

Development pressure of the dryland environment: Ecological implications



Sophie Parker, Ph.D.



Outline

- **Development pressure**
 - Definition and types of development
 - Environmental changes associated with different types of development
- **Ecological impacts of development**
 - Core habitat destruction
 - Habitat fragmentation and severing of connectivity
 - Disruption of ecological processes and alteration of disturbance regimes
 - Water resource depletion
 - Pollution
- **What makes arid systems unique?**

What constitutes 'development'?

- Human alteration of landforms from a natural or semi-natural state for a purpose such as housing, industrial use, or agriculture.

Types of development

- Housing and Commercial Structures
- Electricity Generation, Transmission Lines, and Utility Corridors
- Mining
- Agriculture
- Transportation Infrastructure

- Groundwater Pumping, Water Diversions, and Streambed Modifications

Types of development

- Housing and Commercial Structures
- Electricity Generation, Transmission Lines, and Utility Corridors
- Mining
- Agriculture
- Transportation Infrastructure
- Groundwater Pumping, Water Diversions, and Streambed Modifications

Alluvial Fans are Common in the Desert

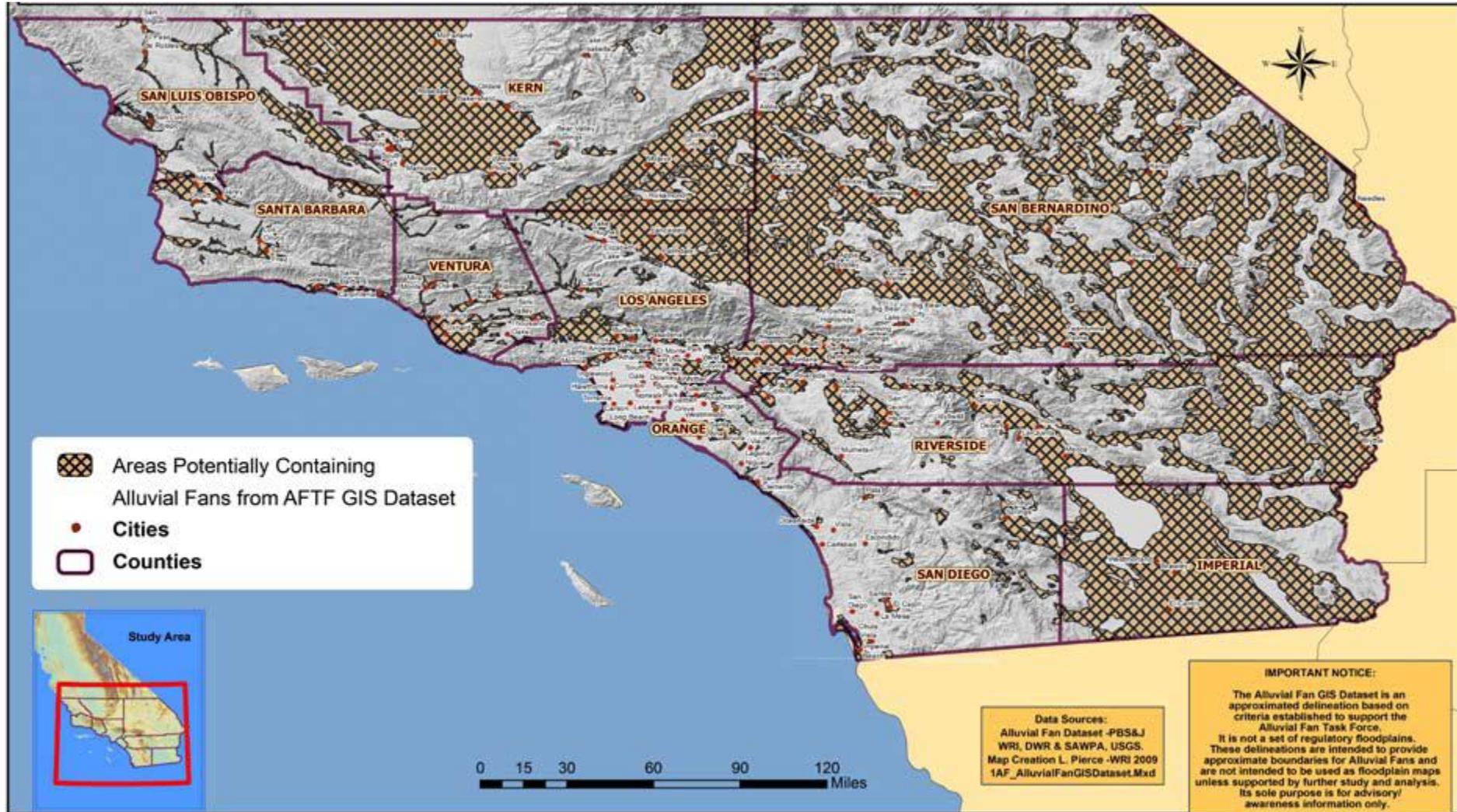


Figure 1-3: Areas Potentially Containing Alluvial Fans. *For advisory/awareness information only.* Source: Alluvial Fan Task Force

Alluvial Fans are Common in the Desert

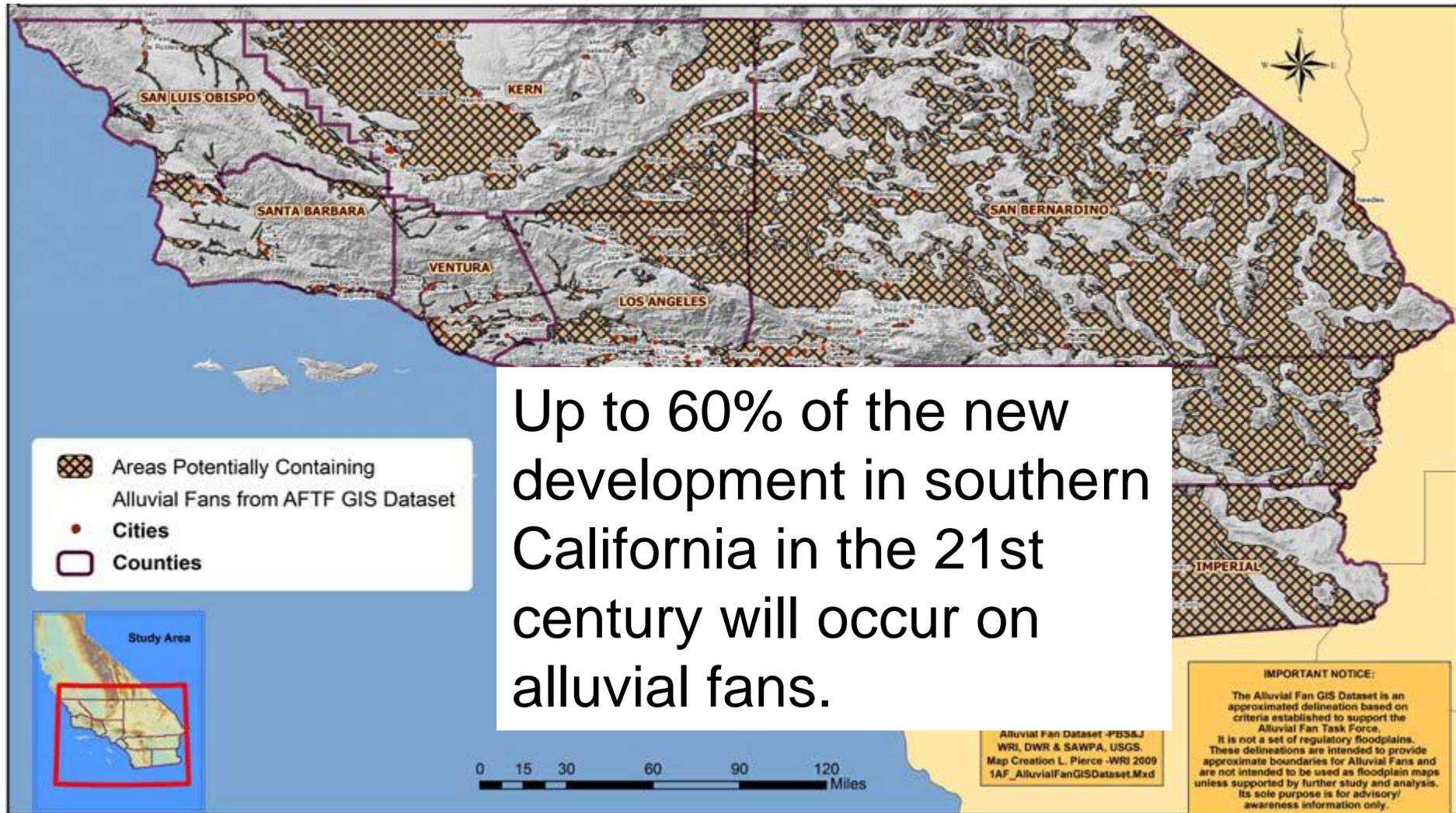
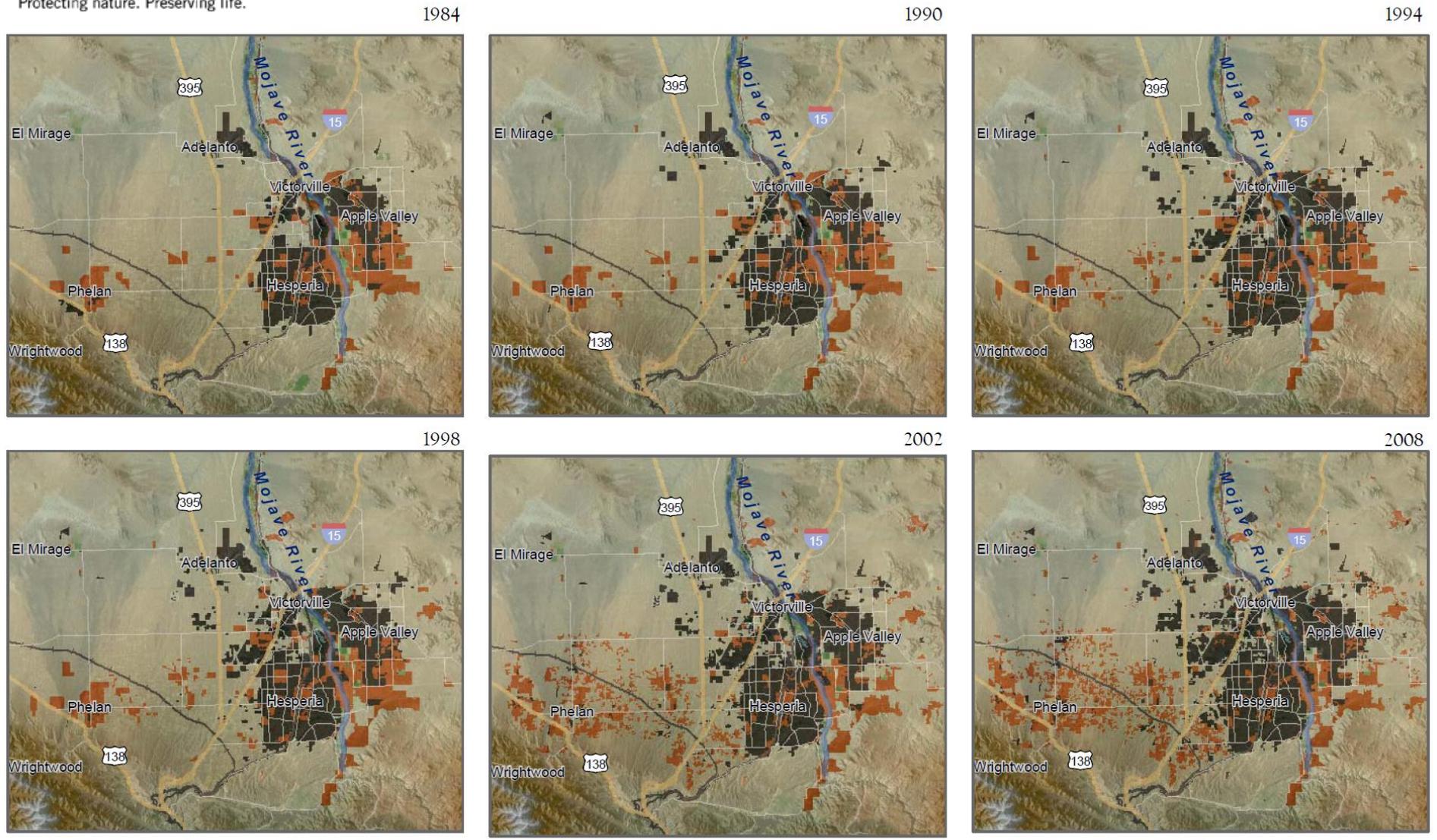


Figure 1-3: Areas Potentially Containing Alluvial Fans. *For advisory/awareness information only.* Source: Alluvial Fan Task Force

photo credit: Bruce Perry, Department of Geological Sciences, CSU Long Beach





Land Use		Other Features	
	Urban / Industrial		State
	Rural Development		Major Road
			County
			Major River
			Other Road
			Railroad

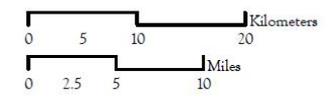


Figure 5-3
Proposed
Electricity Generation

Project Area

 Mojave Desert

Proposed Electricity Generation

 Solar
 Wind

Includes footprint of BLM right-of-way applications for CA and AZ, point locations for NV, CA, and AZ.
CA locations accessed 9/13/10.

Proposed Transmission Lines

Voltage Class

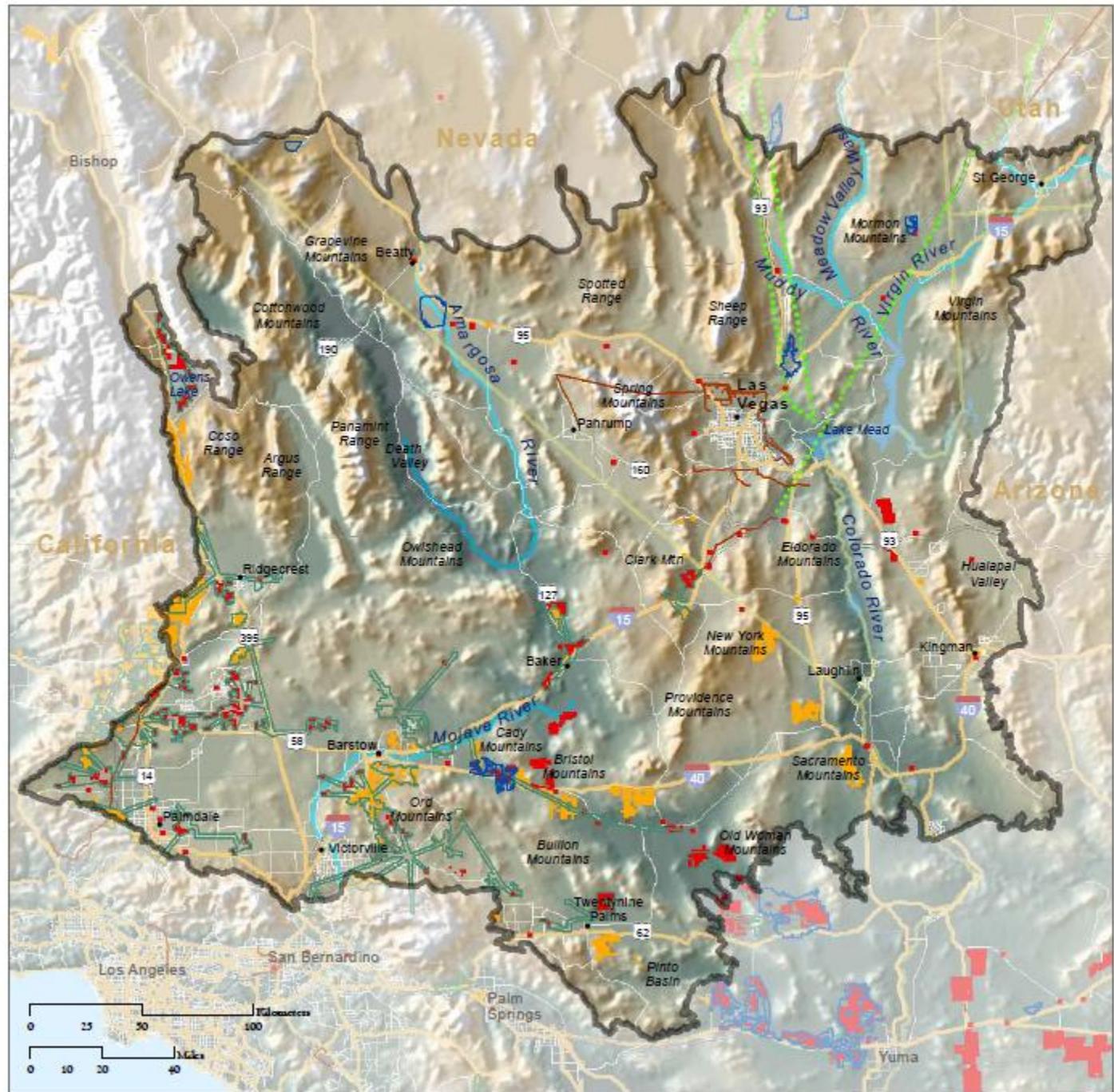
 500
 100 - 345
 Under 100
 DC Line

Electricity Generation Zones

 BLM Solar Energy Study Area
 CA RETI
Certified Renewable Energy Zone

Other Features

 State Road
 Major Road
 County Road
 Other Road
 Major River



Daggett Solar Power Facility, Mojave Desert



Brightsource Solar Power Facility in Israel



Photo courtesy of www.brightsourceenergy.com

Ivanpah Solar Power Facility Location: Brightsource



Photo courtesy of www.brightsourceenergy.com



459-foot-tall towers; 347,000 heliostat mirrors
4,000 acre (6.25 square mile) footprint

Ivanpah Solar Power Facility Site

Photograph from Oct 2010



Tehachapi Foothills, West Mojave Desert, CA



Transmission lines through Ivanpah Valley, CA



Edison substation in West Mojave, CA



Environmental Changes with Development

- clearing of native vegetation, grading of site, scraping of soils
- leveling and paving for transportation infrastructure: roads, rail, and airports
- excavation and earth moving
- building of structures: buildings, towers, windmills, utility lines
- water diversions and streambed modifications
- water use
- introduction of non-native species (including crops and livestock)
- irrigation
- noise and vibrations
- light
- heat island effects
- edge effects: recreation, disposal, etc.

Ecological impacts caused by the environmental changes brought on by development

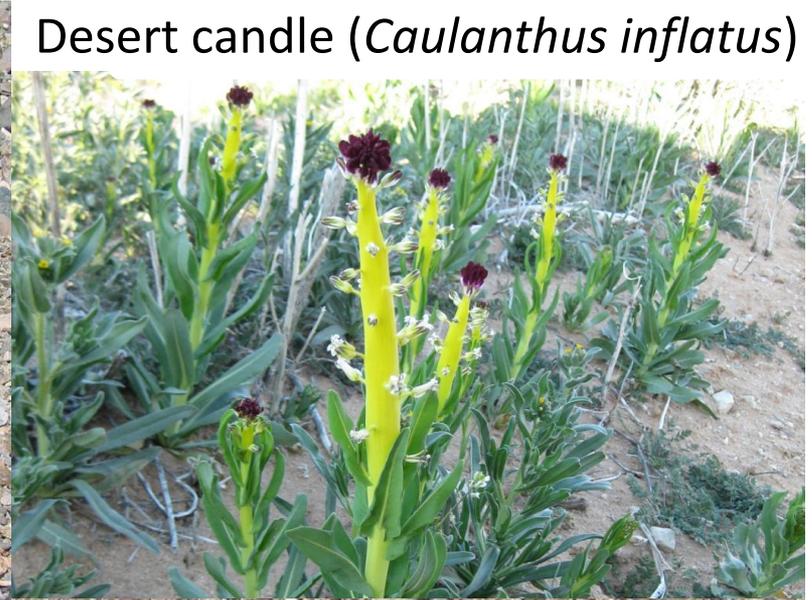
- Core habitat destruction
- Habitat fragmentation and severing of landscape-scale connectivity
- Disruption of ecological processes and alteration of disturbance regimes
- Water resource depletion
- Pollution

= major threats to biodiversity

Core habitat destruction



Opuntia in bloom



Desert candle (*Caulanthus inflatus*)



Desert tortoise burrow

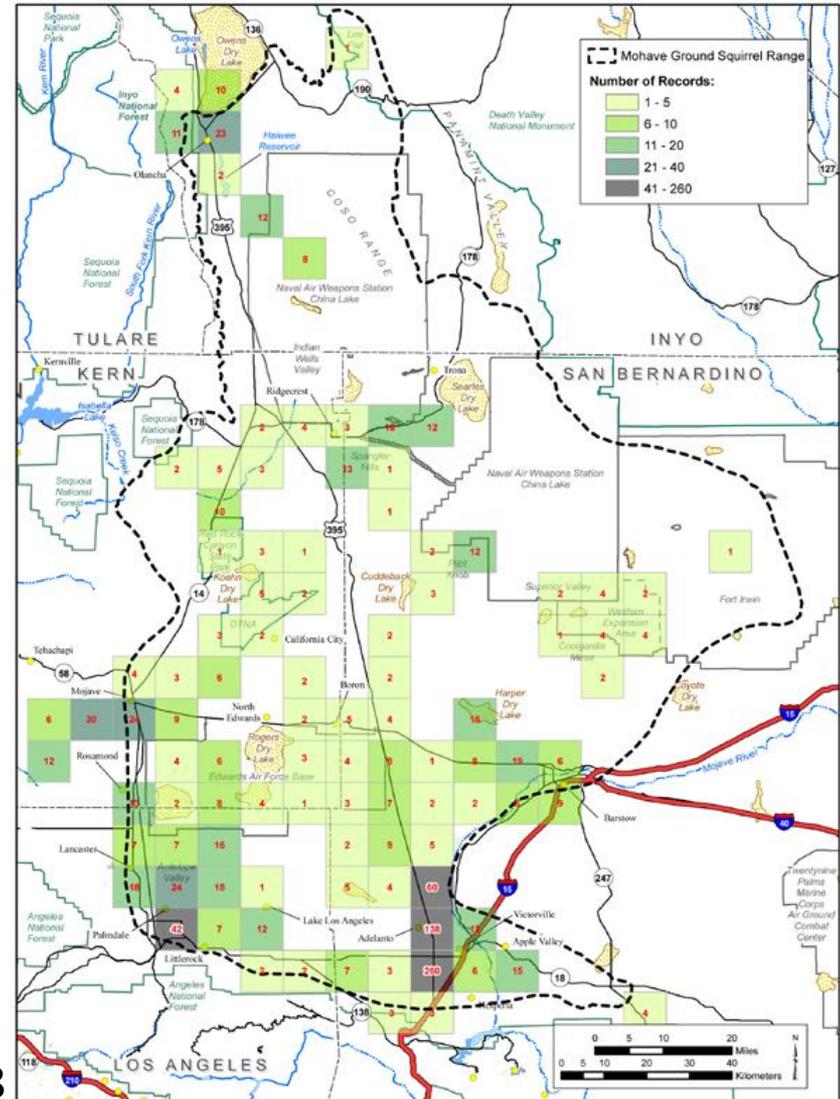


Desert iguana (*Dipsosaurus dorsalis*)

Core habitat destruction

Mohave Ground Squirrel

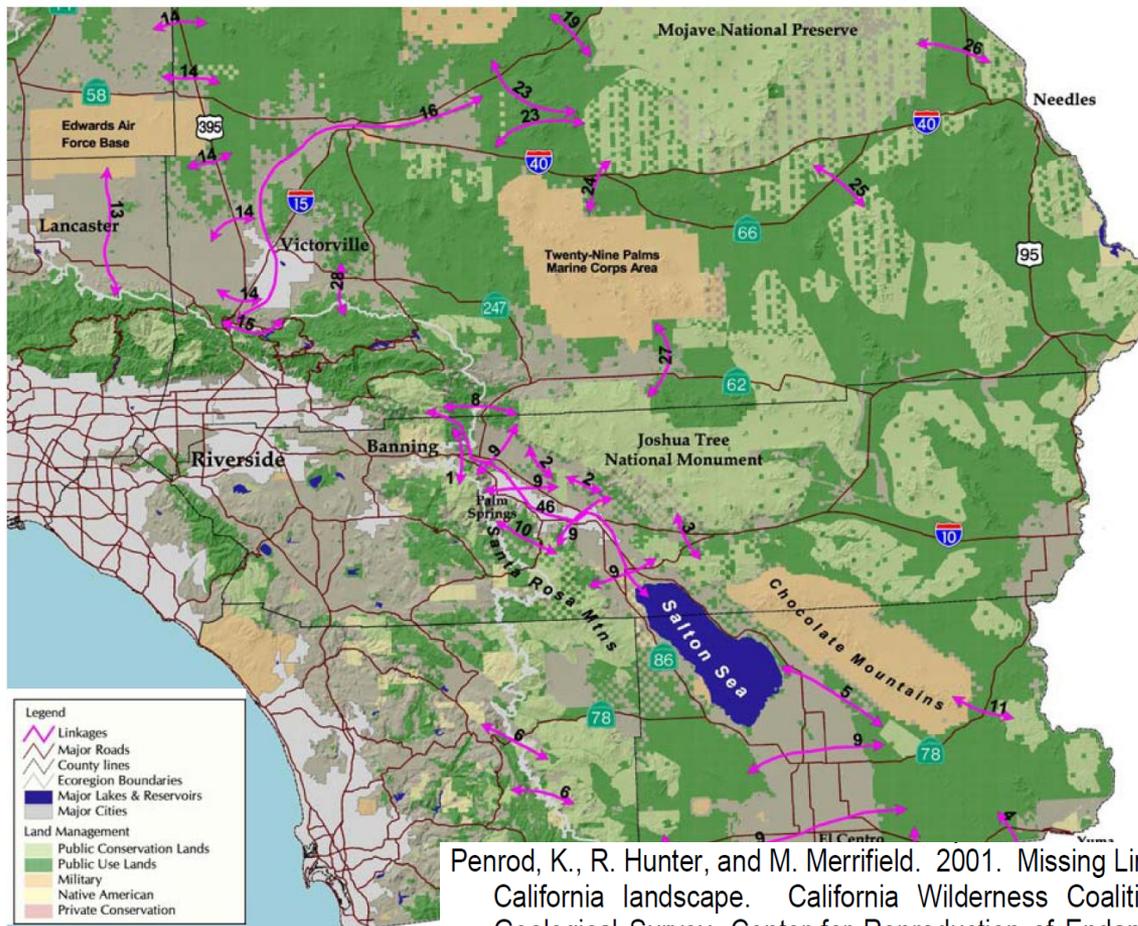
- state-listed as threatened
- found only in the western Mojave Desert of California
- limited range makes it vulnerable to habitat destruction caused by development



map from Leitner 2008

Habitat fragmentation and degradation

- interruption of wildlife movement



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.

Habitat fragmentation and degradation

- interruption of wildlife movement
 - through washes: interrupted by streambed modification
 - across landscapes: interrupted by large developments
 - through the air: wind and solar facilities can negatively impact bird, bat, and insect populations
 - direct strikes on roads: fencing and linkage issues
 - high-speed rail will be fenced (no passage?)
- invasion by non-native species
- facilitation of predators

Disruption of ecological processes and alteration of disturbance regimes

- soil genesis and integrity
 - carbon cycling and sequestration, nutrient cycling
- groundwater recharge
- sand and sediment transport
- pollen dispersal by wind
- increase in fire frequency with disturbance

- some processes are difficult to map
 - cross mapping unit boundaries
 - dynamic in space and time

- recovery is slow: plants are adapted to their environment, long-lived and slow-growing



Depletion of water resources



Depletion of water resources

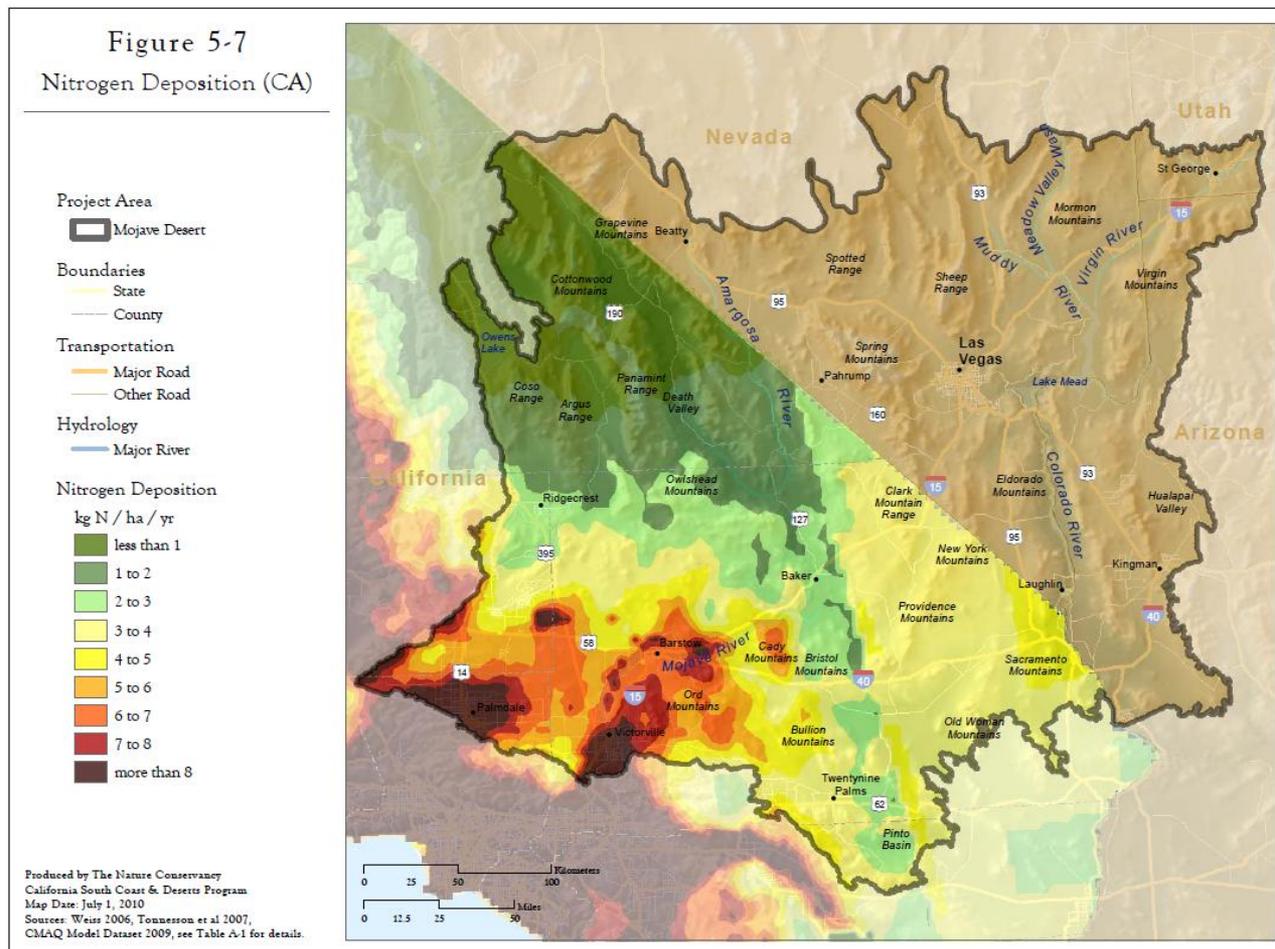
Caused by pumping of groundwater, and leads to:

- Lowering of the groundwater table
- Reduced availability of water at natural springs
- Loss of habitat for aquatic and riparian species
- Necessitates building of more human-managed water sources for wildlife (such as guzzlers)
 - may work for a narrow suite of species that periodically drink from springs (i.e. bighorn), they may not provide many of the benefits of natural springs to plants or other animals



Pollution

- N deposition
 - promotes grass-fire cycle



Pollution

- N deposition
 - promotes grass-fire cycle
- Airborne toxicants
 - lead to disease and death in sensitive species
- Light: from urban areas and industrial facilities
 - problematic for species that have adapted to be active in the nighttime
- Noise and Vibrations
 - problematic for species that have developed sensitive hearing (McGinn and Faddis 1997)

What makes arid systems unique?



What makes arid systems unique?

- Perception
 - arid lands are often portrayed as wasteland with little to no value other than for development

What makes arid systems unique?

- Perception
 - arid lands are often portrayed as wasteland with little to no value other than for development

"Some people look out into the desert and see miles and miles of emptiness. I see miles and miles of gold mine."

-California Governor Arnold Schwarzenegger

What makes arid systems unique?

- Perception
 - arid lands are often portrayed as wasteland with little to no value other than for development
- Present Threat
 - more mesic systems in U.S. have been impacted for centuries
 - conservation and restoration solutions were developed in more mesic environments

What makes arid systems unique?

- Perception
 - arid lands are often portrayed as wasteland with little to no value other than for development
- Present Threat
 - more mesic systems in U.S. have been impacted for centuries
 - conservation and restoration solutions were developed in more mesic environments
- Pace
 - development is happening very rapidly in arid lands

What makes arid systems unique?

- Perception
 - arid lands are often portrayed as wasteland with little to no value other than for development
- Present Threat
 - more mesic systems in U.S. have been impacted for centuries
 - conservation and restoration solutions were developed in more mesic environments
- Pace
 - development is happening very rapidly in arid lands
- Political Pressure
 - desire for a “win-win-win” solution for climate change, job creation, and investment in new technologies

What makes arid systems unique?

- Perception
 - arid lands are often portrayed as wasteland with little to no value other than for development
- Present Threat
 - more mesic systems in U.S. have been impacted for centuries
 - conservation and restoration solutions were developed in more mesic environments
- Pace
 - development is happening very rapidly in arid lands
- Political Pressure
 - desire for a “win-win-win” solution for climate change, job creation, and investment in new technologies
- Public Ownership
 - the majority of arid lands are publically owned

Figure 2-4

Land Ownership

Project Area

Mojave Desert

Boundaries

State

County

Transportation

Major Road

Other Road

Hydrology

Major River

Land Ownership

US Bureau of Land Management

US National Park Service

US Department of Defense

US Fish and Wildlife Service

US Department of Energy

US Forest Service

US Bureau of Indian Affairs

State Lands

Private Conservation

Local Jurisdiction

Private Land



What makes arid systems unique?

- Perception
 - arid lands are often portrayed as wasteland with little to no value other than for development
- Present Threat
 - more mesic systems in U.S. have been impacted for centuries
 - conservation and restoration solutions were developed in more mesic environments
- Pace
 - development is happening very rapidly in arid lands
- Political Pressure
 - desire for a “win-win-win” solution for climate change, job creation, and investment in new technologies
- Public Ownership
 - the majority of arid lands are publically owned
- Preciousness
 - arid lands constitute last great wilderness in North America
 - arid systems are fragile and slow to recover from disturbance

Figure 6-2

Mojave Desert Conservation Value

Project Area

 Mojave Desert

Conservation Value

 Ecologically Core

Land with low levels of anthropogenic disturbance which support conservation targets and whose protection is critical for the long-term conservation of the ecoregion's biological diversity

 Ecologically Intact

Land with low levels of anthropogenic disturbance or which supports conservation targets and which requires a level of protection that will enable it to continue to support ecological processes and provide connectivity

 Moderately Degraded

Land fragmented by roads, off-road vehicle trails or in close proximity to urban, agricultural and other developments

 Highly Converted

Land in urban and agricultural areas that is fragmented and most impacted by human uses

Boundaries

 State

 County

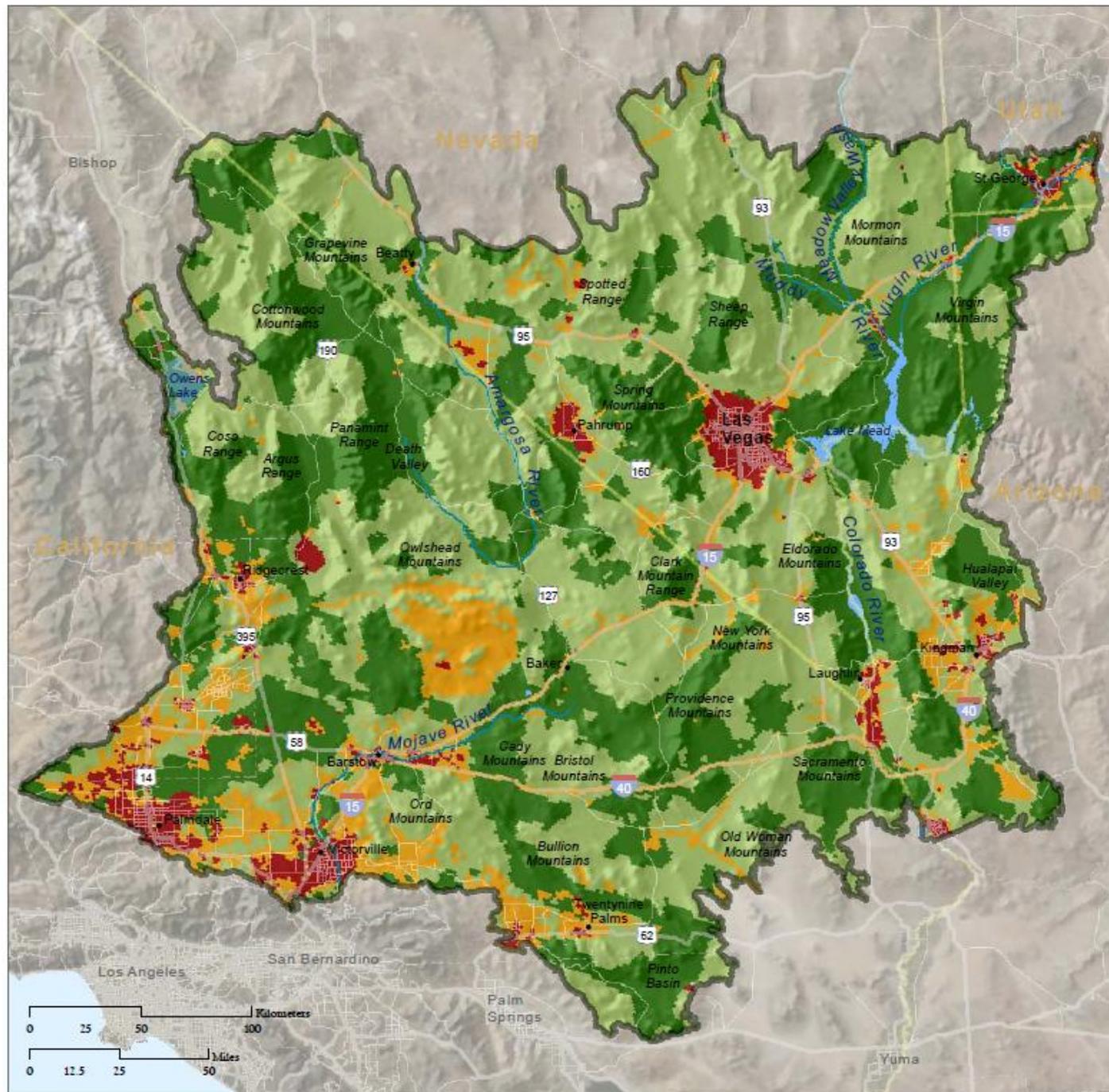
Transportation

 Major Road

 Other Road

Hydrology

 Major River





Mojave Desert Ecoregional Assessment



Mojave Desert Ecoregional Assessment

September 2010
Version 1.1

The Nature Conservancy of California
201 Mission Street, 4th Floor
San Francisco, CA 94105

Planning Team

John M. Randall
Sophie S. Parker
James Moore
Brian Cohen
Laura Crane
Bill Christian
Dick Cameron
Jason B. Mackenzie
Kirk Klausmeyer
Scott Morrison



The Mission of The Nature Conservancy is to preserve the plants, animals and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive.

Cover photographs by James Moore and
Bill Christian © 2010



Recommended Citation:

Randall, J. M., S.S. Parker, J. Moore, B. Cohen, L. Crane, B. Christian, D. Cameron, J. MacKenzie, K. Klausmeyer and S. Morrison. 2010. Mojave Desert Ecoregional Assessment. Unpublished Report. The Nature Conservancy, San Francisco, California. 106 pages + appendices. Available at: <http://conserveonline.org/workspaces/mojave/documents/mojave-desert-ecoregional-2010/@@view.html>.

<http://conserveonline.org/workspaces/mojave/documents/mojave-desert-ecoregional-2010/@@view.html>