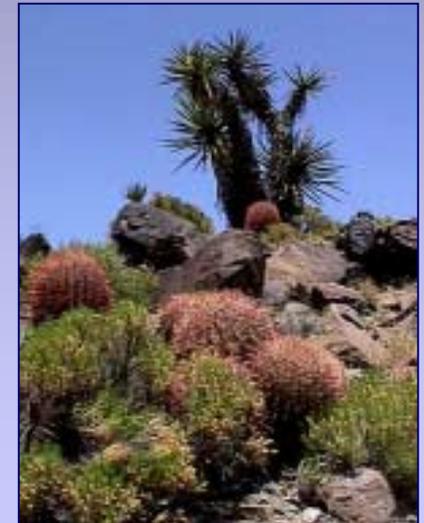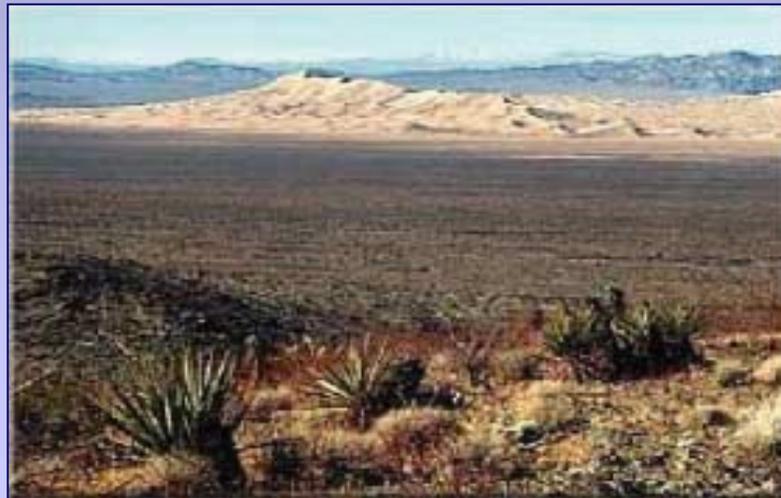# Overview of the Recoverability and Vulnerability of Desert Ecosystems Project

A. Frazier, L. Gaydos, J. Belnap, D. Miller, R. Webb

Arid Southwest Lands Habitat Restoration Conference, March 3, 2003

U.S. Department of the Interior
U.S. Geological Survey

USGS Science for Mojave Desert Land Management

Understanding an ecosystem requires studies at both large and small scales.

- **RVDE (Monday-Tuesday)**
  - **Ecosystems-level, interdisciplinary approach**
  - **Focus on understanding and modeling vulnerability to disturbance and recovery processes**
- **Specific topical studies (Wednesday-Friday)**

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The Mojave Desert is Increasingly Impacted by Land Use

- **Near fast-growing population centers (e.g. Las Vegas) and within day's drive of 40 million people**

- **Multiple jurisdictions: 4 National Park units, 6 military bases, a mosaic of BLM land**

Mojave Ecosystem boundary (yellow) with 50-kilometer buffer (orange)

USGS

Mojave Desert Land Uses

- **Recreation**
- **Mining**
- **Grazing**
- **Military**

USGS

Mojave Desert Land Use Impacts

- **Land use can lead to:**
  - **Disturbance or removal of vegetation**
  - **Soil compaction**
  - **Disturbance of soil crust**
- **Which can further lead to:**
  - **Soil erosion**
  - **Increase invasive species**
  - **Habitat degradation**

USGS RVDE Project

Big Questions

What makes land more or less vulnerable to disturbance?

**What influences recovery from disturbance?**

USGS RVDE Project

Important Points

- **Recovery from disturbance varies across the landscape**

- **Therefore, vulnerability to and recovery from disturbance must be a function of landscape variables**

- **If we can understand these functions, we can map vulnerability and recoverability**

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RVDE Goal

Synthesize geospatial information on landscape variables with scientific understanding of ecosystem processes into maps and models of vulnerability and recovery that are useful for land management

Soil Recovery

Legend

Years

	50 - 75
	76 - 100
	101 - 200
	201 - 300
	>300

20
Kilometers
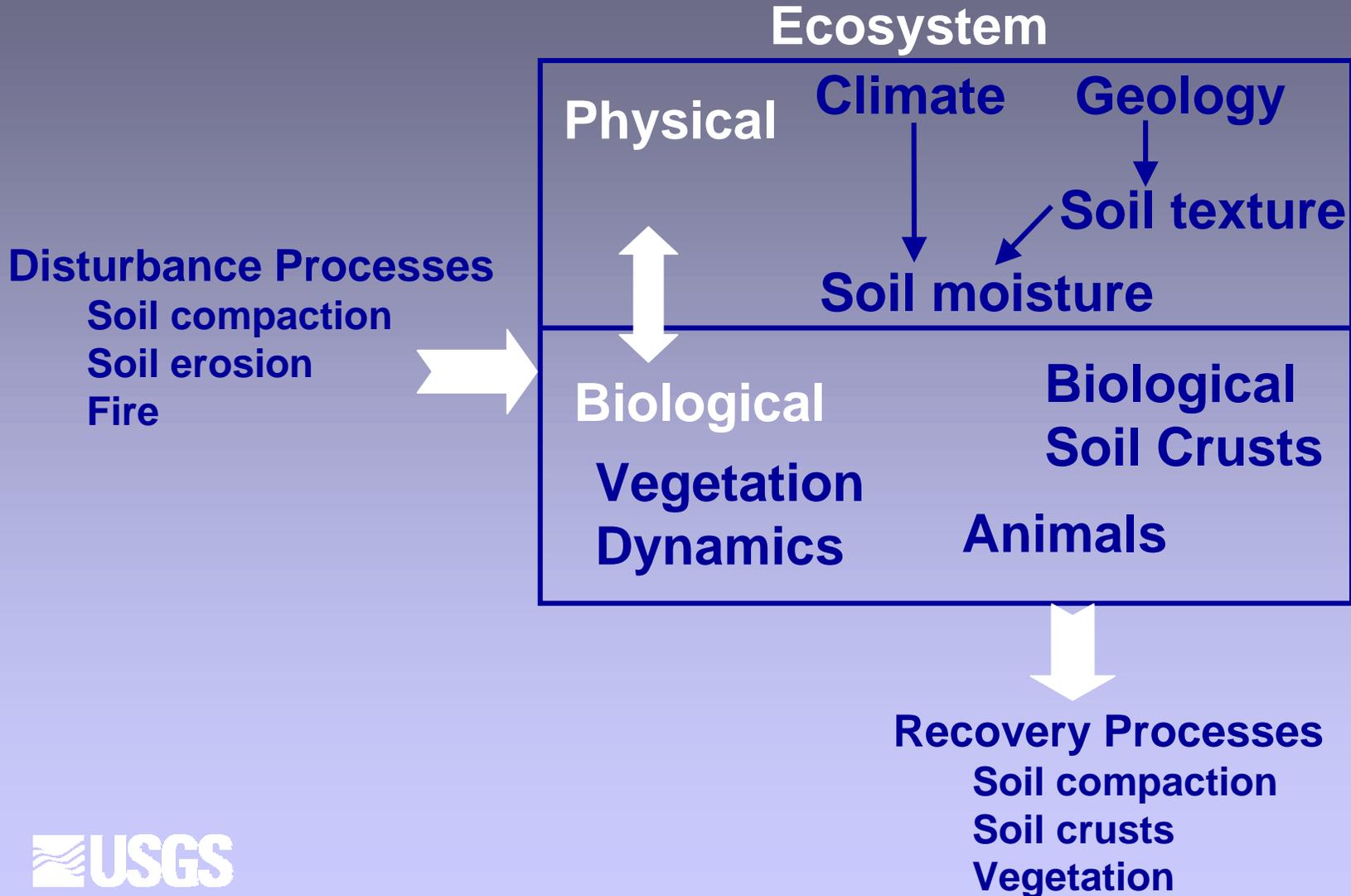
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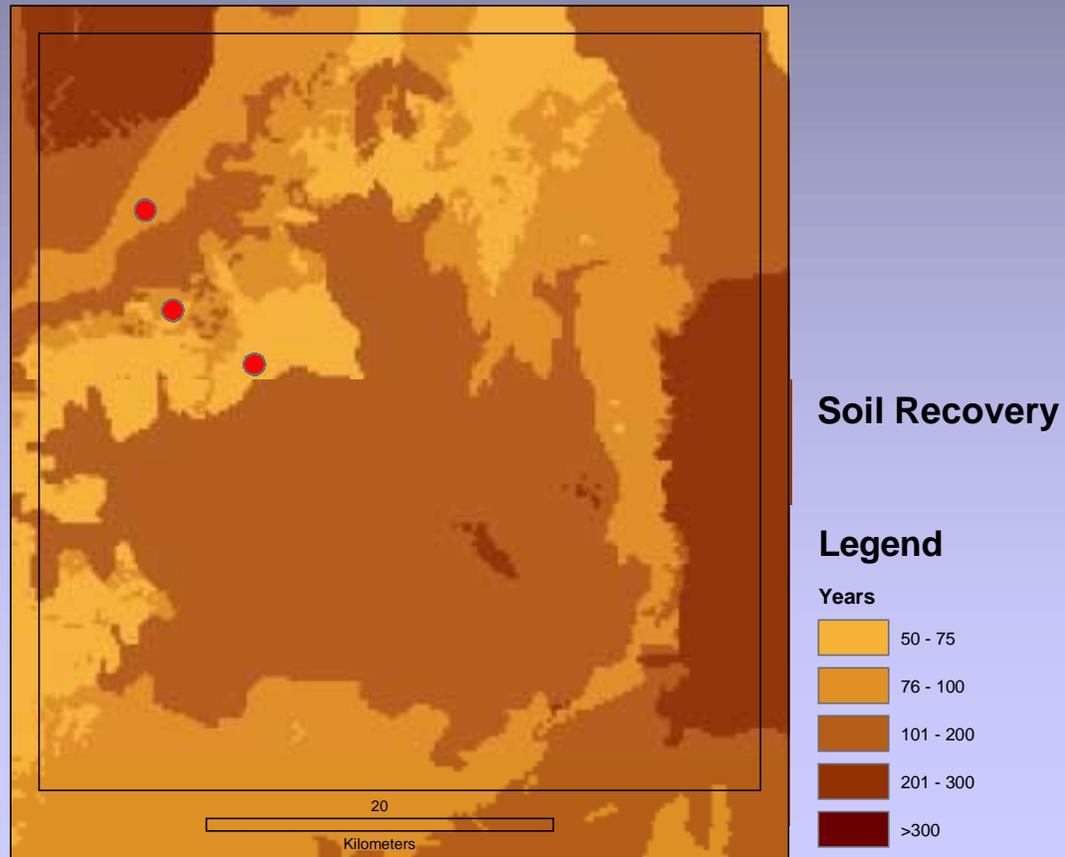
RVDE Project Elements

- **Determine what are the driving landscape variables**
- **Map or model those variables**
- **Do experimental studies to understand disturbance processes**
- **Combine into maps of vulnerability and recoverability**

Driving Landscape Variables

- **What drives the ecosystem drives recovery**
- **Ultimate drivers of ecosystem functions**
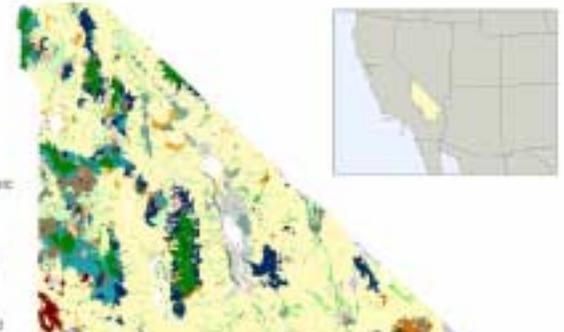 *Climate (water)*
  Geology (soil)

USGS

RVDE Areas of Emphasis

Ecosystem

Physical

Climate   **Geology**

Soil texture

Soil moisture

Disturbance Processes
    Soil compaction
    Soil erosion
    Fire

Biological

Biological Soil Crusts

Vegetation Dynamics

Animals

Recovery Processes
    Soil compaction
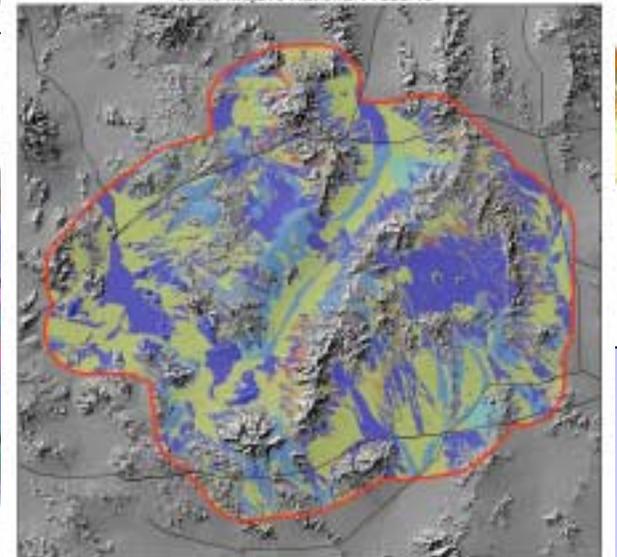   Soil crusts
    Vegetation

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Mapping and Modeling Existing Conditions

- **Surficial Geology**
- **Soil Texture**
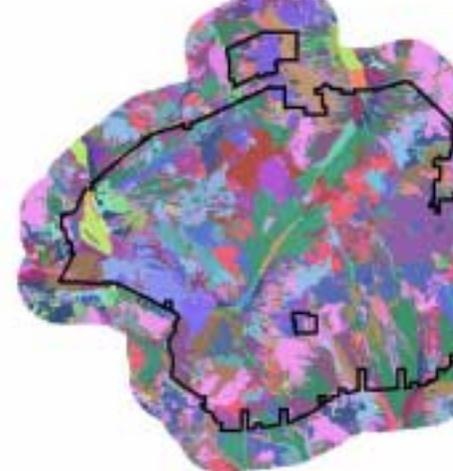- **Soil Moisture**
- **Vegetation**
- **Biological Soil Crust**

Central Mojave Vegetation

Agricultural Land Use
Big Sagebrush Shrubland
Blackbrush Shrubland
Creosote Bush Shrubland
Creosote Bush/Brittlebush Mosaic
Desert Holly Shrubland
Dunes
Galleta Grasslands
High Elevation Pine Woodlands
High Elevation Wash System
Hopsage Shrubland
Joshua Tree Wooded Shrubland
Juniper Wooded Shrub
Lava Beds and Cinder C
Low Elevation Wash Sy
Menodora Shrubland

Surficial Geology

Preliminary Biologic Soil Crust Map of the Mojave National Preserve

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Understand Disturbance Processes

Using both experimental techniques and analysis of historical information, studied:

- **Biological soil crust recovery**
- **Wind erosion vulnerability**
- **Soil compaction recovery and vulnerability**
- **Vegetation dynamics and recovery**

1906

1983

≋USGS

Development of Geospatial Models of Recoverability and Vulnerability

Geospatial maps of physical and/or biological conditions

+

Geologic, hydrologic and ecosystem process understanding

Derived maps of Recoverability/vulnerability

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Application to Land Management

- **Select location or time activities to:**
  - **Minimize disturbance**
  - **Minimize recovery times once disturbed**

- **Support decisions on active vs. passive restoration**

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Current Status

- **Study began in 1998**
- **Progress to date on mapping, modeling and process understanding presented here**
- **Initial work begun on modeling recoverability and vulnerability**
- **Planning for next five years**

Conference Topics

Monday

Tuesday

- **Mapping and modeling landscape variables**
  - **Climate, surficial geology, soil texture, soil moisture**
- **Understanding disturbance processes**
  - **Compaction, erosion, soil crust, fire**
  - **Vegetation dynamics and recovery**
- **Modeling recoverability and vulnerability**
- **Future directions**

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