	2	High Desert Plains and Hills, Mojave Valley-Granite Mountains	2	ANTELOPE, CUDDEBACK	74	2	San Bernardino, Kern	0	90	0	0	0	1	0	0	9
177	3	Eastern Slopes, Tehachapi-Piute Mountains, High Desert Plains and Hills	2	FREMONT, GRAPEVINE	26	1	Kern	32	67	0	1	0	0	0	0	0
178	6	South Valley Alluvium and Basins, Elk Hills and South Valley Terraces, San Emigdio Mountains, Caliente Range-Cuyama Valley, Temblor Range, Northern Transverse Ranges	4	CARRIZO PLAIN, GRAPEVINE, SANTA MARIA, SOUTH VALLEY FLOOR	0	2	Kern, Ventura	34	18	45	0	0	2	0	0	1
179	7	South Valley Alluvium and Basins, Elk Hills and South Valley Terraces, Eastern Slopes, Tehachapi-Piute Mountains, Southern Granitic Foothills, San Emigdio Mountains, High Desert Plains and Hills	3	ANTELOPE, GRAPEVINE, SOUTH VALLEY FLOOR	0	2	Kern, Los Angeles	26	42	29	1	0	1	0	1	0
180	1	Santa Ynez Valleys and Hills	2	SAN ANTONIO, SANTA MARIA	0	1	Santa Barbara	2	82	7	3	0	3	3	0	0
181	3	Amargosa Desert-Pahrump Valley, Kingston Range-Valley Wells, Ivanpah Valley	3	AMARGOSA, IVANPAH, MESQUITE	15	1	San Bernardino	2	63	0	1	0	0	0	0	34
182	1	Silurian Valley-Devil's Playground	1	AMARGOSA	97	1	San Bernardino	0	59	0	13	0	1	0	0	26
183	2	High Desert Plains and Hills, Mojave Valley-Granite Mountains	3	ANTELOPE, CUDDEBACK, FREMONT	91	1	Kern	0	74	0	0	0	0	1	0	24
184	2	South Valley Alluvium and Basins, Southern Granitic Foothills	2	GRAPEVINE, SOUTH VALLEY FLOOR	0	1	Kern	0	19	75	0	0	1	5	0	0
185	1	Santa Ynez Valleys and Hills	1	SAN ANTONIO	0	1	Santa Barbara	0	93	5	0	0	1	0	0	0
186	2	High Desert Plains and Hills, Mojave Valley-Granite Mountains	1	FREMONT	99	1	Kern	0	71	0	0	0	1	0	0	29

Characteristics of Natural Landscape Blocks

ID NLB_Name	elev_MEAN	elev_MIN	elev_MAX	elev_STD	elev_RANGE	mn_integ	std_integ	AREA_ac	AREA_km2	pc_protect	pc_gap12e	pc_gap3	pc_privunp	mn_sprich	std_sprich	CNDDB_plant_count	CNDDB_animal_count	pc_hotspt	pc_crithab	crithab_sp_count	pc_esshab	esshab_sp_count	pc_wtvp	n_ecoreg	Ecoregs
187 Mesquite Mountains	1,072	791	1,428	125	637	96	14	30,031	122	100	99	1	0	155	5	1	1	62	9	1	0	0	0	1	MOJAVE DESERT
188	971	837	1,177	65	340	85	28	11,181	45	100	100	0	0	151	13	0	3	0	72	1	0	0	0	1	MOJAVE DESERT
189	877	405	1,399	224	994	68	22	3,019	12	91	91	0	9	253	5	0	0	0	0	0	0	0	0	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
190 Calico Mountains	844	320	1,651	202	1,331	91	21	1,004,928	4,067	95	84	11	5	152	11	14	16	0	89	1	0	0	0	1	MOJAVE DESERT
191	471	266	796	128	530	74	18	2,196	9	0	0	0	100	254	2	0	0	0	0	0	0	0	0	1	GREAT CENTRAL VALLEY
192	712	615	919	57	304	100	0	3,442	14	100	94	5	0	138	0	0	2	0	0	0	0	0	0	1	MOJAVE DESERT
193	381	235	543	75	308	84	21	5,543	22	59	59	0	41	254	1	6	4	0	0	0	0	0	0	1	GREAT CENTRAL VALLEY
194	490	268	963	138	695	87	21	7,170	29	29	29	0	71	253	3	4	1	0	0	0	0	0	0	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
195	458	124	914	141	790	91	17	25,288	102	0	0	0	100	253	14	0	2	0	0	0	35	1	0	1	CENTRAL COAST
196	1,241	779	1,724	170	945	96	4	5,621	23	74	71	3	26	232	16	0	2	99	0	0	0	0	0	1	SIERRA NEVADA
197	548	509	691	33	182	87	25	4,055	16	99	96	3	1	140	1	0	2	0	0	0	0	0	0	1	MOJAVE DESERT
198	95	89	171	13	82	52	37	5,888	24	74	73	0	26	200	2	3	14	96	0	0	68	1	0	1	GREAT CENTRAL VALLEY
199 Sierra Madre Mountains	957	31	2,082	365	2,051	96	13	805,948	3,262	82	73	9	18	247	16	30	23	0	20	5	38	3	0	3	SOUTH COAST, CENTRAL COAST, GREAT CENTRAL VALLEY
200 Ten Section Oil Field	99	96	102	1	6	77	18	2,288	9	0	0	0	100	196	1	1	3	0	0	0	100	1	0	1	GREAT CENTRAL VALLEY
201 El Paso Mountains	988	590	1,593	163	1,003	90	23	46,959	190	100	99	1	0	166	6	4	11	0	0	0	0	0	0	1	MOJAVE DESERT
202 Casmalia Hills	138	0	501	123	501	89	23	33,455	135	22	22	0	78	290	25	15	22	0	17	2	100	4	5	1	CENTRAL COAST
203 Kingston Range/ Shadow Valley	863	203	2,224	336	2,021	96	16	365,414	1,479	100	82	17	0	161	12	18	22	68	26	2	0	0	0	1	MOJAVE DESERT
204 California Valley/ Kingston Range	947	446	1,871	215	1,425	97	11	122,251	495	99	87	12	1	157	14	19	7	33	0	0	0	0	0	1	MOJAVE DESERT
205	409	404	487	8	83	86	27	3,022	12	98	57	41	2	156	2	3	7	99	68	1	0	0	7	1	MOJAVE DESERT
206	914	855	967	20	112	98	9	3,651	15	85	0	85	15	172	3	0	2	100	0	0	0	0	0	1	MOJAVE DESERT
207	14	1	42	9	41	50	23	2,118	9	99	96	3	1	302	20	7	8	0	89	1	50	3	24	1	CENTRAL COAST
208	298	74	540	79	466	92	12	6,588	27	0	0	0	100	269	7	1	1	0	0	0	84	1	0	1	CENTRAL COAST
209 Lucas Creek	995	190	2,079	451	1,889	87	24	50,621	205	71	54	16	29	254	10	11	15	76	0	0	0	0	0	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
210 Elk Hills	219	79	470	104	391	75	32	55,189	223	85	48	37	15	198	3	9	17	35	0	0	99	1	0	1	GREAT CENTRAL VALLEY
211 Carrizo Plain/ Temblor Range	740	363	1,317	160	954	89	22	163,850	663	88	82	7	12	215	6	11	18	0	0	2	100	2	0	2	CENTRAL COAST, GREAT CENTRAL VALLEY
212	284	192	378	47	186	90	17	2,365	10	0	0	0	100	212	1	0	1	0	0	0	0	0	4	1	GREAT CENTRAL VALLEY
213	627	594	678	24	84	83	27	4,038	16	0	0	0	100	216	3	2	4	0	13	2	100	2	0	1	GREAT CENTRAL VALLEY
214 Piute Mountains/ Scodie Mountains	1,373	632	2,460	337	1,828	89	22	332,205	1,344	97	91	6	3	204	26	26	19	41	0	0	0	0	0	2	MOJAVE DESERT, SIERRA NEVADA
215 Poso Creek	259	172	352	39	180	94	14	3,064	12	0	0	0	100	209	0	0	1	0	0	0	0	0	1	1	GREAT CENTRAL VALLEY
216	327	89	511	75	422	71	11	2,051	8	93	93	0	7	288	23	3	0	0	0	0	0	0	1	1	CENTRAL COAST
217 McKittrick Valley	122	75	247	41	172	74	36	21,967	89	98	98	0	2	196	4	6	12	0	0	0	82	1	0	1	GREAT CENTRAL VALLEY
218	444	329	631	68	302	90	19	3,842	16	0	0	0	100	244	7	2	2	0	61	1	0	0	0	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
219 Nopah Range	873	408	1,935	278	1,527	98	12	122,187	494	100	91	8	0	141	7	8	9	8	1	1	0	0	1	1	MOJAVE DESERT
220 Sequoia National Forest/ Greenhorn Mountains	932	138	1,982	392	1,844	89	24	119,430	483	38	24	14	62	252	16	17	16	76	10	1	0	0	0	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
221	466	363	659	59	296	81	22	5,881	24	91	90	1	9	240	2	1	2	0	0	0	0	0	0	1	CENTRAL COAST
222	856	495	1,134	134	639	95	14	16,035	65	0	0	0	100	245	3	2	1	6	100	1	0	0	0	1	SIERRA NEVADA
223 Five Dog Creek	292	218	365	29	147	88	21	4,900	20	0	0	0	100	210	2	0	2	0	0	0	0	0	0	1	GREAT CENTRAL VALLEY
224	209	0	524	113	524	67	44	10,156	41	81	77	3	19	298	26	16	9	100	9	2	5	2	2	1	CENTRAL COAST
225	517	430	598	31	168	92	16	2,523	10	0	0	0	100	221	7	2	0	0	9	1	0	0	0	2	CENTRAL COAST GREAT CENTRAL VALLEY
226	399	296	569	62	273	76	23	2,340	9	91	91	0	9	242	12	2	1	0	0	0	0	1	0	1	CENTRAL COAST
227	74	71	86	3	15	63	45	8,860	36	34	34	0	66	193	2	4	5	0	0	0	0	0	15	1	GREAT CENTRAL VALLEY
228	208	168	252	16	84	87	23	3,490	14	0	0	0	100	206	1	0	3	0	0	0	0	0	0	1	GREAT CENTRAL VALLEY
229 La Panza Range	677	115	1,553	195	1,438	93	18	483,280	1,956	71	61	10	29	233	12	31	27	0	6	5	29	3	0	3	SOUTH COAST, CENTRAL COAST, GREAT CENTRAL VALLEY
230 Gordon Gulch/ Sand Canyon	363	196	669	103	473	88	22	18,148	73	0	0	0	100	236	16	2	1	0	49	1	0	0	0	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
231	173	151	192	10	41	81	31	4,462	18	0	0	0	100	191	0	0	3	0	0	0	0	0	0	1	GREAT CENTRAL VALLEY

Characteristics of Natural Landscape Blocks

ID	n_subsect	Subsect	HU_num	HU_names	pc_blmacec	n_Counties	Counties	pc_forest	pc_shrub	pc_herb	pc_wetrip	pc_water	pc_dev	pc_crop	pc_pasture	pc_other
187	2	Amargosa Desert-Pahrump Valley, Kingston Range-Valley Wells	2	AMARGOSA, MESQUITE	9	1	San Bernardino	0	57	0	0	0	0	0	0	43
188	2	High Desert Plains and Hills, Mojave Valley-Granite Mountains	1	FREMONT	98	2	San Bernardino, Kern	0	90	0	0	0	0	0	0	10
189	3	South Valley Alluvium and Basins, Tehachapi-Piute Mountains, Southern Granitic Foothills	2	GRAPEVINE, SOUTH VALLEY FLOOR	0	1	Kern	2	83	13	1	0	1	0	0	0
190	4	Searles Valley-Owlshead Mountains, High Desert Plains and Hills, Mojave Valley-Granite Mountains, Silurian Valley-Devil's Playground	10	ANTELOPE, BALLARAT, BICYCLE, COYOTE, CUDDEBACK, FREMONT, GOLDSTONE, MOJAVE, SUPERIOR, TRONA	71	1	San Bernardino	0	73	0	1	0	0	0	0	26
191	3	Hardpan Terraces, South Valley Alluvium and Basins, Southern Granitic Foothills	2	GRAPEVINE, SOUTH VALLEY FLOOR	0	1	Kern	0	17	83	0	0	0	0	0	0
192	2	Searles Valley-Owlshead Mountains, Mojave Valley-Granite Mountains	1	TRONA	0	1	San Bernardino	0	70	0	1	0	0	0	0	29
193	3	Hardpan Terraces, South Valley Alluvium and Basins, Southern Granitic Foothills	2	GRAPEVINE, SOUTH VALLEY FLOOR	0	1	Kern	0	4	94	0	0	1	1	0	0
194	2	Hardpan Terraces, Southern Granitic Foothills	2	GRAPEVINE, SOUTH VALLEY FLOOR	0	1	Kern	0	14	84	1	0	0	0	0	0
195	3	South Costal Santa Lucia Range, Santa Maria Valley, Interior Santa Lucia Range	1	SANTA MARIA	0	2	San Luis Obispo, Santa Barbara	17	72	8	1	0	1	1	1	0
196	1	Tehachapi-Piute Mountains	1	GRAPEVINE	0	1	Kern	27	65	6	1	0	0	0	0	0
197	1	Searles Valley-Owlshead Mountains	1	TRONA	0	1	San Bernardino	0	26	0	0	0	0	0	0	74
198	2	South Valley Alluvium and Basins, Elk Hills and South Valley Terraces	1	SOUTH VALLEY FLOOR	0	1	Kern	0	7	61	0	15	9	4	1	2
199	7	Santa Maria Valley, Santa Ynez Valleys and Hills, Santa Ynez-Sulphur Mountains, Interior Santa Lucia Range, Caliente Range-Cuyama Valley, San Rafael-Topatopa Mountains, Northern Transverse Ranges	6	PITAS POINT, SANTA CLARA - CALLEGUAS, SANTA MARIA, SANTA YNEZ, SOUTH COAST, VENTURA RIVER	0	3	San Luis Obispo, Santa Barbara, Ventura	44	46	8	1	0	1	0	0	0
200	1	South Valley Alluvium and Basins	1	SOUTH VALLEY FLOOR	0	1	Kern	0	0	98	0	0	1	1	0	0
201	2	Searles Valley-Owlshead Mountains, High Desert Plains and Hills	2	FREMONT, INDIAN WELLS	0	1	Kern	0	60	0	2	0	0	0	0	38
202	2	Santa Maria Valley, Santa Ynez Valleys and Hills	2	SAN ANTONIO, SANTA MARIA	0	2	San Luis Obispo, Santa Barbara	1	60	11	2	0	4	0	0	22
203	4	Amargosa Desert-Pahrump Valley, Funeral Mountains-Greenwater Valley, Silurian Valley-Devil's Playground, Kingston Range-Valley Wells	3	AMARGOSA, MESQUITE, MOJAVE	27	2	Inyo, San Bernardino	1	64	0	2	0	0	0	0	33
204	3	Amargosa Desert-Pahrump Valley, Funeral Mountains-Greenwater Valley, Kingston Range-Valley Wells	3	AMARGOSA, MESQUITE, PAHRUMP	16	2	Inyo, San Bernardino	0	66	0	0	0	0	0	0	34
205	1	Funeral Mountains-Greenwater Valley	1	AMARGOSA	72	1	Inyo	0	31	0	5	0	0	0	0	64
206	1	High Desert Plains and Hills	1	INDIAN WELLS	0	1	Kern	0	97	0	0	0	0	0	0	3
207	1	Santa Maria Valley	1	ESTERO BAY	0	1	San Luis Obispo	2	25	2	12	5	2	8	0	45
208	2	South Costal Santa Lucia Range, Interior Santa Lucia Range	2	ESTERO BAY, SANTA MARIA	0	1	San Luis Obispo	6	84	7	0	0	1	0	1	0
209	3	Hardpan Terraces, Tehachapi-Piute Mountains, Southern Granitic Foothills	3	GRAPEVINE, KERN RIVER, SOUTH VALLEY FLOOR	0	1	Kern	33	39	24	2	0	0	0	0	2
210	3	Antelope Plain, South Valley Alluvium and Basins, Elk Hills and South Valley Terraces	1	SOUTH VALLEY FLOOR	40	1	Kern	0	34	55	0	0	8	1	1	1
211	4	Elk Hills and South Valley Terraces, Carrizo Plain, Caliente Range-Cuyama Valley, Temblor Range	5	CARRIZO PLAIN, FELLOWS, GRAPEVINE, SOUTH VALLEY FLOOR, TEMBLOR	75	2	Kern, San Luis Obispo	9	36	45	0	1	3	0	0	6
212	1	Hardpan Terraces	2	SOUTH VALLEY FLOOR, SOUTHERN SIERRA	0	1	Kern	0	6	91	1	0	2	0	0	0
213	1	Carrizo Plain	1	CARRIZO PLAIN	0	1	San Luis Obispo	0	38	56	0	0	2	1	3	0
214	5	Eastern Slopes, Tehachapi-Piute Mountains, Kern Plateau, Southern Granitic Foothills, High Desert Plains and Hills	4	FREMONT, GRAPEVINE, INDIAN WELLS, KERN RIVER	57	1	Kern	20	77	0	1	0	0	0	0	1
215	1	Hardpan Terraces	1	SOUTH VALLEY FLOOR	0	1	Kern	0	1	98	1	0	1	0	0	0
216	1	South Costal Santa Lucia Range	1	ESTERO BAY	0	1	San Luis Obispo	17	82	0	0	0	0	0	0	0
217	2	Antelope Plain, South Valley Alluvium and Basins	1	SOUTH VALLEY FLOOR	98	1	Kern	0	14	36	0	0	3	35	4	8
218	2	Hardpan Terraces, Southern Granitic Foothills	1	SOUTHERN SIERRA	0	1	Kern	0	24	76	0	0	0	0	0	0
219	2	Amargosa Desert-Pahrump Valley, Funeral Mountains-Greenwater Valley	2	AMARGOSA, PAHRUMP	3	1	Inyo	0	56	0	1	0	0	0	0	43
220	3	Hardpan Terraces, Lower Batholith, Southern Granitic Foothills	3	KERN RIVER, SOUTH VALLEY FLOOR, SOUTHERN SIERRA	0	1	Kern	29	44	24	2	0	0	0	0	0
221	1	Interior Santa Lucia Range	1	SALINAS	0	1	San Luis Obispo	27	55	5	5	5	3	0	0	0
222	1	Southern Granitic Foothills	1	SOUTHERN SIERRA	0	1	Kern	8	87	2	3	0	0	0	0	0
223	1	Hardpan Terraces	1	SOUTH VALLEY FLOOR	0	1	Kern	0	1	97	0	0	2	0	0	0
224	1	South Costal Santa Lucia Range	1	ESTERO BAY	0	1	San Luis Obispo	4	85	2	0	0	5	0	0	3
225	1	Paso Robles Hills and Valleys	1	ESTRELLA RIVER	0	1	San Luis Obispo	3	39	57	0	0	1	0	0	0
226	1	Interior Santa Lucia Range	1	SALINAS	91	1	San Luis Obispo	31	64	2	2	0	1	0	0	0
227	1	South Valley Alluvium and Basins	1	SOUTH VALLEY FLOOR	0	1	Kern	0	4	5	2	0	3	61	26	0
228	1	Hardpan Terraces	1	SOUTH VALLEY FLOOR	0	1	Kern	0	1	88	0	0	4	6	1	0
229	5	South Costal Santa Lucia Range, Interior Santa Lucia Range, Paso Robles Hills and Valleys, Carrizo Plain, Caliente Range-Cuyama Valley	5	CARRIZO PLAIN, ESTERO BAY, ESTRELLA RIVER, SALINAS, SANTA MARIA	27	3	Kern, San Luis Obispo, Santa Barbara	31	36	28	0	0	1	0	1	2
230	2	Hardpan Terraces, Southern Granitic Foothills	2	SOUTH VALLEY FLOOR, SOUTHERN SIERRA	0	1	Kern	0	18	81	0	0	0	0	0	0
231	1	Antelope Plain	1	SOUTH VALLEY FLOOR	0	1	Kern	0	4	82	0	0	2	10	0	2

Characteristics of Natural Landscape Blocks

ID	NLB_Name	elev_MEAN	elev_MIN	elev_MAX	elev_STD	elev_RANGE	mn_integ	std_integ	AREA_ac	AREA_km2	pc_protect	pc_gap12e	pc_gap3	pc_privunp	mn_sprich	std_sprich	CNDDB_plant_count	CNDDB_animal_count	pc_hotspt	pc_crithab	crithab_sp_count	pc_esshab	esshab_sp_count	pc_wtvp	n_ecoreg	Ecoregs
232	Resting Spring Range	869	520	1,594	204	1,074	96	16	81,324	329	100	99	1	0	138	1	3	2	0	0	0	0	0	1	1	MOJAVE DESERT
233		478	309	793	81	484	98	9	2,679	11	76	0	76	24	270	2	6	0	0	0	0	100	1	0	1	CENTRAL COAST
234		142	124	180	12	56	93	20	9,649	39	0	0	0	100	191	1	0	4	0	0	0	0	0	0	1	GREAT CENTRAL VALLEY
235		68	65	77	2	12	95	14	20,336	82	18	18	0	82	196	1	7	10	0	0	0	0	0	8	1	GREAT CENTRAL VALLEY
236		464	153	1,465	306	1,312	89	22	48,518	196	1	0	1	99	236	17	5	3	0	44	1	0	0	0	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
237		442	351	602	43	251	86	24	20,749	84	0	0	0	100	214	5	4	5	0	0	0	11	1	0	2	CENTRAL COAST, GREAT CENTRAL VALLEY
238	Kern National Wildlife Refuge	68	64	75	2	11	94	17	32,737	132	56	56	0	44	198	2	7	19	0	0	0	0	0	39	1	GREAT CENTRAL VALLEY
239		233	182	316	26	134	83	26	4,214	17	0	0	0	100	243	12	1	1	0	0	0	0	0	1	1	GREAT CENTRAL VALLEY
240		391	294	514	36	220	91	17	16,073	65	0	0	0	100	213	2	1	1	0	0	0	17	1	0	2	CENTRAL COAST, GREAT CENTRAL VALLEY
241	Allensworth	73	64	81	4	17	55	39	5,459	22	67	67	0	33	196	1	3	9	0	4	1	24	1	65	1	GREAT CENTRAL VALLEY
242	San Geronimo	162	7	488	80	481	92	13	15,309	62	0	0	0	100	275	16	4	4	0	0	0	100	1	0	1	CENTRAL COAST
243		65	63	71	2	8	89	20	18,836	76	3	1	2	97	197	2	0	8	0	0	0	0	0	6	1	GREAT CENTRAL VALLEY
244		540	330	785	92	455	88	21	95,439	386	0	0	0	100	210	6	8	10	0	3	1	52	1	0	2	CENTRAL COAST, GREAT CENTRAL VALLEY
245	Allensworth	63	63	66	0	3	54	42	3,272	13	37	37	0	63	203	2	1	4	0	0	0	0	0	8	1	GREAT CENTRAL VALLEY
246		506	153	1,194	227	1,041	94	15	244,363	989	7	3	4	93	207	11	17	15	0	4	2	67	2	0	3	CENTRAL COAST, CENTRAL COAST, GREAT CENTRAL VALLEY
247	Santa Rosa Creek	175	40	427	67	387	93	12	4,436	18	0	0	0	100	277	21	3	4	0	0	0	100	2	0	1	CENTRAL COAST
248	Las Colinas/ South Dome	156	113	214	17	101	96	12	9,100	37	0	0	0	100	196	7	0	4	0	0	0	0	0	0	1	GREAT CENTRAL VALLEY
249	Pixley National Wildlife Refuge	68	61	76	3	15	75	28	5,715	23	93	93	0	7	202	2	3	9	0	84	1	84	1	76	1	GREAT CENTRAL VALLEY
250	Bluestone Ridge	412	177	952	178	775	94	18	33,696	136	8	0	8	92	205	9	9	7	0	3	1	3	1	0	2	CENTRAL COAST, GREAT CENTRAL VALLEY
251	Sand Ridge	62	58	74	3	16	93	18	19,628	79	0	0	0	100	199	4	3	8	0	0	0	0	0	14	1	GREAT CENTRAL VALLEY
252	Tennessee Ridge	311	170	733	107	563	88	15	17,134	69	1	0	1	99	253	6	5	3	0	1	1	0	0	1	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
253	Death Valley/ Black Mountains/ Amargosa Range	739	-82	1,928	530	2,010	95	19	444,103	1,797	100	100	0	0	145	6	10	6	0	0	0	0	0	1	1	MOJAVE DESERT
254	Homeland Canal	61	58	64	1	6	4	16	7,893	32	92	92	0	8	197	3	0	3	0	0	0	0	0	3	1	GREAT CENTRAL VALLEY
255	Kettleman Hills/ Las Alturas	167	119	225	21	106	95	14	2,130	9	0	0	0	100	202	0	0	2	0	0	0	0	0	0	1	GREAT CENTRAL VALLEY
256	Dudley Ridge	63	59	71	3	12	94	15	4,114	17	0	0	0	100	206	11	0	1	0	0	0	0	0	0	1	GREAT CENTRAL VALLEY
257		389	249	636	71	387	75	20	7,722	31	96	96	0	4	244	12	1	0	0	0	0	0	0	0	1	CENTRAL COAST
258		1,193	471	2,362	303	1,891	96	16	95,386	386	100	97	3	0	155	8	1	12	0	1	1	0	0	0	1	MOJAVE DESERT
259		1,133	1,106	1,195	17	89	55	37	2,191	9	99	88	11	1	234	17	1	4	0	0	0	0	0	0	2	MOJAVE DESERT, SIERRA NEVADA
260	Silver Mountain/ Rose Valley	1,520	1,015	2,307	325	1,292	95	17	82,924	336	99	75	23	1	181	23	5	7	30	0	0	0	0	0	2	MOJAVE DESERT, SIERRA NEVADA
261	Frazier Valley/ Rocky Hill	257	139	539	96	400	75	20	6,059	25	2	0	2	98	256	4	4	2	0	74	1	0	0	2	1	GREAT CENTRAL VALLEY
262		366	244	659	75	415	85	20	4,229	17	94	94	0	6	274	3	0	0	0	0	0	0	0	0	1	CENTRAL COAST
263	Kettleman Hills/ La Bajada	204	127	300	38	173	81	28	4,432	18	35	35	0	65	186	1	1	3	0	0	0	0	0	0	1	GREAT CENTRAL VALLEY
264		1,278	468	2,286	514	1,818	94	21	80,138	324	100	100	0	0	156	11	11	4	0	0	0	0	0	0	1	MOJAVE DESERT
265	Pixley National Wildlife Refuge	66	61	70	1	9	73	32	8,846	36	80	80	0	20	199	1	0	7	0	79	1	79	1	81	1	GREAT CENTRAL VALLEY
266	Gholame Hills	558	336	873	110	537	90	21	50,611	205	3	3	0	97	209	4	3	4	0	0	0	96	1	0	1	CENTRAL COAST
267	Inyo Mountains	1,763	1,145	2,356	284	1,211	96	15	32,493	131	100	99	1	0	175	23	1	0	0	0	0	0	0	0	2	MOJAVE DESERT, SIERRA NEVADA
268		352	195	596	83	401	93	11	6,257	25	8	0	7	92	235	2	0	0	0	0	0	0	0	0	1	CENTRAL COAST
269	Death Valley/ Panamint Range	770	-81	3,361	648	3,442	97	13	1,087,587	4,401	100	100	0	0	162	18	41	23	0	0	0	0	0	0	1	MOJAVE DESERT
270	Yokohl Valley/ Oat Canyon	300	149	766	97	617	86	16	23,214	94	0	0	0	100	254	5	2	1	0	76	1	0	1	0	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
271		316	238	380	28	142	96	9	3,758	15	28	0	28	72	238	0	6	0	0	0	0	0	0	0	1	CENTRAL COAST
272		388	266	571	54	305	93	11	4,665	19	4	0	4	96	259	17	2	1	0	0	0	0	0	0	1	CENTRAL COAST
273	Kettleman Hills	277	157	408	46	251	65	39	16,839	68	75	75	0	25	188	5	1	7	0	0	0	0	0	0	1	GREAT CENTRAL VALLEY
274	Cross Creek	66	65	70	1	5	90	14	2,907	12	0	0	0	100	197	0	0	1	0	0	0	0	0	77	1	GREAT CENTRAL VALLEY
275		338	181	524	76	343	88	12	2,718	11	0	0	0	100	238	13	1	0	0	0	0	0	0	0	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
276	Death Valley	201	-51	670	152	721	81	33	14,787	60	100	100	0	0	148	3	0	0	0	0	0	0	0	0	1	MOJAVE DESERT
277	Kettleman Hills/ North Dome	276	182	402	43	220	48	40	10,167	41	77	77	0	23	193	8	1	6	0	0	0	0	0	0	1	GREAT CENTRAL VALLEY
278	Owens Valley	1,090	1,076	1,142	8	66	93	22	81,169	328	100	99	1	0	224	14	3	16	0	0	0	0	0	4	2	MOJAVE DESERT, SIERRA NEVADA
279	Funeral Mountains	850	-65	2,031	420	2,096	97	15	263,324	1,066	100	99	0	0	142	7	27	12	0	0	0	0	0	0	1	MOJAVE DESERT
280		1,262	1,119	1,441	114	322	45	33	4,406	18	99	95	4	1	240	6	4	8	0	0	0	0	0	18	1	SIERRA NEVADA

ID	n_subsect	Subsect	HU_num	HU_names	pc_blmacec	n_Counties	Counties	pc_forest	pc_shrub	pc_herb	pc_wetrip	pc_water	pc_dev	pc_crop	pc_pasture	pc_other
232	2	Amargosa Desert-Pahrump Valley, Funeral Mountains-Greenwater Valley	2	AMARGOSA, PAHRUMP	0	1	Inyo	0	52	0	1	0	0	0	0	47
233	2	South Costal Santa Lucia Range, Interior Santa Lucia Range	2	ESTERO BAY, SALINAS	0	1	San Luis Obispo	1	93	5	1	0	0	0	0	0
234	1	Antelope Plain	1	SOUTH VALLEY FLOOR	0	1	Kern	0	1	80	0	0	6	10	1	3
235	1	South Valley Alluvium and Basins	1	SOUTH VALLEY FLOOR	0	1	Kern	0	0	1	0	0	3	15	81	0
236	3	Hardpan Terraces, Lower Granitic Foothills, Southern Granitic Foothills	2	SOUTH VALLEY FLOOR, SOUTHERN SIERRA	0	2	Tulare, Kern	7	28	60	1	0	1	2	1	0
237	1	Paso Robles Hills and Valleys	2	ESTRELLA RIVER, SALINAS	0	1	San Luis Obispo	1	16	79	0	0	1	1	2	0
238	2	Antelope Plain, South Valley Alluvium and Basins	1	SOUTH VALLEY FLOOR	0	2	Kings, Kern	0	3	5	14	1	4	13	60	0
239	2	Hardpan Terraces, Lower Granitic Foothills	2	SOUTH VALLEY FLOOR, SOUTHERN SIERRA	0	1	Tulare	0	3	87	0	0	1	9	0	0
240	1	Paso Robles Hills and Valleys	2	ESTRELLA RIVER, SALINAS	0	1	San Luis Obispo	3	27	69	0	0	1	0	0	0
241	1	South Valley Alluvium and Basins	1	SOUTH VALLEY FLOOR	0	1	Tulare	0	0	55	0	0	2	21	22	0
242	1	South Costal Santa Lucia Range	1	ESTERO BAY	0	1	San Luis Obispo	1	55	42	1	0	0	0	0	0
243	2	Tulare Basin, South Valley Alluvium and Basins	1	SOUTH VALLEY FLOOR	0	3	Tulare, Kings, Kern	0	0	1	0	0	1	43	54	0
244	2	Paso Robles Hills and Valleys, Carrizo Plain	3	CARRIZO PLAIN, ESTRELLA RIVER, TEMBLOR	0	2	Kern, San Luis Obispo	3	36	56	0	0	2	1	1	1
245	2	Tulare Basin, South Valley Alluvium and Basins	1	SOUTH VALLEY FLOOR	0	1	Tulare	0	0	11	0	0	3	55	31	0
246	6	Antelope Plain, Elk Hills and South Valley Terraces, Eastern Hills, Paso Robles Hills and Valleys, Carrizo Plain, Temblor Range	4	CARRIZO PLAIN, ESTRELLA RIVER, SOUTH VALLEY FLOOR, TEMBLOR	3	2	Kern, San Luis Obispo	4	26	58	0	0	4	1	2	4
247	1	South Costal Santa Lucia Range	1	ESTERO BAY	0	1	San Luis Obispo	1	37	60	1	0	0	0	0	0
248	2	Antelope Plain, Kettleman Hills and Valleys	1	SOUTH VALLEY FLOOR	0	2	Kings, Kern	0	0	91	0	0	5	4	0	1
249	3	Granitic Alluvial Fans and Terraces, Tulare Basin, South Valley Alluvium and Basins	1	SOUTH VALLEY FLOOR	0	1	Tulare	0	1	36	2	0	2	12	48	0
250	3	Antelope Plain, Eastern Hills, Kettleman Hills and Valleys	4	ESTRELLA RIVER, SOUTH VALLEY FLOOR, SUNFLOWER VALLEY, TEMBLOR	0	3	Kings, Kern, San Luis Obispo	4	10	80	0	0	2	1	1	0
251	2	Tulare Basin, South Valley Alluvium and Basins	1	SOUTH VALLEY FLOOR	0	2	Kings Kern	0	0	1	0	0	2	66	30	0
252	2	Hardpan Terraces, Lower Granitic Foothills	2	SOUTH VALLEY FLOOR, SOUTHERN SIERRA	0	1	Tulare	1	7	88	1	0	1	1	0	3
253	3	Death Valley, Amargosa Desert-Pahrump Valley, Funeral Mountains-Greenwater Valley	1	AMARGOSA	0	1	Inyo	0	39	0	2	0	0	0	0	60
254	1	Tulare Basin	1	SOUTH VALLEY FLOOR	0	2	Tulare, Kings	0	0	9	1	1	3	81	6	0
255	1	Kettleman Hills and Valleys	1	SOUTH VALLEY FLOOR	0	1	Kings	0	0	98	0	0	1	0	0	0
256	3	Tulare Basin, South Valley Alluvium and Basins, Kettleman Hills and Valleys	1	SOUTH VALLEY FLOOR	0	1	Kings	0	0	1	1	0	0	39	59	0
257	2	South Costal Santa Lucia Range, Interior Santa Lucia Range	1	SALINAS	0	1	San Luis Obispo	21	55	22	0	0	1	0	0	0
258	3	Panamint Valley, Searles Valley-Owlshead Mountains, Cosa-Argus Ranges	2	BALLARAT, TRONA	10	1	Inyo	0	24	0	2	0	0	0	0	74
259	1	Owens Valley	1	OWENS	0	1	Inyo	0	93	0	1	0	6	0	0	0
260	2	Owens Valley, Cosa-Argus Ranges	3	INDIAN WELLS, OWENS, UPPER CACTUS	0	1	Inyo	12	40	0	5	0	0	0	0	42
261	2	Hardpan Terraces, Lower Granitic Foothills	2	SOUTH VALLEY FLOOR, SOUTHERN SIERRA	0	1	Tulare	0	10	84	0	0	0	4	0	0
262	2	South Costal Santa Lucia Range, Interior Santa Lucia Range	1	SALINAS	0	1	San Luis Obispo	16	70	12	1	0	1	0	0	0
263	1	Kettleman Hills and Valleys	1	SOUTH VALLEY FLOOR	35	1	Kings	0	0	94	0	0	5	0	0	0
264	4	Death Valley, Panamint Valley, Saline Valley-Cottonwood Mountains, Panamint Range	2	AMARGOSA, BALLARAT	0	1	Inyo	6	37	0	1	0	0	0	0	57
265	2	Granitic Alluvial Fans and Terraces, Tulare Basin	1	SOUTH VALLEY FLOOR	0	1	Tulare	0	3	40	1	0	2	12	41	0
266	4	Diablo Range, Eastern Hills, Gabilan Range, Paso Robles Hills and Valleys	2	ESTRELLA RIVER, SALINAS	0	2	Monterey, San Luis Obispo	34	18	47	0	0	1	0	0	0
267	3	Owens Valley, Inyo Mountains, Cosa-Argus Ranges	2	BALLARAT, OWENS	0	1	Inyo	14	31	0	0	0	0	0	0	56
268	2	Interior Santa Lucia Range, Paso Robles Hills and Valleys	1	SALINAS	0	1	Monterey	17	58	20	1	1	1	1	1	0
269	8	Death Valley, Funeral Mountains-Greenwater Valley, Panamint Valley, Searles Valley-Owlshead Mountains, Mojave Valley-Granite Mountains, Silurian Valley-Devil's Playground, Saline Valley-Cottonwood Mountains, Panamint Range	5	AMARGOSA, BALLARAT, LEACH, OWLSHEAD, TRONA	0	2	Inyo, San Bernardino	4	32	0	3	0	0	0	0	61
270	2	Hardpan Terraces, Lower Granitic Foothills	3	KAWEAH RIVER, SOUTH VALLEY FLOOR, SOUTHERN SIERRA	0	1	Tulare	1	16	82	0	0	0	1	0	0
271	1	Interior Santa Lucia Range	1	SALINAS	0	1	Monterey	9	48	40	0	0	3	0	0	0
272	1	Interior Santa Lucia Range	1	SALINAS	0	1	Monterey	27	51	19	0	0	3	0	0	0
273	1	Kettleman Hills and Valleys	1	SOUTH VALLEY FLOOR	75	1	Kings	0	0	88	0	0	11	1	0	0
274	2	Granitic Alluvial Fans and Terraces, Tulare Basin	1	SOUTH VALLEY FLOOR	0	1	Kings	0	0	83	0	0	0	4	12	0
275	2	Hardpan Terraces, Lower Granitic Foothills	1	KAWEAH RIVER	0	1	Tulare	0	12	88	0	0	0	0	0	0
276	1	Death Valley	1	AMARGOSA	0	1	Inyo	0	40	0	17	0	0	0	0	43
277	2	Panoche and Cantua Fans and Basins, Kettleman Hills and Valleys	1	SOUTH VALLEY FLOOR	58	2	Fresno, Kings	0	1	84	0	0	12	3	0	0
278	1	Owens Valley	1	OWENS	0	1	Inyo	0	20	0	11	2	0	0	0	66
279	4	Death Valley, Amargosa Desert-Pahrump Valley, Funeral Mountains-Greenwater Valley, Grapevine Mountains	1	AMARGOSA	0	1	Inyo	0	42	0	4	0	0	0	0	54
280	1	Owens Valley	1	OWENS	0	1	Inyo	0	46	0	26	1	6	0	0	21

Characteristics of Natural Landscape Blocks

ID	NLB_Name	elev_MEAN	elev_MIN	elev_MAX	elev_STD	elev_RANGE	mn_integ	std_integ	AREA_ac	AREA_km2	pc_protect	pc_gap12e	pc_gap3	pc_privunp	mn_sprich	std_sprich	CNDDB_plant_count	CNDDB_animal_count	pc_hotspt	pc_crithab	crithab_sp_count	pc_esshab	esshab_sp_count	pc_wtvp	n_ecoreg	Ecoregs
281	Weferling Canyon	447	182	734	102	552	89	18	16,295	66	28	0	28	72	230	2	5	0	0	0	0	0	0	0	1	CENTRAL COAST
282	Anticline Ridge	196	153	281	29	128	57	40	4,900	20	64	64	0	36	219	3	1	6	0	0	0	0	0	0	1	GREAT CENTRAL VALLEY
283	Pancho Rico Valley	448	134	749	122	615	92	18	71,778	290	1	0	1	99	214	5	0	3	0	0	0	0	0	0	1	CENTRAL COAST
284	Table Mountain/ Chino Canyon	616	182	1,319	205	1,137	93	18	274,428	1,111	14	11	4	86	210	6	18	12	0	0	1	25	1	0	2	CENTRAL COAST, GREAT CENTRAL VALLEY
285	Lone Oak Mountain	231	145	467	72	322	90	16	2,824	11	0	0	0	100	255	2	1	0	0	96	2	96	1	10	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
286		467	167	780	149	613	89	18	9,335	38	13	0	13	87	231	3	3	1	0	0	0	1	1	0	1	CENTRAL COAST
287		411	266	631	57	365	92	17	5,152	21	0	0	0	100	214	3	0	0	0	0	0	0	0	0	1	CENTRAL COAST
288		1,205	1,117	1,439	53	322	73	32	6,520	26	99	89	9	1	242	4	3	8	74	0	0	0	0	6	1	SIERRA NEVADA
289		1,127	1,098	1,172	11	74	79	28	17,865	72	100	100	0	0	231	5	4	8	91	0	0	0	0	10	1	SIERRA NEVADA
290	Stokes Mountain	303	127	653	120	526	84	13	5,683	23	1	0	1	99	248	4	1	0	0	97	1	96	1	1	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
291		346	135	591	98	456	90	20	22,654	92	0	0	0	100	217	4	1	1	0	12	1	12	1	0	1	CENTRAL COAST
292	Tucker Mountain	340	147	778	163	631	90	10	2,019	8	0	0	0	100	248	5	1	1	0	1	1	0	0	0	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
293	Redwood Mountain/ Pine Ridge	1,489	358	2,497	437	2,139	81	30	66,870	271	99	98	1	1	236	22	12	17	0	0	0	0	0	0	1	SIERRA NEVADA
294		85	73	99	6	26	19	35	2,676	11	83	83	0	17	252	5	1	3	0	0	0	0	0	0	1	CENTRAL COAST
295	Death Valley/ Grapevine Mountains	1,060	-2	2,566	579	2,568	95	18	168,809	683	100	100	0	0	163	10	25	4	0	0	0	0	0	0	1	MOJAVE DESERT
296		396	147	759	137	612	90	21	13,860	56	0	0	0	100	224	9	1	3	0	25	1	25	1	0	1	CENTRAL COAST
297		208	112	306	34	194	96	10	2,394	10	0	0	0	100	246	1	0	0	0	0	0	0	0	0	1	CENTRAL COAST
298		402	309	491	28	182	95	11	3,272	13	0	0	0	100	220	2	0	0	0	52	1	52	1	0	1	CENTRAL COAST
299		55	51	57	1	6	1	4	5,540	22	99	99	0	1	197	1	0	2	0	0	0	0	0	1	1	GREAT CENTRAL VALLEY
300	Juniper Ridge	753	239	1,367	224	1,128	94	17	134,156	543	18	0	18	82	217	4	16	12	0	24	2	24	1	0	2	CENTRAL COAST, GREAT CENTRAL VALLEY
301		245	83	398	65	315	94	8	3,012	12	0	0	0	100	240	10	2	1	0	0	0	0	0	0	1	CENTRAL COAST
302		117	3	351	84	348	80	33	2,519	10	86	81	6	14	279	22	5	5	0	0	0	100	1	1	1	CENTRAL COAST
303		281	131	859	150	728	86	18	10,526	43	10	8	2	90	251	8	1	5	0	5	1	0	0	3	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
304		816	267	1,299	207	1,032	93	13	21,292	86	24	13	10	76	257	5	4	7	0	4	1	25	1	0	1	CENTRAL COAST
305		2,551	2,186	2,879	128	693	100	5	10,008	41	100	97	3	0	177	15	1	0	0	0	0	0	0	0	1	SIERRA NEVADA
306	Joaquin Ridge	701	159	1,595	307	1,436	94	16	240,987	975	55	24	31	45	222	6	23	23	0	0	0	44	2	0	2	CENTRAL COAST, GREAT CENTRAL VALLEY
307		48	48	49	0	1	75	35	2,330	9	95	21	74	5	208	2	0	4	0	0	0	0	0	77	1	GREAT CENTRAL VALLEY
308	Coyote Ridge	279	129	771	146	642	86	15	23,721	96	0	0	0	100	251	7	1	6	0	1	1	1	1	1	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
309		2,259	1,901	2,487	141	586	64	17	3,163	13	100	96	4	0	200	2	3	0	0	0	0	0	0	1	1	SIERRA NEVADA
310	Inyo Mountains/ Saline Valley/ Death Valley	1,300	-24	3,387	676	3,411	97	15	1,576,727	6,381	100	99	1	0	163	33	77	37	26	0	0	0	1	1	2	MOJAVE DESERT, SIERRA NEVADA
311		305	48	622	130	574	26	21	3,613	15	93	93	0	7	257	2	3	4	45	100	1	100	1	0	1	CENTRAL COAST
312		424	300	594	62	294	95	12	4,231	17	0	0	0	100	242	5	2	5	0	0	0	100	2	0	2	CENTRAL COAST, GREAT CENTRAL VALLEY
313	Owens Mountain	185	95	486	62	391	82	16	30,680	124	0	0	0	100	252	6	5	9	0	30	4	51	1	30	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
314	Los Padres National Forest	684	4	1,786	300	1,782	93	18	475,033	1,922	92	77	15	8	263	15	67	27	10	2	4	35	1	0	1	CENTRAL COAST
315		446	161	806	133	645	93	18	63,652	258	65	29	36	35	224	10	6	16	0	0	0	100	2	0	1	GREAT CENTRAL VALLEY
316		762	267	1,422	202	1,155	96	13	194,125	786	12	4	8	88	224	4	16	19	0	16	2	57	3	0	2	CENTRAL COAST, GREAT CENTRAL VALLEY
317	James Meadows	210	40	365	58	325	96	14	6,383	26	21	21	0	79	260	10	7	3	100	10	1	80	1	0	1	CENTRAL COAST
318		138	84	285	35	201	65	31	8,235	33	13	9	4	87	249	10	3	8	0	77	5	80	1	20	1	GREAT CENTRAL VALLEY
319		276	21	681	149	660	61	37	6,622	27	72	72	0	28	262	4	4	2	29	0	0	3	1	0	1	CENTRAL COAST
320	Gravelly Ford Canal	58	54	64	2	10	85	18	4,875	20	0	0	0	100	207	1	5	1	0	0	0	0	0	98	1	GREAT CENTRAL VALLEY
321	Pinnacles National Monument	575	147	1,050	159	903	93	19	83,099	336	34	32	2	66	225	5	8	23	0	28	3	48	2	0	1	CENTRAL COAST
322		121	104	135	5	31	75	21	5,586	23	0	0	0	100	225	14	2	5	0	98	4	100	1	97	1	GREAT CENTRAL VALLEY
323		278	96	617	119	521	76	22	19,875	80	61	59	2	39	251	4	6	12	0	32	5	33	1	5	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
324		49	46	52	1	6	77	30	3,135	13	18	18	0	82	210	1	2	1	0	0	0	0	0	89	1	GREAT CENTRAL VALLEY
325	Pilarcitos Canyon	122	12	286	55	274	12	31	10,296	42	95	88	7	5	259	7	16	7	100	23	1	21	2	0	1	CENTRAL COAST

ID	n_subsect	Subsect	HU_num	HU_names	pc_blmacec	n_Counties	Counties	pc_forest	pc_shrub	pc_herb	pc_wetrip	pc_water	pc_dev	pc_crop	pc_pasture	pc_other
281	1	Interior Santa Lucia Range	1	SALINAS	0	1	Monterey	19	70	6	0	0	2	2	0	0
282	4	Westside Alluvial Fans and Terraces, Panoche and Cantua Fans and Basins, Eastern Hills, Kettleman Hills and Valleys	2	COAST RANGE, SOUTH VALLEY FLOOR	47	1	Fresno	0	0	69	2	0	13	7	9	0
283	4	Diablo Range, Interior Santa Lucia Range, Gabilan Range, Paso Robles Hills and Valleys	1	SALINAS	0	1	Monterey	29	38	30	0	0	1	0	0	0
284	5	Diablo Range, Eastern Hills, Gabilan Range, Kettleman Hills and Valleys, Paso Robles Hills and Valleys	5	COAST RANGE, ESTRELLA RIVER, SALINAS, SOUTH VALLEY FLOOR, SUNFLOWER VALLEY	1	5	Fresno, Monterey, Kings, Kern, San Luis Obispo	31	20	47	0	0	1	0	0	0
285	2	Hardpan Terraces, Lower Granitic Foothills	2	KAWEAH RIVER, SOUTH VALLEY FLOOR	0	1	Tulare	2	24	67	2	0	1	1	3	0
286	1	Interior Santa Lucia Range	1	SALINAS	0	1	Monterey	25	62	12	1	0	1	0	0	0
287	1	Gabilan Range	1	SALINAS	0	1	Monterey	7	41	50	0	0	2	0	0	0
288	1	Owens Valley	1	OWENS	0	1	Inyo	0	61	0	11	0	3	0	0	25
289	1	Owens Valley	1	OWENS	0	1	Inyo	0	78	0	17	0	0	0	0	5
290	2	Hardpan Terraces, Lower Granitic Foothills	2	KAWEAH RIVER, SOUTH VALLEY FLOOR	0	1	Tulare	0	43	55	0	1	1	1	0	0
291	2	Interior Santa Lucia Range, Gabilan Range	1	SALINAS	0	1	Monterey	0	51	45	1	0	3	0	1	0
292	2	Hardpan Terraces, Lower Granitic Foothills	2	KAWEAH RIVER, SOUTH VALLEY FLOOR	0	1	Tulare	1	30	52	4	0	0	1	12	0
293	3	Lower Batholith, Upper Batholith, Lower Granitic Foothills	2	KAWEAH RIVER, KINGS RIVER	0	2	Fresno, Tulare	84	10	0	5	0	0	0	0	0
294	1	Watsonville Plain-Salinas Valley	1	SALINAS	0	1	Monterey	0	5	1	25	1	7	61	1	0
295	4	Death Valley, Amargosa Desert-Pahrump Valley, Funeral Mountains-Greenwater Valley, Grapevine Mountains	1	AMARGOSA	0	1	Inyo	5	43	0	5	0	0	0	0	47
296	1	Gabilan Range	1	SALINAS	0	2	San Benito, Monterey	10	48	35	1	0	2	1	3	0
297	2	Watsonville Plain-Salinas Valley, Gabilan Range	1	SALINAS	0	1	Monterey	0	52	45	3	0	1	0	0	0
298	1	Gabilan Range	1	SALINAS	0	2	San Benito, Monterey	1	17	81	0	0	1	0	0	0
299	2	Granitic Alluvial Fans and Terraces, Panoche and Cantua Fans and Basins	1	SOUTH VALLEY FLOOR	0	1	Fresno	0	1	1	1	0	5	87	5	0
300	4	Diablo Range, Eastern Hills, Gabilan Range, Kettleman Hills and Valleys	4	COAST RANGE, PAJARO RIVER, SALINAS, SOUTH VALLEY FLOOR	0	3	Fresno, San Benito, Monterey	51	23	23	0	0	1	0	1	1
301	1	Gabilan Range	1	SALINAS	0	1	Monterey	1	82	13	3	0	1	0	0	0
302	1	North Costal Santa Lucia Range	1	SANTA LUCIA	0	1	Monterey	32	58	1	1	0	3	3	1	1
303	4	Hardpan Terraces, Hardpan Terraces, Granitic Alluvial Fans and Terraces, Lower Granitic Foothills	2	KINGS RIVER, SOUTH VALLEY FLOOR	0	1	Fresno	1	30	56	9	1	1	2	0	0
304	3	Watsonville Plain-Salinas Valley, North Costal Santa Lucia Range, Interior Santa Lucia Range	2	CARMEL RIVER, SALINAS	0	1	Monterey	2	83	12	1	0	1	0	0	2
305	1	Inyo Mountains	2	EUREKA, OWENS	0	1	Inyo	40	54	2	0	0	0	0	0	4
306	5	Westside Alluvial Fans and Terraces, Panoche and Cantua Fans and Basins, Diablo Range, Eastern Hills, Kettleman Hills and Valleys	3	COAST RANGE, PAJARO RIVER, SOUTH VALLEY FLOOR	17	2	Fresno, San Benito	26	21	50	0	0	1	0	0	2
307	1	Granitic Alluvial Fans and Terraces	1	SOUTH VALLEY FLOOR	0	1	Fresno	0	2	4	57	11	3	22	0	0
308	3	Hardpan Terraces, Granitic Alluvial Fans and Terraces, Lower Granitic Foothills	2	KINGS RIVER, SOUTH VALLEY FLOOR	0	1	Fresno	0	20	76	2	0	0	2	0	0
309	1	Upper Batholith	1	KINGS RIVER	0	1	Fresno	93	2	0	5	0	0	0	0	1
310	7	Owens Valley, Death Valley, Panamint Valley, Benton-Upper Owens Valleys, Inyo Mountains, Saline Valley-Cottonwood Mountains, Cosa-Argus Ranges	6	AMARGOSA, BALLARAT, EUREKA, OWENS, RACE TRACK, SALINE	1	1	Inyo	11	36	0	2	0	0	0	0	51
311	1	North Costal Santa Lucia Range	1	CARMEL RIVER	0	1	Monterey	19	78	1	0	0	2	0	0	0
312	2	Westside Alluvial Fans and Terraces, Eastern Hills	3	COAST RANGE, DELTA-MENDOTA CANAL, MIDDLE WEST SIDE	0	2	Fresno, San Benito	0	5	94	0	0	1	0	0	0
313	3	Hardpan Terraces, Hardpan Terraces, Lower Granitic Foothills	4	KINGS RIVER, SAN JOAQUIN RIVER, SAN JOAQUIN VALLEY FLOOR, SOUTH VALLEY FLOOR	0	1	Fresno	0	12	84	1	1	1	1	0	0
314	3	North Costal Santa Lucia Range, South Costal Santa Lucia Range, Interior Santa Lucia Range	4	CARMEL RIVER, ESTERO BAY, SALINAS, SANTA LUCIA	1	2	Monterey, San Luis Obispo	27	61	4	1	0	1	0	0	6
315	2	Westside Alluvial Fans and Terraces, Eastern Hills	4	COAST RANGE, DELTA-MENDOTA CANAL, MIDDLE WEST SIDE, SOUTH VALLEY FLOOR	7	2	Fresno, San Benito	1	23	72	1	0	2	0	0	2
316	2	Diablo Range, Eastern Hills	3	COAST RANGE, PAJARO RIVER, SALINAS	3	1	San Benito	44	24	30	1	0	1	0	0	0
317	1	North Costal Santa Lucia Range	2	CARMEL RIVER, SALINAS	0	1	Monterey	19	75	3	0	0	2	0	0	0
318	2	Hardpan Terraces, Lower Granitic Foothills	3	AHWAHNEE, SAN JOAQUIN VALLEY FLOOR, SOUTH VALLEY FLOOR	0	2	Madera, Fresno	0	8	76	4	1	3	6	2	0
319	2	Watsonville Plain-Salinas Valley, North Costal Santa Lucia Range	1	SALINAS	0	1	Monterey	1	85	8	2	0	4	0	0	0
320	1	Granitic Alluvial Fans and Terraces	1	SAN JOAQUIN VALLEY FLOOR	0	1	Madera	0	0	95	0	0	3	1	2	0
321	2	Diablo Range, Gabilan Range	2	PAJARO RIVER, SALINAS	0	2	San Benito, Monterey	36	43	19	1	0	1	0	0	0
322	2	Hardpan Terraces, Lower Granitic Foothills	2	AHWAHNEE, SAN JOAQUIN VALLEY FLOOR	0	1	Madera	0	1	97	0	0	2	0	0	0
323	1	Lower Granitic Foothills	3	AHWAHNEE, SAN JOAQUIN RIVER, SAN JOAQUIN VALLEY FLOOR	0	2	Madera, Fresno	0	56	36	4	2	0	0	0	1
324	1	Granitic Alluvial Fans and Terraces	1	SAN JOAQUIN VALLEY FLOOR	0	1	Madera	0	0	67	7	0	5	8	12	0
325	2	Watsonville Plain-Salinas Valley, North Costal Santa Lucia Range	1	SALINAS	69	1	Monterey	3	67	15	1	0	14	0	0	0

Characteristics of Natural Landscape Blocks

ID	NLB_Name	elev_MEAN	elev_MIN	elev_MAX	elev_STD	elev_RANGE	mn_integ	std_integ	AREA_ac	AREA_km2	pc_protect	pc_gap12e	pc_gap3	pc_privunp	mn_sprich	std_sprich	CNDDB_plant_count	CNDDB_animal_count	pc_hotspt	pc_crithab	crithab_sp_count	pc_esshab	esshab_sp_count	pc_wtvp	n_ecoreg	Ecoregs
326		1,580	619	2,719	444	2,100	95	17	256,249	1,037	100	99	1	0	163	29	28	18	0	0	0	0	0	0	2	MOJAVE DESERT, SIERRA NEVADA
327	Fresno River	53	50	57	2	7	86	20	3,128	13	0	0	0	100	212	1	0	2	0	0	0	0	0	94	1	GREAT CENTRAL VALLEY
328		353	206	493	44	287	72	33	3,049	12	98	97	2	2	248	0	1	5	0	0	0	0	0	0	1	SIERRA NEVADA
329	Lone Willow	43	41	46	1	5	90	14	7,312	30	0	0	0	100	215	5	1	2	0	0	0	0	0	96	1	GREAT CENTRAL VALLEY
330		125	100	189	19	89	79	29	4,600	19	0	0	0	100	231	15	1	4	0	0	4	71	1	58	1	GREAT CENTRAL VALLEY
331		144	98	308	28	210	81	23	27,170	110	11	11	0	89	240	8	3	8	0	24	5	81	1	39	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
332	Ash Slough	39	37	40	1	3	87	18	2,899	12	0	0	0	100	217	4	1	0	0	0	0	0	0	88	1	GREAT CENTRAL VALLEY
333	San Luis Canal	34	30	46	3	16	91	14	17,344	70	91	78	13	9	211	3	1	3	0	0	0	0	0	94	1	GREAT CENTRAL VALLEY
334		5	0	59	7	59	13	10	2,855	12	91	89	2	9	265	17	1	11	0	26	3	100	1	41	1	CENTRAL COAST
335		80	74	87	2	13	85	21	2,588	10	0	0	0	100	207	1	0	2	0	97	2	98	1	89	1	GREAT CENTRAL VALLEY
336	Eastman Lake NRA	151	82	309	45	227	89	18	42,805	173	7	7	0	93	232	13	6	11	0	30	6	43	1	34	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
337	Santa Cruz Mountains/ Pescadero Creek	225	34	552	104	518	84	10	14,419	58	0	0	0	100	265	9	3	5	0	0	0	15	1	0	1	CENTRAL COAST
338	Merced National Wildlife Refuge	32	29	34	1	5	44	40	5,158	21	91	78	12	9	222	2	2	5	0	5	5	5	1	62	1	GREAT CENTRAL VALLEY
339		2,228	1,812	2,539	143	727	73	18	7,386	30	100	97	3	0	211	7	1	2	0	0	0	0	0	2	1	SIERRA NEVADA
340	Ortigalita Ridge/ San Luis Reservoir	491	66	1,133	229	1,067	93	16	313,336	1,268	7	5	2	93	225	8	14	25	0	4	2	89	2	1	2	CENTRAL COAST, GREAT CENTRAL VALLEY
341	Flat Top Mountain	259	85	629	107	544	84	26	30,628	124	0	0	0	100	238	8	2	1	0	19	4	19	1	12	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
342	Pigeon Point	338	86	541	100	455	81	11	6,020	24	17	17	0	83	246	10	0	2	0	1	1	44	1	0	1	CENTRAL COAST
343		138	72	377	59	305	87	26	28,827	117	23	23	0	77	227	11	10	11	0	55	7	56	1	44	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
344	San Luis Island	25	20	28	1	8	78	26	11,273	46	99	73	26	1	224	1	4	14	0	14	5	15	1	91	1	GREAT CENTRAL VALLEY
345	San Andreas Rift	484	174	808	130	634	75	13	2,970	12	9	9	0	91	274	1	1	2	0	0	0	0	0	0	1	CENTRAL COAST
346	Bear Creek	29	24	35	2	11	89	18	12,057	49	100	57	43	0	221	1	10	12	0	61	5	61	1	82	1	GREAT CENTRAL VALLEY
347	Sugarloaf Mountain	376	10	795	180	785	55	38	13,560	55	80	73	7	20	276	4	6	6	0	0	0	98	1	0	1	CENTRAL COAST
348	Kesterson National Wildlife Refuge	24	17	30	2	13	80	26	35,823	145	99	81	19	1	219	4	9	15	0	3	4	16	1	93	1	GREAT CENTRAL VALLEY
349	San Andreas Rift	724	499	959	91	460	59	11	2,289	9	27	0	27	73	271	1	5	0	0	0	0	99	1	0	1	CENTRAL COAST
350	Bonny Doon	409	190	587	80	397	23	24	2,288	9	61	61	0	39	274	13	9	2	0	0	0	100	1	0	1	CENTRAL COAST
351		347	268	443	30	175	94	13	2,191	9	0	0	0	100	249	1	0	0	95	0	0	0	0	0	1	SIERRA NEVADA
352		123	62	367	50	305	83	25	51,679	209	39	39	0	61	225	12	15	14	0	36	8	83	1	74	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
353		68	54	90	8	36	69	16	3,362	14	0	0	0	100	214	1	0	0	0	99	6	99	1	98	1	GREAT CENTRAL VALLEY
354		19	16	22	1	6	72	20	3,489	14	91	30	61	9	224	1	3	3	0	0	0	0	0	60	1	GREAT CENTRAL VALLEY
355		432	102	793	158	691	4	12	2,273	9	96	96	0	4	270	0	6	4	0	85	1	1	1	0	1	CENTRAL COAST
356		2,453	1,192	4,331	737	3,139	94	19	379,769	1,537	100	88	12	0	222	24	67	38	67	0	0	2	1	1	1	SIERRA NEVADA
357		281	117	454	69	337	9	8	2,997	12	94	94	0	6	269	1	3	3	0	6	1	0	0	0	1	CENTRAL COAST
358		95	57	153	19	96	85	22	7,923	32	50	50	0	50	216	1	2	11	0	69	6	69	1	76	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
359		593	348	947	143	599	94	9	11,005	45	2	0	2	98	252	5	0	2	100	0	0	0	0	0	1	SIERRA NEVADA
360	Table Top Mountain	143	73	237	32	164	90	21	25,962	105	30	30	0	70	218	8	6	14	0	98	7	98	1	77	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
361	Santa Cruz Mountains	438	94	1,154	210	1,060	71	23	54,622	221	44	27	17	56	262	9	15	7	0	3	2	1	1	0	1	CENTRAL COAST
362		1,162	358	2,108	329	1,750	82	28	55,048	223	90	80	10	10	233	8	19	26	17	0	0	0	0	0	1	SIERRA NEVADA
363		2,052	1,249	3,397	524	2,148	80	29	194,401	787	98	86	13	2	230	8	28	24	11	4	2	28	2	5	1	SIERRA NEVADA
364		881	358	1,521	239	1,163	85	29	10,650	43	81	52	29	19	237	5	6	4	73	0	0	0	0	0	1	SIERRA NEVADA
365		547	220	973	168	753	62	19	7,110	29	68	68	0	32	266	1	6	2	0	28	1	0	1	0	1	CENTRAL COAST
366	Castle Rock	635	268	949	154	681	52	25	3,804	15	88	85	3	12	267	2	3	2	0	1	1	0	0	0	1	CENTRAL COAST
367	Hunter Valley Mountain	552	255	970	139	715	86	25	13,195	53	60	20	40	40	256	7	5	1	98	0	0	0	0	0	1	SIERRA NEVADA
368		1,507	689	1,955	249	1,266	56	36	8,302	34	100	96	3	0	226	4	8	17	0	0	0	0	0	1	1	SIERRA NEVADA
369		2,275	2,010	2,775	168	765	80	30	17,807	72	100	99	1	0	253	6	3	2	0	0	0	47	1	0	1	SIERRA NEVADA
370		670	251	1,075	175	824	93	19	38,861	157	79	11	68	21	270	17	8	10	100	0	0	0	0	0	1	SIERRA NEVADA
371	Cardoza Ridge	125	79	263	33	184	93	10	21,371	86	0	0	0	100	237	14	6	17	0	78	6	73	1	32	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
372		84	39	131	14	92	88	21	29,387	119	7	7	0	93	220	8	9	10	0	86	6	87	1	68	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
373		83	6	189	41	183	74	26	7,184	29	85	81	4	15	305	18	3	5	0	0	1	100	1	3	1	CENTRAL COAST

Characteristics of Natural Landscape Blocks

ID	n_subsect	Subsect	HU_num	HU_names	pc_blmacec	n_Counties	Counties	pc_forest	pc_shrub	pc_herb	pc_wetrip	pc_water	pc_dev	pc_crop	pc_pasture	pc_other
326	7	Death Valley, Benton-Upper Owens Valleys, White Mountains, Silver Peak Mountains-Fish Lake Valley, Inyo Mountains, Saline Valley-Cottonwood Mountains, Grapevine Mountains	5	AMARGOSA, DEEP SPRINGS, EUREKA, FISH LAKE, OWENS	0	1	Inyo	19	69	0	1	0	0	0	0	11
327	2	Hardpan Terraces, Granitic Alluvial Fans and Terraces	1	SAN JOAQUIN VALLEY FLOOR	0	1	Madera	0	0	35	4	0	2	40	19	0
328	1	Lower Granitic Foothills	2	AHWAHNEE, SAN JOAQUIN RIVER	0	1	Madera	0	52	39	8	0	0	0	0	0
329	1	Granitic Alluvial Fans and Terraces	1	SAN JOAQUIN VALLEY FLOOR	0	1	Madera	0	0	83	4	0	1	6	7	0
330	2	Hardpan Terraces, Lower Foothills Metamorphic Belt	2	AHWAHNEE, SAN JOAQUIN VALLEY FLOOR	0	1	Madera	0	1	97	0	0	2	0	0	0
331	3	Hardpan Terraces, Lower Foothills Metamorphic Belt, Lower Granitic Foothills	2	AHWAHNEE, SAN JOAQUIN VALLEY FLOOR	0	1	Madera	0	8	86	2	2	2	0	0	1
332	2	San Joaquin Basin, Granitic Alluvial Fans and Terraces	1	SAN JOAQUIN VALLEY FLOOR	0	1	Madera	0	0	80	2	0	1	7	11	0
333	2	Westside Alluvial Fans and Terraces, San Joaquin Basin	1	DELTA-MENDOTA CANAL	0	1	Merced	0	1	3	69	1	3	18	5	0
334	1	Watsonville Plain-Salinas Valley	2	BOLSA NUEVA, SALINAS	0	1	Monterey	4	13	2	42	25	9	1	1	1
335	1	Hardpan Terraces	1	SAN JOAQUIN VALLEY FLOOR	0	2	Madera, Merced	0	0	79	0	0	0	11	9	0
336	3	Hardpan Terraces, Lower Foothills Metamorphic Belt, Lower Granitic Foothills	3	AHWAHNEE, MARIPOSA, SAN JOAQUIN VALLEY FLOOR	0	3	Mariposa, Madera, Merced	0	8	86	1	2	1	1	0	0
337	3	Santa Clara Valley, Santa Cruz Mountains, Leeward Hills	1	PAJARO RIVER	0	3	Santa Clara, Santa Cruz, San Benito	8	69	19	1	0	2	0	0	0
338	2	Manteca-Merced Alluvium, San Joaquin Basin	1	SAN JOAQUIN VALLEY FLOOR	0	1	Merced	0	2	5	47	1	6	32	7	0
339	2	Lower Batholith, Upper Batholith	1	SAN JOAQUIN RIVER	0	1	Madera	73	4	0	3	0	0	0	0	19
340	4	Westside Alluvial Fans and Terraces, Western Diablo Range, Diablo Range, Eastern Hills	4	COAST RANGE, DELTA-MENDOTA CANAL, MIDDLE WEST SIDE, PAJARO RIVER	0	4	Merced, Fresno, Santa Clara, San Benito	11	19	67	1	0	2	0	0	0
341	4	Hardpan Terraces, Manteca-Merced Alluvium, Lower Foothills Metamorphic Belt, Lower Granitic Foothills	3	AHWAHNEE, MARIPOSA, SAN JOAQUIN VALLEY FLOOR	0	2	Mariposa, Merced	0	34	62	3	0	0	1	0	0
342	2	Santa Clara Valley, Western Diablo Range	2	PAJARO RIVER, SANTA CLARA	0	1	Santa Clara	6	61	29	1	0	2	0	0	0
343	3	Hardpan Terraces, Manteca-Merced Alluvium, Lower Foothills Metamorphic Belt	2	MARIPOSA, SAN JOAQUIN VALLEY FLOOR	0	2	Mariposa, Merced	0	10	85	1	0	1	2	1	0
344	1	San Joaquin Basin	2	DELTA-MENDOTA CANAL, SAN JOAQUIN VALLEY FLOOR	0	1	Merced	0	5	13	74	0	3	1	3	0
345	2	Santa Cruz Mountains, Watsonville Plain-Salinas Valley	1	PAJARO RIVER	0	1	Santa Cruz	56	41	1	0	0	1	0	0	0
346	2	Manteca-Merced Alluvium, San Joaquin Basin	1	SAN JOAQUIN VALLEY FLOOR	0	1	Merced	0	0	31	47	0	2	6	14	0
347	2	Santa Cruz Mountains, Watsonville Plain-Salinas Valley	2	BIG BASIN, PAJARO RIVER	0	1	Santa Cruz	90	7	0	0	0	3	0	0	0
348	2	Manteca-Merced Alluvium, San Joaquin Basin	2	DELTA-MENDOTA CANAL, SAN JOAQUIN VALLEY FLOOR	0	1	Merced	0	1	5	82	2	3	6	1	0
349	1	Santa Cruz Mountains	3	BIG BASIN, PAJARO RIVER, SANTA CLARA	0	1	Santa Cruz	70	25	3	1	0	1	0	0	0
350	1	Santa Cruz Mountains	1	BIG BASIN	0	1	Santa Cruz	69	23	2	1	0	4	1	0	0
351	2	Lower Foothills Metamorphic Belt, Lower Granitic Foothills	1	MARIPOSA	0	1	Mariposa	0	57	33	10	0	0	0	0	0
352	4	Hardpan Terraces, Camanche Terraces, Manteca-Merced Alluvium, Lower Foothills Metamorphic Belt	2	MARIPOSA, SAN JOAQUIN VALLEY FLOOR	0	2	Mariposa, Merced	0	3	93	1	0	1	0	0	0
353	2	Hardpan Terraces, Manteca-Merced Alluvium	1	SAN JOAQUIN VALLEY FLOOR	0	1	Merced	0	1	90	2	1	1	6	0	0
354	2	Manteca-Merced Alluvium, San Joaquin Basin	2	DELTA-MENDOTA CANAL, SAN JOAQUIN VALLEY FLOOR	0	2	Stanislaus, Merced	0	1	22	67	4	1	1	4	0
355	1	Santa Cruz Mountains	1	BIG BASIN	0	1	Santa Cruz	92	5	0	0	0	2	0	0	0
356	4	Benton-Upper Owens Valleys, White Mountains, Silver Peak Mountains-Fish Lake Valley, Inyo Mountains	3	DEEP SPRINGS, FISH LAKE, OWENS	0	2	Mono, Inyo	40	39	0	2	0	1	0	1	17
357	1	Santa Cruz Mountains	1	BIG BASIN	0	1	Santa Cruz	82	11	0	1	5	1	0	0	0
358	2	Hardpan Terraces, Manteca-Merced Alluvium	1	SAN JOAQUIN VALLEY FLOOR	0	1	Merced	0	1	80	2	0	3	5	8	0
359	2	Lower Foothills Metamorphic Belt, Lower Granitic Foothills	2	MARIPOSA, MERCED RIVER	0	1	Mariposa	2	85	9	4	0	0	0	0	0
360	3	Hardpan Terraces, Camanche Terraces, Lower Foothills Metamorphic Belt	2	MERCED RIVER, SAN JOAQUIN VALLEY FLOOR	0	1	Merced	0	1	96	1	0	0	0	0	0
361	3	Santa Cruz Mountains, Leeward Hills, Watsonville Plain-Salinas Valley	3	BIG BASIN, PAJARO RIVER, SANTA CLARA	0	2	Santa Clara, Santa Cruz	29	63	4	1	0	2	0	0	0
362	2	Upper Foothills Metamorphic Belt, Lower Batholith	1	MERCED RIVER	1	1	Mariposa	81	14	0	4	0	0	0	0	1
363	4	Eastern Slopes, Crowley Flowlands, Benton-Upper Owens Valleys, Glass Mountain	3	ADOBE, MONO, OWENS	20	2	Mono, Inyo	30	58	0	6	0	0	0	1	4
364	1	Upper Foothills Metamorphic Belt	1	MERCED RIVER	0	1	Mariposa	56	40	0	3	0	0	0	0	0
365	1	Santa Cruz Mountains	3	BIG BASIN, SAN MATEO, SANTA CLARA	0	2	San Mateo, Santa Cruz	77	20	1	0	0	1	0	0	0
366	1	Santa Cruz Mountains	2	BIG BASIN, SANTA CLARA	0	1	Santa Clara	57	40	0	0	0	2	0	0	0
367	1	Lower Foothills Metamorphic Belt	2	MARIPOSA, MERCED RIVER	19	1	Mariposa	1	75	0	3	1	0	0	0	21
368	2	Upper Foothills Metamorphic Belt, Lower Batholith	1	MERCED RIVER	0	1	Mariposa	81	12	0	6	0	1	0	0	0
369	4	Eastern Slopes, Mono Valley, Crowley Flowlands, Glass Mountain	1	MONO	0	1	Mono	13	72	0	0	0	0	0	0	15
370	2	Upper Foothills Metamorphic Belt, Lower Foothills Metamorphic Belt	2	MARIPOSA, MERCED RIVER	11	1	Mariposa	31	65	0	4	0	0	0	0	0
371	3	Hardpan Terraces, Camanche Terraces, Lower Foothills Metamorphic Belt	3	MERCED RIVER, SAN JOAQUIN VALLEY FLOOR, TUOLUMNE RIVER	0	3	Stanislaus, Mariposa, Merced	0	13	72	12	1	0	1	1	0
372	2	Hardpan Terraces, Camanche Terraces	1	SAN JOAQUIN VALLEY FLOOR	0	2	Stanislaus, Merced	0	3	82	3	1	3	7	1	0
373	1	Santa Cruz Mountains	2	BIG BASIN, SAN MATEO	0	1	San Mateo	8	69	7	6	1	2	7	0	0

Characteristics of Natural Landscape Blocks

ID	NLB_Name	elev_MEAN	elev_MIN	elev_MAX	elev_STD	elev_RANGE	mn_integ	std_integ	AREA_ac	AREA_km2	pc_protect	pc_gap12e	pc_gap3	pc_privunp	mn_sprich	std_sprich	CNDDB_plant_count	CNDDB_animal_count	pc_hotspt	pc_crithab	crithab_sp_count	pc_esshab	esshab_sp_count	pc_wtvp	n_ecoreg	Ecoregs
374		282	2	839	156	837	77	26	86,524	350	55	54	1	45	283	23	38	26	6	53	3	100	1	0	1	CENTRAL COAST
375	Sierra Nevada	2,503	268	4,409	722	4,141	86	22	3,676,447	14,878	99	97	2	1	180	45	162	85	12	13	4	0	2	2	2	MOJAVE DESERT, SIERRA NEVADA
376		403	135	783	123	648	70	23	4,002	16	68	43	25	32	270	1	2	4	100	0	1	100	1	0	1	CENTRAL COAST
377		540	140	856	158	716	54	37	5,435	22	89	49	40	11	273	3	6	1	91	0	0	32	2	0	1	CENTRAL COAST
378		150	0	379	81	379	68	26	12,765	52	24	24	0	76	276	19	6	9	5	3	2	100	1	2	1	CENTRAL COAST
379		60	34	82	8	48	78	19	5,706	23	0	0	0	100	218	4	3	0	0	57	3	57	1	81	1	GREAT CENTRAL VALLEY
380		83	46	134	14	88	91	19	32,812	133	6	6	0	94	230	12	14	5	0	96	4	91	1	71	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
381		96	67	181	20	114	91	16	3,074	12	0	0	0	100	250	4	4	3	0	91	4	91	1	41	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
382		67	46	114	9	68	66	30	4,404	18	0	0	0	100	218	3	1	1	0	15	3	75	1	64	1	GREAT CENTRAL VALLEY
383		10	6	17	2	11	22	32	7,605	31	91	91	0	9	225	1	3	5	86	0	0	0	0	18	1	GREAT CENTRAL VALLEY
384		2,132	1,704	2,696	164	992	94	18	165,033	668	97	56	41	3	227	16	24	21	0	0	0	58	1	1	1	SIERRA NEVADA
385		268	11	721	139	710	77	20	15,808	64	44	16	29	56	269	5	4	3	65	0	0	100	1	0	1	CENTRAL COAST
386		642	333	941	147	608	85	21	2,429	10	96	92	3	4	269	11	0	0	0	0	0	0	0	0	1	SIERRA NEVADA
387		365	244	509	42	265	93	18	4,132	17	94	94	0	6	253	3	7	1	0	0	0	0	0	0	1	SIERRA NEVADA
388		10	5	14	2	9	26	33	8,513	34	90	90	0	10	226	1	2	12	100	11	3	8	1	28	1	GREAT CENTRAL VALLEY
389		119	70	217	30	147	92	14	4,211	17	0	0	0	100	247	3	2	3	0	17	4	67	1	21	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
390		99	49	182	23	133	90	15	20,554	83	0	0	0	100	227	10	5	7	0	6	4	93	1	35	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
391		1	0	42	2	42	8	24	21,485	87	95	95	0	5	285	9	9	14	100	0	2	3	1	28	1	CENTRAL COAST
392	Mt Allison	390	74	805	191	731	31	41	12,918	52	85	85	0	15	262	13	2	8	6	18	1	55	1	0	1	CENTRAL COAST
393		2,095	1,967	2,569	124	602	91	23	13,625	55	93	23	70	7	227	6	8	0	0	0	0	71	1	1	1	SIERRA NEVADA
394		382	315	528	39	213	74	30	3,346	14	96	96	1	4	249	0	8	6	0	0	0	0	0	0	1	SIERRA NEVADA
395		221	25	636	122	611	74	19	15,187	61	54	36	18	46	287	21	0	2	7	0	0	100	1	1	1	CENTRAL COAST
396		167	52	389	81	337	47	40	2,557	10	69	69	0	31	264	1	2	9	0	0	0	98	1	2	1	CENTRAL COAST
397		280	86	638	151	552	40	34	6,993	28	100	100	0	0	281	5	14	7	67	10	3	100	1	2	1	CENTRAL COAST
398		2,423	2,044	2,742	121	698	96	15	16,875	68	92	0	92	8	231	10	4	3	0	0	0	96	1	1	1	SIERRA NEVADA
399		1	0	3	1	3	7	23	5,855	24	93	93	0	7	292	1	1	13	100	0	0	0	0	55	1	CENTRAL COAST
400		388	226	607	100	381	83	22	2,350	10	13	9	4	87	236	6	1	1	0	0	0	100	1	0	2	CENTRAL COAST, GREAT CENTRAL VALLEY
401	Diablo Range	516	50	1,316	244	1,266	91	19	762,975	3,088	36	35	2	64	232	8	44	40	1	13	4	54	1	0	2	CENTRAL COAST, GREAT CENTRAL VALLEY
402		299	85	652	127	567	89	16	17,730	72	2	1	1	98	245	7	7	17	0	25	2	93	1	0	1	GREAT CENTRAL VALLEY
403	Mountain House	240	92	524	100	432	86	21	6,216	25	0	0	0	100	229	10	1	6	0	0	0	98	1	1	1	GREAT CENTRAL VALLEY
404		80	44	126	12	82	75	21	17,613	71	3	3	0	97	221	6	1	4	0	2	1	75	1	63	1	GREAT CENTRAL VALLEY
405		3	0	83	6	83	5	17	10,551	43	95	95	0	5	279	6	1	15	44	0	0	0	0	24	1	CENTRAL COAST
406		1,051	704	1,550	157	846	96	13	3,702	15	95	1	94	5	234	3	3	0	0	0	0	100	1	0	1	SIERRA NEVADA
407	Garin Regional Park	199	18	397	81	379	0	0	3,237	13	93	93	0	7	268	3	1	4	0	75	1	100	1	1	1	CENTRAL COAST
408	Sunol Ridge	349	70	651	117	581	7	14	6,814	28	91	91	0	9	259	2	2	3	0	91	1	100	1	1	1	CENTRAL COAST
409	Gopher Ridge	187	46	476	102	430	87	17	43,036	174	0	0	0	100	240	10	2	9	0	0	0	35	1	24	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
410		55	37	82	8	45	89	20	7,332	30	0	0	0	100	219	1	0	0	0	26	1	13	1	24	1	GREAT CENTRAL VALLEY
411	Montara Mountain	242	14	586	110	572	24	41	24,112	98	86	86	0	14	279	17	28	15	4	39	2	99	1	1	1	CENTRAL COAST
412		245	146	362	43	216	84	16	3,637	15	0	0	0	100	236	9	1	9	0	0	0	100	1	0	1	GREAT CENTRAL VALLEY
413		49	34	70	7	36	88	17	3,326	13	0	0	0	100	218	0	1	3	0	86	2	70	1	55	1	GREAT CENTRAL VALLEY
414		203	127	332	37	205	82	19	4,626	19	19	1	18	81	235	3	3	11	0	0	0	100	1	0	1	GREAT CENTRAL VALLEY
415		495	319	668	66	349	71	6	3,717	15	20	0	20	80	255	8	0	3	0	0	0	0	0	0	1	SIERRA NEVADA
416		410	155	864	115	709	83	14	25,548	103	17	0	17	83	245	3	4	3	0	0	0	26	2	0	1	SIERRA NEVADA
417		429	329	616	76	287	74	23	4,514	18	0	0	0	100	244	0	3	0	0	0	0	0	0	10	1	SIERRA NEVADA
418		243	62	470	121	408	80	22	25,773	104	10	10	0	90	243	7	3	2	0	0	0	6	1	9	2	SIERRA NEVADA, GREAT CENTRAL VALLEY

Characteristics of Natural Landscape Blocks

ID	n_subsect	Subsect	HU_num	HU_names	pc_blmacec	n_Counties	Counties	pc_forest	pc_shrub	pc_herb	pc_wetrip	pc_water	pc_dev	pc_crop	pc_pasture	pc_other
374	2	Santa Cruz Mountains, Watsonville Plain-Salinas Valley	3	BIG BASIN, SAN MATEO, SANTA CLARA	0	2	San Mateo, Santa Cruz	70	23	3	1	0	2	1	0	0
375	14	Glaciated Batholith, Upper Batholith, Eastern Slopes, Kern Plateau, Lower Batholith, Owens Valley, Lower Granitic Foothills, Benton-Upper Owens Valleys, and 6 others	10	INDIAN WELLS, KAWEAH RIVER, KERN RIVER, KINGS RIVER, MERCED RIVER, MONO, OWENS, SAN JOAQUIN RIVER, SOUTHERN SIERRA, TUOLUMNE RIVER	1	8	Mono, Tuolumne, Mariposa, Madera, Fresno, Inyo, Tulare, Kern	53	15	0	3	1	0	0	0	28
376	1	Santa Cruz Mountains	1	SAN MATEO	0	1	San Mateo	49	39	8	1	0	3	0	0	0
377	1	Santa Cruz Mountains	2	SAN MATEO, SANTA CLARA	0	1	Santa Clara	53	40	4	0	0	2	0	0	0
378	1	Santa Cruz Mountains	1	SAN MATEO	0	1	San Mateo	16	69	9	3	0	2	1	0	0
379	2	Camanche Terraces, Manteca-Merced Alluvium	1	SAN JOAQUIN VALLEY FLOOR	0	1	Stanislaus	0	2	60	5	0	3	24	6	0
380	2	Camanche Terraces, Lower Foothills Metamorphic Belt	1	SAN JOAQUIN VALLEY FLOOR	0	1	Stanislaus	0	1	83	5	1	2	5	2	0
381	2	Camanche Terraces, Lower Foothills Metamorphic Belt	2	SAN JOAQUIN VALLEY FLOOR, TUOLUMNE RIVER	0	2	Tuolumne, Stanislaus	0	4	78	15	0	3	0	0	0
382	1	Camanche Terraces	1	SAN JOAQUIN VALLEY FLOOR	0	1	Stanislaus	0	1	70	1	0	1	21	6	0
383	3	Sodic Claypan Terraces, Westside Alluvial Fans and Terraces, Manteca-Merced Alluvium	2	DELTA-MENDOTA CANAL, SAN JOAQUIN VALLEY FLOOR	0	1	Stanislaus	0	1	4	22	3	4	39	26	0
384	5	Eastern Slopes, Bodie Hills-Excelsior Mountains, Mono Valley, Crowley Flowlands, Glass Mountain	3	ADOBE, MONO, OWENS	0	1	Mono	27	68	0	0	0	0	0	0	5
385	1	Santa Cruz Mountains	1	SAN MATEO	0	1	San Mateo	27	56	13	2	0	1	0	0	0
386	1	Lower Foothills Metamorphic Belt	1	TUOLUMNE RIVER	0	1	Tuolumne	17	79	0	4	0	0	0	0	0
387	1	Lower Foothills Metamorphic Belt	2	STANISLAUS RIVER, TUOLUMNE RIVER	94	1	Tuolumne	0	96	0	3	1	0	0	0	0
388	3	Sodic Claypan Terraces, Westside Alluvial Fans and Terraces, Manteca-Merced Alluvium	3	DELTA-MENDOTA CANAL, SAN JOAQUIN DELTA, SAN JOAQUIN VALLEY FLOOR	0	2	San Joaquin, Stanislaus	0	1	7	18	3	3	14	55	0
389	2	Camanche Terraces, Lower Foothills Metamorphic Belt	3	SAN JOAQUIN VALLEY FLOOR, STANISLAUS RIVER, TUOLUMNE RIVER	0	2	Tuolumne, Stanislaus	0	1	93	4	0	2	0	0	0
390	2	Camanche Terraces, Lower Foothills Metamorphic Belt	2	SAN JOAQUIN VALLEY FLOOR, TUOLUMNE RIVER	0	1	Stanislaus	0	4	88	3	0	2	2	2	0
391	1	Bay Flats	2	SANTA CLARA, SOUTH BAY	0	3	Alameda, San Mateo, Santa Clara	0	5	0	29	58	8	0	0	0
392	2	Bay Flats, Fremont-Livermore Hills and Valleys	2	SANTA CLARA, SOUTH BAY	0	2	Alameda, Santa Clara	5	39	43	1	0	11	0	0	0
393	2	Bodie Hills-Excelsior Mountains, Mono Valley	1	MONO	0	1	Mono	19	80	0	0	0	0	0	0	0
394	1	Lower Foothills Metamorphic Belt	2	STANISLAUS RIVER, TUOLUMNE RIVER	86	1	Tuolumne	0	97	0	3	0	0	0	0	0
395	1	Santa Cruz Mountains	2	SAN MATEO, SOUTH BAY	0	1	San Mateo	17	71	5	2	0	2	2	0	0
396	2	East Bay Hills-Mt. Diablo, Fremont-Livermore Hills and Valleys	2	SANTA CLARA, SOUTH BAY	0	1	Alameda	1	34	47	1	0	17	0	0	0
397	1	Santa Cruz Mountains	3	SAN MATEO, SANTA CLARA, SOUTH BAY	0	1	San Mateo	56	30	1	3	2	6	2	0	0
398	3	Sweetwater Mountains-Pine Grove Hills, Bodie Hills-Excelsior Mountains, Mono Valley	2	EAST WALKER RIVER, MONO	0	1	Mono	20	78	0	0	0	0	0	0	2
399	2	Bay Flats, Santa Clara Valley	1	SOUTH BAY	0	1	San Mateo	0	2	1	71	24	3	0	0	0
400	2	Fremont-Livermore Hills and Valleys, Eastern Hills	1	SOUTH BAY	0	1	Alameda	0	6	88	0	0	2	4	0	0
401	6	Santa Clara Valley, Westside Alluvial Fans and Terraces, Fremont-Livermore Hills and Valleys, Western Diablo Range, Diablo Range, Eastern Hills	7	CARBONA, DELTA-MENDOTA CANAL, MIDDLE WEST SIDE, NORTH DIABLO RANGE, PAJARO RIVER, SANTA CLARA, SOUTH BAY	0	5	San Joaquin, Stanislaus, Alameda, Merced, Santa Clara	35	30	33	1	0	1	0	0	0
402	2	Westside Alluvial Fans and Terraces, Eastern Hills	3	CARBONA, NORTH DIABLO RANGE, SOUTH BAY	0	2	San Joaquin, Alameda	0	4	90	0	0	1	0	0	5
403	2	Westside Alluvial Fans and Terraces, Eastern Hills	3	CARBONA, NORTH DIABLO RANGE, SOUTH BAY	0	1	Alameda	0	1	99	0	0	0	0	0	1
404	2	Hardpan Terraces, Camanche Terraces	2	NORTH VALLEY FLOOR, SAN JOAQUIN VALLEY FLOOR	0	1	Stanislaus	0	2	86	3	1	3	2	3	0
405	1	Bay Flats	2	SANTA CLARA, SOUTH BAY	0	1	Alameda	0	8	1	19	65	7	0	0	0
406	2	Upper Foothills Metamorphic Belt, Batholith and Volcanic Flows	1	TUOLUMNE RIVER	0	1	Tuolumne	83	13	0	5	0	0	0	0	0
407	2	Bay Flats, East Bay Hills-Mt. Diablo	1	SOUTH BAY	0	1	Alameda	2	44	46	0	0	8	0	0	0
408	2	East Bay Hills-Mt. Diablo, Fremont-Livermore Hills and Valleys	1	SOUTH BAY	0	1	Alameda	4	59	30	2	0	5	0	0	0
409	2	Camanche Terraces, Lower Foothills Metamorphic Belt	4	GOPHER RIDGE, NORTH VALLEY FLOOR, SAN JOAQUIN VALLEY FLOOR, STANISLAUS RIVER	0	3	Calaveras, Tuolumne, Stanislaus	0	25	69	3	0	1	1	1	0
410	2	Hardpan Terraces, Camanche Terraces	1	NORTH VALLEY FLOOR	0	2	San Joaquin, Stanislaus	0	2	89	3	0	2	1	2	0
411	2	Santa Cruz Mountains, Leeward Hills	2	SAN MATEO, SOUTH BAY	0	1	San Mateo	24	66	1	1	3	4	1	0	0
412	1	Fremont-Livermore Hills and Valleys	1	SOUTH BAY	0	2	Contra Costa, Alameda	0	3	94	1	0	3	0	0	0
413	2	Hardpan Terraces, Camanche Terraces	1	NORTH VALLEY FLOOR	0	1	San Joaquin	0	0	95	0	0	0	4	0	0
414	1	Fremont-Livermore Hills and Valleys	1	SOUTH BAY	0	2	Contra Costa, Alameda	0	0	90	0	0	6	0	0	4
415	1	Lower Foothills Metamorphic Belt	1	STANISLAUS RIVER	0	1	Calaveras	4	91	0	5	0	0	0	0	0
416	1	Lower Foothills Metamorphic Belt	2	STANISLAUS RIVER, UPPER CALAVERAS	0	2	Calaveras, Tuolumne	0	93	0	6	0	0	0	0	0
417	1	Lower Foothills Metamorphic Belt	2	GOPHER RIDGE, STANISLAUS RIVER	0	1	Calaveras	0	94	0	5	0	0	0	0	0
418	2	Camanche Terraces, Lower Foothills Metamorphic Belt	3	GOPHER RIDGE, NORTH VALLEY FLOOR, STANISLAUS RIVER	0	2	Calaveras, Stanislaus	0	37	58	3	1	1	0	0	0

Characteristics of Natural Landscape Blocks

ID	NLB_Name	elev_MEAN	elev_MIN	elev_MAX	elev_STD	elev_RANGE	mn_integ	std_integ	AREA_ac	AREA_km2	pc_protect	pc_gap12e	pc_gap3	pc_privunp	mn_sprich	std_sprich	CNDDB_plant_count	CNDDB_animal_count	pc_hotspt	pc_crithab	crithab_sp_count	pc_esshab	esshab_sp_count	pc_wtvp	n_ecoreg	Ecoregs
419	Brushy Peak	174	0	509	113	509	85	21	19,249	78	22	21	1	78	228	11	12	16	0	24	5	97	2	7	1	GREAT CENTRAL VALLEY
420		260	83	462	105	379	82	9	7,044	29	16	16	0	84	246	7	2	1	0	0	0	0	0	6	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
421		202	17	393	72	376	0	0	2,587	10	92	92	0	8	280	17	18	9	100	23	1	0	0	0	1	CENTRAL COAST
422		509	377	694	68	317	83	17	3,692	15	0	0	0	100	265	3	0	0	0	0	0	100	1	0	1	SIERRA NEVADA
423		2,501	1,812	3,098	211	1,286	94	18	63,515	257	93	33	60	7	222	6	14	6	0	0	0	76	1	1	1	SIERRA NEVADA
424		190	27	373	71	346	2	10	3,957	16	95	95	0	5	269	4	6	5	14	6	1	0	1	1	1	CENTRAL COAST
425	Duck Creek North Fork	64	38	97	9	59	91	13	10,642	43	0	0	0	100	219	1	0	4	0	69	2	68	1	30	1	GREAT CENTRAL VALLEY
426	Cherokee Creek	380	281	601	57	320	73	22	8,238	33	0	0	0	100	245	1	0	0	0	0	0	100	1	0	1	SIERRA NEVADA
427		80	42	151	18	109	85	23	25,570	103	0	0	0	100	225	9	0	8	0	65	2	6	1	11	1	GREAT CENTRAL VALLEY
428		86	35	163	24	128	80	13	3,420	14	71	71	0	29	259	2	4	10	0	38	2	100	2	12	1	GREAT CENTRAL VALLEY
429		412	283	547	55	264	77	21	5,245	21	0	0	0	100	251	8	0	1	0	0	0	100	1	0	1	SIERRA NEVADA
430		287	73	617	109	544	37	40	16,053	65	87	87	0	13	258	4	6	4	12	94	1	13	1	0	1	CENTRAL COAST
431		304	153	485	71	332	0	0	2,323	9	99	99	0	1	267	5	10	5	100	49	1	0	0	1	1	CENTRAL COAST
432		261	60	657	120	597	12	30	5,365	22	94	94	0	6	256	2	12	6	2	53	1	78	1	0	1	CENTRAL COAST
433		2,471	253	3,814	604	3,561	85	22	793,060	3,209	99	95	3	1	177	38	39	38	0	4	1	8	2	3	1	SIERRA NEVADA
434		339	25	1,165	189	1,140	77	30	66,313	268	64	64	0	36	249	14	27	20	0	26	5	100	2	1	2	CENTRAL COAST, GREAT CENTRAL VALLEY
435	Bear Mountains	426	85	853	154	768	71	14	36,366	147	19	9	10	81	244	4	0	1	0	0	0	21	1	3	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
436		584	315	824	107	509	69	16	10,950	44	16	0	16	84	268	11	2	2	0	0	0	99	1	0	1	SIERRA NEVADA
437	Calaveras Big Trees	1,138	327	1,712	363	1,385	78	29	11,498	47	91	54	37	9	229	14	4	0	0	0	0	4	1	0	1	SIERRA NEVADA
438		601	373	816	95	443	70	11	2,892	12	41	0	41	59	263	10	1	0	0	0	0	23	1	0	1	SIERRA NEVADA
439		268	206	352	35	146	78	11	2,928	12	18	0	18	82	250	0	0	1	0	0	0	0	1	0	1	SIERRA NEVADA
440		228	36	514	103	478	66	35	17,547	71	50	50	0	50	265	3	11	9	0	0	1	99	1	0	2	CENTRAL COAST, GREAT CENTRAL VALLEY
441	Mandeville Island	-1	-3	1	1	4	10	24	5,834	24	88	88	0	12	230	3	6	2	0	100	1	0	0	5	1	GREAT CENTRAL VALLEY
442	Duck Creek	75	36	146	18	110	87	10	27,456	111	12	12	0	88	224	5	0	8	0	0	0	0	0	25	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
443		327	236	451	48	215	77	17	2,319	9	0	0	0	100	249	2	0	1	0	0	0	91	1	3	1	SIERRA NEVADA
444		131	1	336	73	335	53	41	7,343	30	100	100	0	0	320	5	5	11	100	0	2	70	1	3	1	CENTRAL COAST
445		455	248	758	108	510	71	14	7,442	30	21	0	21	79	261	11	2	1	0	0	0	0	0	0	1	SIERRA NEVADA
446	Briones Hills	225	48	444	82	396	26	34	14,603	59	94	94	0	6	268	4	6	6	100	95	2	25	1	0	1	CENTRAL COAST
447		-1	-3	3	1	6	2	11	2,840	11	98	96	2	2	235	0	4	1	0	100	1	0	0	1	1	GREAT CENTRAL VALLEY
448		122	66	218	29	152	79	7	2,490	10	7	7	1	93	238	8	2	1	0	0	0	0	0	0	1	SIERRA NEVADA
449		256	36	571	95	535	11	26	7,682	31	96	96	0	4	276	7	11	11	100	94	2	0	0	0	1	CENTRAL COAST
450		51	23	111	14	88	79	20	2,270	9	0	0	0	100	235	1	1	4	0	0	0	0	0	25	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
451		-1	-3	0	1	3	0	2	5,024	20	100	99	1	0	235	1	4	1	0	100	1	0	0	0	1	GREAT CENTRAL VALLEY
452		514	294	756	105	462	65	18	4,593	19	7	0	7	93	262	12	0	0	0	0	0	0	0	0	1	SIERRA NEVADA
453		205	4	487	102	483	56	32	3,692	15	100	100	0	0	310	11	19	4	100	78	1	100	1	5	1	CENTRAL COAST
454	Pine Ridge	963	599	1,779	174	1,180	78	21	38,492	156	42	16	26	58	231	12	2	1	0	0	0	44	1	0	1	SIERRA NEVADA
455		415	189	599	103	410	62	24	2,703	11	20	0	20	80	258	10	0	1	0	0	0	0	0	0	1	SIERRA NEVADA
456		182	41	337	61	296	52	38	5,627	23	57	57	0	43	274	2	1	2	100	87	1	65	1	0	1	CENTRAL COAST
457		306	169	523	78	354	85	16	20,610	83	2	0	2	98	249	2	0	2	0	0	0	0	0	0	1	SIERRA NEVADA
458		2,569	1,659	3,550	368	1,891	94	17	94,965	384	99	94	5	1	232	5	21	7	0	0	0	0	0	1	1	SIERRA NEVADA
459	Montezuma Hills	27	0	55	13	55	34	31	3,841	16	89	89	0	11	232	3	1	4	0	4	1	0	0	0	1	GREAT CENTRAL VALLEY
460		283	6	634	157	628	57	32	3,115	13	99	99	0	1	312	17	12	4	87	49	1	100	1	4	1	CENTRAL COAST
461		80	42	140	15	98	75	23	6,470	26	0	0	0	100	233	2	0	3	0	44	1	0	0	8	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
462		428	60	771	150	711	79	26	5,702	23	99	9	90	1	280	10	22	3	100	3	1	77	1	6	1	CENTRAL COAST
463		213	84	357	63	273	78	15	7,648	31	2	1	1	98	251	3	3	0	0	0	0	0	0	1	1	SIERRA NEVADA
464	Staten Island	-1	-2	5	1	7	0	4	10,216	41	93	93	0	7	233	1	7	3	0	100	1	0	0	0	1	GREAT CENTRAL VALLEY
465		121	3	321	77	318	36	43	2,319	9	89	89	0	11	288	3	4	6	100	0	0	0	0	3	1	CENTRAL COAST

Characteristics of Natural Landscape Blocks

ID	n_subsect	Subsect	HU_num	HU_names	pc_blmacec	n_Counties	Counties	pc_forest	pc_shrub	pc_herb	pc_wetrip	pc_water	pc_dev	pc_crop	pc_pasture	pc_other
419	3	Westside Alluvial Fans and Terraces, Fremont-Livermore Hills and Valleys, Eastern Hills	4	CARBONA, NORTH DIABLO RANGE, SAN JOAQUIN DELTA, SOUTH BAY	0	2	Contra Costa, Alameda	0	4	90	1	1	3	1	0	0
420	2	Camanche Terraces, Lower Foothills Metamorphic Belt	3	GOPHER RIDGE, NORTH VALLEY FLOOR, UPPER CALAVERAS	0	1	Calaveras	0	19	75	5	1	0	0	0	0
421	1	Leeward Hills	1	SOUTH BAY	0	1	San Mateo	3	75	3	0	0	19	0	0	0
422	2	Upper Foothills Metamorphic Belt, Lower Foothills Metamorphic Belt	2	STANISLAUS RIVER, UPPER CALAVERAS	0	1	Calaveras	7	84	0	8	0	0	0	0	0
423	2	Sweetwater Mountains-Pine Grove Hills, Bodie Hills-Excelsior Mountains	2	EAST WALKER RIVER, MONO	0	1	Mono	32	66	1	0	0	0	0	0	1
424	1	East Bay Hills-Mt. Diablo	1	SOUTH BAY	0	1	Alameda	18	60	3	1	1	17	0	0	0
425	2	Hardpan Terraces, Camanche Terraces	1	NORTH VALLEY FLOOR	0	1	San Joaquin	0	1	95	0	0	0	2	1	0
426	1	Lower Foothills Metamorphic Belt	1	UPPER CALAVERAS	0	1	Calaveras	0	92	0	8	0	0	0	0	0
427	2	Hardpan Terraces, Camanche Terraces	1	NORTH VALLEY FLOOR	0	3	Calaveras, San Joaquin, Stanislaus	0	3	92	1	0	2	1	1	0
428	3	Suisun Hills and Valleys, Westside Alluvial Fans and Terraces, Eastern Hills	2	NORTH DIABLO RANGE, SAN JOAQUIN DELTA	0	1	Contra Costa	0	0	96	1	0	2	1	0	0
429	1	Lower Foothills Metamorphic Belt	1	UPPER CALAVERAS	0	1	Calaveras	2	89	0	9	0	0	0	0	0
430	1	East Bay Hills-Mt. Diablo	2	SOUTH BAY, SUISUN	0	2	Contra Costa, Alameda	11	57	25	2	1	3	0	0	0
431	1	East Bay Hills-Mt. Diablo	1	SOUTH BAY	0	2	Contra Costa, Alameda	50	45	0	0	0	4	0	0	0
432	1	East Bay Hills-Mt. Diablo	2	NORTH DIABLO RANGE, SUISUN	0	1	Contra Costa	14	28	47	1	0	10	0	0	0
433	12	Glaciated Batholith, Eastern Slopes, Batholith and Volcanic Flows, Upper Batholith and Volcanic Flows, Upper Batholith, Glaciated Batholith and Volcanic Flows, Sweetwater Mountains-Pine Grove Hills, Upper Foothills Metamorphic Belt, and 4 others	6	EAST WALKER RIVER, MERCED RIVER, MONO, STANISLAUS RIVER, TUOLUMNE RIVER, WEST WALKER RIVER	0	4	Alpine, Mono, Tuolumne, Mariposa	55	8	0	4	1	0	0	0	32
434	3	East Bay Hills-Mt. Diablo, Fremont-Livermore Hills and Valleys, Eastern Hills	3	NORTH DIABLO RANGE, SOUTH BAY, SUISUN	0	2	Contra Costa, Alameda	13	26	56	1	2	2	0	0	0
435	2	Camanche Terraces, Lower Foothills Metamorphic Belt	4	GOPHER RIDGE, NORTH VALLEY FLOOR, STANISLAUS RIVER, UPPER CALAVERAS	0	1	Calaveras	1	72	21	6	0	0	0	0	0
436	2	Upper Foothills Metamorphic Belt, Lower Foothills Metamorphic Belt	1	UPPER CALAVERAS	0	1	Calaveras	29	63	0	7	0	0	0	0	0
437	2	Upper Foothills Metamorphic Belt, Batholith and Volcanic Flows	2	STANISLAUS RIVER, UPPER CALAVERAS	0	2	Calaveras, Tuolumne	76	18	0	5	0	0	0	0	0
438	2	Upper Foothills Metamorphic Belt, Lower Foothills Metamorphic Belt	1	UPPER CALAVERAS	0	1	Calaveras	44	50	0	7	0	0	0	0	0
439	2	Camanche Terraces, Lower Foothills Metamorphic Belt	3	LOWER CALAVERAS, NORTH VALLEY FLOOR, UPPER CALAVERAS	0	1	Calaveras	0	55	6	5	2	0	0	0	33
440	3	Suisun Hills and Valleys, East Bay Hills-Mt. Diablo, Eastern Hills	3	NORTH DIABLO RANGE, SAN JOAQUIN DELTA, SUISUN	0	1	Contra Costa	4	32	58	0	0	4	0	0	0
441	1	Delta	1	SAN JOAQUIN DELTA	0	2	San Joaquin, Contra Costa	0	1	3	36	8	0	50	3	0
442	2	Hardpan Terraces, Camanche Terraces	1	NORTH VALLEY FLOOR	0	2	Calaveras, San Joaquin	0	6	87	1	0	1	5	1	0
443	1	Lower Foothills Metamorphic Belt	2	LOWER CALAVERAS, MIDDLE SIERRA	0	1	Calaveras	0	89	1	10	0	0	0	0	0
444	1	Marin Hills and Valleys	2	BAY BRIDGES, MARIN COASTAL	0	1	Marin	9	58	13	1	0	11	0	0	8
445	2	Upper Foothills Metamorphic Belt, Lower Foothills Metamorphic Belt	2	MIDDLE SIERRA, UPPER CALAVERAS	0	1	Calaveras	23	71	0	6	0	0	0	0	0
446	2	Suisun Hills and Valleys, East Bay Hills-Mt. Diablo	2	SAN PABLO, SUISUN	0	1	Contra Costa	5	49	37	3	2	3	0	0	0
447	1	Delta	1	SACRAMENTO DELTA	0	1	Sacramento	0	0	10	15	3	0	37	34	0
448	1	Camanche Terraces	2	MIDDLE SIERRA, NORTH VALLEY FLOOR	7	1	Amador	0	38	37	1	0	1	0	0	22
449	2	Bay Flats, East Bay Hills-Mt. Diablo	2	BAY BRIDGES, SAN PABLO	0	2	Contra Costa, Alameda	12	54	20	1	0	14	0	0	0
450	2	Hardpan Terraces, Camanche Terraces	1	NORTH VALLEY FLOOR	0	2	Amador, San Joaquin	0	11	74	8	2	2	1	1	0
451	1	Delta	2	SACRAMENTO DELTA, SAN JOAQUIN DELTA	0	1	Sacramento	0	0	3	1	0	4	84	7	0
452	2	Upper Foothills Metamorphic Belt, Lower Foothills Metamorphic Belt	2	MIDDLE SIERRA, UPPER CALAVERAS	0	1	Calaveras	30	64	0	5	0	0	0	0	0
453	1	Marin Hills and Valleys	1	MARIN COASTAL	0	1	Marin	41	37	6	0	0	6	0	0	9
454	2	Upper Foothills Metamorphic Belt, Batholith and Volcanic Flows	2	MIDDLE SIERRA, UPPER CALAVERAS	0	1	Calaveras	69	25	0	6	0	0	0	0	0
455	1	Lower Foothills Metamorphic Belt	2	MIDDLE SIERRA, UPPER CALAVERAS	0	2	Amador, Calaveras	25	71	0	2	1	0	0	0	0
456	2	Suisun Hills and Valleys, East Bay Hills-Mt. Diablo	2	SAN PABLO, SUISUN	0	1	Contra Costa	0	28	68	1	0	3	0	0	0
457	2	Camanche Terraces, Lower Foothills Metamorphic Belt	3	LOWER CALAVERAS, MIDDLE SIERRA, NORTH VALLEY FLOOR	0	2	Amador, Calaveras	0	89	2	5	3	0	0	0	0
458	5	Eastern Slopes, Pine Nut Mountains, Antelope-Mason Valleys and Hills, Sweetwater Mountains-Pine Grove Hills, Bodie Hills-Excelsior Mountains	2	EAST WALKER RIVER, WEST WALKER RIVER	0	1	Mono	66	22	0	1	0	0	0	0	10
459	2	Sodic Claypan Terraces, Delta	2	SACRAMENTO DELTA, VALLEY PUTAH-CACHE	0	2	Sacramento, Solano	0	0	24	1	4	2	5	64	0
460	1	Marin Hills and Valleys	1	MARIN COASTAL	0	1	Marin	47	28	10	0	0	7	0	0	8
461	1	Camanche Terraces	1	NORTH VALLEY FLOOR	0	2	Amador, San Joaquin	0	3	84	3	0	3	0	0	7
462	1	Marin Hills and Valleys	2	BAY BRIDGES, MARIN COASTAL	0	1	Marin	63	26	1	0	0	7	0	0	2
463	2	Camanche Terraces, Lower Foothills Metamorphic Belt	2	MIDDLE SIERRA, NORTH VALLEY FLOOR	1	1	Amador	0	74	21	3	1	1	0	0	0
464	2	Sodic Claypan Terraces, Delta	2	SACRAMENTO DELTA, SAN JOAQUIN DELTA	0	2	Sacramento, San Joaquin	0	0	1	1	4	1	93	0	0
465	2	Marin Hills and Valleys, Mount St. Helena Flows and Valleys	2	BAY BRIDGES, SAN PABLO	0	1	Marin	37	39	5	1	0	17	0	0	0

Characteristics of Natural Landscape Blocks

ID	NLB_Name	elev_MEAN	elev_MIN	elev_MAX	elev_STD	elev_RANGE	mn_integ	std_integ	AREA_ac	AREA_km2	pc_protect	pc_gap12e	pc_gap3	pc_privunp	mn_sprich	std_sprich	CNDDB_plant_count	CNDDB_animal_count	pc_hotspt	pc_crithab	crithab_sp_count	pc_esshab	esshab_sp_count	pc_wtvp	n_ecoreg	Ecoregs
466	Bear Slough	4	0	8	2	8	52	36	4,277	17	87	86	2	13	228	2	1	3	0	52	1	0	0	41	1	GREAT CENTRAL VALLEY
467	Hopkins Ravine	47	8	83	14	75	85	24	5,849	24	0	0	0	100	225	2	3	2	0	0	0	37	1	1	1	GREAT CENTRAL VALLEY
468		1	0	6	1	6	8	19	3,228	13	94	83	11	6	232	1	8	3	0	100	1	0	0	13	1	GREAT CENTRAL VALLEY
469		277	153	383	43	230	81	20	3,023	12	0	0	0	100	247	1	0	0	0	0	0	0	0	1	1	SIERRA NEVADA
470	Lightning Mountain	2,447	1,395	3,478	349	2,083	80	20	280,220	1,134	100	98	2	0	180	27	12	16	0	0	0	0	0	3	1	SIERRA NEVADA
471	Dry Creek	74	32	184	21	152	81	25	32,098	130	40	40	0	60	227	4	4	9	0	57	4	37	1	30	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
472		250	71	483	84	412	16	32	2,979	12	84	84	0	16	273	4	3	2	100	0	0	76	1	3	1	CENTRAL COAST
473		8	4	12	2	8	44	32	3,938	16	95	91	4	5	227	1	3	7	0	0	0	0	0	57	1	GREAT CENTRAL VALLEY
474		168	13	348	63	335	32	26	8,508	34	54	54	0	46	260	2	0	6	85	26	1	100	1	0	1	CENTRAL COAST
475		232	5	537	109	532	63	37	20,980	85	96	59	37	4	277	10	23	22	91	4	1	91	1	3	1	CENTRAL COAST
476		14	8	19	3	11	77	25	2,954	12	92	92	0	8	226	0	1	7	0	0	0	0	0	81	1	GREAT CENTRAL VALLEY
477		156	79	237	30	158	85	12	5,798	23	0	0	0	100	248	4	2	1	0	0	0	15	1	1	1	SIERRA NEVADA
478		706	498	889	79	391	67	19	4,759	19	12	0	12	88	244	20	1	1	0	0	0	2	1	0	1	SIERRA NEVADA
479	Irish Hill	116	60	196	37	136	87	16	6,354	26	1	1	0	99	251	3	6	0	0	3	3	56	2	2	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
480		168	19	440	73	421	69	31	8,221	33	61	60	0	39	270	3	11	13	100	21	1	100	1	2	1	CENTRAL COAST
481		7	0	28	5	28	84	25	7,220	29	22	22	0	78	227	2	9	6	0	58	1	91	1	71	1	GREAT CENTRAL VALLEY
482	Grizzly Island	6	0	127	15	127	92	15	61,327	248	22	6	15	78	242	9	18	20	2	82	7	16	1	71	1	GREAT CENTRAL VALLEY
483		1,365	1,172	1,609	92	437	62	16	3,094	13	94	0	94	6	214	3	1	0	0	0	0	97	1	0	1	SIERRA NEVADA
484		38	26	49	5	23	67	25	2,608	11	8	8	0	92	224	1	0	1	0	82	3	83	1	66	1	GREAT CENTRAL VALLEY
485	Quartz Mountain	455	191	660	95	469	75	19	17,737	72	6	0	6	94	260	10	0	2	0	0	0	1	1	0	1	SIERRA NEVADA
486		2	0	33	3	33	38	35	2,760	11	88	86	2	12	273	11	0	8	0	0	0	0	0	30	1	CENTRAL COAST
487		277	197	371	44	174	67	25	2,554	10	0	0	0	100	250	2	0	1	0	0	0	99	1	1	1	SIERRA NEVADA
488		74	0	182	47	182	79	33	2,329	9	99	99	0	1	289	23	7	12	100	0	1	100	1	6	1	CENTRAL COAST
489		161	49	289	45	240	51	26	3,395	14	66	66	0	34	254	2	2	1	0	0	0	100	1	0	1	CENTRAL COAST
490	Stone Lake	2	0	7	1	7	7	18	7,847	32	96	96	0	4	231	2	1	4	0	91	1	0	0	10	1	GREAT CENTRAL VALLEY
491		112	62	185	32	123	78	25	4,926	20	1	0	1	99	250	8	5	0	0	0	0	55	2	2	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
492		500	367	626	59	259	71	19	2,858	12	1	0	1	99	265	9	0	0	0	0	0	81	1	3	1	SIERRA NEVADA
493		833	522	1,264	148	742	72	21	21,580	87	6	0	6	94	240	21	3	1	0	0	0	92	1	0	1	SIERRA NEVADA
494	Browns Creek	58	31	107	13	76	83	20	31,664	128	21	18	3	79	227	6	2	9	0	57	4	81	1	30	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
495		203	20	565	106	545	54	39	16,720	68	67	67	0	33	269	4	9	5	100	0	0	61	1	2	1	CENTRAL COAST
496		16	0	53	11	53	81	27	20,259	82	27	25	1	73	224	5	18	14	0	29	7	99	1	73	1	GREAT CENTRAL VALLEY
497		2,039	1,584	2,467	217	883	97	11	8,243	33	99	94	5	1	235	7	0	0	0	0	0	0	0	0	1	SIERRA NEVADA
498		1	0	3	0	3	39	34	10,269	42	91	82	9	9	255	8	2	10	0	0	0	0	0	20	1	CENTRAL COAST
499		153	0	427	98	427	69	29	33,274	135	97	97	0	3	313	13	32	30	64	47	3	100	1	5	1	CENTRAL COAST
500		4	-6	91	11	97	46	32	5,149	21	90	31	59	10	268	13	4	8	1	0	0	22	1	62	1	CENTRAL COAST
501	Little Holland Tract/ Yolo Bypass	2	0	9	1	9	76	23	2,147	9	28	28	0	72	232	2	0	0	0	100	1	0	0	75	1	GREAT CENTRAL VALLEY
502		2	0	5	1	5	61	38	2,908	12	93	62	31	7	230	1	1	8	0	97	1	0	0	74	1	GREAT CENTRAL VALLEY
503		182	3	475	90	472	65	26	10,189	41	33	33	0	67	260	3	6	5	49	0	0	1	1	1	1	CENTRAL COAST
504	Tolay Creek	80	1	246	44	245	40	30	6,445	26	61	61	0	39	258	8	0	6	0	0	0	100	1	0	1	CENTRAL COAST
505		141	57	250	36	193	66	35	11,871	48	14	14	0	86	249	3	2	1	0	0	0	99	1	2	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
506		2,282	867	3,155	361	2,288	77	21	182,273	738	98	91	8	2	178	24	5	13	0	0	0	0	0	2	1	SIERRA NEVADA
507		3	0	7	2	7	2	7	2,023	8	93	93	0	7	230	2	2	14	0	25	1	5	1	18	1	GREAT CENTRAL VALLEY
508		155	8	460	71	452	82	21	23,151	94	43	39	4	57	287	24	8	8	100	30	3	100	1	2	1	CENTRAL COAST
509		128	42	331	59	289	72	25	3,688	15	44	44	0	56	263	1	0	2	67	12	2	44	1	2	1	CENTRAL COAST
510	Lake Marie	240	12	574	121	562	68	25	12,520	51	38	38	0	62	266	7	7	1	0	2	1	70	2	0	2	CENTRAL COAST, NORTH COAST
511	Middle Fork Cosumnes River	502	238	685	85	447	60	18	13,195	53	12	3	9	88	260	8	0	0	0	0	0	100	1	0	1	SIERRA NEVADA
512	Big Mountain Ridge	1,003	509	1,446	246	937	64	20	14,590	59	59	0	59	41	224	6	2	1	0	0	0	100	1	0	1	SIERRA NEVADA

Characteristics of Natural Landscape Blocks

ID	n_subsect	Subsect	HU_num	HU_names	pc_blmacec	n_Counties	Counties	pc_forest	pc_shrub	pc_herb	pc_wetrip	pc_water	pc_dev	pc_crop	pc_pasture	pc_other
466	2	Hardpan Terraces, Sodic Claypan Terraces	4	NORTH VALLEY FLOOR, SACRAMENTO DELTA, SAN JOAQUIN DELTA, VALLEY-AMERICAN	23	2	Sacramento, San Joaquin	0	2	26	46	1	1	24	1	0
467	1	Sodic Claypan Terraces	2	SUISUN, VALLEY PUTAH-CACHE	0	1	Solano	0	1	86	2	0	2	3	7	0
468	1	Sodic Claypan Terraces	2	SACRAMENTO DELTA, SAN JOAQUIN DELTA	0	2	Sacramento, San Joaquin	0	1	2	20	4	1	72	0	0
469	1	Lower Foothills Metamorphic Belt	1	MIDDLE SIERRA	0	1	Amador	0	80	15	4	0	0	0	0	0
470	8	Upper Batholith and Volcanic Flows, Upper Batholith and Volcanic Flows, Glaciated Batholith and Volcanic Flows, Batholith and Volcanic Flows, Eastern Slopes, Pine Nut Mountains, Antelope-Mason Valleys and Hills, Sweetwater Mountains-Pine Grove Hills	4	EAST FORK CARSON RIVER, MIDDLE SIERRA, STANISLAUS RIVER, WEST WALKER RIVER	6	4	Alpine, Mono, Calaveras, Tuolumne	75	10	0	4	0	0	0	0	11
471	2	Hardpan Terraces, Camanche Terraces	1	NORTH VALLEY FLOOR	0	3	Sacramento, Amador, San Joaquin	0	5	88	2	1	2	2	1	0
472	1	Marin Hills and Valleys	3	BAY BRIDGES, MARIN COASTAL, SAN PABLO	0	1	Marin	30	28	37	0	0	3	0	0	2
473	2	Hardpan Terraces, Sodic Claypan Terraces	1	NORTH VALLEY FLOOR	0	1	Sacramento	0	1	48	15	1	0	33	3	0
474	2	Suisun Hills and Valleys, Delta	2	SAN PABLO, SUISUN	0	2	Napa, Solano	0	10	84	1	0	3	0	0	1
475	1	Marin Hills and Valleys	2	BAY BRIDGES, MARIN COASTAL	0	1	Marin	53	25	14	0	1	5	0	0	2
476	1	Hardpan Terraces	1	NORTH VALLEY FLOOR	0	1	Sacramento	0	1	78	8	1	2	9	3	0
477	2	Camanche Terraces, Lower Foothills Metamorphic Belt	2	MIDDLE SIERRA, NORTH VALLEY FLOOR	0	1	Amador	0	35	59	5	0	1	0	0	0
478	2	Upper Foothills Metamorphic Belt, Lower Foothills Metamorphic Belt	1	MIDDLE SIERRA	0	1	Amador	58	36	0	6	0	0	0	0	0
479	2	Camanche Terraces, Lower Foothills Metamorphic Belt	2	MIDDLE SIERRA, NORTH VALLEY FLOOR	1	1	Amador	0	37	56	6	0	0	0	0	0
480	1	Marin Hills and Valleys	1	MARIN COASTAL	0	1	Marin	38	26	31	1	0	3	0	0	1
481	2	Yolo-American Basins, Sodic Claypan Terraces	2	SACRAMENTO DELTA, VALLEY PUTAH-CACHE	0	1	Solano	0	0	86	8	0	2	4	0	0
482	3	Suisun Hills and Valleys, Sodic Claypan Terraces, Delta	1	SUISUN	0	1	Solano	0	1	30	60	5	1	2	1	0
483	2	Upper Foothills Metamorphic Belt, Batholith and Volcanic Flows	1	MIDDLE SIERRA	0	1	El Dorado	89	0	0	11	0	0	0	0	0
484	1	Hardpan Terraces	1	NORTH VALLEY FLOOR	0	1	Sacramento	0	0	86	0	1	0	3	9	0
485	2	Upper Foothills Metamorphic Belt, Lower Foothills Metamorphic Belt	1	MIDDLE SIERRA	0	1	Amador	8	84	0	7	0	0	0	0	0
486	2	Coastal Hills-Santa Rosa Plain, Mount St. Helena Flows and Valleys	1	SAN PABLO	0	2	Sonoma, Marin	0	0	64	21	8	5	0	0	1
487	1	Lower Foothills Metamorphic Belt	1	MIDDLE SIERRA	0	1	Amador	0	68	15	6	0	1	0	0	10
488	1	Marin Hills and Valleys	1	MARIN COASTAL	0	1	Marin	8	25	61	4	0	1	0	0	1
489	1	Suisun Hills and Valleys	2	SAN PABLO, SUISUN	0	2	Napa, Solano	1	8	88	0	0	2	0	0	1
490	3	Hardpan Terraces, Yolo-American Basins, Sodic Claypan Terraces	2	SACRAMENTO DELTA, VALLEY-AMERICAN	0	1	Sacramento	0	1	7	12	2	1	67	10	0
491	2	Camanche Terraces, Lower Foothills Metamorphic Belt	2	MIDDLE SIERRA, NORTH VALLEY FLOOR	0	2	Sacramento, Amador	0	36	61	1	0	1	0	0	0
492	1	Lower Foothills Metamorphic Belt	1	MIDDLE SIERRA	0	1	Amador	4	89	0	5	0	0	2	1	0
493	2	Upper Foothills Metamorphic Belt, Lower Foothills Metamorphic Belt	1	MIDDLE SIERRA	0	2	El Dorado, Amador	60	32	0	7	0	0	0	0	0
494	2	Hardpan Terraces, Camanche Terraces	1	NORTH VALLEY FLOOR	0	2	Sacramento, Amador	0	2	91	1	0	2	3	1	0
495	2	Marin Hills and Valleys, Mount St. Helena Flows and Valleys	2	MARIN COASTAL, SAN PABLO	0	1	Marin	23	33	40	1	0	2	0	0	1
496	1	Sodic Claypan Terraces	3	SACRAMENTO DELTA, SUISUN, VALLEY PUTAH-CACHE	0	1	Solano	0	0	90	3	0	2	4	1	0
497	2	Eastern Slopes, Pine Nut Mountains	1	EAST FORK CARSON RIVER	0	1	Alpine	90	7	0	2	0	0	0	0	1
498	1	Mount St. Helena Flows and Valleys	1	SAN PABLO	0	3	Sonoma, Napa, Solano	0	1	60	26	11	2	0	0	1
499	1	Marin Hills and Valleys	1	MARIN COASTAL	0	1	Marin	45	34	14	2	0	2	0	0	3
500	3	Coastal Hills-Santa Rosa Plain, Marin Hills and Valleys, Mount St. Helena Flows and Valleys	1	SAN PABLO	0	2	Sonoma, Marin	2	5	34	51	4	2	0	0	1
501	1	Yolo-American Basins	1	SACRAMENTO DELTA	0	1	Yolo	0	2	19	53	2	1	15	8	0
502	3	Hardpan Terraces, Yolo-American Basins, Sodic Claypan Terraces	2	SACRAMENTO DELTA, VALLEY-AMERICAN	0	1	Sacramento	0	1	66	19	4	1	9	0	0
503	2	Marin Hills and Valleys, Mount St. Helena Flows and Valleys	2	MARIN COASTAL, SAN PABLO	0	1	Marin	3	48	45	0	0	1	0	0	2
504	2	Coastal Hills-Santa Rosa Plain, Mount St. Helena Flows and Valleys	1	SAN PABLO	0	1	Sonoma	2	3	85	0	0	1	9	0	1
505	2	Camanche Terraces, Lower Foothills Metamorphic Belt	2	MIDDLE SIERRA, NORTH VALLEY FLOOR	0	3	El Dorado, Sacramento, Amador	0	27	69	2	0	1	0	0	1
506	7	Upper Foothills Metamorphic Belt, Upper Batholith and Volcanic Flows, Glaciated Batholith and Volcanic Flows, Batholith and Volcanic Flows, Eastern Slopes, Carson Range, Carson Valley-Truckee Meadows	5	AMERICAN RIVER, EAST FORK CARSON RIVER, MIDDLE SIERRA, STANISLAUS RIVER, WEST FORK CARSON RIVER	0	3	Alpine, Amador, Calaveras	69	14	0	5	0	0	0	0	12
507	3	Hardpan Terraces, Yolo-American Basins, Sodic Claypan Terraces	2	SACRAMENTO DELTA, VALLEY-AMERICAN	0	1	Sacramento	0	1	50	20	3	11	15	0	0
508	1	Marin Hills and Valleys	1	MARIN COASTAL	0	1	Marin	5	38	54	0	0	1	0	0	1
509	2	Coastal Hills-Santa Rosa Plain, Marin Hills and Valleys	2	MARIN COASTAL, SAN PABLO	0	2	Sonoma, Marin	2	23	74	0	0	0	0	0	1
510	2	Suisun Hills and Valleys, Mount St. Helena Flows and Valleys	2	SAN PABLO, SUISUN	0	2	Napa, Solano	2	42	48	1	1	3	2	0	2
511	2	Upper Foothills Metamorphic Belt, Lower Foothills Metamorphic Belt	1	MIDDLE SIERRA	0	2	El Dorado, Amador	13	79	0	8	0	0	0	0	0
512	3	Upper Foothills Metamorphic Belt, Batholith and Volcanic Flows, Lower Foothills Metamorphic Belt	1	MIDDLE SIERRA	0	1	El Dorado	73	19	0	7	0	0	0	0	0

Characteristics of Natural Landscape Blocks

ID	NLB_Name	elev_MEAN	elev_MIN	elev_MAX	elev_STD	elev_RANGE	mn_integ	std_integ	AREA_ac	AREA_km2	pc_protect	pc_gap12e	pc_gap3	pc_privunp	mn_sprich	std_sprich	CNDDB_plant_count	CNDDB_animal_count	pc_hotspt	pc_crithab	crithab_sp_count	pc_esshab	esshab_sp_count	pc_wtvp	n_ecoreg	Ecoregs
513		489	295	708	90	413	53	14	3,350	14	35	34	1	65	272	8	0	0	0	0	0	100	1	0	1	SIERRA NEVADA
514		59	40	77	7	37	78	15	2,877	12	0	0	0	100	228	0	1	5	0	0	0	99	1	95	1	GREAT CENTRAL VALLEY
515	Yolo Bypass	3	0	8	1	8	83	25	7,628	31	83	35	48	17	229	2	4	6	0	100	1	0	0	60	1	GREAT CENTRAL VALLEY
516	Logtown Ridge	289	109	550	90	441	69	14	27,101	110	11	4	6	89	249	1	0	1	0	0	0	100	1	0	1	SIERRA NEVADA
517	Sturdevant Ridge	1,133	667	1,624	205	957	63	19	17,100	69	59	0	59	41	221	3	1	5	0	0	0	99	1	0	1	SIERRA NEVADA
518		1,379	1,138	1,563	93	425	76	21	4,046	16	87	0	87	13	213	3	1	1	0	0	0	99	1	0	1	SIERRA NEVADA
519		2,353	1,696	3,045	248	1,349	69	22	43,741	177	100	91	9	0	176	12	7	11	0	0	0	0	0	4	1	SIERRA NEVADA
520		60	38	83	10	45	82	18	4,415	18	0	0	0	100	227	1	1	1	0	0	0	44	1	31	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
521		214	93	528	85	435	89	5	3,151	13	95	95	0	5	254	1	0	0	0	0	0	0	0	3	1	NORTH COAST
522	Coyote Creek	65	32	104	17	72	88	15	13,688	55	11	2	9	89	239	10	2	8	0	0	0	53	2	18	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
523		113	51	171	22	120	91	12	6,033	24	7	0	7	93	249	3	1	4	0	0	0	90	2	7	1	SIERRA NEVADA
524		1,378	1,190	1,573	80	383	66	18	2,861	12	22	0	22	78	209	3	1	0	0	0	0	98	1	0	1	SIERRA NEVADA
525		142	47	343	51	296	76	27	14,494	59	16	12	4	84	246	4	1	2	0	0	0	97	1	4	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
526		58	0	201	38	201	74	35	18,977	77	100	100	0	0	316	3	44	18	70	49	3	100	1	5	1	CENTRAL COAST
527	Chileno Valley	136	4	420	67	416	82	21	32,289	131	42	42	0	58	273	16	10	8	100	40	3	85	1	2	1	CENTRAL COAST
528	Marble Valley	270	153	396	57	243	71	14	6,756	27	9	9	0	91	247	1	1	1	0	0	0	100	1	0	1	SIERRA NEVADA
529		391	114	592	83	478	79	10	2,303	9	93	93	0	7	255	1	5	0	0	22	1	99	1	0	1	NORTH COAST
530		54	5	135	34	130	74	24	2,226	9	59	59	0	41	268	5	4	3	100	0	0	34	1	2	1	CENTRAL COAST
531		19	7	59	6	52	0	0	2,497	10	92	92	0	8	229	0	0	8	0	18	1	0	0	38	1	GREAT CENTRAL VALLEY
532	English Hills	59	34	115	13	81	76	10	3,400	14	0	0	0	100	237	10	1	1	0	0	0	0	0	5	2	GREAT CENTRAL VALLEY, NORTH COAST
533		2,532	1,521	3,311	301	1,790	74	25	40,357	163	99	93	7	1	220	15	5	6	0	0	0	0	0	2	1	SIERRA NEVADA
534		77	6	150	34	144	65	23	3,004	12	13	13	0	87	259	1	4	1	100	0	0	0	0	2	1	CENTRAL COAST
535	Sacramento Bypass	4	2	9	1	7	4	13	4,019	16	94	93	1	6	233	1	0	3	0	0	1	0	0	5	1	GREAT CENTRAL VALLEY
536		71	-2	185	47	187	71	28	5,147	21	42	42	0	58	286	20	11	5	71	14	2	87	1	3	1	CENTRAL COAST
537		1,021	575	1,467	213	892	77	31	6,173	25	97	20	78	3	216	4	3	2	0	0	0	0	0	0	1	SIERRA NEVADA
538		79	4	281	46	277	61	19	5,014	20	27	27	0	73	267	7	4	3	100	0	0	0	0	2	1	CENTRAL COAST
539	Bennett Mountain	268	70	575	99	505	0	2	5,663	23	96	96	0	4	248	4	8	3	18	0	0	31	2	1	1	NORTH COAST
540	Mt Hood	499	125	829	140	704	57	25	9,390	38	95	94	0	5	250	1	6	1	0	0	0	9	2	0	1	NORTH COAST
541		204	58	520	101	462	75	25	2,350	10	93	93	0	7	260	0	3	5	0	0	0	0	0	1	1	NORTH COAST
542		313	142	489	77	347	57	19	7,154	29	59	35	24	41	254	2	8	1	0	0	0	0	0	0	1	SIERRA NEVADA
543		334	142	541	70	399	73	16	2,900	12	1	1	0	99	254	1	0	2	0	0	0	0	0	0	1	SIERRA NEVADA
544		376	208	607	78	399	75	14	3,965	16	2	0	2	98	254	4	1	0	0	0	0	0	0	0	1	SIERRA NEVADA
545	Curry Creek	28	20	37	4	17	75	12	4,021	16	0	0	0	100	224	2	1	3	0	0	0	64	1	62	1	GREAT CENTRAL VALLEY
546		164	0	433	95	433	55	21	8,403	34	97	97	0	3	288	19	3	7	3	0	0	0	0	0	2	CENTRAL COAST, NORTH COAST
547		353	137	499	101	362	18	25	4,591	19	90	88	2	10	257	7	2	1	0	0	0	0	0	0	1	SIERRA NEVADA
548		445	144	721	150	577	91	5	8,138	33	79	78	2	21	242	5	4	3	0	0	0	13	1	0	1	NORTH COAST
549		354	164	517	94	353	0	0	2,057	8	96	95	0	4	269	2	2	1	0	0	0	0	0	0	1	SIERRA NEVADA
550		579	163	862	133	699	64	14	3,610	15	94	92	2	6	256	3	2	0	0	0	0	34	1	0	1	NORTH COAST
551	Dunnigan Hills/ Smith Creek	55	21	84	13	63	90	15	9,135	37	0	0	0	100	215	9	0	2	0	0	0	0	0	1	1	GREAT CENTRAL VALLEY
552		399	164	705	119	541	9	11	8,026	32	93	92	2	7	257	19	2	2	0	0	0	0	0	0	1	SIERRA NEVADA
553		295	65	471	87	406	78	13	3,224	13	93	93	0	7	255	10	6	2	100	0	0	24	1	0	1	NORTH COAST
554		448	211	704	116	493	7	3	2,453	10	94	90	4	6	242	20	0	1	0	0	0	0	0	0	1	SIERRA NEVADA
555	Coon Creek	29	24	36	2	12	80	21	2,028	8	46	46	0	54	221	1	0	0	0	0	0	78	1	74	1	GREAT CENTRAL VALLEY
556		838	344	1,257	191	913	82	19	3,694	15	94	94	0	6	259	2	15	1	100	0	0	31	1	0	1	NORTH COAST
557		44	29	77	10	48	72	18	4,480	18	16	16	0	84	242	10	1	2	0	0	0	89	1	76	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
558		834	425	1,160	183	735	86	11	4,379	18	29	0	29	71	221	3	0	2	0	0	0	0	0	0	1	SIERRA NEVADA
559		631	276	898	153	622	60	36	3,251	13	56	38	18	44	226	1	1	1	0	0	0	0	0	0	1	SIERRA NEVADA
560	Dunnigan Hills	76	19	135	22	116	89	22	15,107	61	0	0	0	100	220	5	2	2	0	3	1	0	0	1	1	GREAT CENTRAL VALLEY
561		181	13	330	67	317	70	29	3,197	13	96	96	0	4	310	1	7	3	0	85	1	0	0	0	1	NORTH COAST
562		84	39	159	29	120	78	11	2,334	9	10	10	0	90	252	0	0	0	0	0	0	0	0	27	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
563	Bear River	246	82	511	89	429	77	8	8,734	35	14	11	3	86	248	2	0	1	0	0	0	0	0	0	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
564		2,099	1,817	2,557	134	740	80	21	8,778	36	80	22	59	20	211	5	2	7	0	0	0	0	0	1	1	SIERRA NEVADA
565		347	42	746	137	704	84	27	33,419	135	23	23	1	77	247	3	9	4	0	17	1	0	0	0	1	NORTH COAST
566	The Cedars/ Adams Ridge	362	133	746	120	613	97	8	76,638	310	46	7	39	54	243	4	18	11	0	0	0	65	2	0	1	NORTH COAST

Characteristics of Natural Landscape Blocks

ID	n_subsect	Subsect	HU_num	HU_names	pc_blmacec	n_Counties	Counties	pc_forest	pc_shrub	pc_herb	pc_wetrip	pc_water	pc_dev	pc_crop	pc_pasture	pc_other
513	2	Upper Foothills Metamorphic Belt, Lower Foothills Metamorphic Belt	1	MIDDLE SIERRA	0	1	El Dorado	20	72	0	7	0	2	0	0	0
514	1	Hardpan Terraces	1	VALLEY-AMERICAN	0	1	Sacramento	0	0	91	0	0	2	0	0	7
515	2	Yolo Alluvial Fans, Yolo-American Basins	1	SACRAMENTO DELTA	0	1	Yolo	0	1	16	70	0	0	10	2	0
516	1	Lower Foothills Metamorphic Belt	1	MIDDLE SIERRA	0	2	El Dorado, Amador	0	84	10	5	0	0	0	0	0
517	2	Upper Foothills Metamorphic Belt, Batholith and Volcanic Flows	1	MIDDLE SIERRA	0	1	El Dorado	88	4	0	6	0	0	0	0	1
518	2	Upper Foothills Metamorphic Belt, Batholith and Volcanic Flows	1	MIDDLE SIERRA	0	1	El Dorado	89	0	0	6	0	0	0	0	4
519	4	Upper Batholith and Volcanic Flows, Glaciated Batholith and Volcanic Flows, Tahoe Valley, Eastern Slopes	4	AMERICAN RIVER, LAKE TAHOE, MIDDLE SIERRA, WEST FORK CARSON RIVER	0	3	El Dorado, Alpine, Amador	74	14	0	7	0	0	0	0	6
520	1	Hardpan Terraces	1	VALLEY-AMERICAN	0	1	Sacramento	0	9	80	3	0	2	5	0	0
521	2	Ultramafic Complex, Western Foothills	1	SUISUN	0	1	Napa	1	74	9	3	9	1	0	0	1
522	3	Hardpan Terraces, Camanche Terraces, Lower Foothills Metamorphic Belt	3	MIDDLE SIERRA, NORTH VALLEY FLOOR, VALLEY-AMERICAN	0	1	Sacramento	0	6	91	1	0	0	1	1	0
523	3	Hardpan Terraces, Camanche Terraces, Lower Foothills Metamorphic Belt	3	AMERICAN RIVER, MIDDLE SIERRA, NORTH VALLEY FLOOR	0	1	Sacramento	0	4	92	1	0	4	0	0	0
524	2	Upper Foothills Metamorphic Belt, Batholith and Volcanic Flows	2	AMERICAN RIVER, MIDDLE SIERRA	0	1	El Dorado	88	2	0	6	0	0	0	0	4
525	2	Camanche Terraces, Lower Foothills Metamorphic Belt	3	AMERICAN RIVER, MIDDLE SIERRA, NORTH VALLEY FLOOR	0	2	El Dorado, Sacramento	0	21	73	2	0	2	0	0	2
526	1	Marin Hills and Valleys	1	MARIN COASTAL	0	1	Marin	12	18	59	2	1	2	0	0	6
527	2	Coastal Hills-Santa Rosa Plain, Marin Hills and Valleys	3	BODEGA, MARIN COASTAL, SAN PABLO	0	2	Sonoma, Marin	4	38	57	1	0	1	0	0	1
528	1	Lower Foothills Metamorphic Belt	1	MIDDLE SIERRA	0	1	El Dorado	0	52	43	3	0	1	0	0	0
529	1	Mount St. Helena Flows and Valleys	2	SAN PABLO, SUISUN	0	1	Napa	3	88	5	1	1	1	0	0	1
530	1	Coastal Hills-Santa Rosa Plain	2	BODEGA, MARIN COASTAL	0	1	Marin	1	3	93	0	0	2	0	0	1
531	1	Hardpan Terraces	1	VALLEY-AMERICAN	0	1	Sacramento	0	8	24	21	15	20	12	0	0
532	3	Suisun Hills and Valleys, Yolo Alluvial Fans, Sodic Claypan Terraces	1	VALLEY PUTAH-CACHE	0	1	Solano	0	3	93	0	0	3	1	0	0
533	5	Glaciated Batholith and Volcanic Flows, Tahoe Valley, Eastern Slopes, Carson Range, Carson Valley-Truckee Meadows	2	LAKE TAHOE, WEST FORK CARSON RIVER	0	2	El Dorado, Alpine	71	8	0	3	0	0	1	0	16
534	1	Coastal Hills-Santa Rosa Plain	1	BODEGA	0	2	Sonoma, Marin	1	3	93	0	0	2	0	0	0
535	2	Yolo Alluvial Fans, Yolo-American Basins	2	SACRAMENTO DELTA, VALLEY PUTAH-CACHE	0	1	Yolo	0	0	6	4	2	1	81	6	0
536	1	Coastal Hills-Santa Rosa Plain	2	BODEGA, MARIN COASTAL	0	2	Sonoma, Marin	1	13	80	2	1	1	0	0	2
537	2	Upper Foothills Metamorphic Belt, Batholith and Volcanic Flows	1	AMERICAN RIVER	0	1	El Dorado	87	6	0	6	0	0	0	0	1
538	1	Coastal Hills-Santa Rosa Plain	2	BODEGA, RUSSIAN RIVER	0	1	Sonoma	3	9	85	1	0	1	0	0	1
539	1	Mount St. Helena Flows and Valleys	2	RUSSIAN RIVER, SAN PABLO	0	1	Sonoma	47	34	10	1	2	6	0	0	0
540	1	Mount St. Helena Flows and Valleys	2	RUSSIAN RIVER, SAN PABLO	0	2	Sonoma, Napa	55	38	4	0	0	1	0	0	2
541	2	Mount St. Helena Flows and Valleys, Ultramafic Complex	1	SAN PABLO	0	1	Napa	30	37	21	4	5	0	0	0	2
542	1	Lower Foothills Metamorphic Belt	1	AMERICAN RIVER	28	1	El Dorado	0	94	0	5	0	0	0	0	0
543	1	Lower Foothills Metamorphic Belt	1	AMERICAN RIVER	0	1	El Dorado	0	97	0	2	0	1	0	0	0
544	1	Lower Foothills Metamorphic Belt	1	AMERICAN RIVER	0	1	El Dorado	3	91	0	6	0	0	0	0	0
545	1	Hardpan Terraces	1	VALLEY-AMERICAN	0	1	Placer	0	1	74	0	0	0	24	1	0
546	2	Coastal Franciscan, Coastal Hills-Santa Rosa Plain	2	BODEGA, RUSSIAN RIVER	0	1	Sonoma	48	23	23	1	1	3	0	0	1
547	2	Upper Foothills Metamorphic Belt, Lower Foothills Metamorphic Belt	1	AMERICAN RIVER	0	2	Placer, El Dorado	3	89	0	5	1	2	0	0	0
548	1	Ultramafic Complex	1	PUTAH CREEK	75	1	Napa	17	79	4	0	0	0	0	0	0
549	2	Upper Foothills Metamorphic Belt, Lower Foothills Metamorphic Belt	1	AMERICAN RIVER	0	1	Placer	18	70	0	7	5	1	0	0	0
550	2	Mount St. Helena Flows and Valleys, Ultramafic Complex	2	PUTAH CREEK, SAN PABLO	0	1	Napa	48	50	1	0	0	1	0	0	0
551	2	Yolo Alluvial Fans, Dunnigan Hills	2	COLUSA BASIN, VALLEY PUTAH-CACHE	0	1	Yolo	0	1	79	1	0	1	16	2	0
552	2	Upper Foothills Metamorphic Belt, Lower Foothills Metamorphic Belt	1	AMERICAN RIVER	0	2	Placer, El Dorado	24	70	0	5	1	1	0	0	0
553	2	Mount St. Helena Flows and Valleys, Central Franciscan	1	RUSSIAN RIVER	0	1	Sonoma	36	43	19	0	0	1	0	0	1
554	1	Upper Foothills Metamorphic Belt	1	AMERICAN RIVER	0	1	Placer	45	49	0	5	1	0	0	0	0
555	1	Hardpan Terraces	1	VALLEY-AMERICAN	0	1	Placer	0	0	82	3	0	2	6	5	0
556	1	Mount St. Helena Flows and Valleys	3	PUTAH CREEK, RUSSIAN RIVER, SAN PABLO	0	3	Lake, Sonoma, Napa	65	33	2	0	0	0	0	0	0
557	2	Hardpan Terraces, Lower Foothills Metamorphic Belt	3	AMERICAN RIVER, MARYSVILLE, VALLEY-AMERICAN	0	1	Placer	0	1	82	6	0	1	4	6	0
558	1	Upper Foothills Metamorphic Belt	1	AMERICAN RIVER	0	1	Placer	86	4	0	9	0	0	0	0	1
559	1	Upper Foothills Metamorphic Belt	1	AMERICAN RIVER	0	1	Placer	67	25	0	7	0	0	0	0	1
560	2	Yolo Alluvial Fans, Dunnigan Hills	2	COLUSA BASIN, VALLEY PUTAH-CACHE	0	1	Yolo	0	3	84	0	0	0	9	4	0
561	1	Coastal Franciscan	1	MENDOCINO COAST	0	1	Sonoma	97	2	1	0	0	0	0	0	0
562	2	Hardpan Terraces, Lower Foothills Metamorphic Belt	2	BEAR RIVER, MARYSVILLE	0	1	Placer	0	26	70	2	0	1	0	0	0
563	1	Lower Foothills Metamorphic Belt	2	AMERICAN RIVER, BEAR RIVER	0	3	Yuba, Nevada, Placer	0	90	2	7	0	0	0	0	0
564	1	Tahoe-Truckee	2	LAKE TAHOE, TRUCKEE RIVER	0	1	Placer	93	1	0	5	0	1	0	0	0
565	1	Coastal Franciscan	2	MENDOCINO COAST, RUSSIAN RIVER	4	1	Sonoma	42	38	7	0	0	1	0	0	11
566	3	Central Franciscan, Ultramafic Complex, Western Foothills	1	PUTAH CREEK	4	2	Lake, Napa	20	68	11	0	0	0	0	0	1

Characteristics of Natural Landscape Blocks

ID	NLB_Name	elev_MEAN	elev_MIN	elev_MAX	elev_STD	elev_RANGE	mn_integ	std_integ	AREA_ac	AREA_km2	pc_protect	pc_gap12e	pc_gap3	pc_privunp	mn_sprich	std_sprich	CNDDB_plant_count	CNDDB_animal_count	pc_hotspt	pc_crithab	crithab_sp_count	pc_esshab	esshab_sp_count	pc_wtvp	n_ecoreg	Ecoregs
567	Mosquito Ridge/ Crystal Ridge	1,881	246	3,034	584	2,788	82	22	277,370	1,122	88	59	30	12	193	17	23	24	0	0	0	0	1	1	1	SIERRA NEVADA
568		1,969	1,805	2,269	121	464	0	0	2,282	9	92	89	3	8	211	1	1	5	0	0	0	0	0	2	1	SIERRA NEVADA
569		2,010	1,634	2,412	192	778	69	15	2,333	9	82	72	11	18	214	1	0	1	0	0	0	0	0	0	1	SIERRA NEVADA
570	Blue Ridge/ Rocky Ridge	384	42	918	190	876	95	11	123,280	499	39	13	26	61	237	8	10	10	0	0	0	40	1	0	2	GREAT CENTRAL VALLEY, NORTH COAST
571		1,935	1,669	2,141	96	472	83	20	2,780	11	85	6	79	15	214	1	0	0	0	0	0	0	0	0	1	SIERRA NEVADA
572	Sawtooth Ridge	1,535	544	2,437	403	1,893	87	17	81,647	330	71	41	31	29	196	13	4	11	0	0	0	0	0	0	1	SIERRA NEVADA
573		243	78	504	95	426	84	18	14,679	59	41	3	38	59	248	3	1	4	0	0	0	0	0	0	1	SIERRA NEVADA
574		402	89	811	148	722	89	19	23,023	93	3	2	1	97	246	5	0	4	0	0	0	0	0	0	1	NORTH COAST
575	Capay Hills	250	61	585	113	524	95	10	75,133	304	1	1	0	99	225	8	3	5	0	0	0	0	1	0	2	GREAT CENTRAL VALLEY, NORTH COAST
576		536	161	966	160	805	95	16	63,435	257	88	59	29	12	244	12	6	6	0	0	0	45	1	0	1	NORTH COAST
577		425	165	702	125	537	70	11	2,091	8	47	29	18	53	264	5	0	0	0	0	0	0	0	0	1	SIERRA NEVADA
578		2,013	1,518	2,551	234	1,033	90	15	9,306	38	78	0	78	22	213	2	0	0	0	0	0	0	0	0	1	SIERRA NEVADA
579		95	46	216	33	170	77	17	2,410	10	0	0	0	100	246	1	0	2	0	0	0	0	0	0	1	SIERRA NEVADA
580	Big Foot Mountain	384	195	625	75	430	95	9	11,860	48	24	24	0	76	247	4	0	0	0	0	0	0	0	0	1	NORTH COAST
581		78	13	236	44	223	88	22	5,938	24	0	0	0	100	239	5	0	1	100	0	0	0	0	0	1	GREAT CENTRAL VALLEY
582		278	122	527	72	405	94	12	3,057	12	0	0	0	100	242	3	1	1	0	0	0	0	0	0	1	NORTH COAST
583		1,098	905	1,306	89	401	83	23	3,145	13	78	58	19	22	213	3	1	1	0	0	0	0	0	0	1	SIERRA NEVADA
584		504	168	883	151	715	96	5	6,482	26	8	0	8	92	242	0	1	1	0	0	0	0	0	0	1	NORTH COAST
585		300	49	846	196	797	91	22	57,037	231	10	4	6	90	224	6	5	4	0	0	0	4	1	0	2	GREAT CENTRAL VALLEY, NORTH COAST
586		119	33	280	48	247	77	18	5,953	24	0	0	0	100	252	4	1	1	0	0	0	0	0	0	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
587	Gube Mountain	424	139	781	135	642	95	10	14,948	60	0	0	0	100	243	2	0	1	0	0	0	0	0	0	1	NORTH COAST
588	Colusa National Wildlife Refuge	13	12	19	1	7	53	39	4,498	18	91	88	3	9	221	3	3	3	0	0	0	0	0	84	1	GREAT CENTRAL VALLEY
589		73	35	117	21	82	76	16	2,160	9	0	0	0	100	253	3	0	1	0	0	0	11	1	19	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
590	Chaparral Hill/ Yuba River	371	67	864	167	797	76	19	29,874	121	40	21	19	60	253	10	1	7	0	0	0	2	1	0	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
591		1,814	1,535	2,020	89	485	90	15	5,120	21	92	0	92	8	231	18	2	0	0	0	0	0	0	0	2	SIERRA NEVADA, MODOC PLATEAU
592		495	362	743	72	381	71	18	2,569	10	3	0	3	97	268	5	1	0	0	0	0	0	0	0	1	SIERRA NEVADA
593		216	167	290	25	123	74	16	2,034	8	0	0	0	100	253	5	0	1	0	0	0	0	0	0	1	SIERRA NEVADA
594		151	17	635	107	618	89	20	25,018	101	7	7	0	93	233	4	3	3	94	0	0	0	0	0	1	GREAT CENTRAL VALLEY
595	Lafayette Ridge/ Black Buttes	1,741	448	2,782	509	2,334	85	19	176,772	715	62	26	36	38	195	14	20	12	0	1	1	0	1	2	1	SIERRA NEVADA
596		114	45	278	50	233	73	24	4,714	19	0	0	0	100	260	4	0	1	0	0	0	0	0	3	1	SIERRA NEVADA
597		1,927	1,559	2,438	169	879	85	25	15,239	62	96	0	96	4	229	14	2	0	0	0	0	0	0	0	1	SIERRA NEVADA
598		372	191	681	99	490	78	15	9,468	38	46	28	18	54	264	7	1	1	0	0	0	0	0	0	1	SIERRA NEVADA
599		487	190	789	118	599	93	10	2,627	11	0	0	0	100	242	2	0	1	0	0	0	0	0	0	1	NORTH COAST
600	Sanel Mountain	553	168	1,015	198	847	95	10	27,402	111	0	0	0	100	242	9	3	1	0	0	0	0	0	0	1	NORTH COAST
601	Colusa Basin	17	15	22	1	7	26	37	6,078	25	96	96	0	4	218	3	0	1	0	0	0	0	0	34	1	GREAT CENTRAL VALLEY
602		1,464	845	2,117	265	1,272	80	23	15,264	62	67	0	67	33	202	2	3	4	0	0	0	0	0	0	1	SIERRA NEVADA
603		76	29	186	35	157	74	20	10,526	43	7	7	0	93	244	10	2	3	0	0	0	14	1	29	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
604		769	530	1,005	92	475	64	23	3,458	14	25	22	3	75	255	20	1	0	0	11	1	14	1	0	1	SIERRA NEVADA
605		1,634	1,517	1,858	76	341	90	24	2,686	11	100	0	100	0	222	8	3	0	0	0	0	0	0	0	1	MODOC PLATEAU
606		162	72	252	41	180	74	20	5,184	21	0	0	0	100	261	3	1	0	0	0	0	0	0	0	1	SIERRA NEVADA
607		670	325	1,340	190	1,015	96	13	69,951	283	72	14	58	28	246	13	22	12	0	0	0	0	0	0	1	NORTH COAST
608	Butte Sink	16	14	25	2	11	59	42	22,016	89	94	91	3	6	232	5	1	9	45	0	0	0	0	62	1	GREAT CENTRAL VALLEY
609		895	714	1,124	75	410	66	29	3,198	13	90	50	40	10	225	1	1	0	0	2	1	74	1	0	1	SIERRA NEVADA
610	Delevan National Wildlife Refuge	18	17	20	1	3	79	20	5,658	23	100	100	0	0	222	1	2	2	0	0	0	0	0	75	1	GREAT CENTRAL VALLEY
611		423	153	811	127	658	75	18	15,304	62	0	0	0	100	257	8	1	0	0	0	0	0	0	0	1	SIERRA NEVADA
612		308	45	732	155	687	93	19	65,560	265	5	0	5	95	223	7	14	8	0	0	0	0	0	0	2	GREAT CENTRAL VALLEY, NORTH COAST
613	Bald Mountain Range	1,871	1,469	2,662	272	1,193	89	18	57,942	234	69	17	52	31	239	14	7	2	0	0	0	0	0	0	2	SIERRA NEVADA, MODOC PLATEAU
614		1,487	1,484	1,494	1	10	89	16	2,923	12	0	0	0	100	233	8	1	2	0	0	0	0	0	87	2	SIERRA NEVADA, MODOC PLATEAU
615	Mayacmas Mountains	752	399	1,142	114	743	97	12	29,669	120	89	0	89	11	239	2	4	0	0	0	0	0	0	0	1	NORTH COAST
616	Sacramento National Wildlife Refuge	22	18	28	2	10	55	40	11,633	47	98	98	0	2	219	2	6	4	0	0	0	12	1	57	1	GREAT CENTRAL VALLEY
617		1,853	1,452	2,174	151	722	64	22	3,699	15	100	83	17	0	213	7	1	3	0	0	0	0	0	1	1	SIERRA NEVADA

Characteristics of Natural Landscape Blocks

ID	n_subsect	Subsect	HU_num	HU_names	pc_blmacec	n_Counties	Counties	pc_forest	pc_shrub	pc_herb	pc_wetrip	pc_water	pc_dev	pc_crop	pc_pasture	pc_other
567	6	Upper Foothills Metamorphic Belt, Upper Batholith and Volcanic Flows, Tahoe-Truckee, Glaciated Batholith and Volcanic Flows, Tahoe Valley, Batholith and Volcanic Flows	4	AMERICAN RIVER, LAKE TAHOE, TRUCKEE RIVER, YUBA RIVER	0	2	Placer, El Dorado	78	10	0	5	0	0	0	0	7
568	2	Upper Batholith and Volcanic Flows, Tahoe-Truckee	1	TRUCKEE RIVER	0	2	Nevada, Placer	83	1	0	10	1	5	0	0	0
569	2	Tahoe-Truckee, Carson Range	1	TRUCKEE RIVER	0	1	Nevada	83	3	0	2	0	0	0	0	12
570	3	Yolo Alluvial Fans, Ultramafic Complex, Western Foothills	4	CACHE CREEK, PUTAH CREEK, UPPER ELMIRA, VALLEY PUTAH-CACHE	2	3	Lake, Yolo, Napa	5	69	24	0	0	1	0	0	1
571	1	Tahoe-Truckee	2	LITTLE TRUCKEE RIVER, TRUCKEE RIVER	0	1	Nevada	91	1	0	2	0	0	0	0	6
572	2	Upper Foothills Metamorphic Belt, Upper Batholith and Volcanic Flows	2	AMERICAN RIVER, YUBA RIVER	0	1	Placer	89	6	0	5	0	0	0	0	1
573	1	Lower Foothills Metamorphic Belt	1	BEAR RIVER	0	2	Yuba, Nevada	0	87	6	6	0	1	0	0	0
574	1	Coastal Franciscan	2	MENDOCINO COAST, RUSSIAN RIVER	0	1	Sonoma	43	40	12	0	0	1	0	0	4
575	3	Yolo Alluvial Fans, Western Foothills, Dunnigan Hills	3	COLUSA BASIN, UPPER ELMIRA, VALLEY PUTAH-CACHE	1	2	Colusa, Yolo	0	71	27	0	0	0	1	0	0
576	3	Clear Lake Hills and Valleys, Ultramafic Complex, Western Foothills	2	CACHE CREEK, PUTAH CREEK	38	3	Lake, Colusa, Yolo	14	74	8	0	0	0	0	0	3
577	2	Granitic and Metamorphic Foothills, Lower Foothills Metamorphic Belt	1	YUBA RIVER	0	1	Nevada	2	92	0	6	0	0	0	0	0
578	1	Tahoe-Truckee	2	LITTLE TRUCKEE RIVER, TRUCKEE RIVER	0	2	Sierra, Nevada	85	10	0	2	0	0	0	0	2
579	1	Lower Foothills Metamorphic Belt	1	YUBA RIVER	0	1	Yuba	0	85	1	12	0	0	0	2	0
580	2	Coastal Franciscan, Central Franciscan	2	MENDOCINO COAST, RUSSIAN RIVER	0	2	Mendocino, Sonoma	34	51	11	0	0	1	0	0	3
581	2	Butte Sink-Sutter Basin, River Alluvium	1	COLUSA BASIN	0	1	Sutter	0	9	80	1	0	3	6	1	0
582	1	Central Franciscan	1	RUSSIAN RIVER	0	1	Mendocino	26	47	24	0	0	0	0	0	2
583	1	Upper Foothills Metamorphic Belt	1	YUBA RIVER	0	1	Nevada	82	11	0	7	0	0	0	0	0
584	1	Central Franciscan	1	RUSSIAN RIVER	0	1	Mendocino	14	77	7	0	0	0	0	0	1
585	3	Yolo Alluvial Fans, Western Foothills, Dunnigan Hills	5	CACHE CREEK, COLUSA BASIN, CORTINA, UPPER ELMIRA, VALLEY PUTAH-CACHE	4	2	Colusa, Yolo	1	67	30	0	0	0	1	0	0
586	2	Hardpan Terraces, Lower Foothills Metamorphic Belt	2	MARYSVILLE, YUBA RIVER	0	1	Yuba	0	82	10	3	1	1	1	2	0
587	1	Coastal Franciscan	1	MENDOCINO COAST	0	2	Mendocino, Sonoma	47	39	12	0	0	0	0	0	3
588	2	Colusa Basin, Yolo Alluvial Fans	1	COLUSA BASIN	0	1	Colusa	0	3	49	32	1	4	11	0	0
589	2	Hardpan Terraces, Lower Foothills Metamorphic Belt	2	MARYSVILLE, YUBA RIVER	0	1	Yuba	0	65	31	2	0	1	1	0	0
590	2	Granitic and Metamorphic Foothills, Lower Foothills Metamorphic Belt	1	YUBA RIVER	0	2	Yuba, Nevada	19	71	0	8	1	0	0	0	1
591	2	Tahoe-Truckee, Fort Sage Mountains-Lemmon Valley	2	SUSANVILLE, TRUCKEE RIVER	0	1	Sierra	80	17	0	2	0	0	0	0	0
592	1	Lower Foothills Metamorphic Belt	1	YUBA RIVER	0	1	Yuba	20	71	0	8	0	0	0	0	0
593	1	Lower Foothills Metamorphic Belt	1	YUBA RIVER	0	2	Butte, Yuba	0	89	0	11	0	0	0	0	0
594	1	Butte Sink-Sutter Basin	1	COLUSA BASIN	0	1	Sutter	0	58	38	0	0	1	3	0	0
595	4	Granitic and Metamorphic Foothills, Upper Foothills Metamorphic Belt, Upper Batholith and Volcanic Flows, Tahoe-Truckee	4	BEAR RIVER, LITTLE TRUCKEE RIVER, TRUCKEE RIVER, YUBA RIVER	0	3	Sierra, Yuba, Nevada	81	10	0	5	1	0	0	0	3
596	2	Hardpan Terraces, Lower Foothills Metamorphic Belt	1	YUBA RIVER	0	1	Butte	0	38	57	5	0	0	0	0	0
597	2	Sierra Valley, Tahoe-Truckee	2	FEATHER RIVER, LITTLE TRUCKEE RIVER	0	1	Sierra	80	17	0	2	0	0	0	0	0
598	2	Granitic and Metamorphic Foothills, Lower Foothills Metamorphic Belt	1	YUBA RIVER	0	2	Butte, Yuba	8	85	0	8	0	0	0	0	0
599	1	Coastal Franciscan	1	MENDOCINO COAST	0	1	Mendocino	60	32	6	0	0	0	0	0	2
600	1	Central Franciscan	2	MENDOCINO COAST, RUSSIAN RIVER	0	1	Mendocino	21	54	16	0	0	1	0	0	8
601	1	Colusa Basin	1	COLUSA BASIN	0	1	Colusa	0	11	8	15	4	2	60	0	0
602	2	Upper Foothills Metamorphic Belt, Upper Batholith and Volcanic Flows	1	YUBA RIVER	0	1	Sierra	93	1	0	6	0	0	0	0	0
603	2	River Alluvium, Hardpan Terraces	2	MARYSVILLE, YUBA RIVER	0	1	Butte	0	33	58	6	0	1	1	1	0
604	2	Granitic and Metamorphic Foothills, Lower Foothills Metamorphic Belt	1	YUBA RIVER	0	1	Yuba	69	28	0	2	0	0	0	0	0
605	1	Fort Sage Mountains-Lemmon Valley	1	SUSANVILLE	0	2	Lassen, Sierra	14	85	0	0	0	0	0	0	0
606	2	Hardpan Terraces, Lower Foothills Metamorphic Belt	1	YUBA RIVER	0	1	Butte	0	81	7	11	0	0	0	0	0
607	4	Eastern Franciscan, Central Franciscan, Clear Lake Hills and Valleys, Western Foothills	1	CACHE CREEK	3	2	Lake, Colusa	20	69	7	0	1	1	0	0	2
608	2	Butte Sink-Sutter Basin, River Alluvium	1	COLUSA BASIN	0	3	Butte, Colusa, Sutter	0	3	15	56	0	1	25	0	0
609	1	Granitic and Metamorphic Foothills	1	YUBA RIVER	0	1	Yuba	95	1	0	3	0	1	0	0	0
610	1	Colusa Basin	1	COLUSA BASIN	0	1	Colusa	0	6	43	48	1	1	2	0	0
611	2	Hardpan Terraces, Lower Foothills Metamorphic Belt	2	FEATHER RIVER, YUBA RIVER	0	2	Butte, Yuba	5	86	0	9	0	0	0	0	0
612	3	Eastern Franciscan, Western Foothills, Dunnigan Hills	4	CACHE CREEK, COLUSA BASIN, CORTINA, STONY CREEK	0	1	Colusa	0	58	41	0	0	0	0	0	0
613	4	Frenchman, Sierra Valley, Tahoe-Truckee, Fort Sage Mountains-Lemmon Valley	4	FEATHER RIVER, LITTLE TRUCKEE RIVER, SUSANVILLE, TRUCKEE RIVER	0	3	Lassen, Plumas, Sierra	58	39	0	1	0	0	0	0	2
614	1	Sierra Valley	1	FEATHER RIVER	0	2	Plumas, Sierra	3	43	0	54	0	0	0	0	0
615	1	Central Franciscan	2	CACHE CREEK, RUSSIAN RIVER	0	2	Mendocino, Lake	31	67	1	0	0	1	0	0	0
616	2	North Valley Alluvium, Colusa Basin	1	COLUSA BASIN	0	2	Glenn, Colusa	0	4	31	31	0	3	30	0	0
617	2	Greenville-Graeagle, Upper Batholith and Volcanic Flows	2	FEATHER RIVER, YUBA RIVER	0	2	Plumas, Sierra	94	0	0	5	0	1	0	0	0

Characteristics of Natural Landscape Blocks

ID	NLB_Name	elev_MEAN	elev_MIN	elev_MAX	elev_STD	elev_RANGE	mn_integ	std_integ	AREA_ac	AREA_km2	pc_protect	pc_gap12e	pc_gap3	pc_privunp	mn_sprich	std_sprich	CNDDB_plant_count	CNDDB_animal_count	pc_hotspt	pc_crithab	crithab_sp_count	pc_esshab	esshab_sp_count	pc_wtvp	n_ecoreg	Ecoregs
618		1,801	1,544	2,201	122	657	86	15	3,257	13	86	0	85	14	245	5	0	1	0	0	0	0	0	0	1	SIERRA NEVADA
619		1,486	1,484	1,495	2	11	92	13	3,955	16	8	8	0	92	237	12	3	3	0	0	0	0	0	42	2	SIERRA NEVADA, MODOC PLATEAU
620		304	119	412	77	293	88	9	2,447	10	3	0	3	97	255	1	2	2	0	0	0	0	0	25	1	SIERRA NEVADA
621	Sacramento National Wildlife Refuge/ Provident Main Canal	26	21	32	2	11	54	41	11,840	48	100	100	0	0	217	3	12	3	0	0	0	16	1	59	1	GREAT CENTRAL VALLEY
622		67	42	153	15	111	86	25	4,596	19	0	0	0	100	246	11	7	6	0	99	2	99	1	77	1	GREAT CENTRAL VALLEY
623		438	219	726	108	507	87	15	2,201	9	49	47	2	51	250	5	3	1	0	50	2	0	0	0	1	NORTH COAST
624	Adams Peak	1,776	1,349	2,486	241	1,137	84	18	13,240	54	73	40	33	27	264	9	3	1	0	0	0	0	0	1	2	SIERRA NEVADA, MODOC PLATEAU
625	North Table Mountain	281	83	479	102	396	85	14	12,450	50	29	28	1	71	263	5	6	5	0	2	2	3	1	34	2	SIERRA NEVADA, GREAT CENTRAL VALLEY
626		48	41	81	6	40	72	31	2,498	10	8	8	0	92	252	3	2	1	0	73	1	73	1	73	1	GREAT CENTRAL VALLEY
627		105	79	171	18	92	74	24	2,518	10	0	0	0	100	266	2	1	1	0	42	1	42	1	11	1	GREAT CENTRAL VALLEY
628		71	53	109	9	56	80	25	3,820	15	0	0	0	100	258	1	5	1	0	0	0	90	1	72	1	GREAT CENTRAL VALLEY
629	Reconnaissance Peak	1,801	1,490	2,494	223	1,004	90	16	19,489	79	82	4	78	18	249	11	6	1	0	0	0	0	0	1	2	SIERRA NEVADA, MODOC PLATEAU
630		423	226	648	82	422	90	14	4,124	17	41	37	4	59	252	6	2	1	0	15	2	0	0	0	1	NORTH COAST
631		1,786	1,415	2,038	127	623	89	18	2,133	9	80	0	80	20	231	1	1	1	0	0	0	0	0	0	1	SIERRA NEVADA
632		167	32	366	58	334	63	20	4,718	19	94	94	0	6	269	12	8	3	0	0	0	0	0	0	1	NORTH COAST
633		1,860	1,317	2,370	287	1,053	85	16	2,769	11	91	0	91	9	280	23	2	1	0	0	0	0	0	0	2	SIERRA NEVADA, MODOC PLATEAU
634		846	456	1,414	207	958	93	16	13,093	53	74	0	74	26	243	2	4	1	0	14	1	0	0	0	1	NORTH COAST
635		30	20	36	3	16	58	40	12,060	49	87	77	10	13	229	1	4	11	0	0	0	10	1	31	1	GREAT CENTRAL VALLEY
636		75	52	147	15	95	86	8	3,052	12	0	0	0	100	254	3	2	0	0	0	0	93	1	52	2	GREAT CENTRAL VALLEY, MODOC PLATEAU
637	Mt Killmore	1,635	578	2,589	345	2,011	82	22	140,739	570	86	38	48	14	205	8	15	14	0	0	0	0	1	1	1	SIERRA NEVADA
638		156	61	320	57	259	84	19	2,227	9	0	0	0	100	250	7	1	0	0	0	0	100	1	58	2	GREAT CENTRAL VALLEY, MODOC PLATEAU
639	Red Clover Valley	1,667	1,650	1,824	14	174	95	12	3,590	15	22	0	22	78	223	3	3	2	0	0	0	0	0	33	1	SIERRA NEVADA
640		128	7	200	41	193	54	32	2,068	8	92	92	0	8	274	13	10	5	0	0	0	0	0	0	1	NORTH COAST
641		1,098	265	2,130	424	1,865	85	20	149,607	605	65	27	38	35	218	20	20	8	0	0	0	20	1	0	1	SIERRA NEVADA
642	Snow Mountain	892	229	2,143	382	1,914	91	18	214,981	870	81	29	52	19	241	8	33	8	0	5	1	0	0	0	1	NORTH COAST
643	Big River/ Hi Chute Ridge	114	0	371	70	371	55	26	17,834	72	97	96	1	3	264	9	16	6	0	6	1	0	0	0	1	NORTH COAST
644	Clark Valley	229	35	623	129	588	93	16	114,249	462	2	0	2	98	222	8	12	2	0	0	0	0	0	3	2	GREAT CENTRAL VALLEY, NORTH COAST
645		906	504	1,267	160	763	86	15	2,857	12	79	0	79	21	223	3	8	2	0	0	0	100	1	0	1	MODOC PLATEAU
646		39	31	44	3	13	34	39	3,023	12	68	68	0	32	228	2	3	10	0	0	0	0	0	24	1	GREAT CENTRAL VALLEY
647	Fort Sage Mountains	1,605	1,219	2,190	263	971	98	10	15,879	64	83	2	81	17	233	12	5	1	0	0	0	0	0	0	1	MODOC PLATEAU
648		181	56	495	105	439	51	37	5,031	20	85	85	0	15	259	3	9	9	0	38	3	39	1	30	2	GREAT CENTRAL VALLEY, MODOC PLATEAU
649		1,261	1,232	1,277	10	45	97	12	3,619	15	71	1	71	29	237	4	4	2	0	0	0	0	0	0	1	MODOC PLATEAU
650		1,188	933	1,527	114	594	87	18	2,224	9	99	0	99	1	223	6	1	0	0	0	0	0	0	0	1	SIERRA NEVADA
651		618	203	1,379	302	1,176	93	19	25,005	101	62	0	62	38	243	12	4	2	0	0	0	0	0	0	1	NORTH COAST
652	Diamond Mountains	1,742	1,252	2,184	228	932	90	17	28,945	117	78	4	75	22	276	25	7	0	0	0	0	0	0	2	2	SIERRA NEVADA, MODOC PLATEAU
653		1,316	965	1,637	145	672	88	17	2,147	9	100	0	100	0	211	0	3	0	0	0	0	0	0	0	1	SIERRA NEVADA
654	Grizzly Mountain	1,765	1,078	2,350	306	1,272	85	20	20,141	82	93	31	62	7	231	3	7	3	0	0	0	0	0	1	1	SIERRA NEVADA
655	Big Bar Mountain/ Stevens Ridge	1,121	68	2,181	520	2,113	84	23	114,028	461	78	27	51	22	223	27	23	13	0	1	1	50	1	0	2	SIERRA NEVADA, MODOC PLATEAU
656		596	184	1,003	188	819	42	23	9,548	39	97	97	1	3	264	17	3	2	0	0	0	0	0	0	1	MODOC PLATEAU
657		107	80	132	10	52	84	19	3,721	15	0	0	0	100	216	2	2	1	0	93	1	93	1	98	1	GREAT CENTRAL VALLEY
658		1,389	922	1,739	153	817	90	16	3,042	12	81	0	81	19	219	4	2	2	0	0	0	0	0	1	1	SIERRA NEVADA
659		1,220	1,218	1,223	1	5	96	11	3,299	13	100	0	100	0	235	2	0	0	0	0	0	0	0	9	1	MODOC PLATEAU
660	Orland Buttes/ Stone Valley/ Julian Rocks	206	61	443	81	382	92	17	78,400	317	0	0	0	100	212	7	3	0	0	0	0	0	0	0	2	GREAT CENTRAL VALLEY, NORTH COAST
661		70	58	103	8	45	80	28	7,392	30	20	20	0	80	232	5	7	6	0	0	0	92	1	90	2	GREAT CENTRAL VALLEY, MODOC PLATEAU
662	Cottonwood Peak	1,777	1,260	2,120	178	860	86	20	10,504	43	84	0	84	16	258	30	1	0	0	0	0	0	0	2	2	SIERRA NEVADA, MODOC PLATEAU
663		57	45	68	4	23	64	39	5,924	24	41	35	5	59	226	3	7	8	0	0	0	61	1	70	1	GREAT CENTRAL VALLEY
664		79	63	93	6	30	73	10	2,685	11	0	0	0	100	219	1	0	0	0	0	0	0	0	66	1	GREAT CENTRAL VALLEY
665	Deadwood Canyon	1,259	720	1,904	218	1,184	83	25	16,024	65	92	0	92	8	212	6	9	1	0	0	0	31	1	1	2	SIERRA NEVADA, MODOC PLATEAU
666		1,622	1,085	2,251	236	1,166	88	18	25,766	104	95	1	95	5	226	3	5	1	0	0	0	0	0	1	1	SIERRA NEVADA
667	Mount Hope	1,473	448	2,161	350	1,713	84	20	63,398	257	90	66	24	10	212	7	16	8	0	0	0	52	1	1	2	SIERRA NEVADA, MODOC PLATEAU
668		79	67	98	7	31	90	20	2,351	10	70	70	0	30	229	0	4	3	0	0	0	100	1	100	1	GREAT CENTRAL VALLEY

Characteristics of Natural Landscape Blocks

ID	n_subsect	Subsect	HU_num	HU_names	pc_blmacec	n_Counties	Counties	pc_forest	pc_shrub	pc_herb	pc_wetrip	pc_water	pc_dev	pc_crop	pc_pasture	pc_other
618	1	Frenchman	1	FEATHER RIVER	0	1	Plumas	91	7	0	2	0	0	0	0	0
619	1	Sierra Valley	1	FEATHER RIVER	0	1	Plumas	5	64	0	31	0	0	0	0	0
620	1	Lower Foothills Metamorphic Belt	2	BUTTE CREEK, FEATHER RIVER	0	1	Butte	0	96	0	4	0	0	0	0	0
621	1	Colusa Basin	1	COLUSA BASIN	0	2	Glenn, Colusa	0	3	23	32	1	3	29	9	0
622	1	Hardpan Terraces	2	BUTTE CREEK, COLUSA BASIN	0	1	Butte	0	14	77	5	0	0	3	0	0
623	2	Coastal Franciscan, Central Franciscan	2	MENDOCINO COAST, RUSSIAN RIVER	0	1	Mendocino	70	23	7	0	0	0	0	0	0
624	3	Diamond Mountains-Crystal Peak, Frenchman, Fort Sage Mountains-Lemmon Valley	2	FEATHER RIVER, SUSANVILLE	0	2	Lassen, Plumas	58	38	0	1	0	0	0	0	3
625	2	Hardpan Terraces, Lower Foothills Metamorphic Belt	3	BUTTE CREEK, COLUSA BASIN, FEATHER RIVER	0	1	Butte	2	80	7	11	0	0	0	0	0
626	3	North Valley Alluvium, Butte Sink-Sutter Basin, Tuscan Flows	1	COLUSA BASIN	0	1	Butte	0	1	73	1	0	0	25	0	0
627	2	Hardpan Terraces, Tuscan Flows	2	BUTTE CREEK, COLUSA BASIN	0	1	Butte	1	59	14	26	0	0	0	0	0
628	3	North Valley Alluvium, Hardpan Terraces, Tuscan Flows	1	COLUSA BASIN	0	1	Butte	0	47	44	8	0	0	0	0	0
629	2	Frenchman, Sierra Valley	1	FEATHER RIVER	0	1	Plumas	58	37	0	2	0	0	0	0	3
630	2	Coastal Franciscan, Central Franciscan	2	MENDOCINO COAST, RUSSIAN RIVER	0	1	Mendocino	41	38	17	0	0	1	0	0	3
631	2	Frenchman, Greenville-Graeagle	1	FEATHER RIVER	0	1	Plumas	97	0	0	1	0	0	0	0	1
632	1	Coastal Franciscan	1	MENDOCINO COAST	0	1	Mendocino	90	7	0	0	0	2	0	0	0
633	3	Diamond Mountains-Crystal Peak, Frenchman, Honey Lake Basin	2	FEATHER RIVER, SUSANVILLE	0	2	Lassen, Plumas	74	22	0	2	0	0	0	0	2
634	1	Central Franciscan	3	CACHE CREEK, EEL RIVER, RUSSIAN RIVER	0	2	Mendocino, Lake	62	35	1	0	0	1	0	0	1
635	3	North Valley Alluvium, Butte Sink-Sutter Basin, River Alluvium	1	COLUSA BASIN	0	2	Butte, Glenn	0	3	11	22	5	0	38	19	0
636	1	Tuscan Flows	1	COLUSA BASIN	0	1	Butte	0	33	66	0	0	0	0	0	0
637	4	Greenville-Graeagle, Granitic and Metamorphic Foothills, Upper Foothills Metamorphic Belt, Upper Batholith and Volcanic Flows	2	FEATHER RIVER, YUBA RIVER	0	3	Plumas, Sierra, Yuba	91	2	0	6	0	0	0	0	1
638	1	Tuscan Flows	2	BUTTE CREEK, COLUSA BASIN	0	1	Butte	0	86	6	2	0	6	0	0	0
639	1	Frenchman	1	FEATHER RIVER	0	1	Plumas	25	54	0	20	1	0	0	0	0
640	1	Coastal Franciscan	1	MENDOCINO COAST	0	1	Mendocino	92	1	1	0	0	6	0	0	0
641	6	Greenville-Graeagle, Bucks Lake, Granitic and Metamorphic Foothills, Upper Foothills Metamorphic Belt, Upper Batholith and Volcanic Flows, Lower Foothills Metamorphic Belt	2	FEATHER RIVER, YUBA RIVER	0	4	Plumas, Butte, Sierra, Yuba	82	10	0	6	1	0	0	0	1
642	4	Eastern Franciscan, Central Franciscan, Clear Lake Hills and Valleys, Western Foothills	3	CACHE CREEK, EEL RIVER, STONY CREEK	1	3	Glenn, Lake, Colusa	45	45	5	0	0	1	0	0	3
643	1	Coastal Franciscan	1	MENDOCINO COAST	0	1	Mendocino	84	6	0	1	0	6	0	0	3
644	5	North Valley Alluvium, Colusa Basin, Eastern Franciscan, Western Foothills, Dunnigan Hills	3	COLUSA BASIN, CORTINA, STONY CREEK	0	2	Glenn, Colusa	0	34	65	0	0	1	0	0	0
645	1	Granitic and Metamorphic Foothills	1	FEATHER RIVER	0	1	Butte	90	3	0	6	0	0	0	0	1
646	1	North Valley Alluvium	2	COLUSA BASIN, TEHAMA	0	2	Butte, Glenn	0	3	3	21	4	3	66	0	0
647	2	Fort Sage Mountains-Lemmon Valley, Honey Lake Basin	1	SUSANVILLE	0	1	Lassen	33	64	0	1	0	0	0	0	1
648	2	North Valley Alluvium, Tuscan Flows	4	BUTTE CREEK, COLUSA BASIN, EASTERN TEHAMA, TEHAMA	0	1	Butte	2	57	30	4	0	7	1	0	0
649	1	Honey Lake Basin	1	SUSANVILLE	0	1	Lassen	0	86	0	12	0	1	0	0	0
650	1	Greenville-Graeagle	1	FEATHER RIVER	0	1	Plumas	83	11	0	6	0	0	0	0	0
651	2	Eastern Franciscan, Western Foothills	1	STONY CREEK	0	1	Glenn	30	50	17	0	0	2	0	0	2
652	3	Diamond Mountains-Crystal Peak, Frenchman, Honey Lake Basin	2	FEATHER RIVER, SUSANVILLE	0	2	Lassen, Plumas	71	27	0	1	0	0	0	0	0
653	1	Greenville-Graeagle	1	FEATHER RIVER	0	1	Plumas	95	1	0	3	0	0	0	0	0
654	3	Fredonyer Butte-Grizzly Peak, Frenchman, Greenville-Graeagle	1	FEATHER RIVER	0	1	Plumas	96	1	0	3	0	0	0	0	0
655	4	Greenville-Graeagle, Bucks Lake, Granitic and Metamorphic Foothills, Lower Foothills Metamorphic Belt	2	FEATHER RIVER, YUBA RIVER	0	2	Plumas, Butte	78	14	0	6	1	0	0	0	1
656	3	Shignletown-Paradise, Granitic and Metamorphic Foothills, Tuscan Flows	1	BUTTE CREEK	96	1	Butte	61	31	0	7	0	0	0	0	0
657	2	North Valley Alluvium, Tehama Terraces	1	TEHAMA	0	2	Tehama, Glenn	0	7	91	0	0	1	1	0	0
658	1	Greenville-Graeagle	1	FEATHER RIVER	0	1	Plumas	91	2	0	7	0	0	0	0	0
659	1	Honey Lake Basin	1	SUSANVILLE	0	1	Lassen	0	83	0	15	0	0	0	0	2
660	4	North Valley Alluvium, Western Foothills, Tehama Terraces, Dunnigan Hills	4	COLUSA BASIN, CORTINA, STONY CREEK, TEHAMA	0	2	Tehama, Glenn	0	33	64	0	0	1	1	1	0
661	1	North Valley Alluvium	1	TEHAMA	0	2	Tehama, Butte	0	2	88	1	0	2	5	2	0
662	3	Diamond Mountains-Crystal Peak, Frenchman, Honey Lake Basin	2	FEATHER RIVER, SUSANVILLE	0	2	Lassen, Plumas	63	10	0	1	0	0	0	0	26
663	1	North Valley Alluvium	1	TEHAMA	0	2	Tehama, Butte	0	5	58	8	3	2	23	0	0
664	1	North Valley Alluvium	1	TEHAMA	0	1	Tehama	0	1	94	0	0	1	2	2	0
665	1	Greenville-Graeagle	1	FEATHER RIVER	0	1	Plumas	87	7	0	5	0	0	0	0	0
666	4	Diamond Mountains-Crystal Peak, Fredonyer Butte-Grizzly Peak, Frenchman, Greenville-Graeagle	1	FEATHER RIVER	0	1	Plumas	89	5	0	3	0	0	0	0	3
667	4	Lassen-Almanor, Greenville-Graeagle, Bucks Lake, Granitic and Metamorphic Foothills	2	BUTTE CREEK, FEATHER RIVER	0	2	Plumas, Butte	84	10	0	5	0	0	0	0	1
668	1	North Valley Alluvium	1	TEHAMA	0	1	Tehama	0	1	90	0	0	1	8	0	0

Characteristics of Natural Landscape Blocks

ID	NLB_Name	elev_MEAN	elev_MIN	elev_MAX	elev_STD	elev_RANGE	mn_integ	std_integ	AREA_ac	AREA_km2	pc_protect	pc_gap12e	pc_gap3	pc_privunp	mn_sprich	std_sprich	CNDDB_plant_count	CNDDB_animal_count	pc_hotspt	pc_crithab	crithab_sp_count	pc_esshab	esshab_sp_count	pc_wtvp	n_ecoreg	Ecoregs
669		538	184	1,355	272	1,171	92	18	52,909	214	59	23	35	41	245	13	9	4	0	0	0	0	0	0	1	NORTH COAST
670		1,217	1,215	1,222	1	7	94	10	2,085	8	70	19	50	30	235	4	0	4	0	0	0	0	0	41	1	MODOC PLATEAU
671		1,424	1,085	1,887	188	802	84	22	8,187	33	72	0	72	28	230	2	1	1	0	0	0	0	0	0	1	SIERRA NEVADA
672		230	143	413	52	270	89	18	32,596	132	0	0	0	100	214	6	4	3	0	0	0	0	0	1	2	GREAT CENTRAL VALLEY, NORTH COAST
673		162	135	205	14	70	89	21	2,242	9	0	0	0	100	227	1	0	0	0	0	0	0	0	0	2	GREAT CENTRAL VALLEY, NORTH COAST
674		1,004	366	1,616	234	1,250	96	12	40,955	166	99	64	35	1	233	5	1	1	0	17	1	0	0	0	1	NORTH COAST
675		1,974	1,594	2,271	130	677	63	21	5,236	21	92	71	22	8	236	5	2	0	0	0	0	0	0	1	1	SIERRA NEVADA
676		1,355	1,243	1,556	60	313	94	17	5,711	23	87	0	87	13	251	12	0	0	0	0	0	0	0	0	1	MODOC PLATEAU
677		2,168	1,862	2,353	85	491	86	15	2,578	10	95	0	95	5	235	3	3	3	0	0	0	0	0	1	1	SIERRA NEVADA
678		112	93	144	12	51	84	19	2,577	10	16	16	0	84	222	0	5	2	0	81	1	98	1	95	1	GREAT CENTRAL VALLEY
679		961	283	2,083	345	1,800	93	16	245,124	992	68	40	28	32	234	7	13	8	0	26	1	0	0	0	1	NORTH COAST
680		1,541	1,537	1,565	3	28	89	14	2,197	9	0	0	0	100	243	5	0	1	0	0	0	0	0	95	1	SIERRA NEVADA
681	McClure Creek	159	116	227	23	111	88	21	11,017	45	0	0	0	100	219	7	0	1	0	21	1	21	1	7	2	GREAT CENTRAL VALLEY, NORTH COAST
682	Devils Parade Ground	927	528	1,387	172	859	89	15	13,046	53	83	72	11	17	259	10	4	3	0	0	0	0	0	0	1	MODOC PLATEAU
683		601	425	767	74	342	92	10	2,145	9	0	0	0	100	253	2	0	1	0	0	0	0	0	0	1	NORTH COAST
684		110	91	135	9	44	86	21	6,182	25	0	0	0	100	223	0	0	2	0	95	1	95	1	70	1	GREAT CENTRAL VALLEY
685	Butt Mountain	1,796	1,045	2,391	253	1,346	80	19	21,953	89	98	77	22	2	219	4	1	2	0	0	0	0	0	1	1	MODOC PLATEAU
686	Black Oak Mountain	773	328	1,273	224	945	76	24	12,449	50	92	88	3	8	250	4	0	7	0	62	2	0	0	0	1	NORTH COAST
687		1,426	1,289	1,600	61	311	43	27	2,534	10	88	88	1	12	264	22	3	2	0	0	0	0	0	1	2	SIERRA NEVADA, MODOC PLATEAU
688		239	155	382	39	227	94	11	29,109	118	0	0	0	100	218	9	0	0	0	0	0	13	1	2	2	GREAT CENTRAL VALLEY, NORTH COAST
689		679	429	1,212	184	783	95	10	3,344	14	0	0	0	100	231	2	0	0	0	0	0	0	0	0	1	NORTH COAST
690		150	110	208	20	98	90	15	7,416	30	0	0	0	100	220	7	0	0	0	33	1	33	1	20	2	GREAT CENTRAL VALLEY, NORTH COAST
691	Mill Creek Rim	1,174	645	1,783	255	1,138	94	12	10,182	41	79	73	6	21	251	17	1	2	0	0	0	0	0	0	1	MODOC PLATEAU
692	Mooney Island	70	60	78	3	18	32	30	3,165	13	84	83	1	16	224	3	0	9	0	0	0	0	0	35	1	GREAT CENTRAL VALLEY
693		123	101	152	10	51	89	17	3,334	13	0	0	0	100	228	1	1	0	0	92	1	92	1	48	2	GREAT CENTRAL VALLEY, NORTH COAST
694		196	158	251	16	93	94	9	2,283	9	0	0	0	100	211	0	0	0	0	0	0	0	0	0	1	NORTH COAST
695	Ishi Wilderness	474	56	1,362	263	1,306	94	16	271,981	1,101	65	52	13	35	253	11	13	16	0	1	8	10	1	15	2	GREAT CENTRAL VALLEY, MODOC PLATEAU
696		1,895	1,739	2,126	84	387	47	28	6,370	26	99	92	7	1	238	7	0	1	0	0	0	0	0	2	1	MODOC PLATEAU
697	Red Mountain	765	227	1,244	204	1,017	72	25	12,904	52	78	77	1	22	252	8	10	0	0	57	2	0	0	0	1	NORTH COAST
698		439	167	858	148	691	89	21	29,889	121	73	47	27	27	245	6	4	3	0	11	2	11	1	4	1	MODOC PLATEAU
699		735	336	1,148	156	812	90	14	4,648	19	13	8	5	87	246	3	1	0	0	19	2	0	0	0	1	NORTH COAST
700		678	451	1,063	106	612	94	9	7,150	29	14	0	14	86	260	8	0	1	0	0	0	0	0	0	1	MODOC PLATEAU
701		417	194	941	137	747	92	15	14,869	60	4	0	4	96	247	2	7	1	0	11	2	11	1	5	1	MODOC PLATEAU
702		1,717	1,712	1,735	3	23	97	11	5,225	21	99	0	99	1	238	3	3	8	0	0	0	0	0	21	1	MODOC PLATEAU
703		1,633	1,557	1,903	82	346	62	32	7,377	30	85	74	11	15	268	7	4	10	0	0	0	0	0	12	1	MODOC PLATEAU
704		1,526	1,243	2,044	145	801	97	12	164,429	665	87	1	85	13	236	14	13	6	0	0	0	59	1	2	1	MODOC PLATEAU
705		111	96	179	10	83	36	35	5,931	24	96	96	0	4	232	4	3	7	0	4	2	7	2	0	2	MODOC PLATEAU, NORTH COAST
706	Table Mountain	197	76	503	77	427	72	32	51,076	207	86	83	3	14	238	6	11	21	0	67	2	68	1	29	3	GREAT CENTRAL VALLEY, MODOC PLATEAU, NORTH COAST
707		2,189	1,666	3,169	238	1,503	78	25	38,022	154	100	96	4	0	212	7	16	14	0	0	0	0	0	3	1	MODOC PLATEAU
708		1,707	1,699	1,725	7	26	97	8	2,488	10	100	0	100	0	237	3	1	2	0	100	1	100	1	31	1	MODOC PLATEAU
709	Sinkyone	308	1	776	176	775	76	24	10,844	44	91	91	0	9	290	12	7	0	0	88	2	0	0	0	1	NORTH COAST
710	Lassen Volcanic Wilderness	2,047	1,501	2,681	163	1,180	75	20	117,885	477	100	96	4	0	212	7	25	18	0	0	0	0	0	2	1	MODOC PLATEAU
711		533	192	1,519	252	1,327	95	15	90,326	366	5	0	5	95	233	18	6	1	0	0	0	36	1	0	1	NORTH COAST
712		1,623	1,614	1,744	22	130	97	10	15,482	63	14	0	14	86	218	7	1	2	0	0	0	0	0	24	1	MODOC PLATEAU
713		1,614	1,613	1,621	1	8	95	15	7,208	29	0	0	0	100	226	7	1	1	0	0	0	0	0	22	1	MODOC PLATEAU
714	Noble Ridge/ Beegum Gorge	955	424	1,486	184	1,062	81	24	20,939	85	91	64	27	9	241	13	2	3	0	0	0	0	0	0	1	NORTH COAST
715	Island Mountain	576	79	1,399	255	1,320	94	11	109,676	444	3	1	2	97	232	5	1	5	0	1	2	0	0	0	1	NORTH COAST
716	Bald Hills	1,745	1,560	1,996	84	436	78	26	14,653	59	80	72	9	20	267	7	1	4	0	0	0	0	0	0	1	MODOC PLATEAU
717		1,085	844	1,412	102	568	91	17	2,589	10	82	0	82	18	231	1	1	1	0	26	1	0	0	0	1	NORTH COAST
718		1,809	1,697	2,096	88	399	51	25	11,188	45	98	89	9	2	236	1	2	1	0	0	0	0	0	6	1	MODOC PLATEAU
719	Bald Hills	310	152	741	92	589	94	14	92,916	376	0	0	0	100	221	11	2	1	0	0	0	33	1	0	1	NORTH COAST

Characteristics of Natural Landscape Blocks

ID	n_subsect	Subsect	HU_num	HU_names	pc_blmacec	n_Counties	Counties	pc_forest	pc_shrub	pc_herb	pc_wetrip	pc_water	pc_dev	pc_crop	pc_pasture	pc_other
669	2	Eastern Franciscan, Western Foothills	2	BALL MOUNTAIN, STONY CREEK	0	2	Tehama, Glenn	15	59	23	0	0	1	0	0	0
670	1	Honey Lake Basin	1	SUSANVILLE	0	1	Lassen	0	41	0	2	37	0	7	13	0
671	3	Diamond Mountains-Crystal Peak, Fredonyer Butte-Grizzly Peak, Greenville-Graeagle	1	FEATHER RIVER	0	1	Plumas	92	3	0	4	0	0	0	0	0
672	3	North Valley Alluvium, Western Foothills, Tehama Terraces	3	BALL MOUNTAIN, STONY CREEK, TEHAMA	0	2	Tehama, Glenn	0	40	59	0	0	0	0	0	0
673	2	North Valley Alluvium, Tehama Terraces	1	TEHAMA	0	1	Tehama	0	11	84	2	0	1	0	2	0
674	1	Eastern Franciscan	1	STONY CREEK	0	2	Tehama, Glenn	68	28	0	0	0	1	0	0	3
675	1	Fredonyer Butte-Grizzly Peak	1	FEATHER RIVER	0	2	Lassen, Plumas	92	0	3	3	0	0	0	0	2
676	1	Honey Lake Basin	1	SUSANVILLE	0	1	Lassen	25	72	0	1	0	0	1	0	0
677	2	Diamond Mountains-Crystal Peak, Fredonyer Butte-Grizzly Peak	2	FEATHER RIVER, SUSANVILLE	0	2	Lassen, Plumas	82	16	0	0	0	0	0	0	2
678	2	North Valley Alluvium, Tehama Terraces	1	TEHAMA	0	1	Tehama	0	5	90	1	0	3	0	1	0
679	2	Eastern Franciscan, Central Franciscan	2	EEL RIVER, STONY CREEK	0	3	Mendocino, Glenn, Lake	56	28	3	0	0	1	0	0	12
680	1	Fredonyer Butte-Grizzly Peak	1	FEATHER RIVER	0	1	Lassen	22	41	0	37	0	0	0	0	0
681	2	North Valley Alluvium, Tehama Terraces	1	TEHAMA	0	1	Tehama	0	12	87	0	0	0	0	1	0
682	2	Shignletown-Paradise, Tuscan Flows	1	EASTERN TEHAMA	0	1	Tehama	47	46	0	7	0	0	0	0	0
683	1	Coastal Franciscan	2	EEL RIVER, MENDOCINO COAST	0	1	Mendocino	96	1	0	0	0	0	0	0	2
684	2	North Valley Alluvium, Tehama Terraces	1	TEHAMA	0	1	Tehama	0	1	92	1	0	1	1	5	0
685	2	Shignletown-Paradise, Lassen-Almanor	3	BUTTE CREEK, EASTERN TEHAMA, FEATHER RIVER	0	2	Tehama, Plumas	94	0	0	4	0	0	0	0	1
686	1	Coastal Franciscan	1	EEL RIVER	60	1	Mendocino	92	7	0	0	0	0	0	0	0
687	3	Blacks Mountain-Susanville Peak, Fredonyer Butte-Grizzly Peak, Honey Lake Basin	1	SUSANVILLE	88	1	Lassen	83	10	0	6	0	0	0	0	0
688	3	North Valley Alluvium, Western Foothills, Tehama Terraces	2	BALL MOUNTAIN, TEHAMA	0	1	Tehama	0	45	54	1	0	0	0	0	0
689	1	Central Franciscan	1	EEL RIVER	0	1	Mendocino	21	46	17	0	0	3	0	0	13
690	2	North Valley Alluvium, Tehama Terraces	1	TEHAMA	0	1	Tehama	0	11	86	1	0	1	0	0	0
691	3	Shignletown-Paradise, Lassen-Almanor, Tuscan Flows	1	EASTERN TEHAMA	0	1	Tehama	61	31	0	8	0	0	0	0	0
692	1	North Valley Alluvium	1	TEHAMA	0	1	Tehama	0	8	8	25	4	1	50	4	0
693	2	North Valley Alluvium, Tehama Terraces	1	TEHAMA	0	1	Tehama	0	7	90	0	0	1	0	2	0
694	1	Tehama Terraces	1	TEHAMA	0	1	Tehama	0	24	75	1	0	0	0	0	0
695	3	North Valley Alluvium, Shignletown-Paradise, Tuscan Flows	2	EASTERN TEHAMA, TEHAMA	0	2	Tehama, Butte	5	76	14	3	0	0	0	0	0
696	2	Blacks Mountain-Susanville Peak, Lassen-Almanor	1	FEATHER RIVER	0	2	Lassen, Plumas	45	0	0	3	0	0	0	0	52
697	2	Coastal Franciscan, Central Franciscan	1	EEL RIVER	52	1	Mendocino	61	6	0	0	0	2	0	0	31
698	1	Tuscan Flows	3	EASTERN TEHAMA, REDDING, TEHAMA	1	1	Tehama	0	93	5	1	0	0	0	0	0
699	2	Coastal Franciscan, Central Franciscan	1	EEL RIVER	0	1	Mendocino	51	21	6	0	0	1	0	0	22
700	2	Shignletown-Paradise, Tuscan Flows	1	WHITMORE	0	1	Tehama	13	83	0	4	0	0	0	0	0
701	1	Tuscan Flows	3	EASTERN TEHAMA, REDDING, WHITMORE	0	1	Tehama	28	67	2	2	0	0	0	1	0
702	1	Blacks Mountain-Susanville Peak	1	SUSANVILLE	0	1	Lassen	10	67	0	23	0	0	0	0	0
703	2	Blacks Mountain-Susanville Peak, Eagle Lake-Observation Peak	1	SUSANVILLE	54	1	Lassen	63	15	0	2	12	0	2	0	5
704	4	Eagle Lake-Observation Peak, Honey Lake Basin, Cottonwood-Skedaddle Mountains, Madeline Plain	2	MADELINE PLAINS, SUSANVILLE	1	1	Lassen	13	84	0	2	0	0	0	0	1
705	2	Tehama Terraces, Tuscan Flows	1	REDDING	95	2	Shasta, Tehama	0	23	15	10	9	4	29	9	0
706	3	North Valley Alluvium, Tehama Terraces, Tuscan Flows	3	REDDING, TEHAMA, WHITMORE	65	2	Shasta, Tehama	0	55	36	2	2	2	1	2	0
707	1	Lassen-Almanor	4	EASTERN TEHAMA, FEATHER RIVER, PIT RIVER, WHITMORE	0	2	Shasta, Tehama	77	4	0	3	0	0	0	0	15
708	2	Blacks Mountain-Susanville Peak, Lassen-Almanor	1	PIT RIVER	0	1	Lassen	27	61	0	12	0	0	0	0	0
709	1	Coastal Franciscan	3	CAPE MENDOCINO, EEL RIVER, MENDOCINO COAST	0	2	Humboldt, Mendocino	85	8	1	0	1	2	0	0	3
710	3	Blacks Mountain-Susanville Peak, Hat Creek Rim, Lassen-Almanor	5	EASTERN TEHAMA, FEATHER RIVER, PIT RIVER, SUSANVILLE, WHITMORE	0	4	Shasta, Lassen, Tehama, Plumas	89	0	0	5	2	0	0	0	5
711	5	Trinity Mountain-Hayfork, Rattlesnake Creek, Eastern Franciscan, Western Foothills, Tehama Terraces	3	REDDING, SHASTA BALLY, TEHAMA	0	1	Tehama	10	80	8	1	0	1	0	0	0
712	2	Likely Mountain, Madeline Plain	1	MADELINE PLAINS	0	1	Lassen	1	98	0	1	0	0	0	0	0
713	1	Madeline Plain	1	MADELINE PLAINS	0	1	Lassen	0	98	0	1	0	0	0	0	0
714	3	Trinity Mountain-Hayfork, Rattlesnake Creek, Western Foothills	1	SHASTA BALLY	0	2	Shasta, Tehama	55	43	0	0	0	1	0	0	1
715	2	Coastal Franciscan, Central Franciscan	1	EEL RIVER	0	3	Humboldt, Trinity, Mendocino	38	30	9	0	1	1	0	0	22
716	2	Blacks Mountain-Susanville Peak, Eagle Lake-Observation Peak	2	MADELINE PLAINS, SUSANVILLE	71	1	Lassen	88	11	0	1	0	0	0	0	0
717	2	Trinity Mountain-Hayfork, Rattlesnake Creek	2	SHASTA BALLY, TRINITY RIVER	0	2	Trinity, Shasta	90	10	0	0	0	0	0	0	0
718	1	Blacks Mountain-Susanville Peak	2	PIT RIVER, SUSANVILLE	0	1	Lassen	63	8	0	6	0	0	0	0	23
719	3	Trinity Mountain-Hayfork, Western Foothills, Tehama Terraces	2	REDDING, SHASTA BALLY	0	2	Shasta, Tehama	0	69	29	1	0	0	0	0	0

Characteristics of Natural Landscape Blocks

ID	NLB_Name	elev_MEAN	elev_MIN	elev_MAX	elev_STD	elev_RANGE	mn_integ	std_integ	AREA_ac	AREA_km2	pc_protect	pc_gap12e	pc_gap3	pc_privunp	mn_sprich	std_sprich	CNDDB_plant_count	CNDDB_animal_count	pc_hotspt	pc_crithab	crithab_sp_count	pc_esshab	esshab_sp_count	pc_wtvp	n_ecoreg	Ecoregs
720		1,087	164	2,458	515	2,294	90	18	469,746	1,901	68	53	16	32	231	11	29	14	0	6	1	19	1	0	2	GREAT CENTRAL VALLEY, NORTH COAST
721		1,749	1,485	2,418	137	933	93	19	141,598	573	70	11	59	30	239	10	8	7	0	0	0	50	1	10	1	MODOC PLATEAU
722	Thousand Lakes	1,966	1,510	2,638	185	1,128	83	15	24,063	97	100	95	4	0	224	6	3	0	0	0	0	0	0	0	1	MODOC PLATEAU
723		276	227	335	22	108	91	8	2,454	10	65	65	0	35	248	7	0	0	0	0	0	0	0	98	1	MODOC PLATEAU
724	South Fork Mountain/ Chinquapin Butte	1,135	713	1,834	238	1,121	90	18	38,060	154	94	62	32	6	231	3	6	4	0	58	1	0	0	0	1	NORTH COAST
725	Yellow Jacket Butte	330	43	770	182	727	93	10	10,557	43	1	0	1	99	235	4	1	1	0	1	1	0	0	0	1	NORTH COAST
726		239	58	579	101	521	48	31	2,618	11	99	99	0	1	239	1	0	1	0	97	1	0	0	0	1	NORTH COAST
727		1,803	1,486	2,075	147	589	69	24	2,380	10	88	87	2	12	228	1	0	0	0	0	0	0	0	2	1	MODOC PLATEAU
728		1,849	1,380	2,355	216	975	95	9	2,983	12	97	0	97	3	242	7	1	2	0	0	0	0	0	0	1	MODOC PLATEAU
729		333	66	831	174	765	93	9	3,608	15	0	0	0	100	250	1	0	1	0	0	0	0	0	0	1	NORTH COAST
730	Humboldt Redwoods/ Grasshopper Mountain	426	32	1,029	212	997	75	27	31,685	128	98	98	0	2	240	3	5	5	0	98	1	0	0	0	1	NORTH COAST
731	Charles Mountain	1,042	248	1,784	286	1,536	92	13	37,937	154	38	21	18	62	236	4	6	4	0	37	2	0	0	0	1	NORTH COAST
732		1,021	367	1,941	291	1,574	88	19	62,886	254	64	38	26	36	236	7	2	6	0	8	1	0	0	0	1	NORTH COAST
733	King Range	496	3	1,216	236	1,213	80	20	36,467	148	99	98	0	1	269	21	2	6	0	44	2	0	0	0	1	NORTH COAST
734	Whiskeytown	809	257	1,881	384	1,624	64	26	34,575	140	94	93	1	6	248	6	3	13	0	0	0	0	0	0	1	NORTH COAST
735		517	351	983	103	632	73	35	5,758	23	91	87	4	9	254	1	2	6	0	0	0	0	0	0	1	NORTH COAST
736	Cinder Butte	1,120	973	1,563	107	590	93	17	35,742	145	94	66	28	6	236	7	4	6	0	4	2	4	1	0	1	MODOC PLATEAU
737		430	261	835	102	574	89	24	4,920	20	61	43	18	39	264	7	0	5	0	0	0	0	0	0	1	MODOC PLATEAU
738		1,369	1,362	1,386	5	24	92	16	3,576	14	3	0	3	97	222	4	2	2	0	0	0	0	0	69	1	MODOC PLATEAU
739		1,674	1,538	2,148	96	610	94	17	89,836	364	31	1	30	69	237	12	10	2	0	0	0	33	1	32	1	MODOC PLATEAU
740	Rockefeller Redwood Forest	449	44	937	199	893	72	28	14,605	59	82	82	0	18	240	3	8	5	0	79	1	0	0	0	1	NORTH COAST
741		732	394	1,092	144	698	90	24	2,256	9	57	16	41	43	254	2	0	1	0	0	0	0	0	0	1	NORTH COAST
742	Beaver Creek Rim/ Indian Mountain	1,468	1,008	1,993	217	985	96	12	92,705	375	74	4	71	26	256	8	5	4	0	0	0	0	0	2	1	MODOC PLATEAU
743		1,268	1,030	1,663	146	633	95	8	3,749	15	0	0	0	100	237	7	0	2	0	0	0	0	0	1	1	MODOC PLATEAU
744	Bear Wallow Mountain	914	447	1,557	237	1,110	92	15	20,707	84	82	63	19	18	229	3	4	6	0	17	1	0	0	0	1	NORTH COAST
745		1,070	903	1,329	58	426	96	12	8,066	33	84	0	84	16	246	8	0	4	0	0	0	0	0	1	1	MODOC PLATEAU
746	Popcorn Cave	1,134	999	1,688	107	689	97	11	17,890	72	91	0	91	9	264	10	2	1	0	0	0	0	0	1	1	MODOC PLATEAU
747		1,263	717	1,761	271	1,044	95	10	2,184	9	70	0	70	30	233	0	0	2	0	61	1	0	0	0	1	NORTH COAST
748		772	565	877	72	312	93	10	2,220	9	0	0	0	100	248	2	2	1	0	0	0	0	0	0	1	MODOC PLATEAU
749		1,081	937	1,368	93	431	96	11	3,966	16	74	0	74	26	239	1	4	0	0	26	2	16	1	2	1	MODOC PLATEAU
750		1,392	1,362	1,609	47	247	99	4	5,926	24	77	0	77	23	222	4	3	2	0	0	0	15	1	3	1	MODOC PLATEAU
751		1,382	1,273	1,549	56	276	97	10	4,984	20	92	0	92	8	260	2	0	1	0	0	0	0	0	1	1	MODOC PLATEAU
752		1,253	1,249	1,256	2	7	95	5	3,833	16	10	10	1	90	249	5	0	1	0	0	0	0	0	71	1	MODOC PLATEAU
753		491	324	808	108	484	76	32	7,097	29	100	100	0	0	257	1	2	4	0	0	0	0	0	0	1	MODOC PLATEAU
754		1,047	653	1,552	179	899	89	15	9,750	39	58	0	58	42	241	6	3	10	0	57	1	0	0	0	1	MODOC PLATEAU
755		690	277	1,046	156	769	86	20	7,183	29	0	0	0	100	241	2	3	0	0	0	0	0	0	0	1	NORTH COAST
756		905	788	1,003	38	215	94	7	2,715	11	0	0	0	100	235	5	2	0	0	0	0	0	0	2	1	MODOC PLATEAU
757		1,439	1,298	1,741	77	443	94	9	8,115	33	23	0	23	77	262	2	0	0	0	0	0	0	0	0	1	MODOC PLATEAU
758		968	853	1,027	40	174	97	8	2,128	9	99	0	99	1	244	1	2	1	0	0	0	0	0	0	1	MODOC PLATEAU
759		830	585	1,102	116	517	67	28	5,404	22	95	81	14	5	252	1	1	1	0	44	1	0	0	0	1	NORTH COAST
760		553	301	1,318	192	1,017	96	15	79,823	323	88	79	9	12	264	6	5	17	0	0	0	0	0	0	1	MODOC PLATEAU
761		1,415	1,354	1,461	25	107	97	11	2,348	10	98	0	98	2	242	5	0	2	3	0	0	0	0	0	1	MODOC PLATEAU
762		437	154	842	178	688	65	25	2,770	11	95	95	0	5	238	2	1	3	0	79	1	0	0	0	1	NORTH COAST
763		685	400	1,033	142	633	95	11	2,049	8	92	1	91	8	232	2	0	1	0	0	0	0	0	0	1	NORTH COAST
764		1,001	370	1,892	280	1,522	85	21	50,402	204	96	71	26	4	231	1	3	12	0	26	1	0	0	0	1	NORTH COAST
765	Big Valley	1,259	1,255	1,275	3	20	93	14	7,075	29	26	20	7	74	248	3	1	1	0	0	0	0	0	45	1	MODOC PLATEAU
766		544	325	1,116	175	791	89	27	3,554	14	88	23	65	12	254	1	0	1	0	0	0	0	0	0	1	NORTH COAST
767		839	722	986	54	264	68	30	2,407	10	96	90	6	4	249	1	1	1	0	95	1	0	0	0	1	NORTH COAST
768	Pilot Butte	1,266	1,258	1,304	6	46	92	20	14,259	58	87	2	86	13	250	5	7	4	0	0	0	0	0	50	1	MODOC PLATEAU
769		430	323	795	96	472	83	33	5,244	21	79	62	17	21	256	1	2	3	0	0	0	0	0	0	2	MODOC PLATEAU, NORTH COAST
770		1,423	1,306	1,608	64	302	97	10	2,859	12	29	0	29	71	263	1	0	0	0	0	0	0	0	2	1	MODOC PLATEAU
771		1,364	1,295	1,707	69	412	95	14	2,325	9	59	0	59	41	263	1	0	2	0	0	0	0	0	1	1	MODOC PLATEAU
772		830	303	1,581	276	1,278	80	23	13,461	54	89	76	13	11	236	2	2	5	0	42	1	0	0	0	1	NORTH COAST
773		1,377	1,265	1,831	110	566	96	10	13,940	56	37	0	37	63	260	3	0	3	0	0	0	0	0	0	1	MODOC PLATEAU

Characteristics of Natural Landscape Blocks

ID	n_subsect	Subsect	HU_num	HU_names	pc_blmacec	n_Counties	Counties	pc_forest	pc_shrub	pc_herb	pc_wetrip	pc_water	pc_dev	pc_crop	pc_pasture	pc_other
720	5	Rattlesnake Creek, Eastern Franciscan, Central Franciscan, Western Foothills, Tehama Terraces	8	BALL MOUNTAIN, EEL RIVER, MAD RIVER, REDDING, SHASTA BALLY, STONY CREEK, TEHAMA, TRINITY RIVER	0	3	Trinity, Tehama, Mendocino	64	29	4	0	0	1	0	0	2
721	3	Adin Mountains and Valleys, Eagle Lake-Observation Peak, Madeline Plain	2	MADELINE PLAINS, SUSANVILLE	11	1	Lassen	50	43	0	1	0	0	1	1	5
722	2	Hat Creek Rim, Lassen-Almanor	1	PIT RIVER	0	1	Shasta	82	0	0	3	0	0	0	0	14
723	2	Tehama Terraces, Tuscan Flows	2	REDDING, WHITMORE	0	1	Shasta	1	4	40	2	0	0	0	54	0
724	3	Rattlesnake Creek, Eastern Franciscan, Central Franciscan	3	EEL RIVER, MAD RIVER, TRINITY RIVER	0	1	Trinity	92	4	0	0	0	1	0	0	3
725	2	Central Franciscan, Central Franciscan	1	EEL RIVER	0	1	Humboldt	44	21	11	0	2	0	0	0	21
726	1	Coastal Franciscan	1	EEL RIVER	0	1	Humboldt	95	0	0	0	0	5	0	0	0
727	1	Shignletown-Paradise	2	PIT RIVER, WHITMORE	0	1	Shasta	73	1	22	5	0	0	0	0	0
728	2	Hat Creek Rim, Lassen-Almanor	1	PIT RIVER	0	1	Shasta	39	1	0	0	0	0	0	0	60
729	1	Coastal Franciscan	1	CAPE MENDOCINO	0	1	Humboldt	43	19	28	0	0	0	0	0	9
730	1	Coastal Franciscan	2	CAPE MENDOCINO, EEL RIVER	0	1	Humboldt	95	1	0	0	0	2	0	0	1
731	2	Central Franciscan, Central Franciscan	1	EEL RIVER	3	2	Humboldt, Trinity	79	6	2	0	0	0	0	0	13
732	4	Oregon Mountain, Trinity Mountain-Hayfork, Rattlesnake Creek, Western Foothills	2	SHASTA BALLY, TRINITY RIVER	0	2	Trinity, Shasta	71	26	1	0	0	1	0	0	1
733	1	Coastal Franciscan	1	CAPE MENDOCINO	2	1	Humboldt	85	11	2	0	0	1	0	0	2
734	2	Oregon Mountain, Eastern Klamath Mountains	2	SHASTA BALLY, TRINITY RIVER	0	2	Trinity, Shasta	66	28	0	1	1	3	0	0	0
735	2	Oregon Mountain, Eastern Klamath Mountains	1	SHASTA BALLY	0	1	Shasta	19	76	0	1	1	3	0	0	0
736	1	Hat Creek Rim	1	PIT RIVER	0	1	Shasta	58	12	0	1	0	0	1	0	28
737	1	Eastern Klamath Mountains	2	MOUNTAIN GATE, SHASTA DAM	0	1	Shasta	64	26	0	3	5	2	0	0	1
738	2	Cottonwood-Skedaddle Mountains, Surprise Valley	1	SUPRISE VALLEY	0	2	Modoc, Lassen	0	19	2	33	1	0	21	23	1
739	4	Likely Mountain, Adin Mountains and Valleys, Eagle Lake-Observation Peak, Madeline Plain	2	MADELINE PLAINS, PIT RIVER	1	1	Lassen	19	72	4	2	0	0	1	2	0
740	1	Coastal Franciscan	2	CAPE MENDOCINO, EEL RIVER	0	1	Humboldt	93	2	2	0	0	2	0	0	0
741	1	Eastern Klamath Mountains	1	SHASTA BALLY	0	1	Shasta	37	58	1	3	0	1	0	0	0
742	5	Blacks Mountain-Susanville Peak, Hat Creek Rim, Bald Mountain-Dixie Valley, Eagle Lake-Observation Peak, Madeline Plain	2	MADELINE PLAINS, PIT RIVER	0	2	Shasta, Lassen	32	64	0	3	0	0	0	0	0
743	2	Hat Creek Rim, Shignletown-Paradise	1	PIT RIVER	0	1	Shasta	44	1	0	1	0	0	0	0	54
744	2	Rattlesnake Creek, Eastern Franciscan	1	TRINITY RIVER	0	1	Trinity	92	5	0	0	1	0	0	0	2
745	1	Hat Creek Rim	1	PIT RIVER	0	1	Shasta	65	35	0	0	0	0	0	0	1
746	2	Hat Creek Rim, Bald Mountain-Dixie Valley	1	PIT RIVER	0	2	Shasta, Lassen	61	38	0	1	0	0	0	0	0
747	1	Trinity Mountain-Hayfork	1	TRINITY RIVER	0	1	Trinity	97	2	0	0	0	0	0	0	0
748	2	Eastern Klamath Mountains, Shignletown-Paradise	1	PIT RIVER	0	1	Shasta	87	2	0	10	0	0	0	0	0
749	1	Hat Creek Rim	1	PIT RIVER	0	1	Shasta	89	8	0	0	0	0	1	0	1
750	1	Surprise Valley	1	SUPRISE VALLEY	0	1	Modoc	0	60	0	36	0	0	0	1	3
751	2	Mowitz Buttes, Bald Mountain-Dixie Valley	1	PIT RIVER	0	1	Lassen	30	64	0	6	0	0	0	0	0
752	1	Mowitz Buttes	1	PIT RIVER	0	1	Lassen	0	2	0	14	0	0	47	36	0
753	1	Eastern Klamath Mountains	1	SHASTA DAM	0	1	Shasta	92	3	0	2	3	1	0	0	0
754	2	Hat Creek Rim, Shignletown-Paradise	1	PIT RIVER	0	1	Shasta	86	1	0	4	0	0	0	0	9
755	2	Central Franciscan, Coastal Franciscan	1	EEL RIVER	0	1	Humboldt	48	10	3	0	0	1	0	0	38
756	1	Shignletown-Paradise	1	PIT RIVER	0	1	Shasta	92	2	0	5	0	0	0	0	2
757	2	Mowitz Buttes, Adin Mountains and Valleys	1	PIT RIVER	0	2	Modoc, Lassen	10	85	1	3	0	0	0	1	0
758	1	Hat Creek Rim	1	PIT RIVER	0	1	Shasta	60	40	0	0	0	0	0	0	0
759	1	Eastern Klamath Mountains	1	TRINITY RIVER	0	1	Trinity	76	19	1	0	0	3	0	0	1
760	2	Eastern Klamath Mountains, Tehama Terraces	4	MC CLOUD RIVER, MOUNTAIN GATE, SHASTA DAM, WHITMORE	0	1	Shasta	81	9	0	2	8	0	0	0	0
761	2	Pit River Valley, Likely Mountain	1	PIT RIVER	0	1	Modoc	0	94	0	6	0	0	0	0	0
762	1	Coastal Franciscan	1	EEL RIVER	0	1	Humboldt	92	5	1	0	0	0	0	0	1
763	1	Rattlesnake Creek	1	TRINITY RIVER	0	1	Trinity	89	11	0	0	0	0	0	0	0
764	3	Oregon Mountain, Trinity Mountain-Hayfork, Rattlesnake Creek	1	TRINITY RIVER	0	1	Trinity	92	5	0	0	0	1	0	0	1
765	2	Mowitz Buttes, Bald Mountain-Dixie Valley	1	PIT RIVER	0	2	Modoc, Lassen	0	18	1	16	0	0	40	25	0
766	1	Eastern Klamath Mountains	2	SHASTA DAM, UPPER SACRAMENTO	0	1	Shasta	90	3	0	2	1	2	0	2	0
767	1	Eastern Klamath Mountains	1	TRINITY RIVER	0	1	Trinity	88	5	0	0	1	5	0	0	2
768	2	Mowitz Buttes, Adin Mountains and Valleys	1	PIT RIVER	0	2	Modoc, Lassen	0	18	2	13	1	1	17	48	0
769	1	Eastern Klamath Mountains	1	SHASTA DAM	0	1	Shasta	78	2	0	4	9	2	0	4	2
770	1	Adin Mountains and Valleys	1	PIT RIVER	0	1	Modoc	2	91	3	4	0	0	0	0	0
771	1	Adin Mountains and Valleys	1	PIT RIVER	0	1	Modoc	16	67	8	4	0	0	6	0	0
772	1	Trinity Mountain-Hayfork	1	TRINITY RIVER	0	1	Trinity	95	3	0	0	1	1	0	0	0
773	2	Mowitz Buttes, Adin Mountains and Valleys	1	PIT RIVER	0	1	Modoc	9	75	0	3	0	0	1	12	0

ID	NLB_Name	elev_MEAN	elev_MIN	elev_MAX	elev_STD	elev_RANGE	mn_integ	std_integ	AREA_ac	AREA_km2	pc_protect	pc_gap12e	pc_gap3	pc_privunp	mn_sprich	std_sprich	CNDDB_plant_count	CNDDB_animal_count	pc_hotspt	pc_crithab	crithab_sp_count	pc_esshab	esshab_sp_count	pc_wtvp	n_ecoreg	Ecoregs
774	Little Hot Spring Valley	1,065	1,007	1,208	33	201	89	23	32,853	133	90	85	4	10	254	10	8	12	0	11	1	11	1	4	1	MODOC PLATEAU
775		907	721	1,276	125	555	69	30	14,923	60	98	97	1	2	247	2	5	3	0	38	1	0	0	0	1	NORTH COAST
776		1,283	1,262	1,403	20	141	94	13	5,046	20	36	1	35	64	259	7	2	1	0	0	0	0	0	11	1	MODOC PLATEAU
777		1,367	1,362	1,397	6	35	99	3	32,922	133	56	0	56	44	220	2	4	1	0	0	0	3	1	1	1	MODOC PLATEAU
778		1,722	1,428	1,975	127	547	97	10	2,345	9	59	0	59	41	263	2	1	0	0	0	0	0	0	0	1	MODOC PLATEAU
779		1,673	1,335	2,244	173	909	95	15	105,515	427	74	18	56	26	249	12	18	8	0	0	0	0	0	1	1	MODOC PLATEAU
780		1,385	1,314	1,584	79	270	95	10	3,027	12	81	0	81	19	275	7	0	1	0	0	0	0	0	0	1	MODOC PLATEAU
781		1,375	1,266	1,745	95	479	96	10	4,533	18	44	0	44	56	263	4	0	1	0	0	0	0	0	2	1	MODOC PLATEAU
782		823	479	1,223	168	744	94	7	3,539	14	2	0	2	98	250	2	3	3	0	0	0	0	0	0	1	NORTH COAST
783	Dairy Ridge/ Pilot Ridge/ South Fork	944	184	1,785	303	1,601	91	15	97,579	395	46	23	24	54	237	5	11	18	0	9	2	0	0	0	1	NORTH COAST
784		897	577	1,482	151	905	83	24	32,878	133	96	84	12	4	248	4	3	2	0	52	1	0	0	0	1	NORTH COAST
785	McCloud River/ Curl Ridge	921	325	1,891	292	1,566	94	14	167,356	677	74	46	28	26	246	6	10	14	0	38	1	0	0	0	1	MODOC PLATEAU
786	Warner Mountains	1,760	1,226	3,004	263	1,778	94	17	789,959	3,197	83	14	69	17	232	15	71	23	1	0	0	33	1	3	1	MODOC PLATEAU
787		875	722	1,146	93	424	46	33	2,015	8	93	88	5	7	243	2	3	0	0	25	1	0	0	0	1	NORTH COAST
788		1,463	1,280	1,846	117	566	80	22	8,943	36	91	73	19	9	258	2	1	3	0	0	0	0	0	1	1	MODOC PLATEAU
789		1,356	613	2,182	404	1,569	95	11	5,528	22	58	10	48	42	234	5	1	7	0	9	1	0	0	1	1	NORTH COAST
790	Timbered Crater	1,139	1,030	1,214	34	184	95	14	28,071	114	96	78	18	4	246	9	0	0	0	0	1	0	1	0	1	MODOC PLATEAU
791		824	140	1,518	270	1,378	93	14	10,170	41	83	0	83	17	238	5	4	11	0	80	2	0	0	0	1	NORTH COAST
792	Backbone Ridge	909	178	2,122	392	1,944	90	21	128,079	518	84	56	28	16	246	10	12	14	0	13	1	0	0	0	2	MODOC PLATEAU, NORTH COAST
793		1,437	1,293	1,591	63	298	88	17	2,162	9	75	0	75	25	240	4	0	2	0	100	1	0	0	0	1	MODOC PLATEAU
794		1,293	1,168	1,403	49	235	97	11	5,640	23	100	0	100	0	257	8	0	0	0	0	0	0	0	0	1	MODOC PLATEAU
795	Castle Crags	1,462	623	2,186	374	1,563	84	22	19,477	79	89	77	12	11	237	7	12	9	0	13	1	0	0	0	2	MODOC PLATEAU, NORTH COAST
796		1,593	1,431	1,875	95	444	96	10	9,595	39	100	86	14	0	242	6	1	0	0	0	0	0	0	0	1	MODOC PLATEAU
797	Bald Mountain/ Lake City Canyon	1,797	1,376	2,516	246	1,140	90	18	40,763	165	74	40	35	26	271	18	17	8	0	0	0	0	0	2	1	MODOC PLATEAU
798		1,738	1,378	2,168	167	790	94	10	2,036	8	47	0	47	53	225	4	0	4	0	0	0	0	0	0	1	MODOC PLATEAU
799	Mt Eddy	2,189	1,492	2,747	198	1,255	90	18	14,149	57	73	50	23	27	231	17	16	3	0	0	0	0	0	2	1	NORTH COAST
800		1,886	1,517	2,541	222	1,024	94	9	2,657	11	47	0	47	53	222	2	0	1	0	0	0	0	0	0	1	MODOC PLATEAU
801		597	158	1,249	228	1,091	81	24	16,662	67	43	43	0	57	244	5	2	5	0	32	2	0	0	0	1	NORTH COAST
802	Timber Mountain	1,343	1,280	1,479	36	199	88	23	31,996	129	100	77	23	0	256	9	1	1	0	0	0	0	0	0	1	MODOC PLATEAU
803		1,435	1,433	1,460	2	27	95	12	5,176	21	0	0	0	100	268	12	0	7	0	0	0	0	0	58	1	MODOC PLATEAU
804		1,295	1,286	1,316	3	30	98	10	2,010	8	100	0	100	0	247	2	0	0	0	0	0	0	0	0	1	MODOC PLATEAU
805		2,109	1,491	2,406	152	915	76	23	11,733	47	98	88	11	2	235	6	2	3	0	0	0	0	0	0	1	MODOC PLATEAU
806		2,196	1,518	2,581	165	1,063	97	7	7,757	31	82	8	74	18	224	2	8	3	0	38	1	0	0	1	1	NORTH COAST
807		870	423	1,472	238	1,049	92	17	4,766	19	69	2	67	31	225	1	1	2	0	3	1	0	0	0	1	NORTH COAST
808	Mt Shasta	2,178	1,053	4,300	626	3,247	78	25	64,060	259	94	88	6	6	233	17	14	6	0	12	1	0	0	0	1	MODOC PLATEAU
809		538	72	953	241	881	92	10	2,381	10	1	0	1	99	232	2	2	1	0	0	0	0	0	0	1	NORTH COAST
810		1,469	1,316	1,614	76	298	87	23	3,445	14	99	78	21	1	258	2	3	2	0	0	0	0	0	0	1	MODOC PLATEAU
811	Big Cliff Mine	1,561	506	2,475	452	1,969	86	20	58,366	236	96	70	26	4	219	5	9	8	0	46	1	0	0	1	1	NORTH COAST
812		1,521	1,351	1,641	38	290	98	10	177,564	719	88	0	88	12	257	5	12	12	0	0	0	0	0	7	1	MODOC PLATEAU
813	Mount Bidwell/ Larkspur Hills	1,667	1,355	2,527	276	1,172	95	14	95,703	387	74	20	55	26	234	21	11	14	0	0	0	39	1	2	1	MODOC PLATEAU
814	Double Head Mountain/ Timbered Ridge	1,465	1,268	1,746	71	478	95	16	227,384	920	92	0	92	8	256	7	7	11	0	0	0	1	1	6	1	MODOC PLATEAU
815	Salmon Mountains	1,368	76	2,706	471	2,630	88	18	732,472	2,964	98	90	8	2	227	8	44	28	0	13	2	0	0	0	1	NORTH COAST
816		11	0	124	21	124	40	36	3,269	13	97	97	0	3	291	8	12	6	0	85	3	0	0	11	1	NORTH COAST
817	Lava Beds Wilderness	1,287	1,229	1,527	33	298	93	19	54,198	219	99	95	3	1	252	8	4	5	0	0	0	0	0	0	1	MODOC PLATEAU
818	McConaughy Gulch	1,123	842	1,786	189	944	90	16	22,078	89	6	0	6	94	228	5	3	1	0	0	0	0	0	0	1	NORTH COAST
819		1,293	1,231	1,602	54	371	98	11	17,918	73	100	100	0	0	253	8	1	1	0	0	0	0	0	0	1	MODOC PLATEAU
820	Redwood Creek/ Bald Hills	386	3	976	204	973	68	31	51,392	208	96	96	0	4	246	13	8	10	0	1	1	0	0	0	1	NORTH COAST
821		1,232	1,226	1,248	3	22	13	30	7,684	31	100	100	0	0	259	5	1	6	0	0	0	0	0	1	1	MODOC PLATEAU
822		815	794	936	14	142	86	27	3,005	12	0	0	0	100	261	2	1	1	0	0	0	0	0	43	1	MODOC PLATEAU

Characteristics of Natural Landscape Blocks

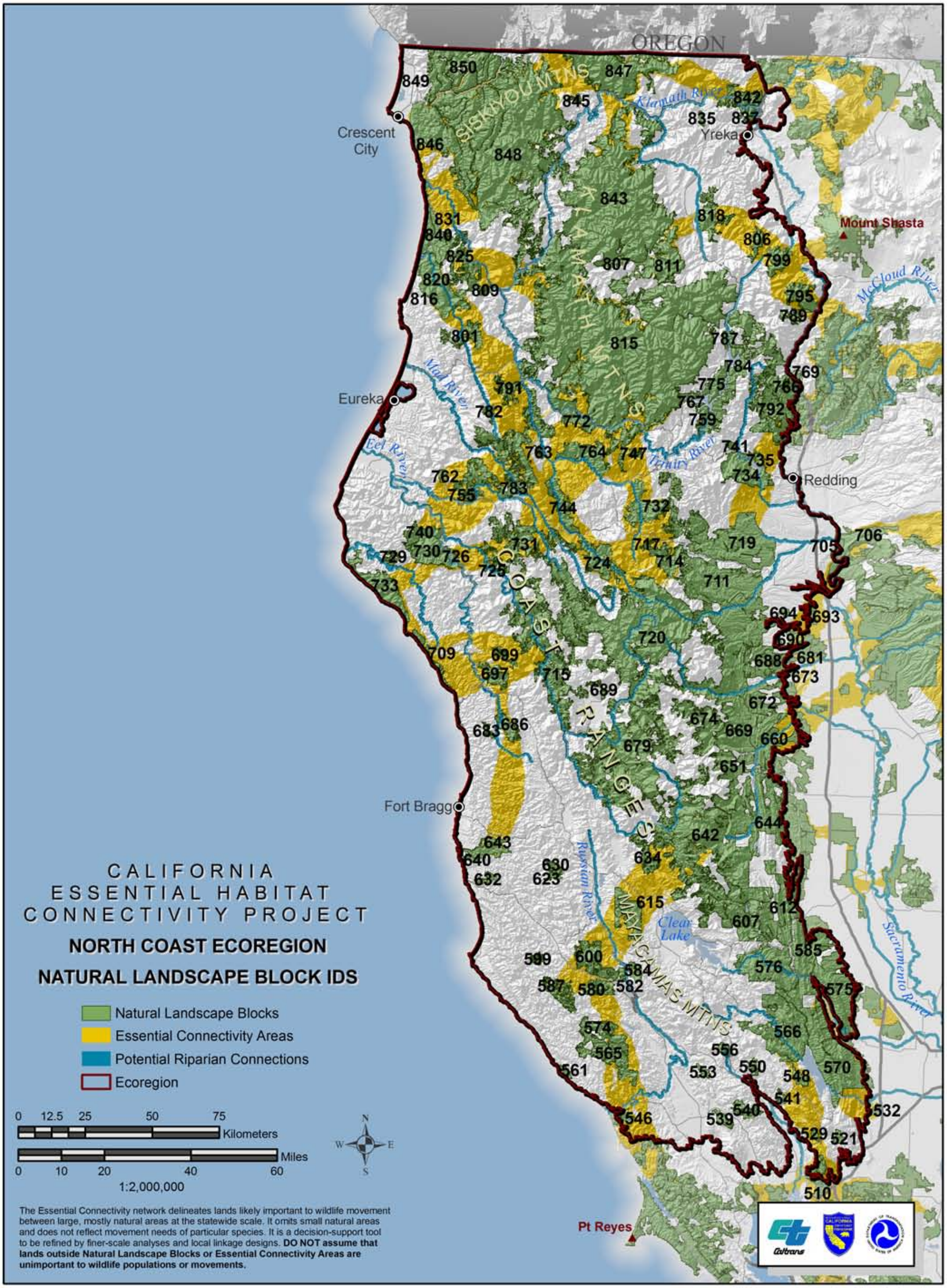
ID	n_subsect	Subsect	HU_num	HU_names	pc_blmacec	n_Counties	Counties	pc_forest	pc_shrub	pc_herb	pc_wetrip	pc_water	pc_dev	pc_crop	pc_pasture	pc_other
774	3	Medicine Lake Lava Flows, Hat Creek Rim, Bald Mountain-Dixie Valley	1	PIT RIVER	0	3	Siskiyou, Modoc, Shasta	75	2	0	0	2	0	2	2	17
775	1	Eastern Klamath Mountains	1	TRINITY RIVER	0	1	Trinity	80	8	1	0	4	4	0	0	3
776	1	Mowitz Buttes	1	PIT RIVER	0	1	Modoc	17	66	0	1	0	0	0	15	0
777	1	Surprise Valley	1	SUPRISE VALLEY	0	1	Modoc	0	46	0	11	0	0	0	0	42
778	2	Likely Mountain, Adin Mountains and Valleys	1	PIT RIVER	0	1	Modoc	49	49	1	1	0	0	0	0	0
779	4	Pit River Valley, Likely Mountain, Adin Mountains and Valleys, Madeline Plain	2	MADELINE PLAINS, PIT RIVER	0	2	Modoc, Lassen	41	53	1	2	0	0	0	1	1
780	2	Pit River Valley, Likely Mountain	1	PIT RIVER	0	1	Modoc	33	43	15	3	0	0	0	0	6
781	2	Mowitz Buttes, Adin Mountains and Valleys	1	PIT RIVER	0	1	Modoc	27	66	2	5	0	0	0	0	0
782	2	Central Franciscan, Central Franciscan	1	REDWOOD CREEK	0	1	Humboldt	90	7	0	0	0	0	0	0	3
783	6	Central Franciscan, Coastal Franciscan, Western Jurassic, Rattlesnake Creek, Eastern Franciscan, Central Franciscan	4	EEL RIVER, MAD RIVER, REDWOOD CREEK, TRINITY RIVER	0	2	Humboldt, Trinity	77	9	1	0	0	1	0	0	12
784	1	Eastern Klamath Mountains	2	SHASTA BALLY, TRINITY RIVER	0	2	Trinity, Shasta	76	13	0	1	5	2	0	0	3
785	2	Eastern Klamath Mountains, Hat Creek Rim	4	MC CLOUD RIVER, PIT RIVER, SHASTA DAM, UPPER SACRAMENTO	0	2	Siskiyou, Shasta	96	1	0	2	0	0	0	0	1
786	8	Warner Mountains, Pit River Valley, Likely Mountain, Eagle Lake-Observation Peak, Honey Lake Basin, Cottonwood-Skedaddle Mountains, Madeline Plain, Surprise Valley	6	DUCK FLAT, MADELINE PLAINS, PIT RIVER, SMOKE CREEK, SUPRISE VALLEY, SUSANVILLE	0	2	Modoc, Lassen	27	64	3	2	0	0	0	1	3
787	2	Eastern Klamath Mountains, Upper Scott Mountains	1	TRINITY RIVER	0	1	Trinity	88	4	2	0	0	6	0	0	0
788	1	Adin Mountains and Valleys	1	PIT RIVER	0	1	Modoc	63	33	1	4	0	0	0	0	0
789	2	Eastern Klamath Mountains, Upper Scott Mountains	2	TRINITY RIVER, UPPER SACRAMENTO	0	2	Trinity, Shasta	92	4	0	3	0	0	0	0	0
790	2	Medicine Lake Lava Flows, Hat Creek Rim	1	PIT RIVER	0	2	Siskiyou, Shasta	91	0	0	0	0	0	0	0	9
791	3	Western Jurassic, Rattlesnake Creek, Eastern Franciscan	1	TRINITY RIVER	0	2	Humboldt, Trinity	94	4	0	2	0	0	0	0	0
792	2	Eastern Klamath Mountains, Upper Scott Mountains	4	SHASTA BALLY, SHASTA DAM, TRINITY RIVER, UPPER SACRAMENTO	0	2	Trinity, Shasta	81	12	0	1	3	1	0	0	2
793	2	High Cascade, Hat Creek Rim	1	MC CLOUD RIVER	0	1	Siskiyou	94	0	0	3	0	0	0	0	3
794	1	Medicine Lake Lava Flows	1	PIT RIVER	0	1	Siskiyou	92	8	0	0	0	0	0	0	0
795	2	Eastern Klamath Mountains, Upper Scott Mountains	1	UPPER SACRAMENTO	0	2	Siskiyou, Shasta	86	8	0	1	0	0	0	0	4
796	2	Medicine Lake Lava Flows, Medicine Lake Highlands	1	PIT RIVER	0	1	Siskiyou	16	0	0	0	0	0	0	0	84
797	4	Goose Lake Basin, Warner Mountains, Pit River Valley, Surprise Valley	3	LAKEVIEW, PIT RIVER, SUPRISE VALLEY	0	1	Modoc	60	27	8	4	0	0	0	1	1
798	1	High Cascade	1	MC CLOUD RIVER	0	1	Siskiyou	82	10	0	5	0	0	0	0	4
799	2	Eastern Klamath Mountains, Upper Scott Mountains	3	KLAMATH RIVER, TRINITY RIVER, UPPER SACRAMENTO	0	2	Siskiyou, Trinity	87	9	0	2	0	0	0	0	2
800	1	High Cascade	2	KLAMATH RIVER, MC CLOUD RIVER	0	1	Siskiyou	72	25	0	1	0	0	0	0	2
801	2	Central Franciscan, Central Franciscan	4	KLAMATH RIVER, MAD RIVER, REDWOOD CREEK, TRINIDAD	43	1	Humboldt	92	3	2	0	0	0	0	0	3
802	3	Medicine Lake Lava Flows, Devil's Garden, Mowitz Buttes	2	KLAMATH RIVER, PIT RIVER	0	1	Modoc	30	70	0	0	0	0	0	0	0
803	2	Goose Lake Basin, Warner Mountains	1	LAKEVIEW	0	1	Modoc	0	0	1	4	63	0	2	30	0
804	1	Medicine Lake Lava Flows	1	KLAMATH RIVER	0	1	Modoc	1	98	0	0	0	0	0	0	0
805	2	Medicine Lake Lava Flows, Medicine Lake Highlands	2	KLAMATH RIVER, PIT RIVER	0	2	Siskiyou, Modoc	60	3	2	0	0	0	0	0	35
806	2	Scott Valley, Upper Scott Mountains	2	KLAMATH RIVER, TRINITY RIVER	0	2	Siskiyou, Trinity	69	29	0	1	0	0	0	0	1
807	2	Upper Salmon Mountains, Forks of Salmon	1	KLAMATH RIVER	0	1	Siskiyou	94	2	0	2	1	0	0	0	1
808	3	Shasta Valley, High Cascade, Hat Creek Rim	3	KLAMATH RIVER, MC CLOUD RIVER, UPPER SACRAMENTO	0	1	Siskiyou	68	4	1	2	0	0	0	0	24
809	1	Eastern Franciscan	1	KLAMATH RIVER	0	1	Humboldt	97	1	0	2	0	0	0	0	0
810	1	Medicine Lake Lava Flows	1	KLAMATH RIVER	0	2	Siskiyou, Modoc	75	24	0	0	0	0	0	0	0
811	3	Upper Salmon Mountains, Upper Scott Mountains, Forks of Salmon	1	KLAMATH RIVER	0	1	Siskiyou	94	1	2	0	0	1	0	0	2
812	4	Devil's Garden, Crowder Flat, Goose Lake Basin, Pit River Valley	3	KLAMATH RIVER, LAKEVIEW, PIT RIVER	0	1	Modoc	15	72	3	6	3	0	0	1	0
813	3	Warner Mountains, Sheldon Range, Surprise Valley	3	COW HEAD LAKE, LAKEVIEW, SUPRISE VALLEY	0	1	Modoc	14	52	15	10	0	0	0	1	7
814	5	Lower Klamath-Tule Lake Basins, Devil's Garden, Crowder Flat, Mowitz Buttes, Pit River Valley	2	KLAMATH RIVER, PIT RIVER	0	1	Modoc	21	73	1	4	0	0	0	0	0
815	10	Upper Scott Mountains, Trinity Mountain-Hayfork, North Trinity Mountain, Oregon Mountain, Forks of Salmon, Upper Salmon Mountains, Western Jurassic, Lower Salmon Mountains, and 2 others	2	KLAMATH RIVER, TRINITY RIVER	0	3	Siskiyou, Humboldt, Trinity	92	4	1	0	0	0	0	0	2
816	3	Humboldt Bay Flats and Terraces, Central Franciscan, Central Franciscan	1	TRINIDAD	0	1	Humboldt	22	0	4	5	59	1	0	0	8
817	3	Medicine Lake Lava Flows, Lower Klamath-Tule Lake Basins, Devil's Garden	1	KLAMATH RIVER	0	2	Siskiyou, Modoc	7	90	0	0	0	0	0	0	2
818	1	Scott Valley	1	KLAMATH RIVER	0	1	Siskiyou	57	24	10	0	0	0	1	2	6
819	2	Medicine Lake Lava Flows, Lower Klamath-Tule Lake Basins	1	KLAMATH RIVER	0	2	Siskiyou, Modoc	14	60	0	0	0	0	0	0	26
820	3	Northern Franciscan, Central Franciscan, Central Franciscan	3	KLAMATH RIVER, REDWOOD CREEK, TRINIDAD	0	1	Humboldt	90	2	1	0	0	1	0	0	5
821	2	Medicine Lake Lava Flows, Lower Klamath-Tule Lake Basins	1	KLAMATH RIVER	0	2	Siskiyou, Modoc	0	15	0	2	0	2	41	40	0
822	1	Shasta Valley	1	KLAMATH RIVER	0	1	Siskiyou	0	17	1	2	0	0	65	15	0

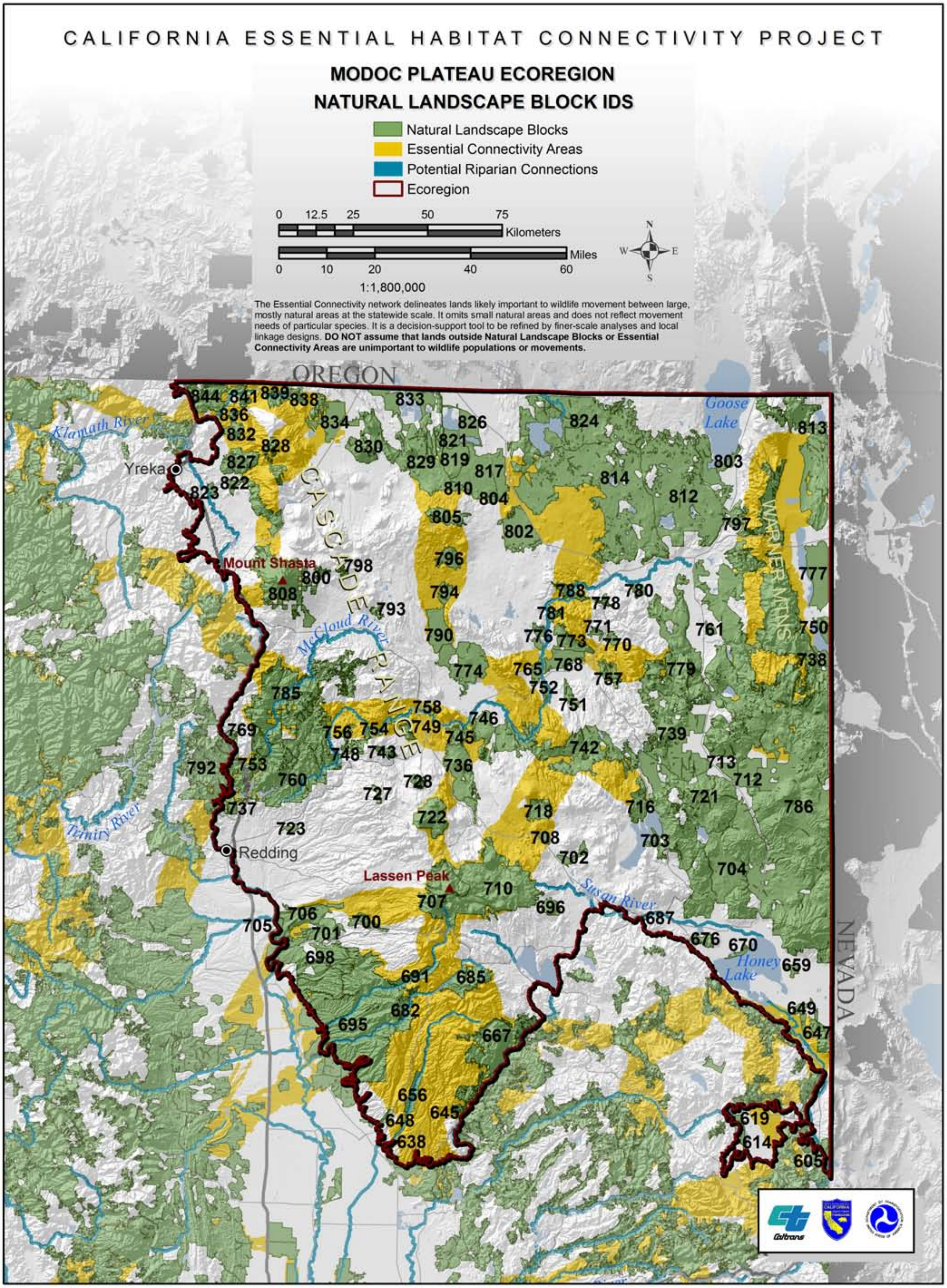
Characteristics of Natural Landscape Blocks

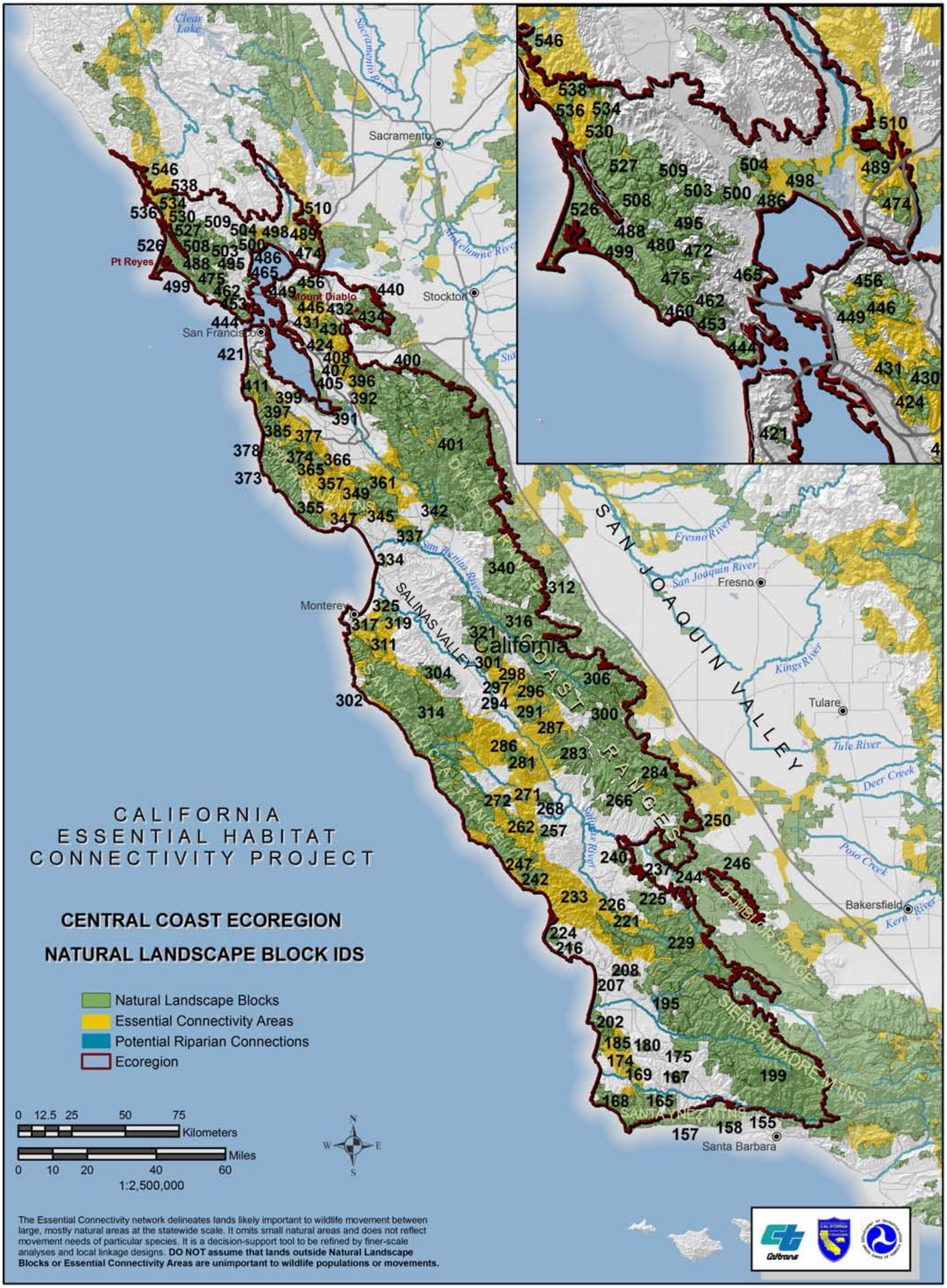
ID	NLB_Name	elev_MEAN	elev_MIN	elev_MAX	elev_STD	elev_RANGE	mn_integ	std_integ	AREA_ac	AREA_km2	pc_protect	pc_gap12e	pc_gap3	pc_privunp	mn_sprich	std_sprich	CNDDB_plant_count	CNDDB_animal_count	pc_hotspt	pc_crithab	crithab_sp_count	pc_esshab	esshab_sp_count	pc_wtvp	n_ecoreg	Ecoregs
823		793	762	851	17	89	93	12	2,088	8	22	3	19	78	265	2	1	2	0	0	0	0	0	7	1	MODOC PLATEAU
824		1,446	1,256	1,756	70	500	97	13	130,956	530	95	24	71	5	250	8	8	14	0	0	0	0	0	5	1	MODOC PLATEAU
825	Redwood/ Williams Ridge/ Holter Ridge	439	7	935	193	928	88	22	45,882	186	28	28	0	72	244	4	12	12	0	0	0	0	0	0	1	NORTH COAST
826		1,229	1,227	1,243	1	16	1	7	13,402	54	100	100	0	0	241	6	0	4	0	0	0	0	0	1	1	MODOC PLATEAU
827	Martin Hill	1,081	814	1,738	189	924	92	15	36,491	148	9	0	9	91	266	11	5	2	0	0	0	0	0	0	1	MODOC PLATEAU
828		1,839	1,222	2,521	298	1,299	91	16	7,406	30	66	0	66	34	264	8	3	2	0	39	1	0	0	0	1	MODOC PLATEAU
829		1,411	1,233	1,982	101	749	93	18	70,949	287	87	40	48	13	250	11	6	11	15	0	0	0	0	1	1	MODOC PLATEAU
830		1,462	1,262	1,889	130	627	93	17	37,265	151	55	1	54	45	247	9	2	4	0	0	0	0	0	0	1	MODOC PLATEAU
831		251	31	492	104	461	68	36	5,278	21	99	99	0	1	243	1	3	5	0	80	1	0	0	1	1	NORTH COAST
832		993	740	1,374	148	634	93	11	7,007	28	0	0	0	100	252	6	1	0	0	0	0	0	0	0	1	MODOC PLATEAU
833		1,244	1,239	1,300	2	61	25	40	26,712	108	96	96	0	4	244	7	0	11	2	0	0	0	0	39	1	MODOC PLATEAU
834	Butte Valley	1,311	1,287	1,537	43	250	90	22	26,107	106	76	61	15	24	265	7	0	2	0	0	0	0	0	1	1	MODOC PLATEAU
835		1,022	615	1,625	200	1,010	96	10	2,051	8	85	0	85	15	237	0	0	0	0	0	0	0	0	1	1	NORTH COAST
836		813	729	893	33	164	90	16	2,290	9	0	0	0	100	245	1	0	0	0	0	0	0	0	0	1	MODOC PLATEAU
837		939	565	1,486	180	921	86	27	9,342	38	79	12	67	21	240	3	0	2	0	0	0	0	0	1	2	MODOC PLATEAU, NORTH COAST
838	Panther Canyon	1,230	798	1,729	239	931	90	17	9,655	39	42	0	42	58	269	5	1	6	0	12	1	0	0	0	1	MODOC PLATEAU
839		976	787	1,171	109	384	84	25	2,478	10	11	0	11	89	269	3	0	4	0	0	0	0	0	2	1	MODOC PLATEAU
840	Gold Bluffs	114	0	305	67	305	66	34	18,991	77	97	97	0	3	266	19	11	11	0	45	1	0	0	3	1	NORTH COAST
841		916	705	1,141	90	436	92	13	2,937	12	0	0	0	100	261	10	0	2	0	0	0	0	0	0	1	MODOC PLATEAU
842	Little Cottonwood Pk	1,011	590	1,909	212	1,319	92	18	12,978	53	58	0	58	42	240	6	0	2	0	0	0	0	0	0	1	NORTH COAST
843	Marble Mountains	1,411	184	2,511	412	2,327	88	18	349,289	1,414	98	89	9	2	228	8	26	14	0	14	1	0	0	0	1	NORTH COAST
844	Wadsworth Flat	929	669	1,331	126	662	91	16	26,560	107	30	4	26	70	252	6	4	7	0	0	0	0	0	0	1	MODOC PLATEAU
845		689	381	1,130	169	749	95	12	2,058	8	96	0	96	4	232	1	0	1	0	0	0	0	0	0	1	NORTH COAST
846		203	0	397	105	397	32	31	3,919	16	100	100	0	0	279	26	11	3	6	74	1	0	0	1	1	NORTH COAST
847	Siskiyou Mountains	1,288	400	2,160	336	1,760	89	19	95,968	388	99	82	17	1	226	7	10	2	0	50	2	0	0	0	1	NORTH COAST
848	Dillon Divide	908	2	2,204	393	2,202	83	23	512,291	2,073	96	83	12	4	231	11	61	21	9	34	2	0	0	0	1	NORTH COAST
849		8	0	25	4	25	64	34	2,014	8	99	99	0	1	305	3	9	5	83	0	0	0	1	28	1	NORTH COAST
850		621	50	1,158	215	1,108	73	23	86,293	349	86	86	0	14	234	15	29	12	66	12	2	0	0	0	1	NORTH COAST

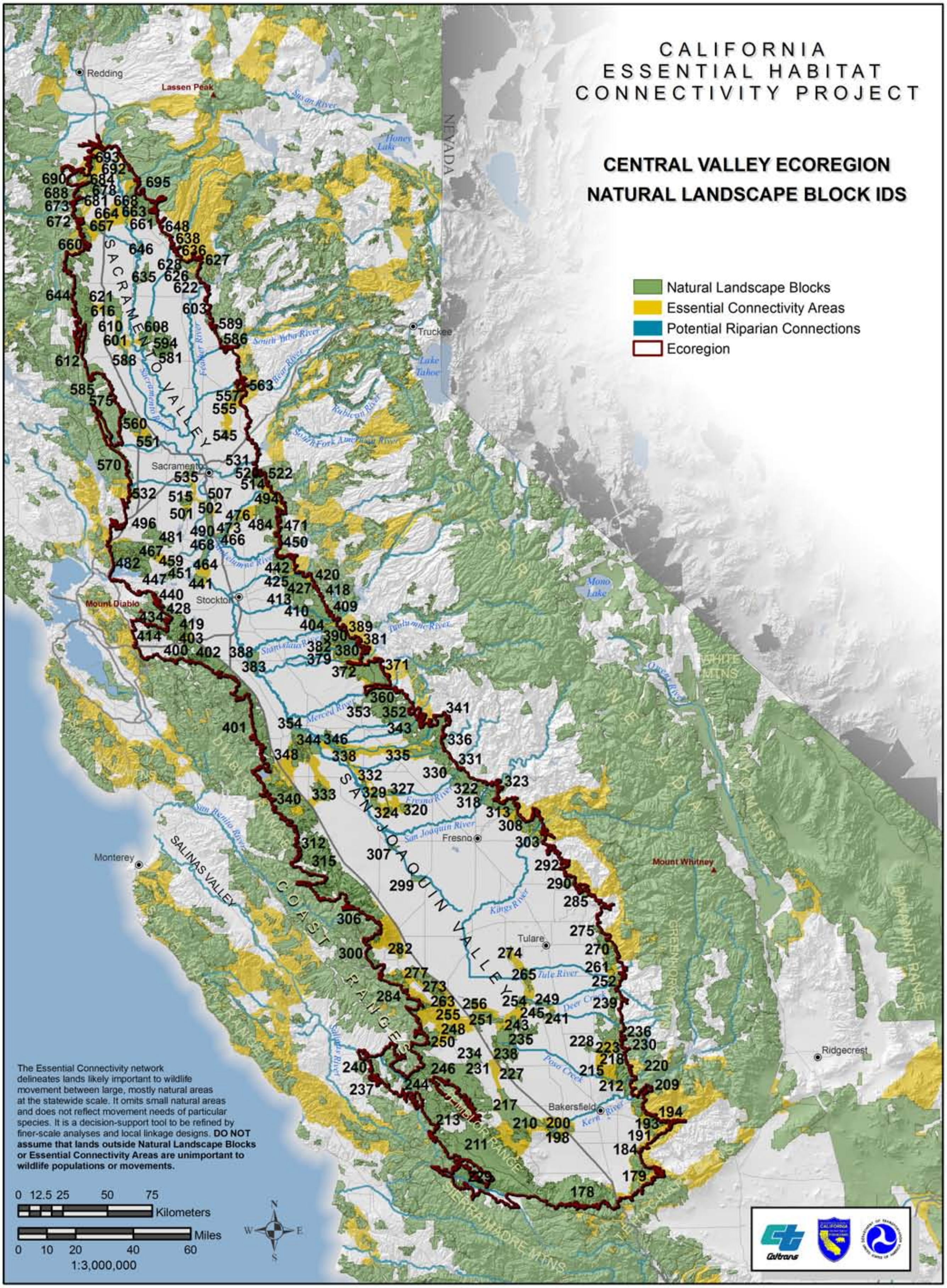
Characteristics of Natural Landscape Blocks

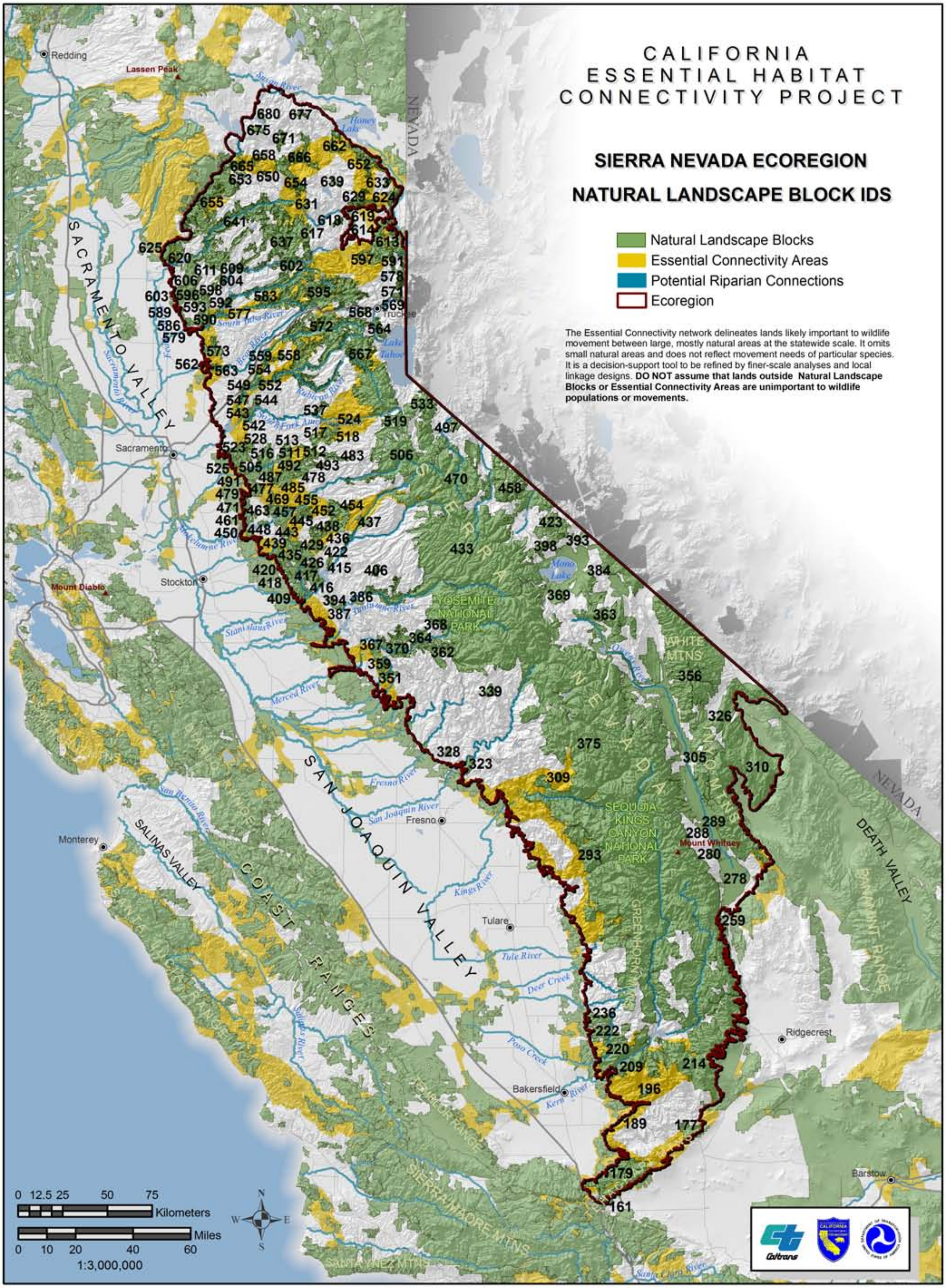
ID	n_subsect	Subsect	HU_num	HU_names	pc_blmacec	n_Counties	Counties	pc_forest	pc_shrub	pc_herb	pc_wetrip	pc_water	pc_dev	pc_crop	pc_pasture	pc_other
823	1	Shasta Valley	1	KLAMATH RIVER	0	1	Siskiyou	1	67	8	0	0	0	11	8	5
824	3	Lower Klamath-Tule Lake Basins, Devil's Garden, Crowder Flat	1	KLAMATH RIVER	0	1	Modoc	19	73	1	5	1	0	0	0	0
825	3	Northern Franciscan, Eastern Franciscan, Central Franciscan	2	KLAMATH RIVER, REDWOOD CREEK	0	1	Humboldt	94	2	1	0	0	1	0	0	2
826	2	Medicine Lake Lava Flows, Lower Klamath-Tule Lake Basins	1	KLAMATH RIVER	0	2	Siskiyou, Modoc	0	0	0	1	5	4	24	66	0
827	2	Old Cascades, Shasta Valley	1	KLAMATH RIVER	0	1	Siskiyou	26	65	0	3	0	0	2	2	1
828	2	Old Cascades, High Cascade	1	KLAMATH RIVER	0	1	Siskiyou	95	0	0	1	0	0	0	0	3
829	3	Medicine Lake Lava Flows, Medicine Lake Highlands, Lower Klamath-Tule Lake Basins	1	KLAMATH RIVER	0	1	Siskiyou	24	66	0	1	0	0	0	1	8
830	1	Medicine Lake Lava Flows	1	KLAMATH RIVER	0	1	Siskiyou	72	24	0	1	0	0	0	2	0
831	1	Northern Franciscan	2	KLAMATH RIVER, REDWOOD CREEK	0	2	Del Norte, Humboldt	97	1	1	0	0	1	0	0	0
832	1	Old Cascades	1	KLAMATH RIVER	0	1	Siskiyou	25	71	0	4	0	0	0	0	0
833	2	Medicine Lake Lava Flows, Lower Klamath-Tule Lake Basins	1	KLAMATH RIVER	0	1	Siskiyou	0	1	0	23	6	0	0	68	1
834	2	High Cascade, Medicine Lake Lava Flows	1	KLAMATH RIVER	0	1	Siskiyou	18	70	3	5	0	0	1	2	0
835	1	Scott Bar Mountain	1	KLAMATH RIVER	0	1	Siskiyou	86	11	0	1	0	1	0	0	0
836	1	Old Cascades	1	KLAMATH RIVER	0	1	Siskiyou	29	66	0	5	0	0	0	0	0
837	1	Scott Bar Mountain	1	KLAMATH RIVER	11	1	Siskiyou	68	27	1	2	0	0	0	2	0
838	2	Old Cascades, High Cascade	1	KLAMATH RIVER	0	1	Siskiyou	87	10	0	2	0	0	0	0	0
839	1	Old Cascades	1	KLAMATH RIVER	0	1	Siskiyou	24	64	2	8	1	0	1	0	1
840	2	Northern Franciscan, Central Franciscan	3	KLAMATH RIVER, REDWOOD CREEK, SMITH RIVER	0	2	Del Norte, Humboldt	83	6	2	2	1	3	0	0	4
841	1	Old Cascades	1	KLAMATH RIVER	0	1	Siskiyou	33	60	0	4	3	0	0	0	0
842	1	Scott Bar Mountain	1	KLAMATH RIVER	0	1	Siskiyou	63	35	1	1	0	0	0	0	0
843	5	Western Jurassic, Scott Bar Mountain, Lower Salmon Mountains, Upper Salmon Mountains, Forks of Salmon	1	KLAMATH RIVER	0	1	Siskiyou	92	5	1	0	0	0	0	0	1
844	2	Scott Bar Mountain, Old Cascades	1	KLAMATH RIVER	3	1	Siskiyou	45	51	0	4	0	0	0	0	0
845	2	Western Jurassic, Siskiyou Mountains	1	KLAMATH RIVER	0	1	Siskiyou	95	3	0	0	0	1	0	0	1
846	1	Northern Franciscan	1	SMITH RIVER	0	1	Del Norte	76	9	5	1	3	7	0	0	2
847	5	Western Jurassic, Siskiyou Mountains, Scott Bar Mountain, Lower Salmon Mountains, Windy Peak	2	KLAMATH RIVER, ROGUE RIVER	0	1	Siskiyou	94	4	0	1	0	0	0	0	1
848	6	Northern Franciscan, Western Jurassic, Gasquet Mountain Ultramafics, Siskiyou Mountains, Lower Salmon Mountains, Eastern Franciscan	3	KLAMATH RIVER, ROGUE RIVER, SMITH RIVER	0	3	Del Norte, Siskiyou, Humboldt	93	3	0	0	0	2	0	0	1
849	1	Northern Franciscan	1	SMITH RIVER	0	1	Del Norte	39	0	42	4	0	2	5	5	4
850	3	Northern Franciscan, Western Jurassic, Gasquet Mountain Ultramafics	3	ROGUE RIVER, SMITH RIVER, WINCHUCK RIVER	0	1	Del Norte	76	21	0	0	0	2	0	0	1

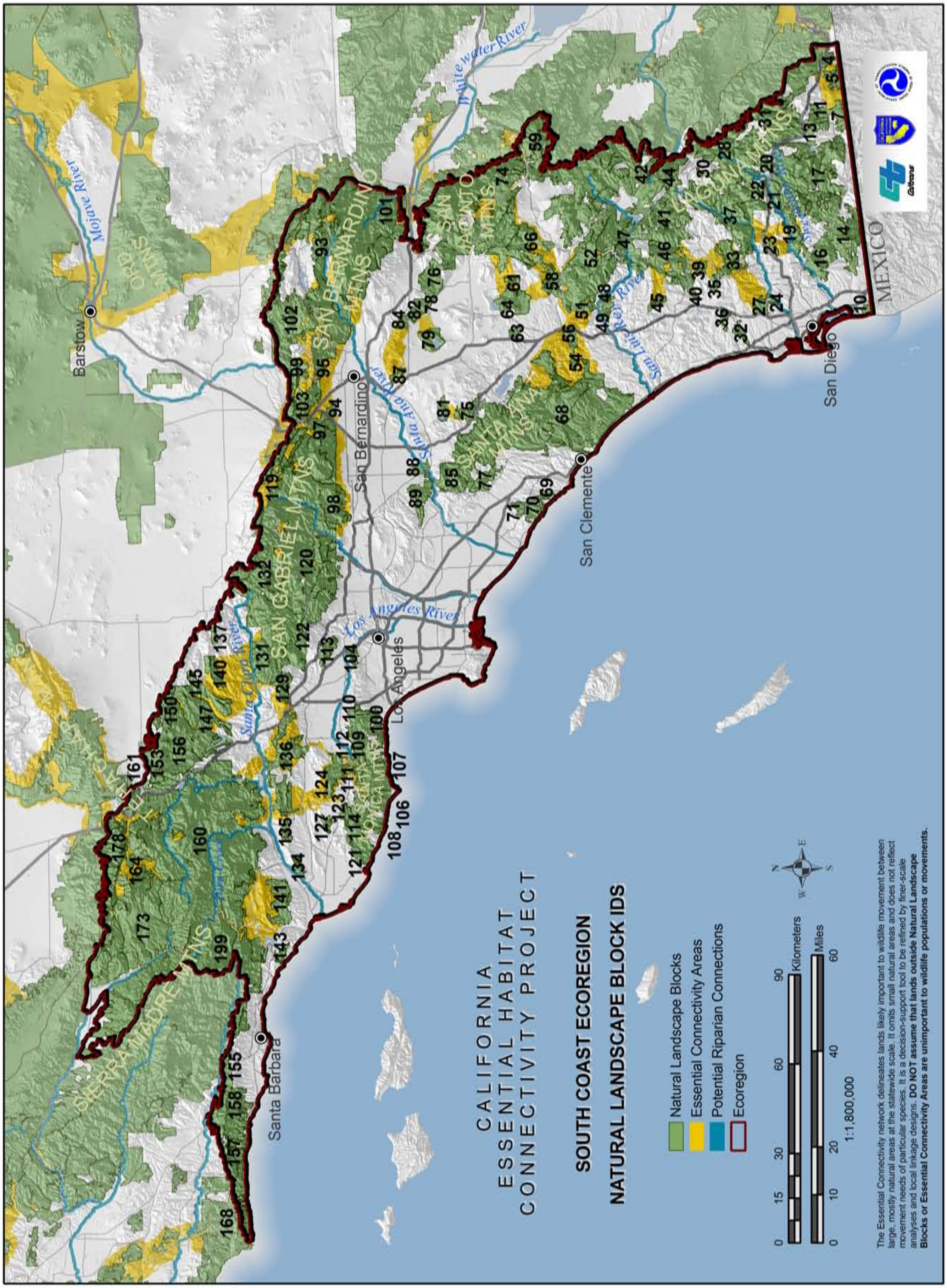

CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
NORTH COAST ECOREGION
NATURAL LANDSCAPE BLOCK IDS
Natural Landscape Blocks
Essential Connectivity Areas
Potential Riparian Connections
Ecoregion
0 12.5 25 50 75
Kilometers
Miles
0 10 20 40 60
1:2,000,000
The Essential Connectivity network delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.
OREGON
SISKIYOU MTNS
KLAMATH MTNS
COAST RANGES
MAYACAMAS MTNS
Crescent City
Yreka
Mount Shasta
Eureka
Redding
Fort Bragg
Pt Reyes
Klamath River
McCloud River
Mad River
Eel River
Trinity River
Russian River
Clear Lake
Sacramento River
Caltrans

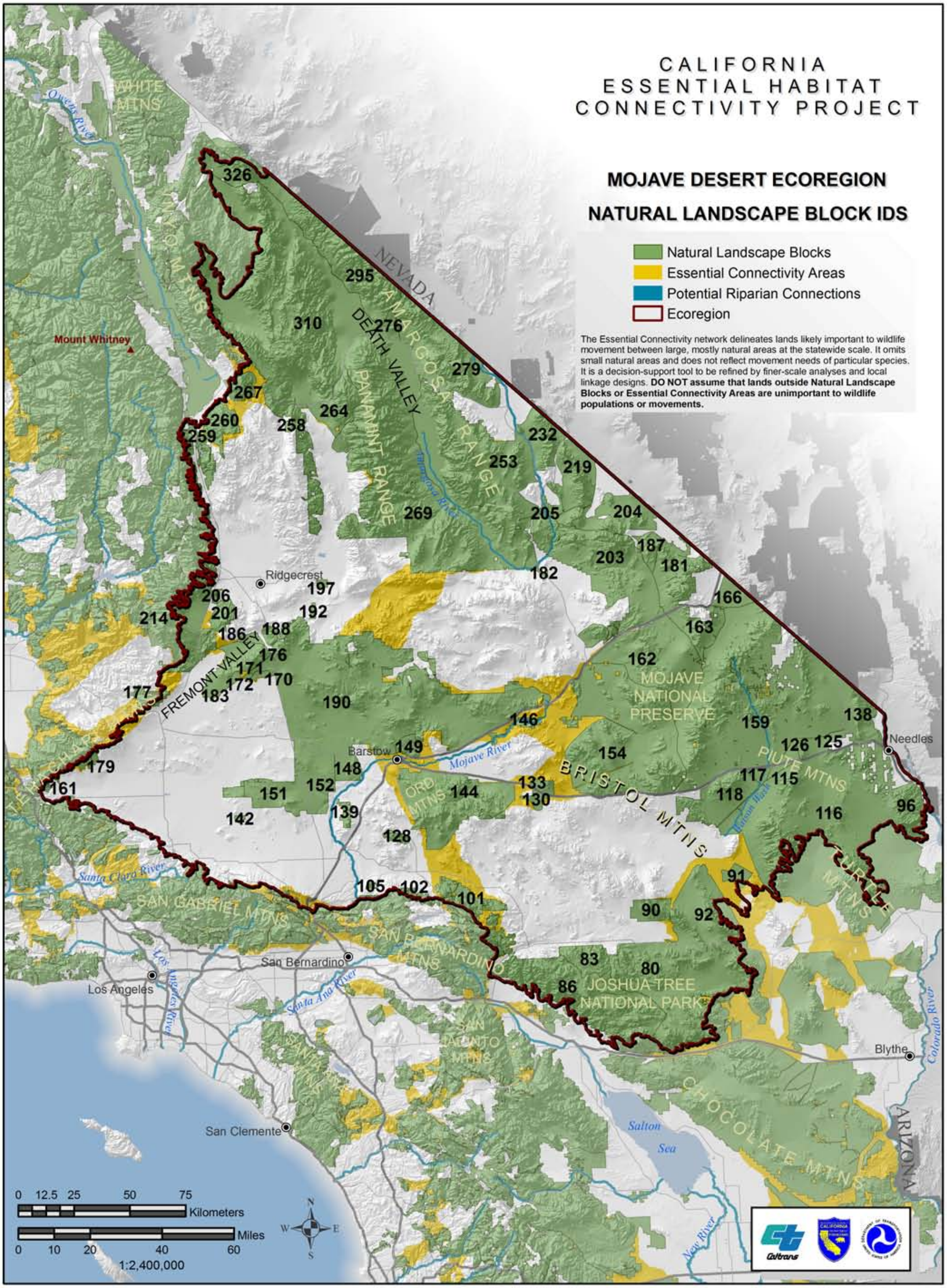

CALIFORNIA ESSENTIAL HABITAT CONNECTIVITY PROJECT
MODOC PLATEAU ECOREGION
NATURAL LANDSCAPE BLOCK IDS
Natural Landscape Blocks
Essential Connectivity Areas
Potential Riparian Connections
Ecoregion
0 12.5 25 50 75 Kilometers
0 10 20 40 60 Miles
1:1,800,000
The Essential Connectivity network delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.
OREGON
NEVADA
CASCADE RANGE
WARNER MTNS
Klamath River
McCloud River
Trinity River
Susan River
Goose Lake
Honey Lake
Yreka
Redding
Mount Shasta
Lassen Peak
844 841 839 838 836 833 834 832 828 830 826 824 821 813 827 829 819 817 803 822 823 814 812 810 804 805 802 797 796 798 800 808 777 794 788 780 778 793 781 790 771 761 750 776 773 770 774 765 768 779 738 785 752 757 751 758 746 769 756 754 749 745 739 742 748 743 792 753 736 713 712 760 728 727 721 737 716 786 722 718 723 708 703 702 704 710 707 696 687 705 706 701 700 676 670 698 659 691 685 682 649 695 667 647 656 645 619 648 638 614 605

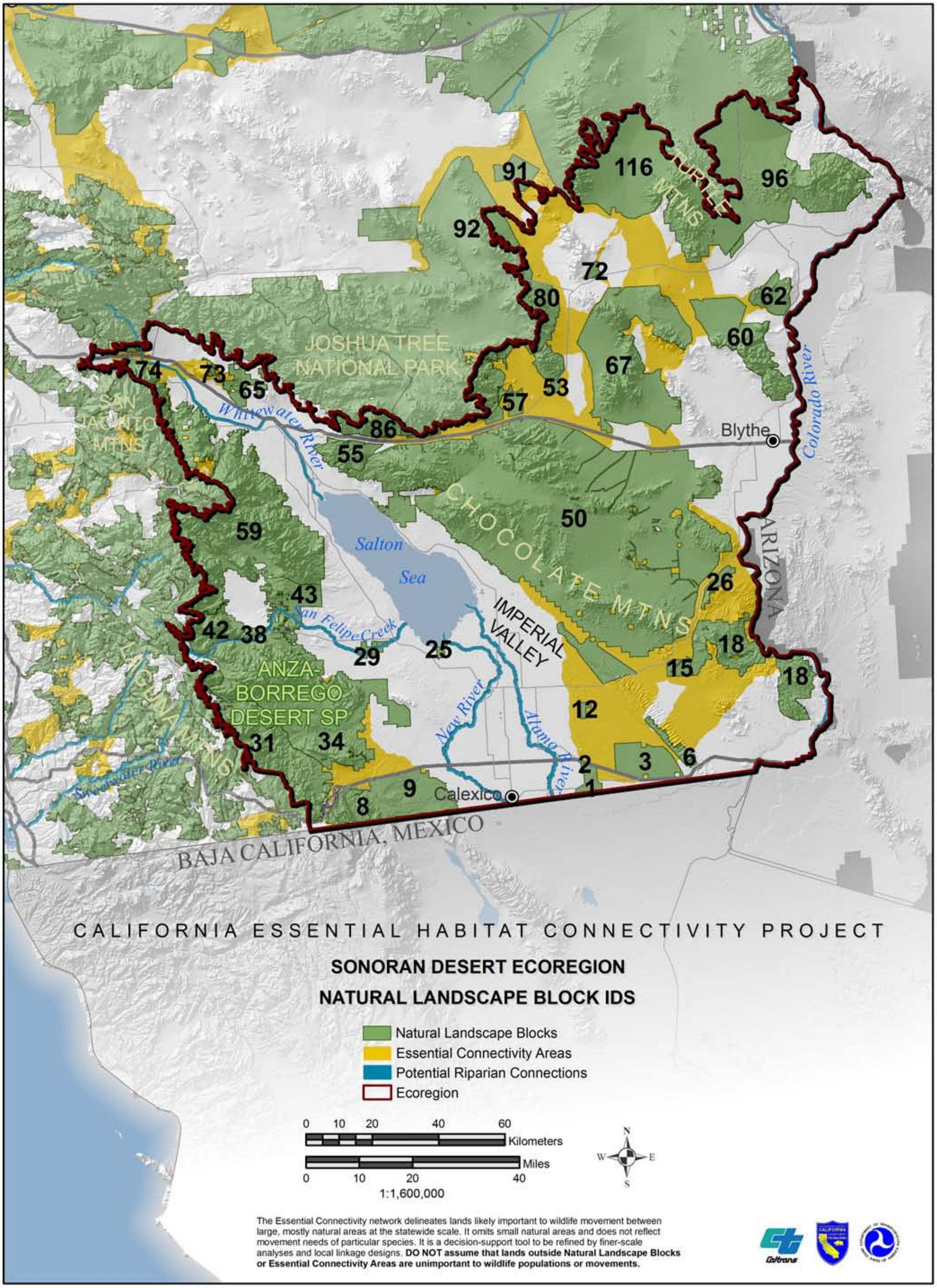

CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
CENTRAL COAST ECOREGION
NATURAL LANDSCAPE BLOCK IDS
Natural Landscape Blocks
Essential Connectivity Areas
Potential Riparian Connections
Ecoregion
0 12.5 25 50 75
Kilometers
Miles
0 10 20 40 60
1:2,500,000
The Essential Connectivity network delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.
Sacramento
Stockton
San Francisco
Pt Reyes
Mount Diablo
Monterey
Fresno
Tulare
Bakersfield
Santa Barbara
California
SAN JOAQUIN VALLEY
SALINAS VALLEY
COAST RANGES
SIERRA MADRE MTNS
SANTA YNEZ MTNS
TEMBLOR RANGE
Clear Lake
Sacramento River
Mokelumne River
San Benito River
San Joaquin River
Fresno River
Kings River
Tule River
Deer Creek
Poso Creek
Kern River
Salinas River
Caltrans


CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
CENTRAL VALLEY ECOREGION
NATURAL LANDSCAPE BLOCK IDS
Natural Landscape Blocks
Essential Connectivity Areas
Potential Riparian Connections
Ecoregion
The Essential Connectivity network delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.
0 12.5 25 50 75
Kilometers
Miles
0 10 20 40 60
1:3,000,000
N
E
S
W
Redding
Lassen Peak
Truckee
Lake Tahoe
Sacramento
Stockton
Mount Diablo
Monterey
Fresno
Tulare
Bakersfield
Ridgecrest
Mount Whitney
Mono Lake
Honey Lake
NEVADA
SACRAMENTO VALLEY
SAN JOAQUIN VALLEY
SALINAS VALLEY
COAST RANGES
Caltrans


CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
SIERRA NEVADA ECOREGION
NATURAL LANDSCAPE BLOCK IDS
Natural Landscape Blocks
Essential Connectivity Areas
Potential Riparian Connections
Ecoregion
The Essential Connectivity network delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.
0 12.5 25 50 75
Kilometers
Miles
0 10 20 40 60
1:3,000,000
Redding
Lassen Peak
Sacramento
Stockton
Mount Diablo
Monterey
Fresno
Tulare
Bakersfield
Ridgecrest
Barstow
Truckee
Mount Whitney
SACRAMENTO VALLEY
SAN JOAQUIN VALLEY
COAST RANGES
SALINAS VALLEY
SIERRA NEVADA
YOSEMITE NATIONAL PARK
SEQUOIA KINGS CANYON NATIONAL PARK
WHITE MTNS
DEATH VALLEY
NEVADA
Mono Lake
Lake Tahoe
Honey Lake
San Joaquin River
Kings River
Kern River
Merced River
Tule River
Fresno River
Stanislaus River
Tuolumne River
Deer Creek
Poso Creek
Owens River
San Benito River
Salinas River
Santa Clara River
SANTA YNEZ MTNS
SIERRA MADRE MTNS
Caltrans


CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
SOUTH COAST ECOREGION
NATURAL LANDSCAPE BLOCK IDS
Natural Landscape Blocks
Essential Connectivity Areas
Potential Riparian Connections
Ecoregion
0 15 30 60 90 Kilometers
0 10 20 40 60 Miles
1:1,800,000
The Essential Connectivity network delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. **DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.**
Barstow
Santa Barbara
Los Angeles
San Bernardino
San Clemente
San Diego
MEXICO
Mojave River
Whitewater River
Los Angeles River
Santa Ana River
San Luis Rey River
SAN GABRIEL MTNS
SAN BERNARDINO MTNS
SAN JACINTO MTNS
SANTA ANA MTNS
SIERRA MADRE MTNS
SANTA MONICA MTNS
ORD MTNS


CALIFORNIA
ESSENTIAL HABITAT
CONNECTIVITY PROJECT
MOJAVE DESERT ECOREGION
NATURAL LANDSCAPE BLOCK IDS
Natural Landscape Blocks
Essential Connectivity Areas
Potential Riparian Connections
Ecoregion
The Essential Connectivity network delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.
NEVADA
ARIZONA
DEATH VALLEY
PANAMINT RANGE
AMARGOSA RANGE
FREMONT VALLEY
MOJAVE NATIONAL PRESERVE
BRISTOL MTNS
PIUTE MTNS
JOSHUA TREE NATIONAL PARK
SAN GABRIEL MTNS
SAN BERNARDINO MTNS
SAN JACINTO MTNS
CHOCOLATE MTNS
WHITE MTNS
Mount Whitney
Ridgecrest
Barstow
Needles
San Bernardino
Los Angeles
San Clemente
Blythe
Owens River
Mojave River
Santa Clara River
Santa Ana River
Los Angeles River
Colorado River
New River
Salton Sea
0 12.5 25 50 75 Kilometers
0 10 20 40 60 Miles
1:2,400,000


CALIFORNIA ESSENTIAL HABITAT CONNECTIVITY PROJECT
SONORAN DESERT ECOREGION
NATURAL LANDSCAPE BLOCK IDS
Natural Landscape Blocks
Essential Connectivity Areas
Potential Riparian Connections
Ecoregion
0 10 20 40 60
Kilometers
Miles
0 10 20 40
1:1,600,000
N
S
E
W
The Essential Connectivity network delineates lands likely important to wildlife movement between large, mostly natural areas at the statewide scale. It omits small natural areas and does not reflect movement needs of particular species. It is a decision-support tool to be refined by finer-scale analyses and local linkage designs. DO NOT assume that lands outside Natural Landscape Blocks or Essential Connectivity Areas are unimportant to wildlife populations or movements.
JOSHUA TREE NATIONAL PARK
CHOCOLATE MTNS
IMPERIAL VALLEY
ANZA-BORREGO DESERT SP
SAN JACINTO MTNS
TURTLE MTNS
ARIZONA
BAJA CALIFORNIA, MEXICO
Salton Sea
Whitewater River
San Felipe Creek
New River
Alamo River
Colorado River
Sweetwater River
Blythe
Calexico
116
96
91
92
72
80
62
60
67
53
57
74
73
65
86
55
50
59
26
43
42
38
29
25
18
15
12
31
34
2
3
6
1
9
8

Appendix D: List of Acronyms

AB2785	California Assembly Bill 2785 *(requires CDFG to map essential wildlife corridors and habitat linkages)*
ACE	Areas of Conservation Emphasis *(defined by CDFG)*
ACEC	Areas of Critical Environmental Concern *(designated by BLM)*
BLM	United States Bureau of Land Management
Caltrans	State of California Department of Transportation
CEHCP	California Essential Habitat Connectivity Project
CEQA	California Environmental Quality Act
CBI	Conservation Biology Institute
CDFG	State of California Department of Fish and Game
CNDDB	California Natural Diversity Database
CPAD	California Protected Area Database
CRCC	California Rangeland Conservation Coalition
CWHR	California Wildlife Habitat Relationships
DEM	Digital Elevation Model
DFG	State of California Department of Fish and Game
DOD	United States Department of Defense
ECA	Essential Connectivity Areas
ECI	Ecological Condition Index
FHWA	Federal Highways Administration
FRAP	California Department of Forestry and Fire Protection's Fire and Resource Assessment Program
FWS	See USFWS
GAP	Gap Analysis Program (*A GAP analysis compares the distributions of species and communities with the protection status of lands. http://gapanalysis.nbii.gov)*
GIS	Geographic Information System
HBV	High Biological Value
HCP	Habitat Conservation Plan
IIC	Integral Index of Connectivity
IWA	Integrity Weighted Area
LCC	Least Cost Corridor
MDT	Multi-disciplinary Team
MPO	Metropolitan Planning Organizations
NCCP	Natural Community Conservation Plans
NGO	Non-Governmental Organization
NLB	Natural Landscape Block
RTPA	Regional Transportation Planning Agencies
RWRI	Rarity-Weighted Richness Index
SAFETEA-LU	Safe Accountable Flexible Efficient Transportation Equity Act of 2005
SB375	California Senate Bill 375 *(requires regional transportation plans to include strategies to meet goals for reducing greenhouse gas emissions)*

SB85	California Senate Bill 85 *(requires CDFG to develop vegetation mapping standards)*
SCML	South Coast Missing Linkages
SCW	SC Wildlands (Science and Collaboration for Connected Wildlands)
SWAP	State Wildlife Action Plan
TAG	Technical Advisory Group
TIGER	United States Census Bureau Topologically Integrated Geographic Encoding and Referencing system
TNC	The Nature Conservancy
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
WCB	Wildlife Conservation Board
WGA	Western Governor's Association
WGWC	Western Governor's Wildlife Council
WRP	Western Regional Partnership

Appendix E: New Approaches to Analysis of Connectivity

This Report used several Geographic Information System (GIS) based procedures to delineate Natural Landscape Blocks and Essential Connectivity Areas. The most important tool for defining essential connectivity areas was least-cost modeling. In this appendix, we briefly describe two relatively new approaches that are relevant to design of corridors and linkages.

Individual-based movement models

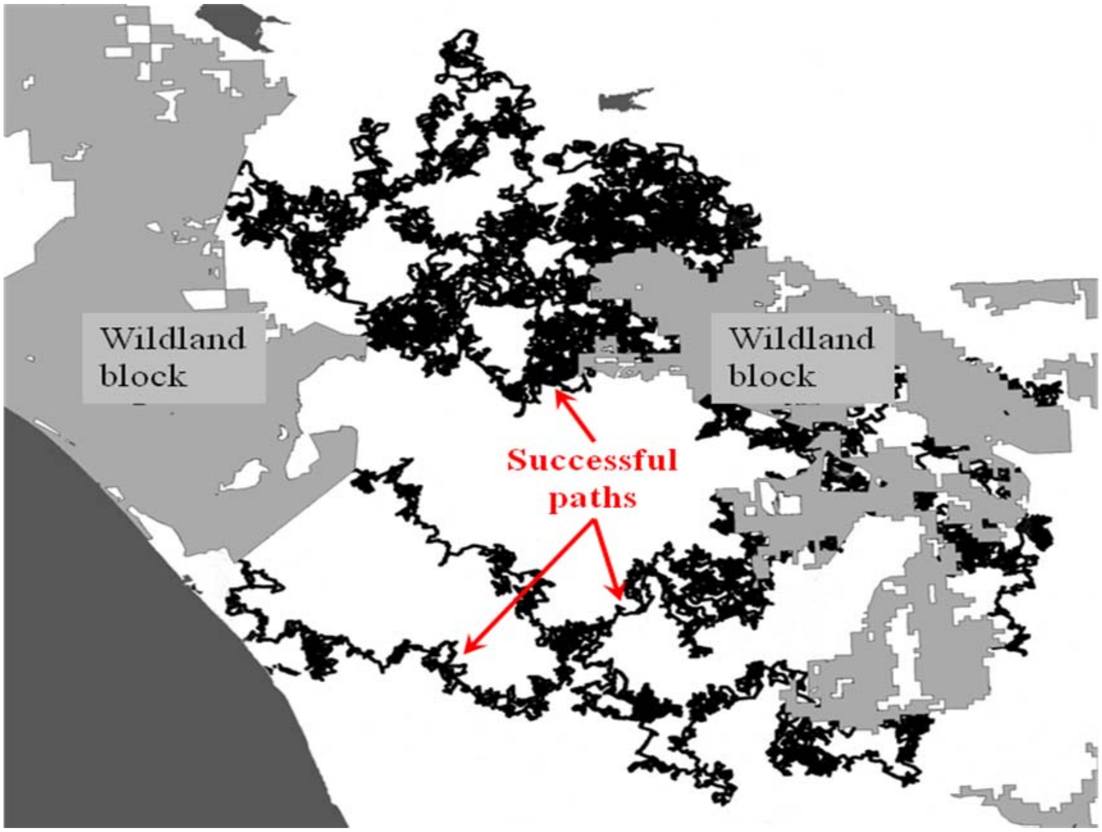
In this approach, the landscape is portrayed in a Geographic Information System as a grid of squares; such a grid is called a *raster*, and each square is called a *pixel*. Each pixel has attributes, such as land cover, topography, and level of human disturbance. The analyst uses these attributes to define polygons (e.g., steep, suburbanized land, or flat, natural land) that are relevant to focal species. These polygons must be set separately for each focal species, because a given polygon (e.g., steep urbanized land) does not affect movement of every species in the same way. The analyst also uses pixel attributes to estimate the energy cost of traveling through the pixel. This “energy cost map” is exactly analogous to the “resistance map” in least-cost modeling.

For each focal species, the analyst then (based on observations of animal movement, or expert opinion) estimates movement parameters, such as the probability that an animal will continue in one direction or choose a new direction at each time interval, travel speed, mean turning angles, and risk of mortality. Each of these parameters can depend on pixel resistance, or the type of polygon in which the animal is located.

The analyst also develops decision rules that govern how an animal’s movement changes as it approaches the boundary of each other type of polygon. Most of these rules are probabilistic (e.g., go straight ahead 60% of the time, right 20% of the time, and left 20% of the time) so that simulated paths can mimic real animals exploring a landscape. Many decision rules are habitat-specific, meaning that the rule is different in each polygon type.

Then the analyst models the release of thousands of simulated animals (*walkers*) in each wildland block, and follows the movement path of each walker for a certain number of time steps. After that number of time steps the walker has either died, remained in the wildland block where it started, or reached the other wildland block. The analyst retains only the paths that successfully reached the other wildland block. These paths represent potential linkages for that focal species. The analyst identifies areas with the highest density of successful paths, or polygons that are most visited, or uses some other procedure to delineate a corridor that is more coherent than the many successful paths.

The map below (from Tracey 2006) illustrates this approach applied to mountain lions potentially moving between the Santa Ana Mountains (west) and the Palomar Mountains (east) in southern California.



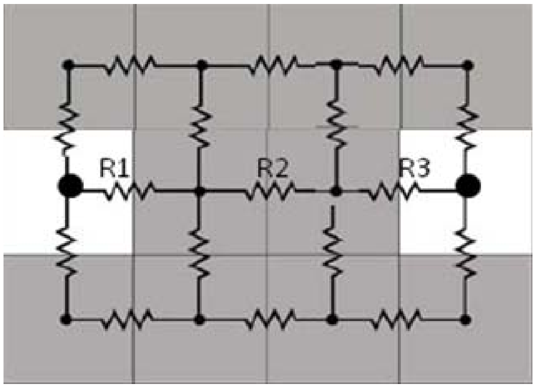
The individual-based movement has several advantages. First, it simulates animal movement, which is highly relevant to corridor design. Furthemore, the model considers the impact of mortality on successful movement, an important relationship ignored by least cost modeling and circuit theory. Finally, it identifies multiple possible paths that are less linear than those produced by least-cost modeling. The main disadvantage of the approach is that ecologists rarely have data to estimate the many parameters in the model. Global Positioning System (GPS) radio-tags will probably soon yield the type of data, and sufficient volumes of data, to estimate these parameters reliably. If a reliably-parameterized model is available, we believe this is an ideal tool for identify wildlife corridors. Although this approach has not yet been used to design a wildlife linkage, we expect that it will become popular in the future. .

Key citations:

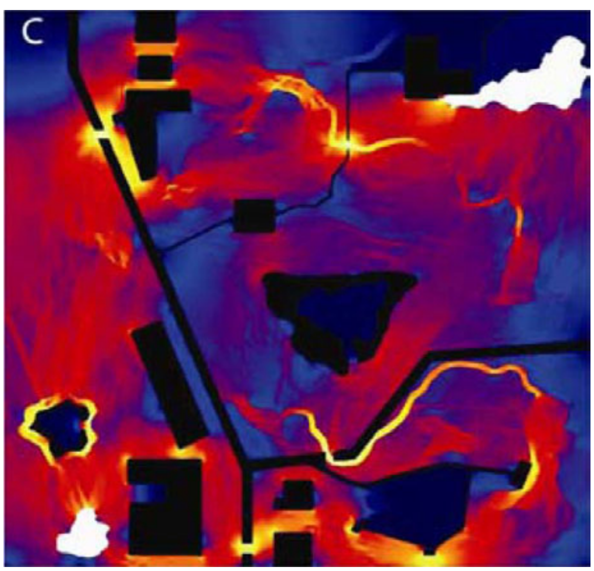
Hargrove, W. W., F. M. Hoffman, and R. A. Efroymson. 2004. A practical map-analysis tool for detecting potential dispersal corridors. Landscape Ecology 20:361-373.

Tracey, JA. 2006. Individual-based modeling as a tool for conserving connectivity. Pages 343-368 (Chapter 14) in KR Crooks and MA Sanjayan. Connectivity Conservation. Cambridge University Press.

Circuit Theory



In circuit theory, each pixel is connected to adjacent pixels by resistors (—/\/\/\—). Resistances are proportional to the difficulty of moving. Two wildland blocks (white pixels) can exchange dispersers via all resistors in the network. Following Kirchhoff's (1845) laws, for resistors connected in series, resistance accumulates as the sum of those resistances (e.g. $R_T = R_1 + R_2 + \ldots R_N$), and so cost-weighted distance increases with map distance. For resistors connected in parallel, $R_{Total} = R_1 * R_2 / (R_1 + R_2)$. Thus cumulative resistance decreases (and movement of animals increases) when multiple paths are available.



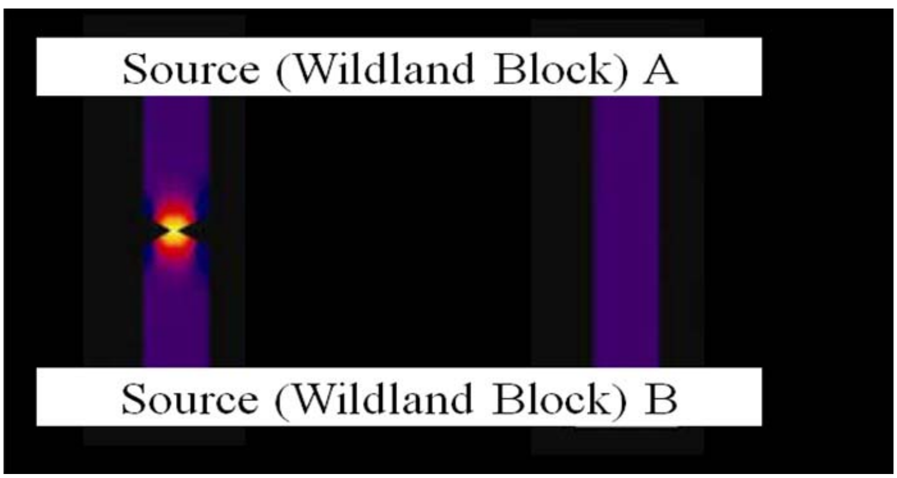
Circuit theory is a new approach that was created to *describe* patterns of gene flow and animal movement, rather than to design a linkage. It portrays the landscape in a Geographic Information System as a grid of squares; such a grid is called a *raster*, and each square is called a *pixel*. The analyst assigns resistance values to each pixel as a function of pixel attributes, such as land cover, topography, and level of human disturbance. These resistance values must be set separately for each focal species, because a given attribute (e.g., percent forest cover) does not affect movement of every species in the same way. This resistance raster is similar to the resistance raster used in least-cost modeling in that they are typically estimated by expert opinion and the literature on habitat use. However, the resistance values in circuit theory are interpreted as movement probabilities (or their reciprocal) rather than energetic cost. The key innovation of circuit theory is that it considers the ability of the *entire landscape* to support animal movement (panel and caption).

In a typical use of a circuit theory model, the analyst applies a "current source" at one wildland block and a "ground" at the other wildland block and solves for "current flow," which is analogous to the number of animals passing through each pixel as they disperse from one wildland block to the other. An area where movement is channeled into a narrow areas (pinchpoint) glows brightly. In the adjacent panel, the Wildland Blocks (current source/ground) are white, hot colors (yellow) indicate high per-pixel movement rates, and blue colors indicate low movement rates.

The advantages of circuit theory are that it reflects the potential for the entire landscape to support animal movement as a graded map, rather than a polygon that categorizes every pixel as either inside or outside the corridor. The maps are visually attractive, Pinchpoints represent vulnerable points along the linkage. It has exactly the same modest data requirements as least-cost modeling.

Although a circuit theory map conveys a lot of information about landscape connectivity, the map does not identify a distinct corridor. Indeed, a polygon that includes areas of highest flow under current conditions may make a poor corridor, because its potential to support movement will decrease (in unpredictable ways) when land outside the corridor is impacted by development. In contrast, the utility of a least-cost corridor does not change when land outside the corridor is converted to non-natural vegetation.

The second drawback is that circuit theory depiction of flow may not highlight the best area to conserve as a linkage. Consider the Figure below, with two linkages connecting the Wildland Blocks (white rectangles). The linkage at left has a pinchpoint, evident as a "hot" area of constricted flow. But the linkage at right is an area of broad unimpeded flow, and would be a better linkage to conserve. Ecologists have not yet developed metrics and decision rules to define unambiguous linkage polygons using circuit theory. Recall that circuit theory was developed as a way to <u>describe movement</u>. It will take some time for it to evolve into an approach to <u>prescribe optimal linkages</u>.



In its current state of development, circuit theory is probably the best way to depict connectivity across an entire landscape, and it usefully identifies the degree of threat facing a linkage. For instance, the linkage on the left is clearly more at risk than the one on the right.

Key papers:

McRae, B.H. 2006. Isolation by resistance. Evolution 60:1551-1561.

McRae, B.H. and P.Beier. 2007. Circuit theory predicts gene flow in plant and animal populations. Proceedings of the National Academy of Sciences of the United States of America 104:19885-19890

McRae, BH, BG Dickson, T. Keitt and VB Shah. 2008. Using circuit theory to model connectivity in ecology, evolution, and conservation. Ecology 89:2712-2724.