The Climate and Deserts Workshop:

Adaptive Management of Desert Ecosystems

in a Changing Climate

a summary by Debra Hughson

National Park Service - Mojave National Preserve

May 28, 2008

Marine Corp Air Ground Combat Center

29 Palms, California

The Future of the West: Adapting to a Warmer World

The Climate and Deserts Workshop

Aquarius Casino Resort, Laughlin, NV, April 9, 2008

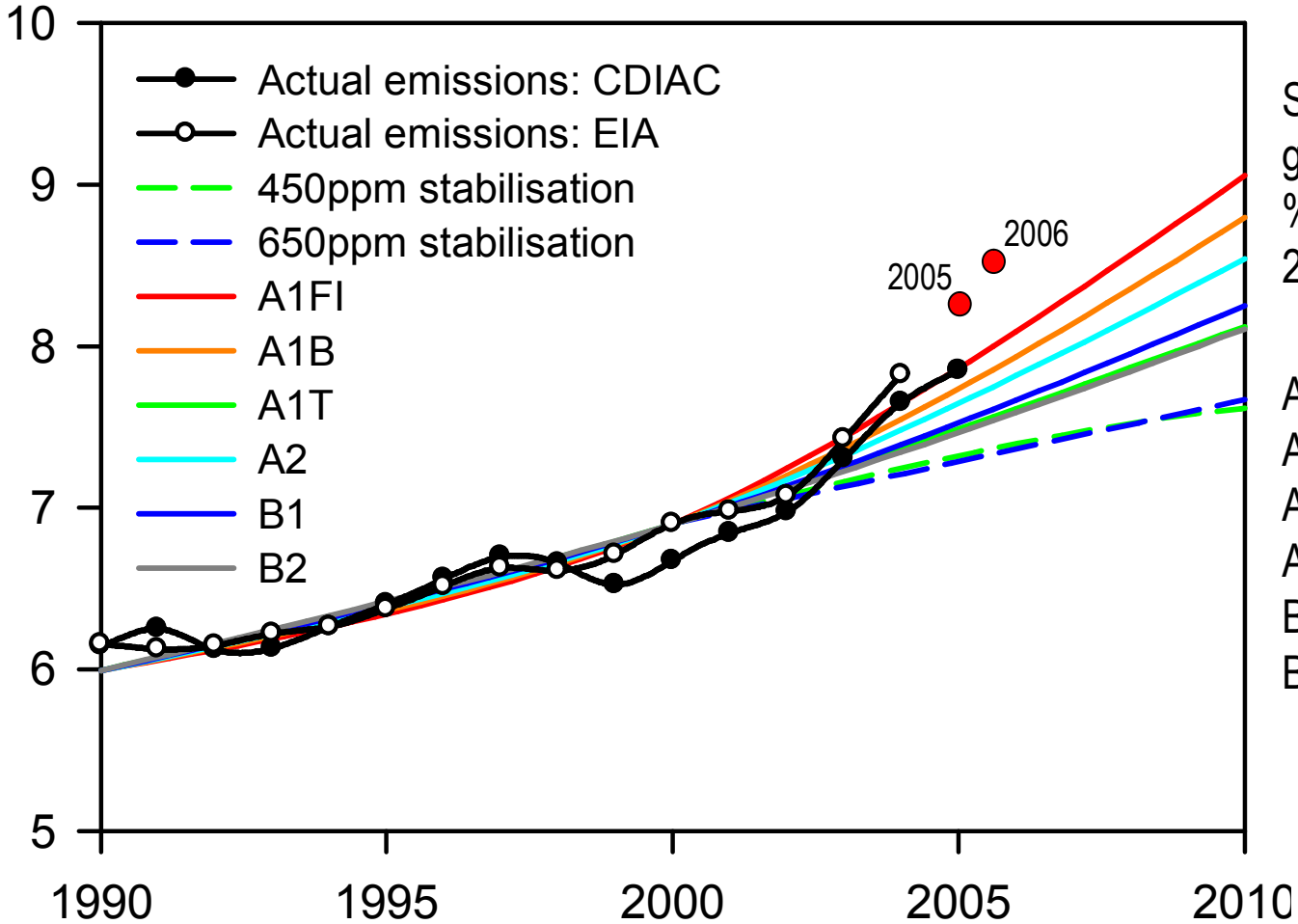
Gregg Garfin

INSTITUTE FOR THE STUDY OF PLANET EARTH

CLIMAS
Climate Assessment Project for the Southwest

RISA
Regional Integrated Sciences and Assessments
Building Bridges Between Climate Sciences and Society

Trajectory of Global Fossil Fuel Emissions

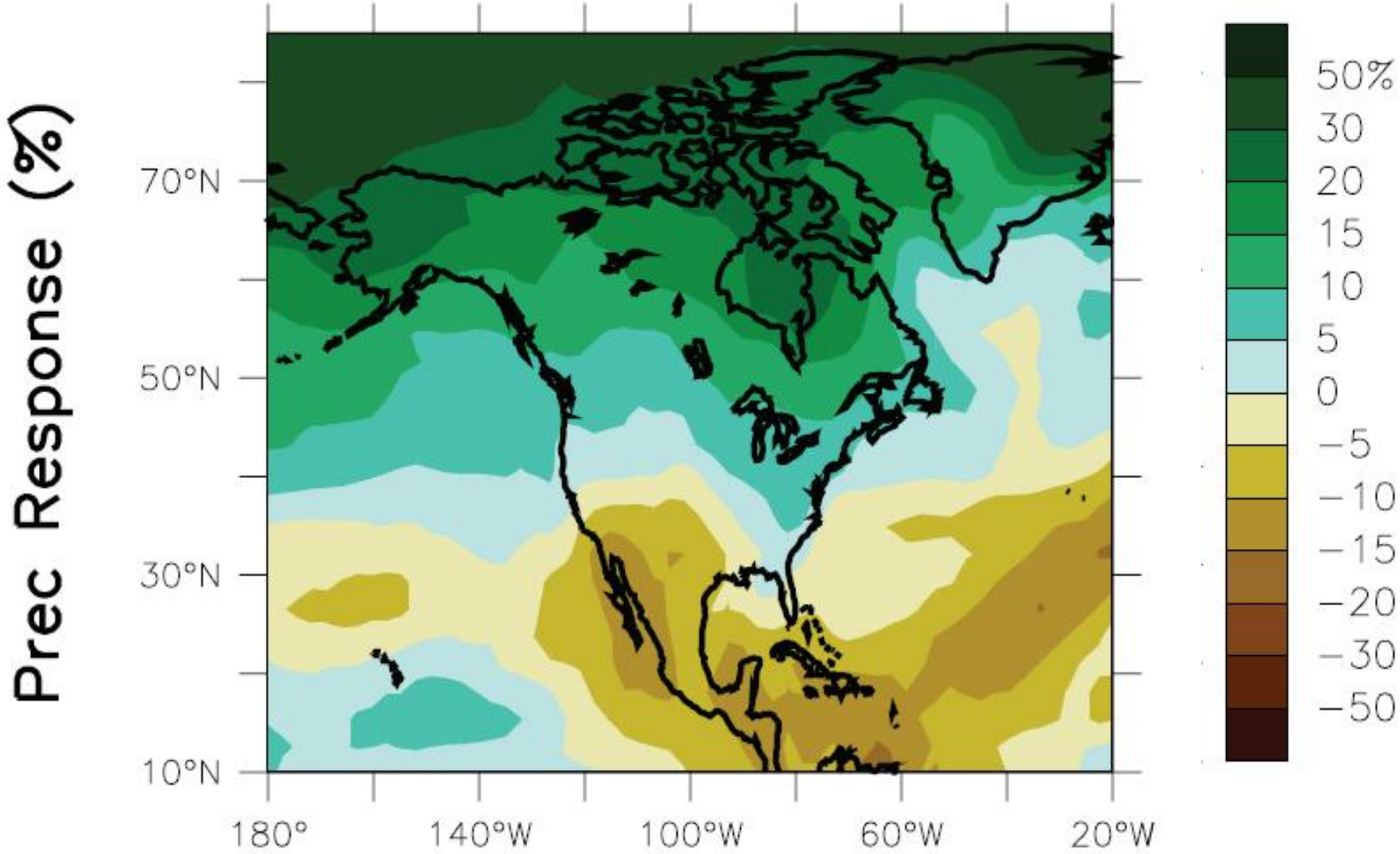


SRES (2000) growth rates in % y^{-1} for 2000-2010:

A1B: 2.42
A1FI: 2.71
A1T: 1.63
A2: 2.13
B1: 1.79
B2: 1.61

Raupach et al. 2007, PNAS

Annual Precipitation: End of 21st Century



IPCC 4th Assessment: Working Group I, Chapter 11, Regional Projections

Dust Bowl Southwest?

- Seager analyzed 19 global climate model results from recent IPCC assessment

- Scenario: rising CO2 until 2050 then slow decline to 720 ppm by 2100
- Result: broad consensus among models that SW will dry significantly in 21st century

★ Arid transition may already be underway

Climate Change and Western Deserts

An Overview

Kelly T. Redmond

Western Regional Climate Center

Desert Research Institute

Reno Nevada

The Climate and Desert Workshop

Adaptive Management of Desert Ecosystems

in a Changing Environment

Laughlin, Nevada 2008 April 9-10

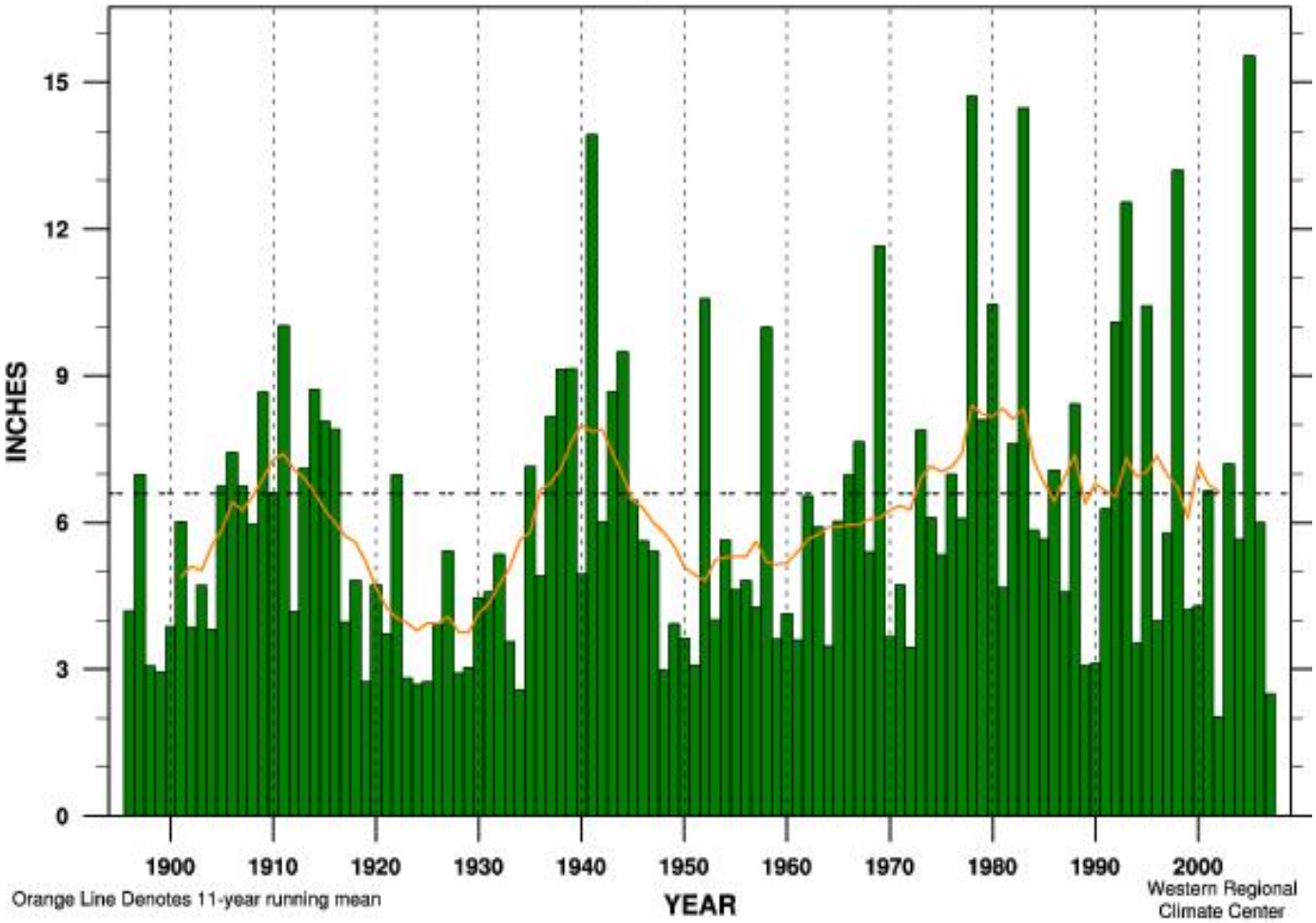
Western Regional
Climate Center

Western United States Warming Climate Evidence

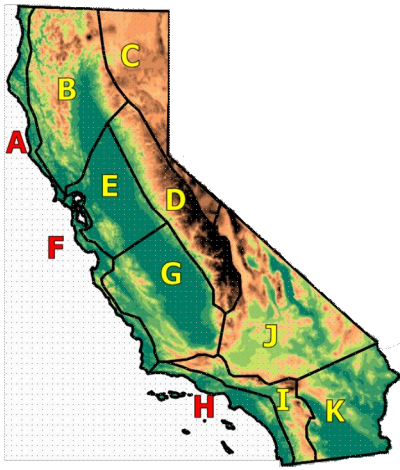
1. Warming - thermometers (NOAA coop surface data network)
2. Warming - thermometers (NOAA upper air data network)
3. Warming - thermometers (subsurface, western boreholes)
4. Snowpack decrease in spring months (Snotel network)
5. More rain / less snow in winter months (NOAA coop network)
6. Earlier snowmelt runoff pulse (date shift, USGS stream gage network)
7. Earlier blooming of lilacs and honeysuckles (phenology networks)
8. Mountain glacier recession and mass loss
9. Upward movement of plant / animal habitat zones
10. Warmer river and lake temperatures

Mohave Desert Region

Precipitation Oct-Sep



Linear Trend 1895-present	+ 1.83 ± 1.63 in.	(+ 27 ± 24%) per 100 yr	
Linear Trend 1949-present	+ 3.17 ± 5.04 in.	(+ 48 ± 76%) per 100 yr	
Linear Trend 1975-present	- 7.31 ± 14.42 in.	(-110 ± 218%) per 100 yr	
Wettest Year	15.54 in. (235%)	in 2005	MEAN 6.59 in.
Driest Year	2.03 in. (30%)	in 2002	STDEV 3.21 in.
Oct-Sep 2007	2.50 in. (37%)		RANK 2 of 112

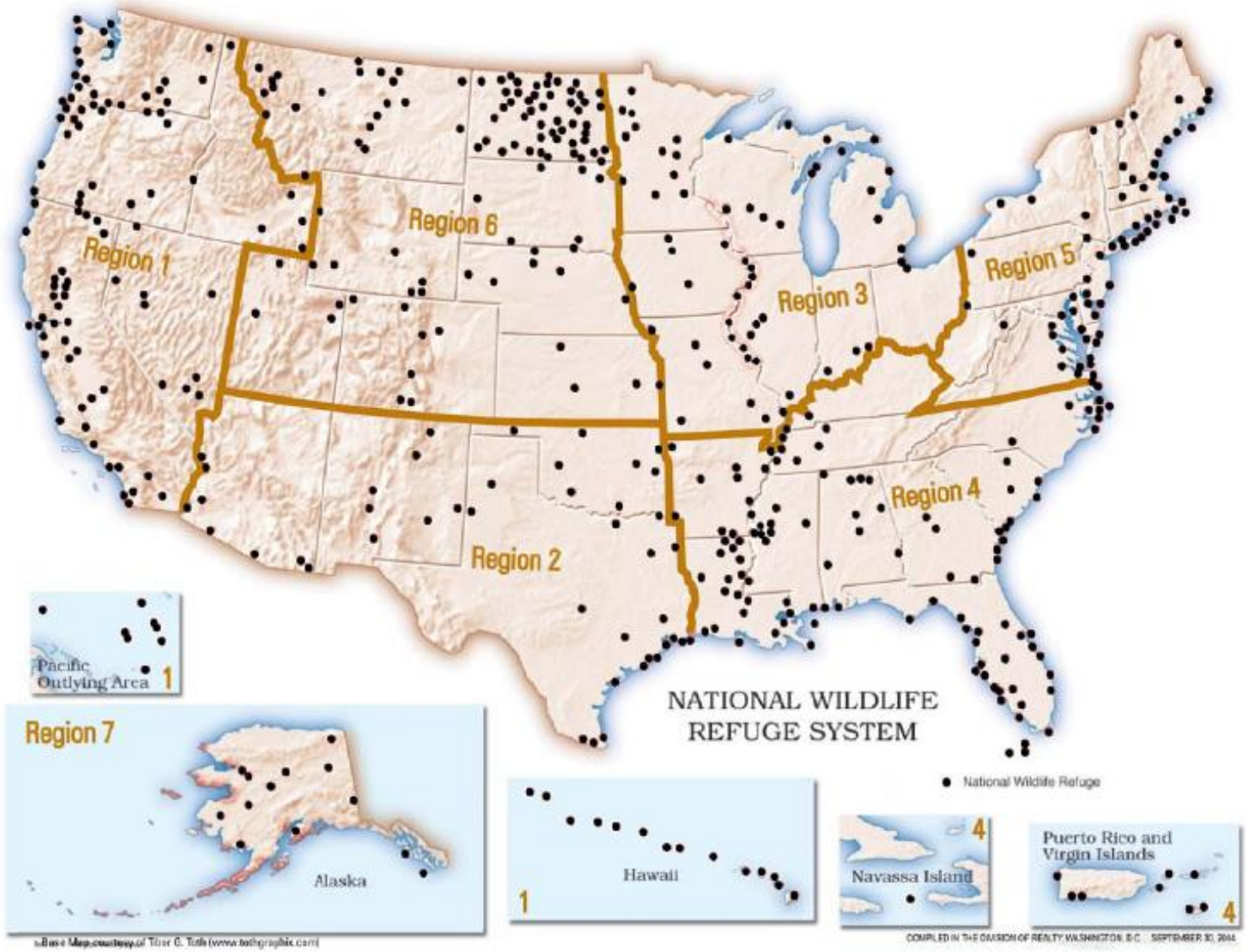


2004

Climate Change and Wildlife Refuges:
Managing for resilience in the face of uncertainty

Brad Griffith and J. Michael Scott
USGS, Alaska and Idaho Cooperative Fish & Wildlife Research Units
University of Alaska Fairbanks and University of Idaho

Desert Manager's Group
Climate Change Symposium
9 April 2008
Laughlin, Nevada


Region 1
Region 2
Region 3
Region 4
Region 5
Region 6
Region 7
Pacific Outlying Area
1
Alaska
Hawaii
1
Navassa Island
4
Puerto Rico and Virgin Islands
4
NATIONAL WILDLIFE REFUGE SYSTEM
National Wildlife Refuge

The Problems with Refuges

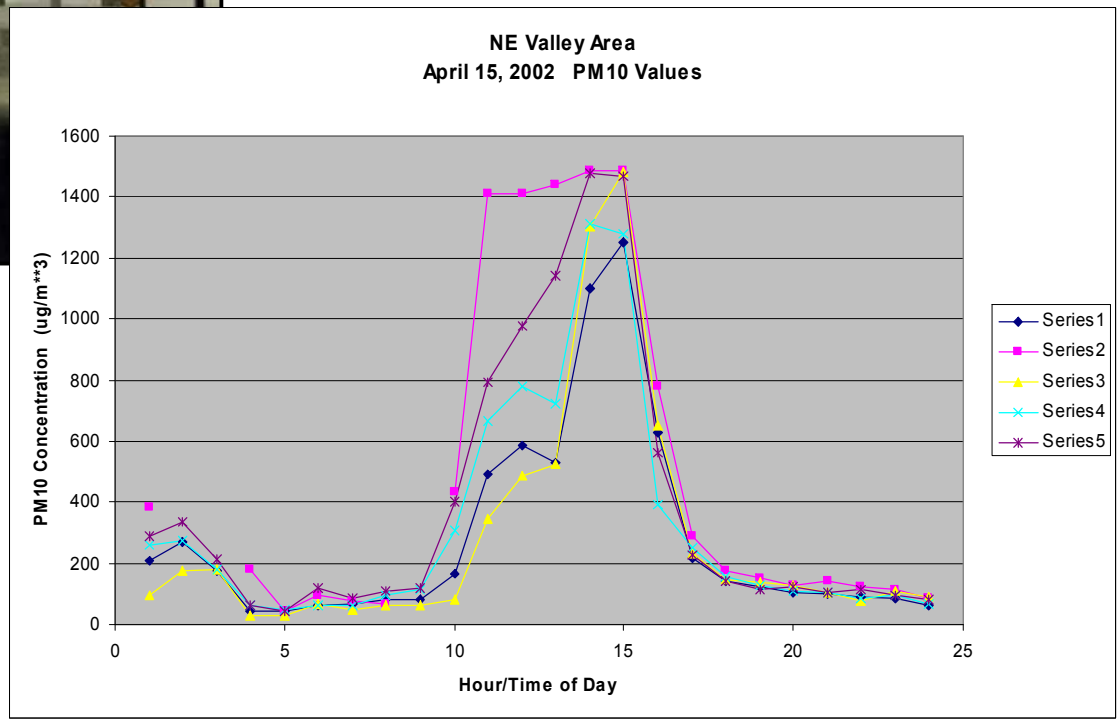
- Too Small to consistently provide
  - Genetically
  - Demographically or
  - Evolutionarily viable populations
- Not well connected
- Embedded in an imperfect matrix

New tools, new ideas and new relationships are needed

- Nontraditional partnerships.
- Thinking across boundaries and scales.
- Thinking across disciplines.
- Reintegration of conservation areas into the American consciousness and landscape (Rosenzweig, 2003).

Las Vegas dust storm April 15, 2002

PM10 values, NE Valley area



Dust in Las Vegas. April 15, 2002

Windstorm was the strongest and most widespread in a decade.

Unhealthy levels of PM10 dust were reported at monitoring stations.

Next step: examine hospital records for mortality

USGS

Ecological Effects of Global Change in the Great Basin and Mojave Deserts

Stanley D. Smith

University of Nevada, Las Vegas

Oblique aerial view of Ring 3; an elevated CO_2 treatment plot

Community change

Photos by T. Huxman & T. Esque

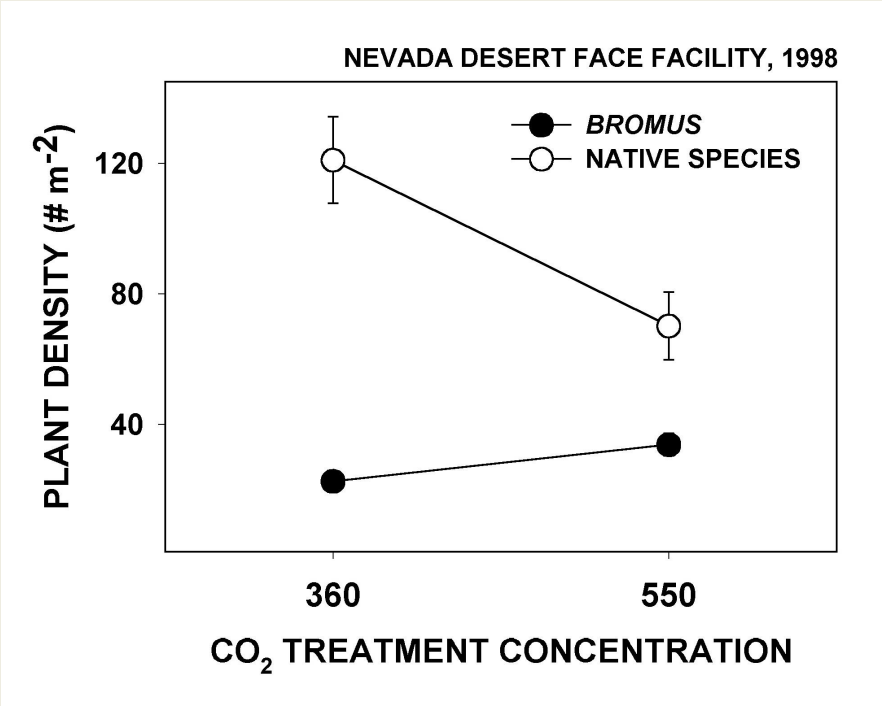
Climate change and the Sonoran Desert

Travis E. Huxman

Ecology and Evolutionary Biology

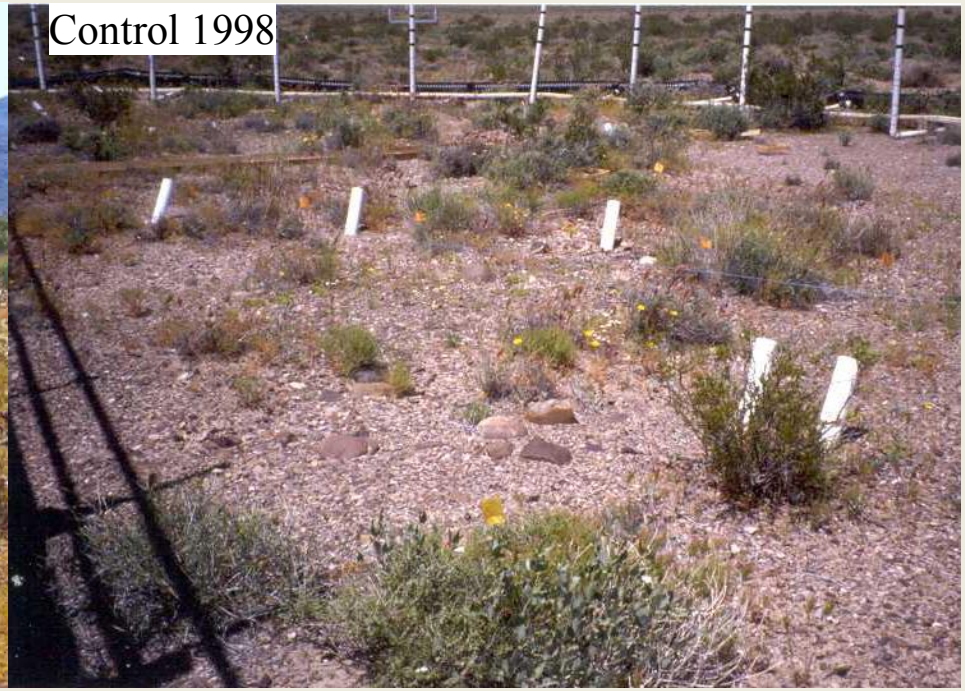
University of Arizona

- Conceptual and experimental examples
- Special case of the Sonoran Desert
- Current patterns and future possibilities



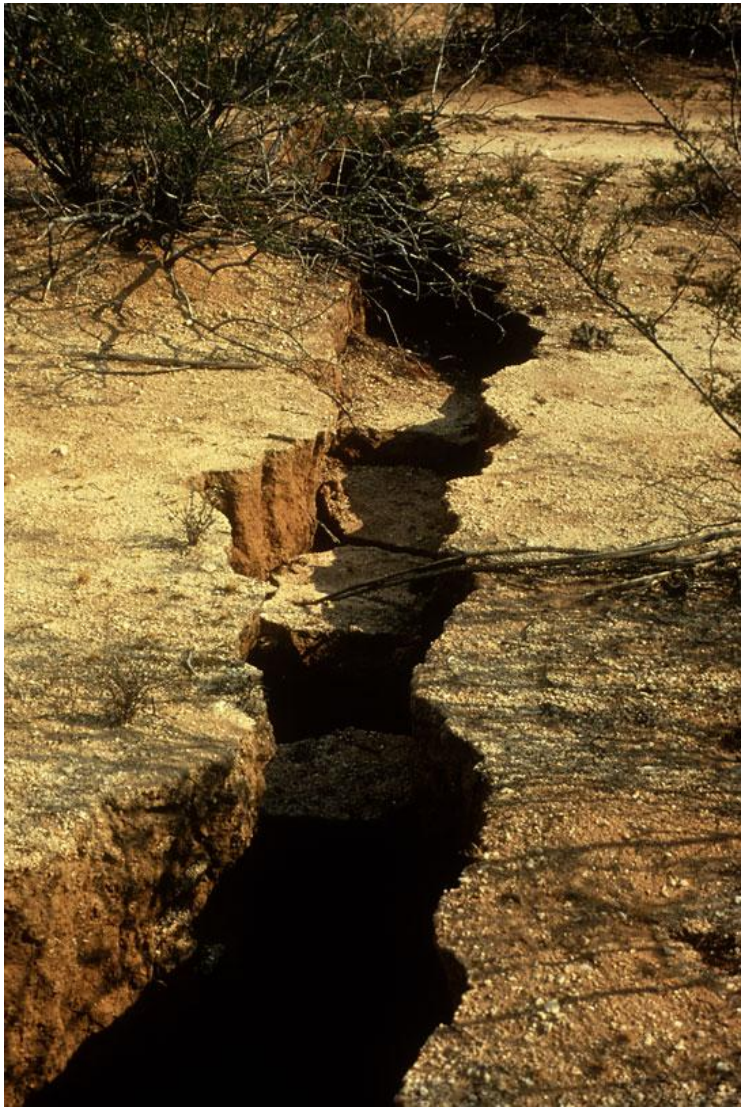
Red Brome (non-native grass) is the 'surprise' in the western U.S.

Rising CO_2 dramatically increases it's relative abundance



Sonoran Desert example – Buffelgrass (*Pennisetum ciliare*)

Challenges for Future Water Management in the Southwest



Stan Leake
U.S. Geological Survey
Tucson, Arizona
saleake@usgs.gov

The Climate and Deserts Workshop:
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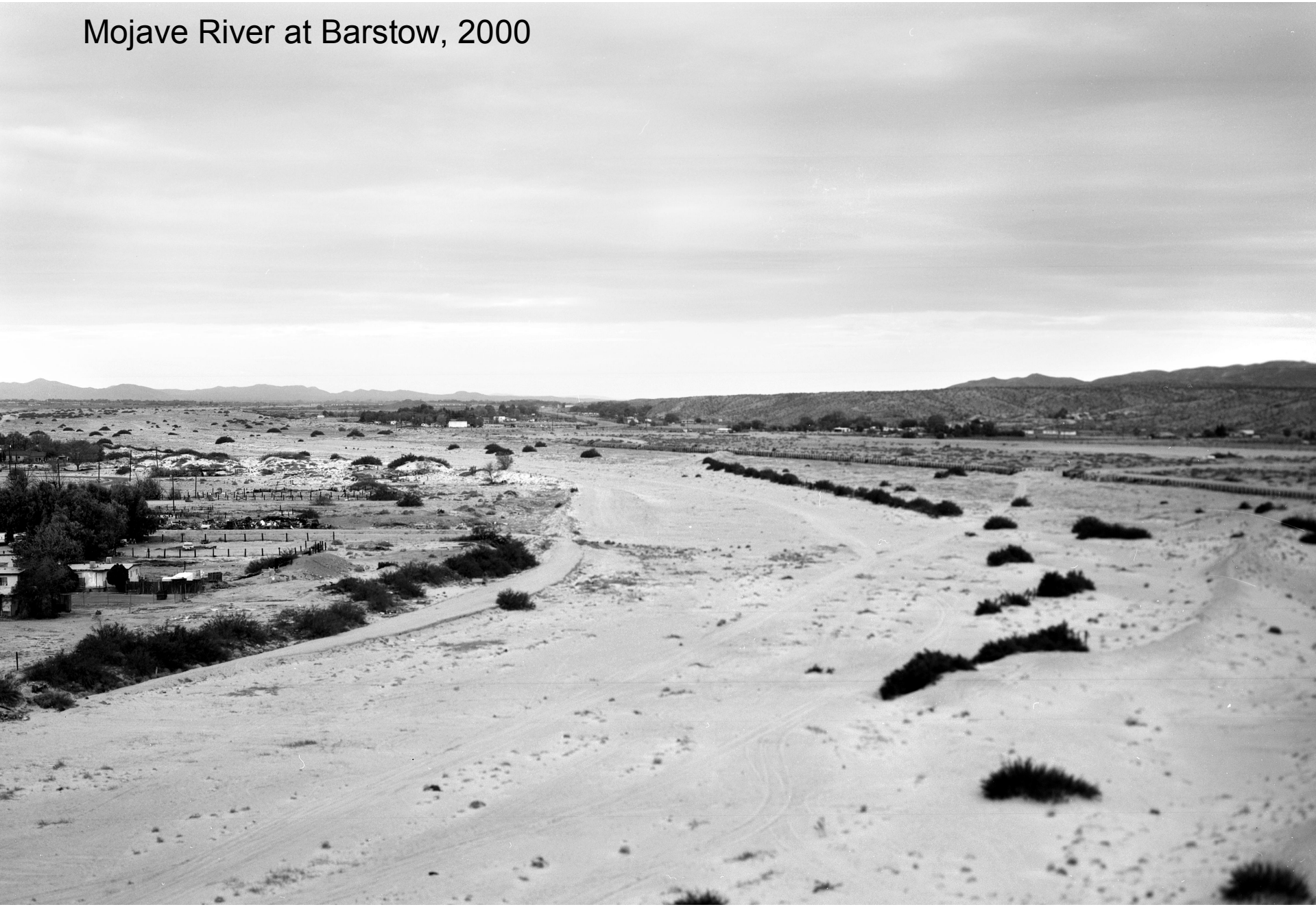
Laughlin, Nevada
April 9-11, 2008

USGS
science for a changing world

Mojave River at Barstow, 1919


Mojave River at Barstow, 2000

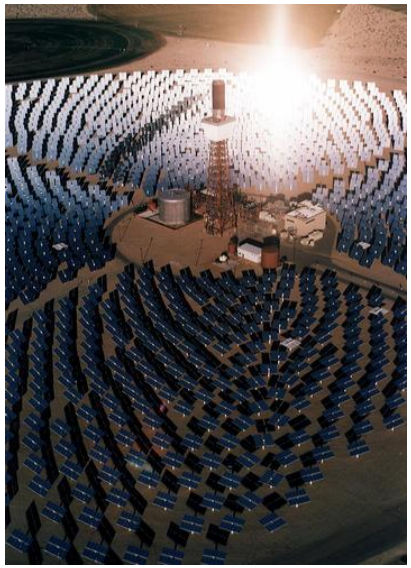
Concluding Thoughts

- Water needs for increasing population in the desert Southwest likely will be at the expense of agriculture

- With regards to desert ecosystems threatened by ground-water withdrawals, adaptive management may be difficult, especially if pumping centers are distant

- With increased ground-water use in some areas, new areas of subsidence and earth fissures may occur and older but now stable areas may experience reactivation of movement

Energy by Design: Blending Landscape Level Planning & The Mitigation Hierarchy



Joseph Kiesecker
Director of Science
The Nature Conservancy
jkiesecker@tnc.org

April 9, 2008

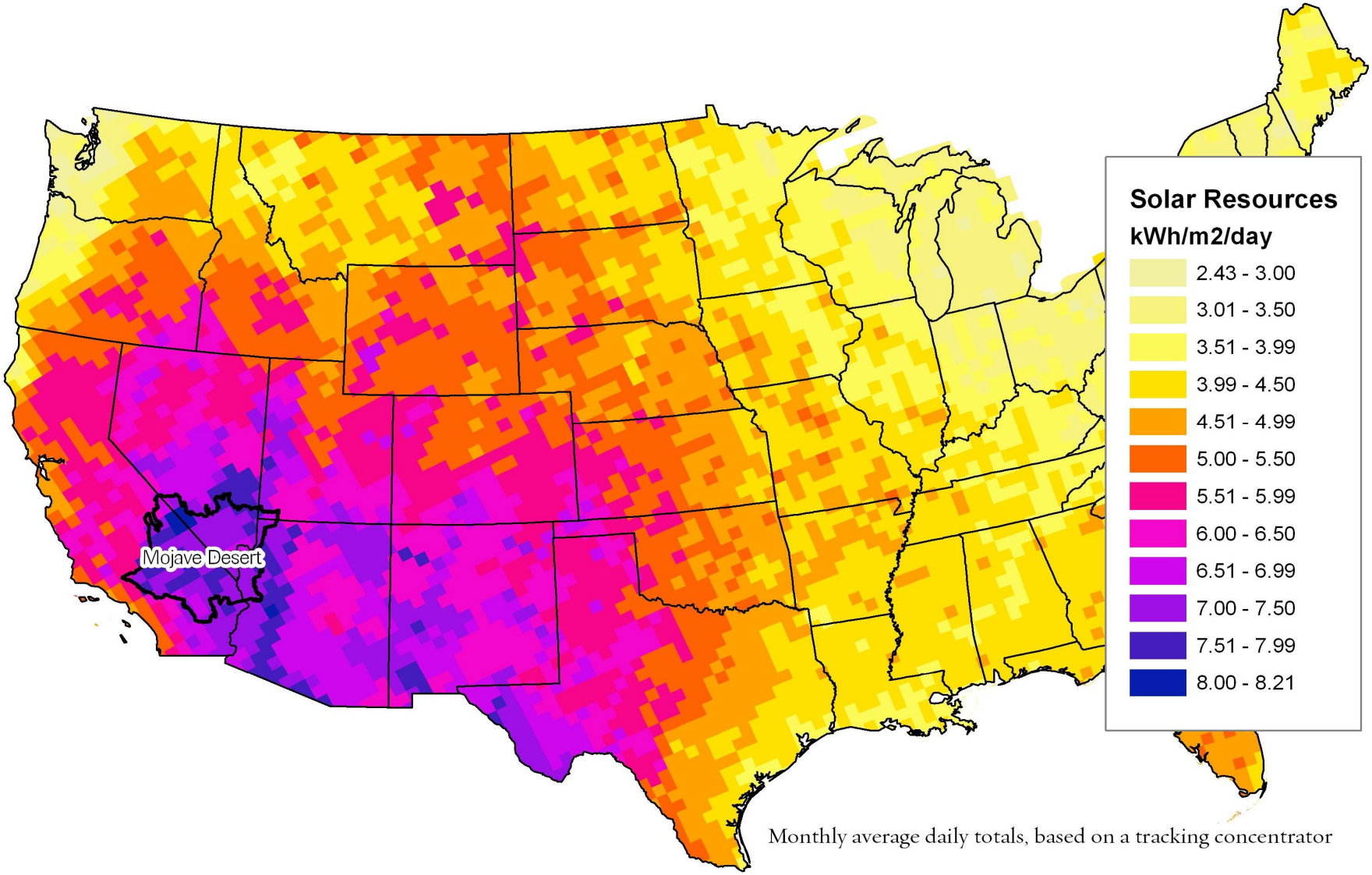
The Nature Conservancy
Protecting nature. Preserving life.™

The United States is the largest energy consumer in terms of total use, using 100 quadrillion BTU:
(29,000 TW = 29,000,000,000 MW = 29,000,000,000,000 KW) in 2005

The majority of this energy is derived from fossil fuels:
40% Petroleum
23% Coal
23% Natural Gas

The remaining 14%:

- Nuclear Power
- Hyrdoelectric Dams
- Miscellaneous Renewable Energy (~3%)



Monthly average daily totals, based on a tracking concentrator

Mitigation Design Questions

1. How do you identify suitable offset sites?
2. How do you ensure offsite mitigation, compensates for onsite impacts?
3. How do you confirm offsets are ecologically equivalent?
4. Once offset sites are located how do you identify appropriate mitigation actions?
5. How do you ensure offsite mitigation conforms to the mitigation hierarchy ?

Climate Change and Urban Form in the West

The Climate and Deserts Workshop
April 9, 2008

Rebecca Carter, PhD
Research Manager,
Sonoran Institute

Better land use planning is essential to effectively mitigating climate change.

Local land use-related actions can:

- Reduce greenhouse gas emissions by ~20%
- Be enacted NOW – no waiting for new tech, etc.
- Additional benefits: cost savings, better quality of life, reduced stress, improved health, etc.

Springs and Groundwater Monitoring and Modeling of Recent and Long-Term Climate Change

Abe Springer
Northern Arizona University
Larry Stevens
Museum Northern Arizona

NORTHERN ARIZONA UNIVERSITY

ARIZONA WATER INSTITUTE

Conclusions

- Springs useful indicators of climate change.
- Local or regional springs can monitor short- or long-term fluctuations.
- New technologies useful for remote sites.
- When coupled with groundwater flow models, monitoring can be more useful.

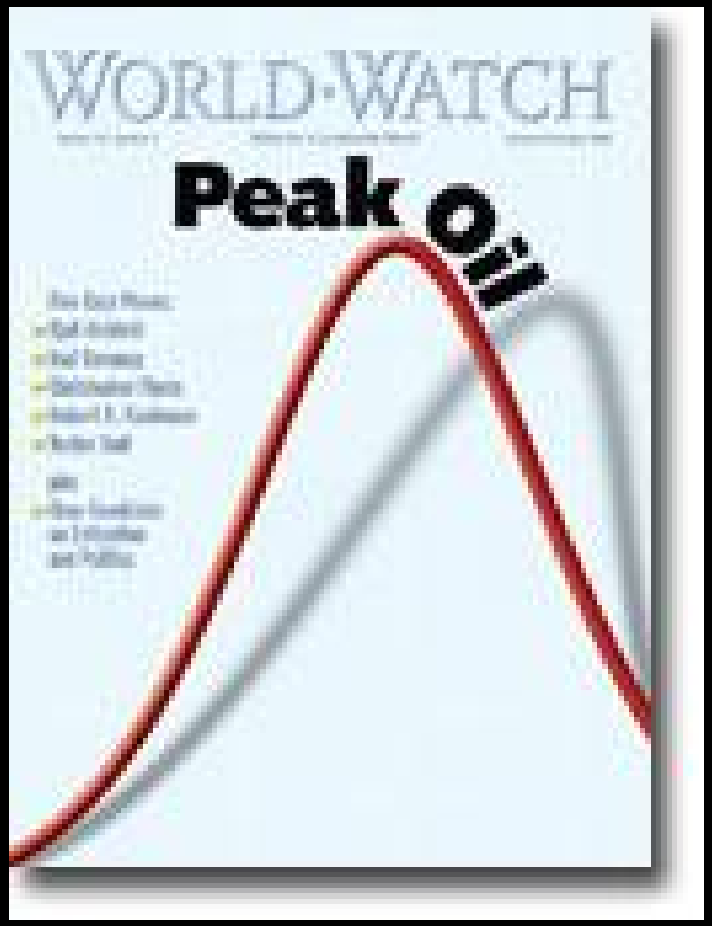
Nonnative plants, regional climate change, and emerging desert fire regimes: learning to love the Homogocene

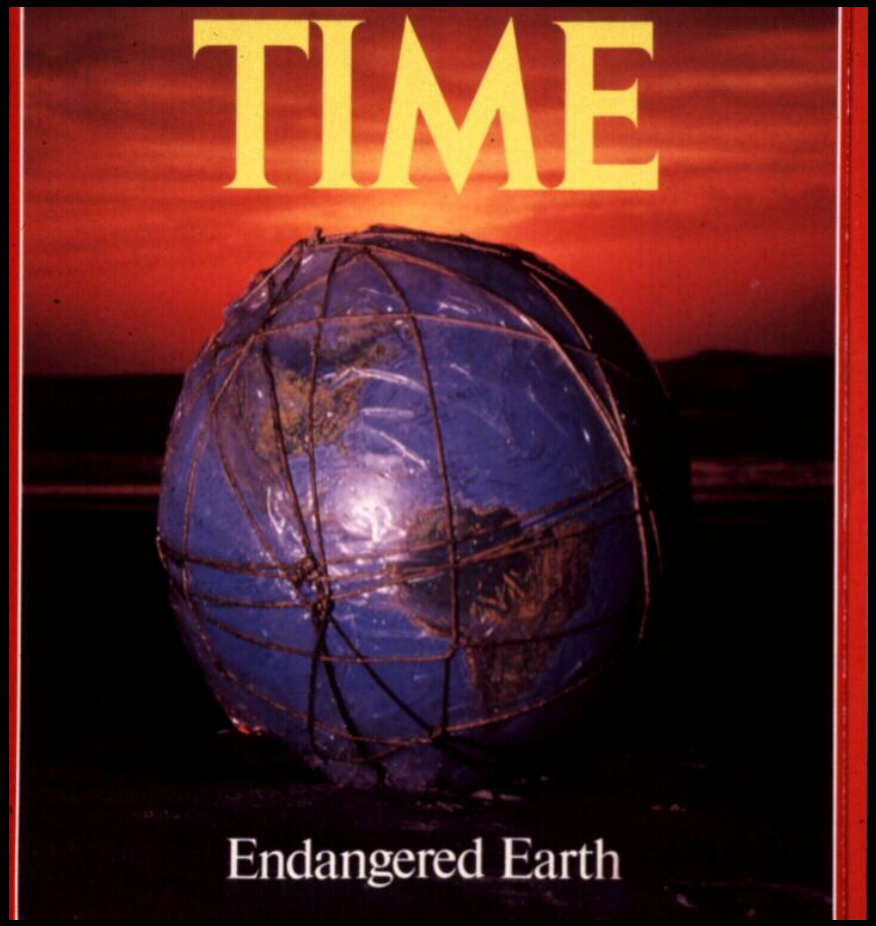
*Biological invasions in the United States**

- Approximately 50,000 species
- Invading 700,000 ha/yr
- At an economic cost of $120 billion/yr
- Threatening 400 species with extinction (42% of listed species)
- Nonnative species provide 98% of our food

Pimentel et al. (2005) *Ecological Economics* 52:273-288

Stopping the addiction, cold turkey





Wildlife Connectivity:

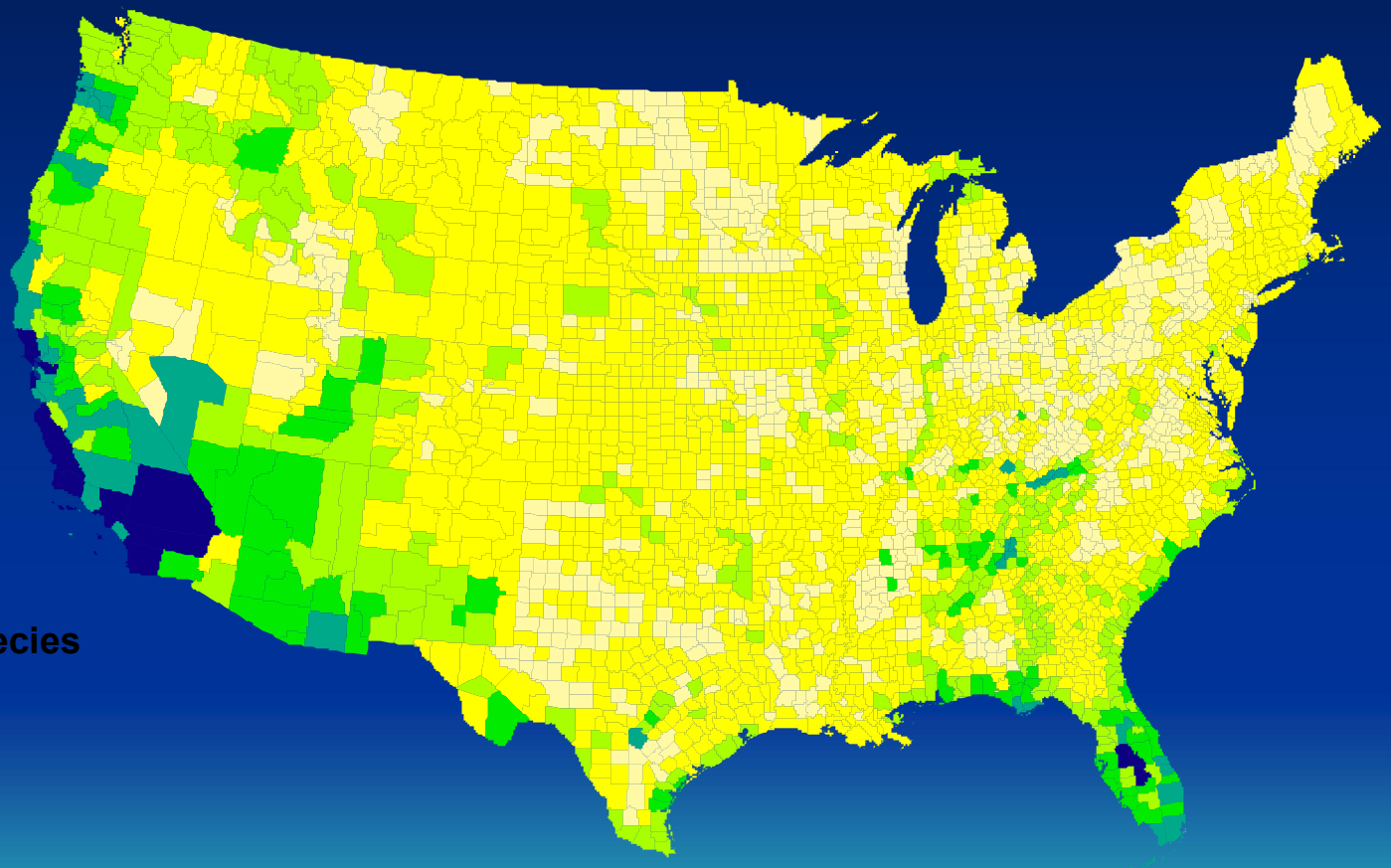
We've been telling you for twenty years that we don't have enough time to gather the data

Tom Scott

UC Integrated Hardwood Range Management Program
Department of Environmental Science, Policy, and Management
University of California, Berkeley

Center For Conservation Biology
and Department of Earth Sciences
University of California, Riverside

Map of Federally-listed Endangered Species by County



Number of Endangered Species

- 0 or 1
- 2 to 5
- 6 to 10
- 10 to 15
- 16 to 25
- >25

Most Endangered Species are found in <10 counties

	NUMBER OF SPECIES	Counties Present	Counties Dominant
NARROW_RANGE ENDEMICS	**1104** (89.4%)	**938** (30%)	**73**
SUB-REGIONAL (State) **DECLINING**	**8** (0.6%)	**746** (24%)	**107**
REGIONAL (multi-state) **DECLINING**	**49** (4.0%)	**835** (27%)	**67**
WIDESPREAD (National) **DECLINING**	**27** (2.2%)	**2645** (84%)	**1835**
SALMONIDS	**32** (2.6%)	**1017** (33%)	**86**
PELAGIC SPECIES	**15** (1.2%)	**100** (3%)	**3**

Managing Landscape Linkages to Conserve Desert Wildlife During Climate Change

Wayne Spencer
Conservation Biology Institute
&
South Coast Wildlands

Can Connectivity Conservation Help?

- **Premise**: Maintaining broad ecological connectivity, and minimizing movement barriers, seems necessary to conserve species and ecological processes in the face of climate change….
- … but is certainly not sufficient for all species and processes.

Modeling Approaches for Predicting Climate Change Impacts on Natural Systems; From Inputs to Algorithms to Outputs and What They Can Tell Us

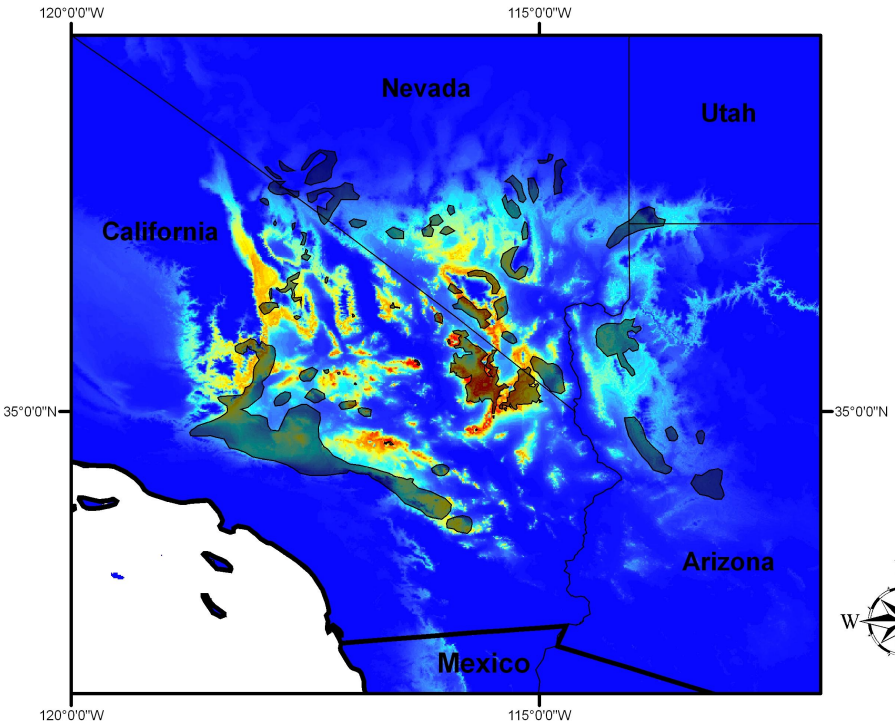
Kirsten E. Ironside[1]

[1] **Merriam-Powell Center for Environmental Research, NAU**

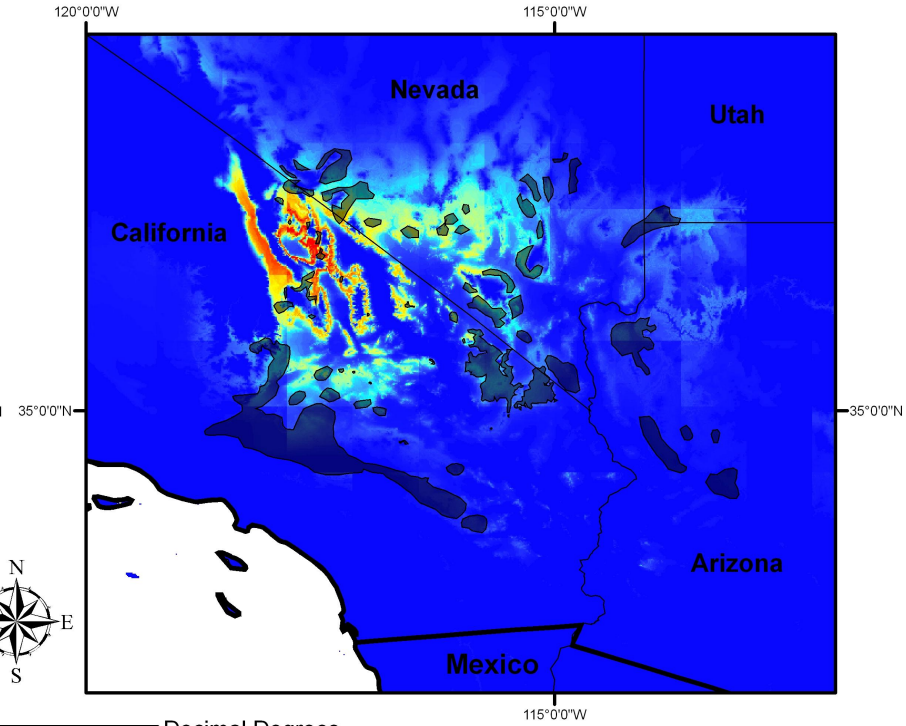
MPCER Research Shown is Supported by the U.S. Department of Energy's Office of Biological and Environmental Research through the Western Regional Center of the National Institute for Climatic Change Research (**http://niccr2.bio.nau.edu/niccr/index.html**)

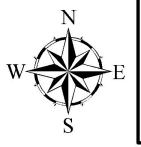
Likelihood of *Yucca brevifolia* Presence for the 20th Century and Future 2xCO_2 Climate

20th Century Climate



Potential Future 2xCO_2 Climate





Legend

Modeling and Natural Resources

Science and the Resource Management Agencies

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in a Changing Climate

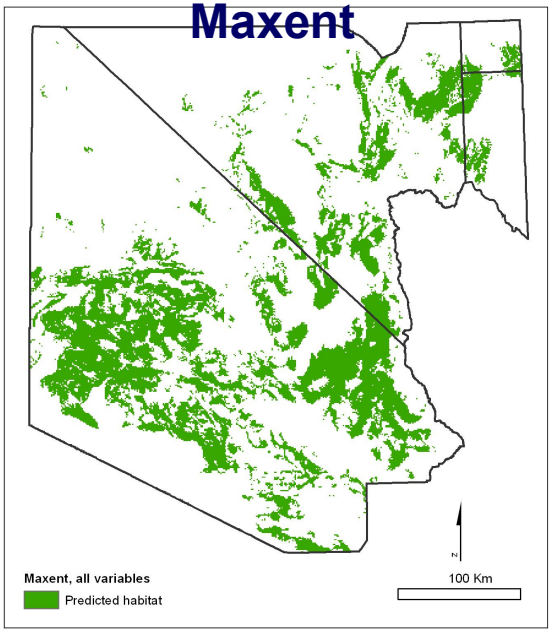
Debra Hughson

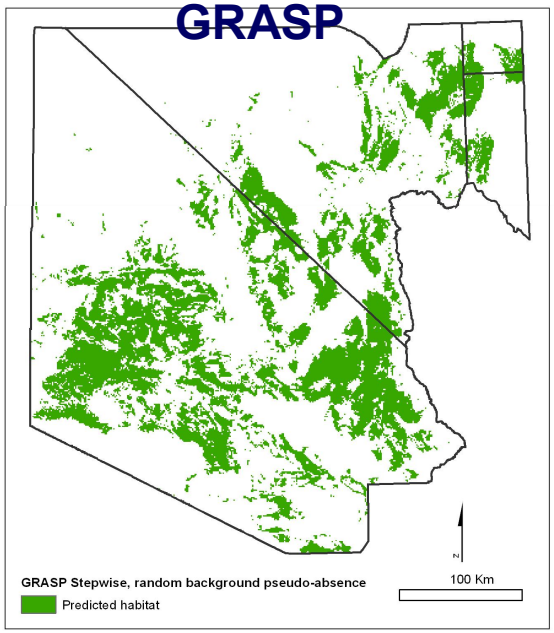
National Park Service - Mojave National Preserve

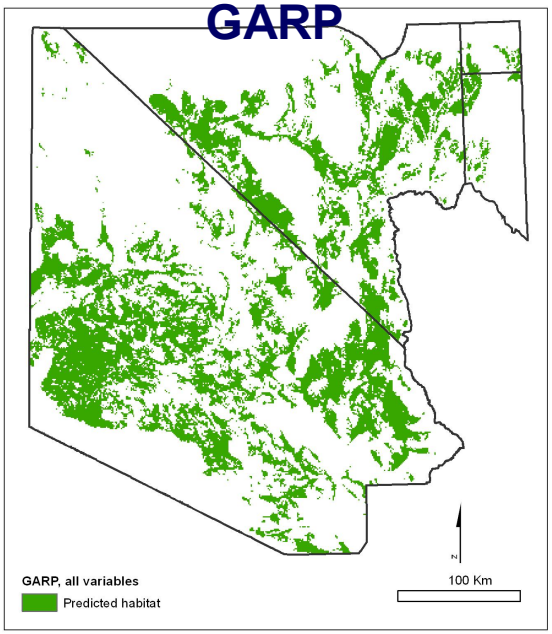
April 10, 2008

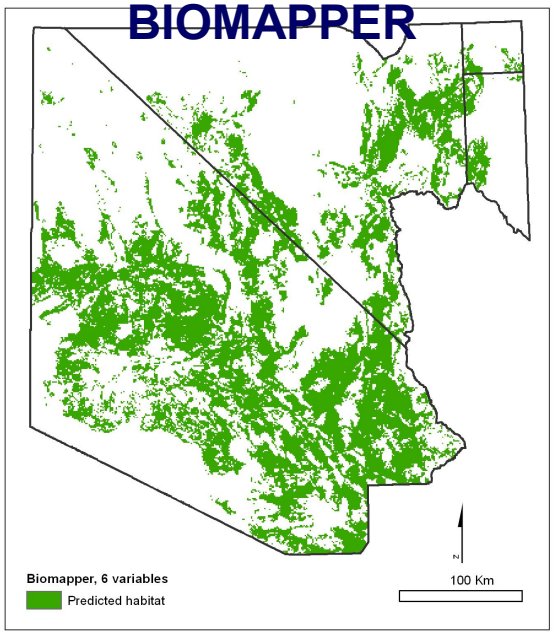
Aquarius Casino Resort

Laughlin, Nevada



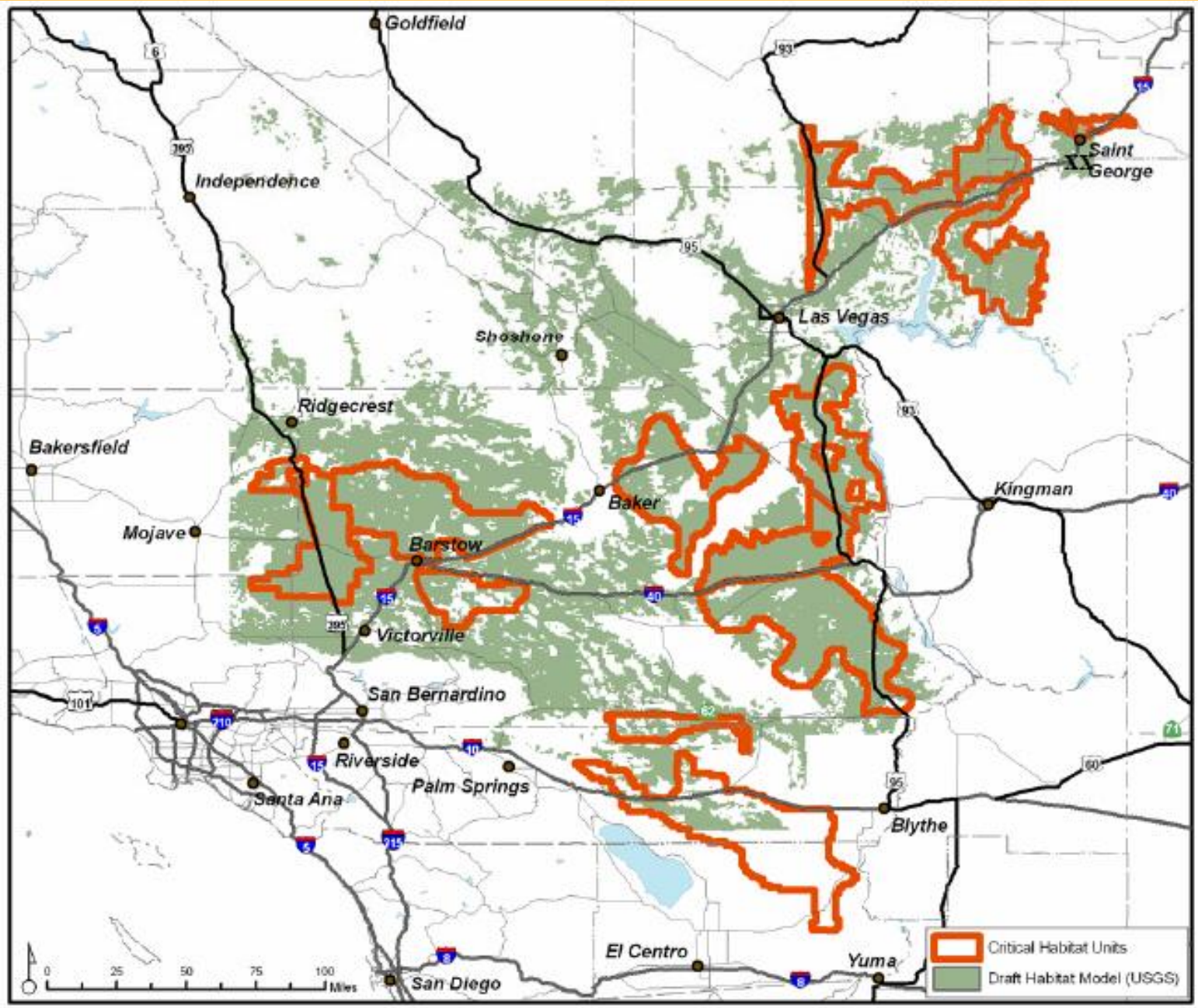






Habitat Model for desert tortoise

- Maximum Entropy
- Generalized Regression Analysis and Spatial Prediction
- Genetic Algorithm for Rule Set Production
- Ecological Niche Factor Analysis


Goldfield
Independence
Saint George
Las Vegas
Shoshone
Ridgecrest
Bakersfield
Baker
Kingman
Mojave
Barstow
Victorville
San Bernardino
Riverside
Palm Springs
Santa Ana
Blythe
El Centro
Yuma
San Diego
0 25 50 75 100 Miles
Critical Habitat Units
Draft Habitat Model (USGS)

USGS
science for a changing world

State and Transition Models For Desert Ecosystems

Todd C. Esque
Western Ecological Research Center

The Climate and Deserts Workshop:
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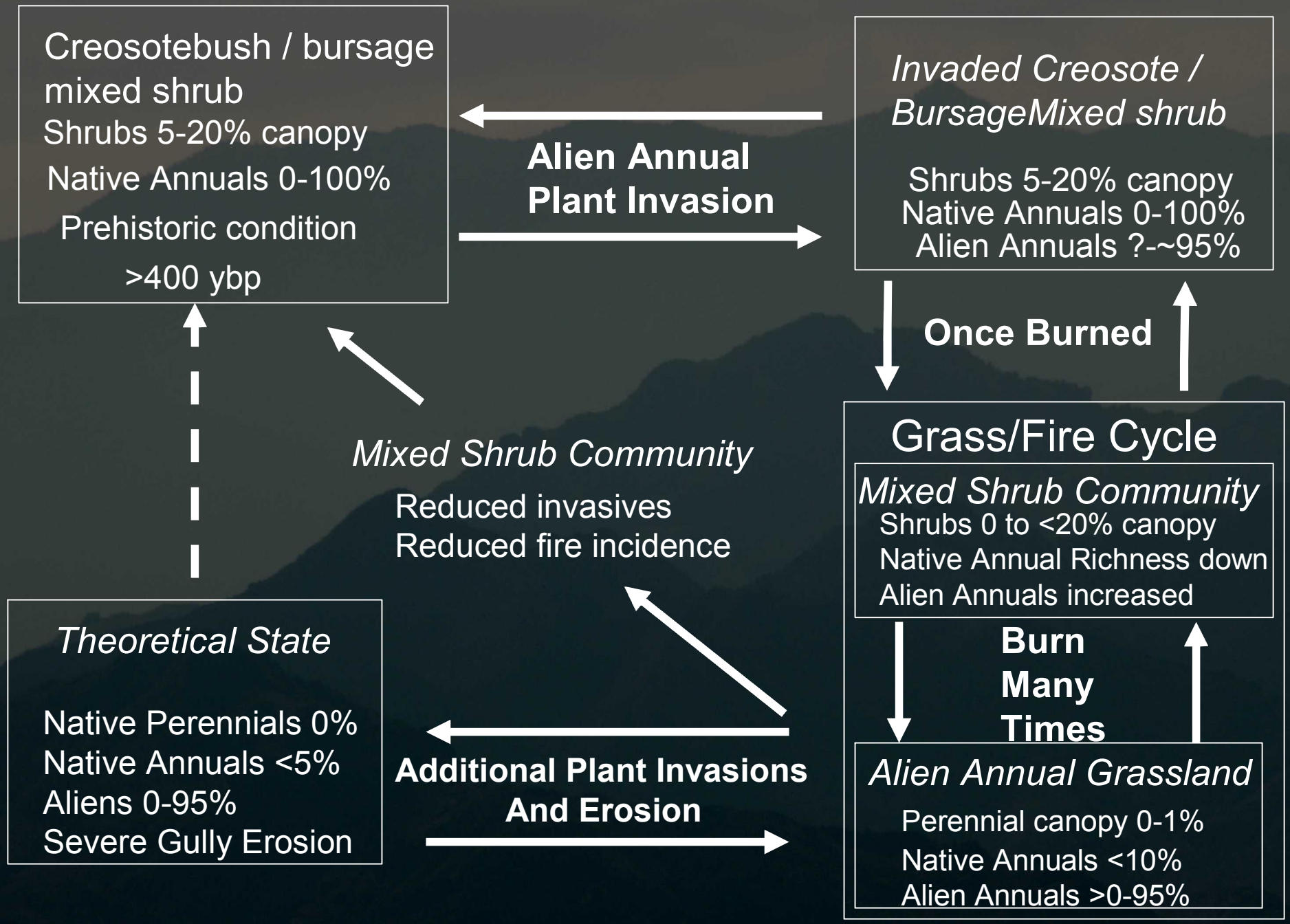
11 April 2008

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


Creosotebush / bursage mixed shrub
Shrubs 5-20% canopy
Native Annuals 0-100%
Prehistoric condition
>400 ybp
Alien Annual Plant Invasion
Invaded Creosote / BursageMixed shrub
Shrubs 5-20% canopy
Native Annuals 0-100%
Alien Annuals ?-~95%
Once Burned
Grass/Fire Cycle
Mixed Shrub Community
Shrubs 0 to <20% canopy
Native Annual Richness down
Alien Annuals increased
Burn Many Times
Alien Annual Grassland
Perennial canopy 0-1%
Native Annuals <10%
Alien Annuals >0-95%
Mixed Shrub Community
Reduced invasives
Reduced fire incidence
Theoretical State
Native Perennials 0%
Native Annuals <5%
Aliens 0-95%
Severe Gully Erosion
Additional Plant Invasions And Erosion

2. Grass/Fire Cycle

Gass Peak Fire, Desert National Wildlife Refuge 2005

USGS

III. Alien Annual Grassland

Climate Change Toolbox: Developing Scenarios for Climate Impact Assessments

Mike Crimmins
Dept. of Soil, Water, & Env. Science &
Arizona Cooperative Extension
The University of Arizona

Resources

- Canadian Climate Change Scenarios Network - http://www.cccsn.ca
- Information on Stochastic Weather Generators - http://www.ipcc-data.org/ddc_weather_generators.html
- General Guidelines on the use of Scenario Data for Climate Impact and Adaptation Assessment - http://www.ipcc-data.org/guidelines/index.html
- Southwest Climate Change Network – Coming soon!

email: crimmins@u.arizona.edu
http://cals.arizona.edu/climate