MANAGING To ACCOMODATE CHANGE: Climate Change and the National Wildlife Refuge System

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Coastal Protected Areas

- 548 National Wildlife Refuges
  - 161 coastal
- ~270 National Parks
  - 35 coastal

Don Edwards San Francisco Bay NWR

Think about a place you love

- What was it when you first came to know it?
- What did it mean to you?
- What is it today?
- What are your hopes and dreams for its future?

A System Born in Crises

Refuge System Timeline

1903	1930s	1966	21st century
Overharvest of birds and mammals	Declining waterfowl numbers	Extinction of wildlife	Extinction and Alteration of Ecosystem Services
Pelican Island NWR	Over 200 refuges established for migratory birds	61 Refuges established for T&E species	Climate change and landuse change

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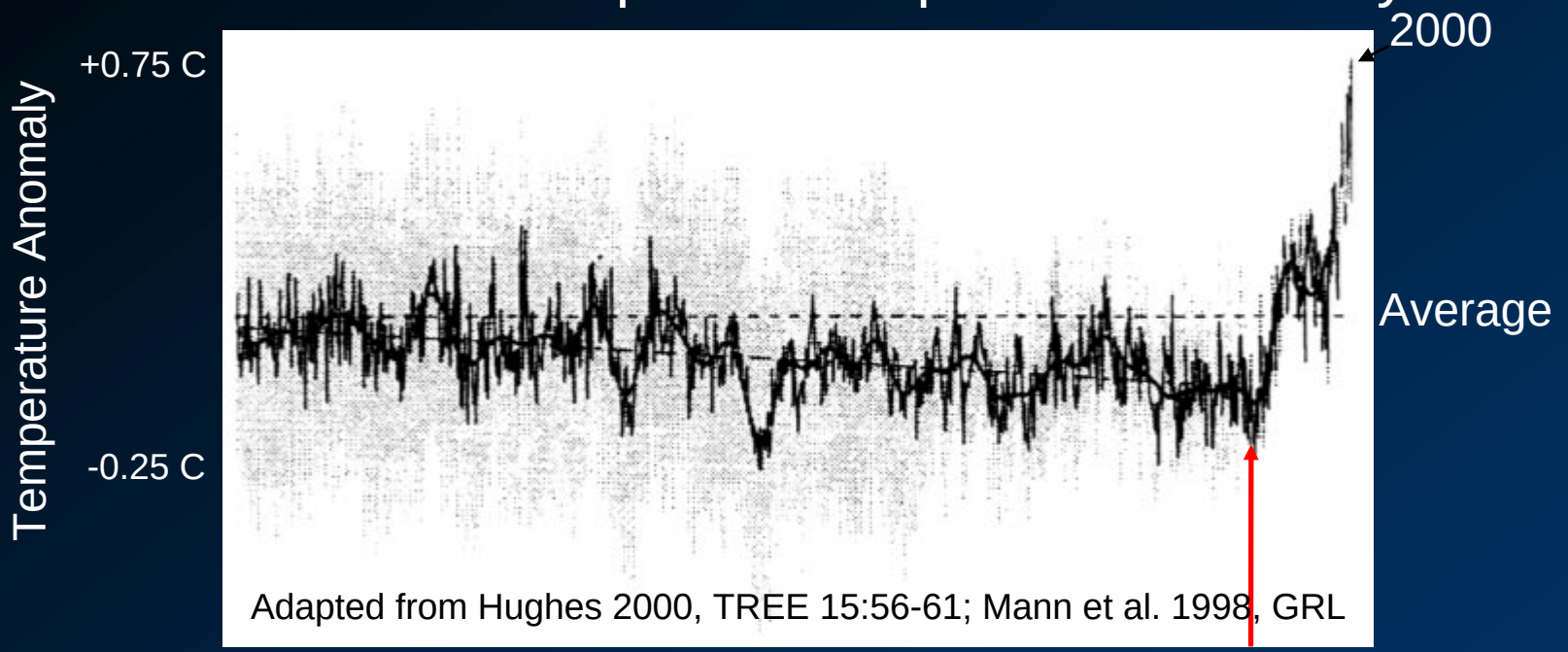
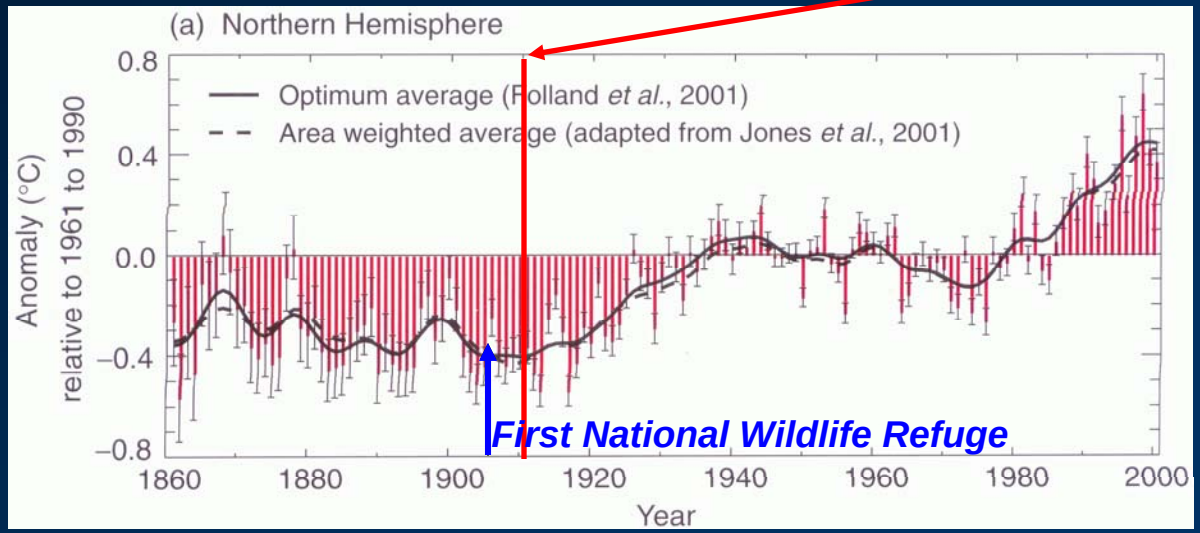
Northern Hemisphere Temperature Anomaly



1000

1910



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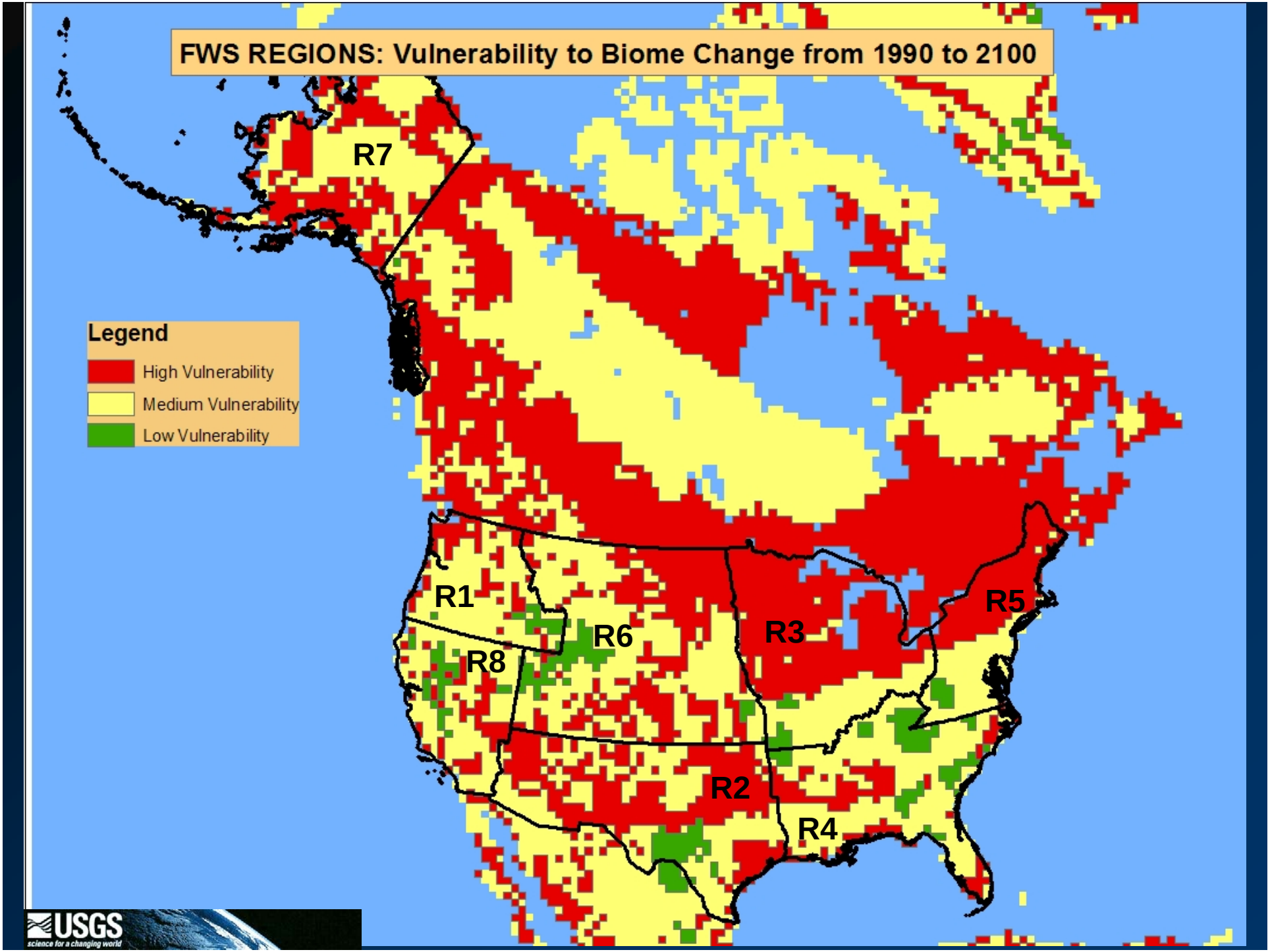
FWS REGIONS: Vulnerability to Biome Change from 1990 to 2100
Legend
High Vulnerability
Medium Vulnerability
Low Vulnerability
R7
R1
R6
R8
R3
R5
R2
R4
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Effects of Global Climate Change

- Climate change likely to surpass habitat loss as the leading threat to biodiversity

  (Thomas et al. 2004)

- Climate change acts synergistically with all other stressors

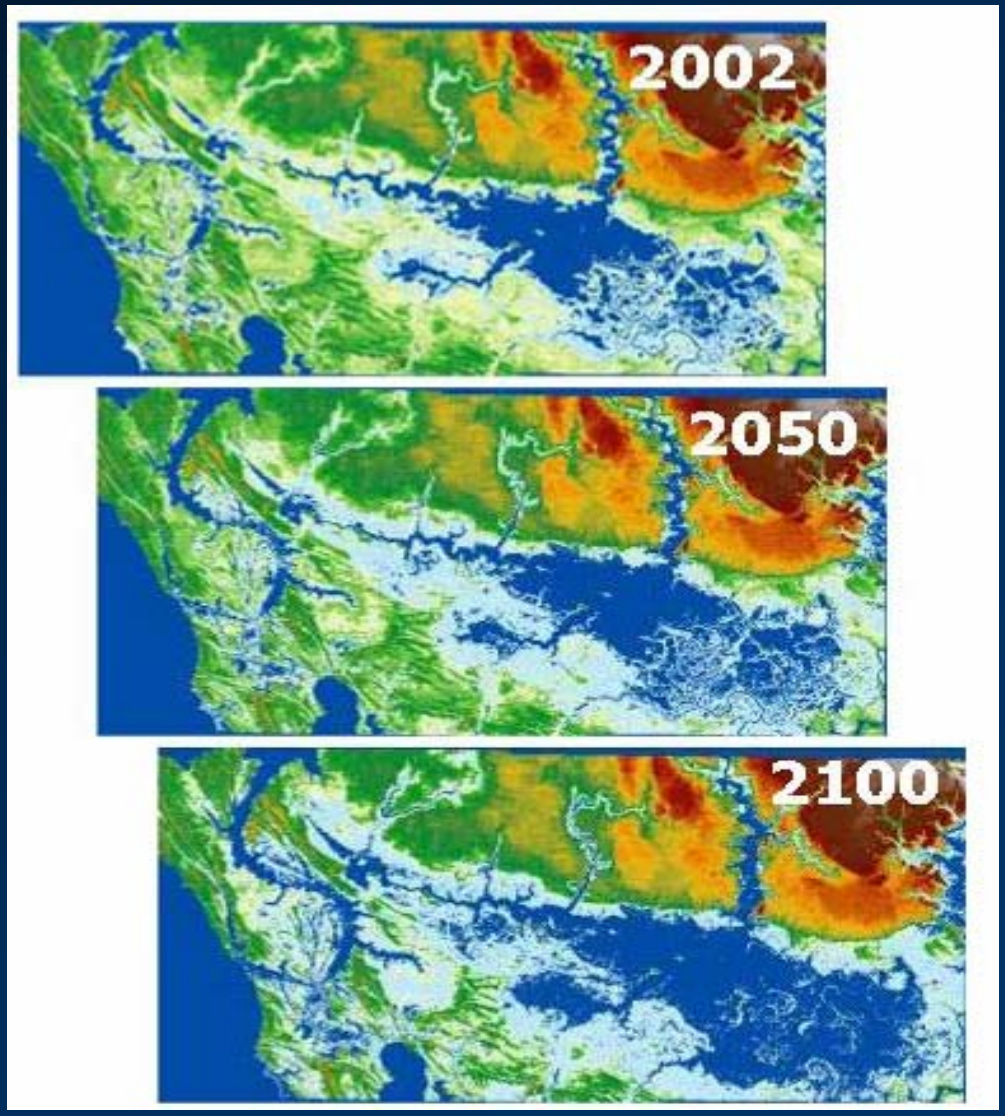
Sea Level Rise

Blackwater NWR

Sea level projected to rise 3mm/yr:

1 foot rise by 2050

2 feet rise by 2100



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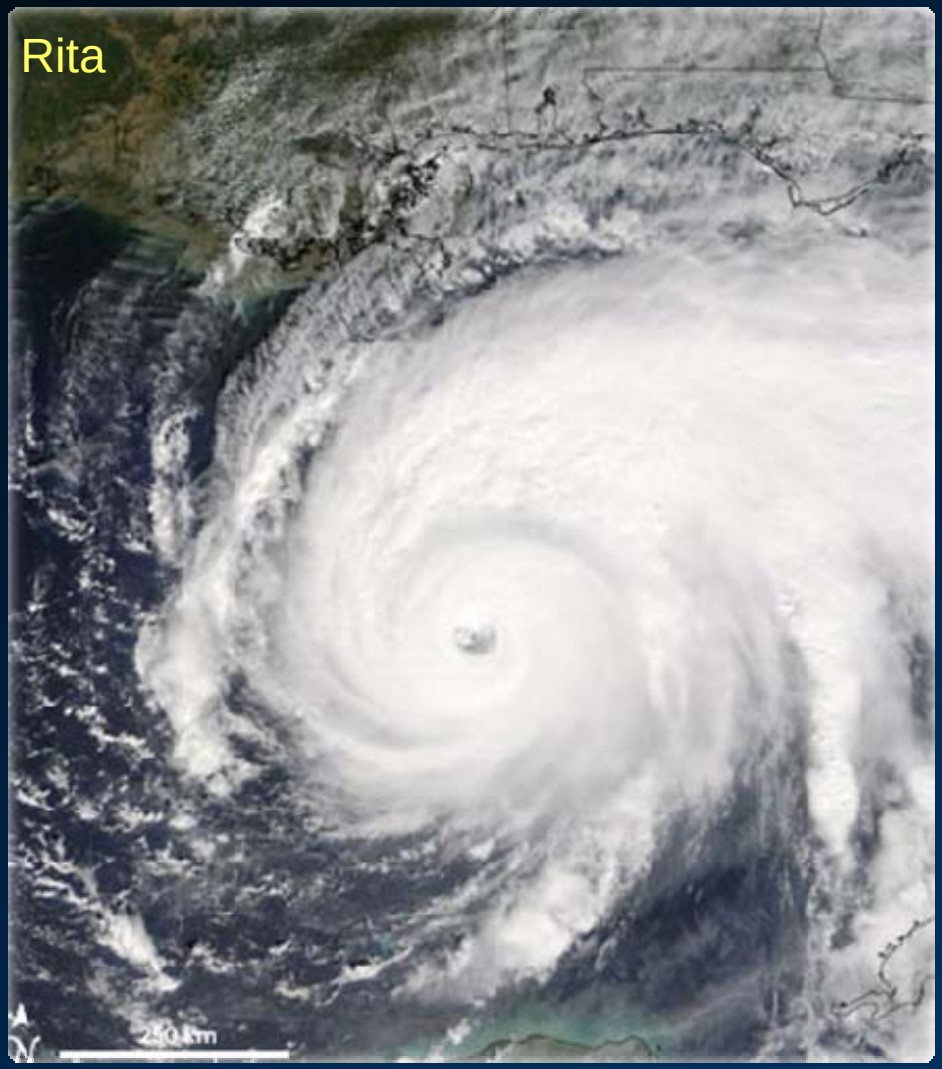
Increase in the intensity and frequency of tropical storms

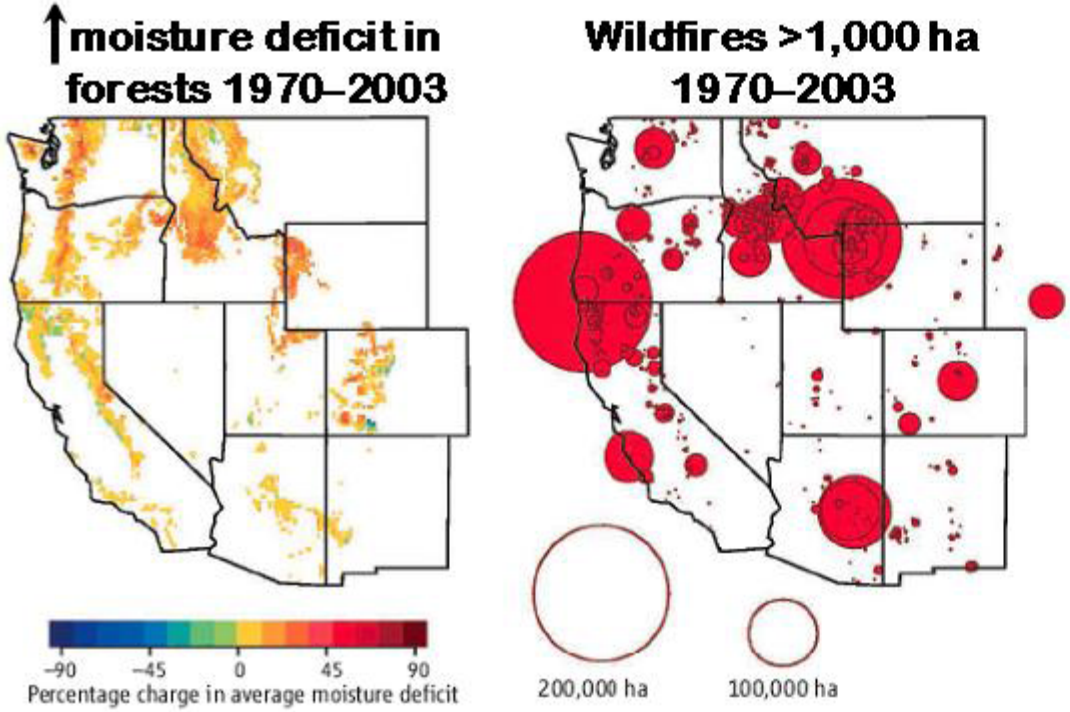


http://coastal.er.usgs.gov/hurricanes/rita/images/hurricane-ritaLG.jpg

http://www.ascn92.dsl.pipex.com/hurricane_rita_damage/hurricane_rita_050924_Lafitte_LA.jpg

Altered Disturbance Regimes

Larger, more frequent wildfires since 1980s in West



- More large wildfires
- Longer wildfire durations
- Longer wildfire seasons
- Strongly associated with increased spring and summer temperatures and earlier spring snowmelt

Running 2006, Westerling et al. 2006

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Climate Change Increases Complexity

- Lots of “usual” problems
  - Fragmentation, pollution competition for water....
- Climate change adds forcing trends
  - These are not uniform across refuges
  - They may create complex non-linear responses
  - The concept of a stable equilibrium is untenable
- Difficult to project
  - What, when and where
- Biome shifts or Non-analog communities

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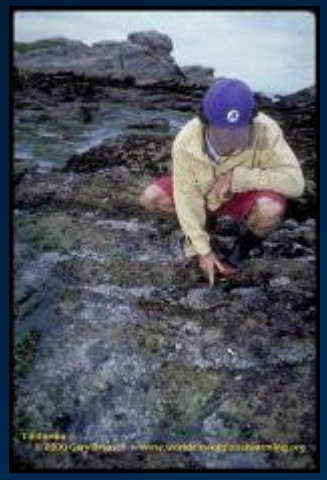
Altered Species Distributions

90% decline in pop. of Sooty Shearwater (1987 – 1994) **(Veit et al. 1997)**

CA shoreline species shifting northwards **(Barry et al. 1995)**



Uncompahgre fritillary butterfly on brink of extinction **(Britten et al. 1994)**

Edith's checkerspot butterfly shifted range northward **(Parmesan 1996, McLaughlin et al. 1999)**

Polar bears increasingly using coastal areas as sea ice melts earlier and freezes later **(Gleason et al. 2006, Schliebe et al. 2006)**

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Altered Phenologies

89 of 100 flowering plants in DC area blooming 4.5 days earlier in 2000 vs. 1970.

Egg laying date of NA tree swallows ~ 9 days earlier (1959 to 1991) (Dunn & Winkler 1999)

Earlier arrival of migrants (Root et al. 2004)

Lilac blooming ~4 days earlier (NE)

Species Interactions

Competitive Displacement

- Red fox displaces Arctic fox

Herbivory

- Mountain pine beetle

Trophic cascade

- Elk wintering in summer habitat

HIGHEST RISK SPECIES

Highest risk:

- Populations on the edges of species ranges
  - (High altitude species, polar species)

- Threatened and endangered species
- Narrowly distributed species

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309 refuges will lose waterfowl species as a result of range contraction.
229 refuges will gain or retain waterfowl species as a result of range expansion or stable range.
Pidgorna 2007 Dissertation
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Protected Areas Insufficient With Global Climate Change

- Too small;
- Too fragmented;
- Embedded in an inhospitable matrix;
  - Anthropogenic, competing land uses
- Expected community shifts
  - e.g. tundra to northern boreal forest

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Most Vulnerable Refuges

- Alaskan refuges (16)
- Coastal refuges (161)
- Refuges projected to experience a biome shift

Arctic NWR

Blackwater NWR

Prairie pothole region

How to respond to climate change and associated complexities?

- Ignore
- Resist
- Reduce non-climate stressors
- Triage
- Mitigate
- Anticipate and adapt
  - Manage to accommodate and exploit change

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New tools, new ideas and new relationships are needed

- Nontraditional partnerships.
- Thinking across boundaries and scales.
- Strategic Habitat Conservation
- Thinking across disciplines.
- The reintegration of conservation areas into the American landscape (Rosenzweig, 2003).

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Managing to accommodate change in the face of uncertainty

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Management opportunities for Individual Refuges

- Increase resilience, reduce stress

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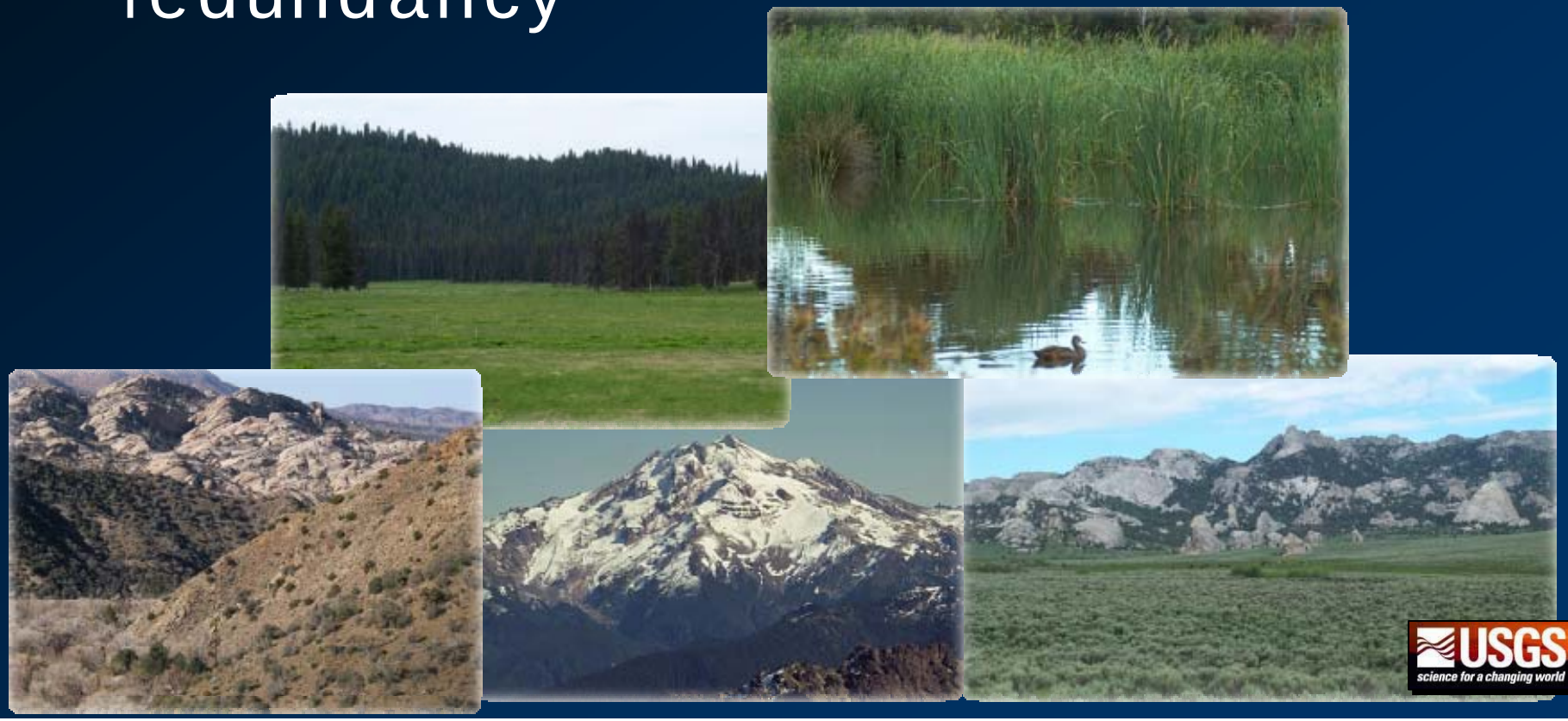
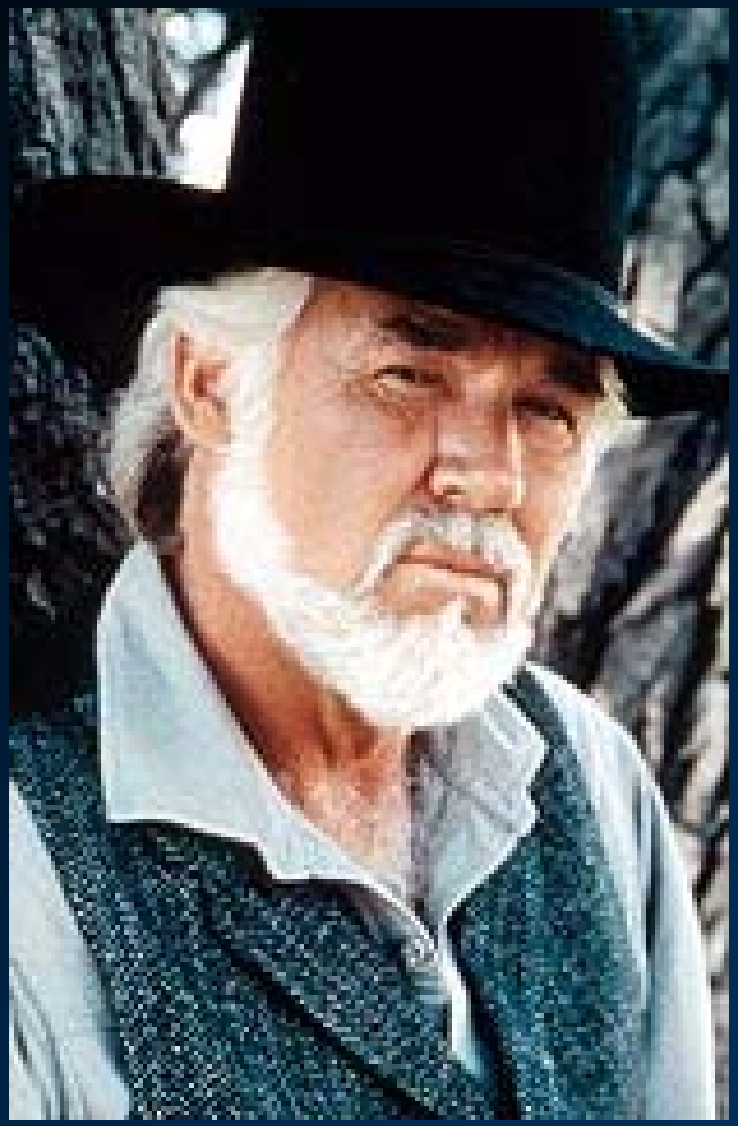
Management opportunities for the National Wildlife Refuge System

- Increase representation and redundancy





You've got to know when to hold 'em

Know when to fold 'em

Know when to walk away

And know when to run.

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Where to go from here?

Challenges

- Water access
- Changing Conditions:
  - ecological and environmental
  - Social and economic
- Unprecedented scale of projected changes
  - Temporal and spatial
- New conservation partnerships
- Increasingly fragmented landscapes
- 80% of threatened and endangered species are conservation reliant
- Increasing human population

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Conservation Assessment

- Determine vision for conservation landscape
- Assess representation and redundancy of conservation targets in existing system(s)
- Identify gaps in conservation network
- Strategically fill gaps
- Assess representation and redundancy under multiple climate change and landuse scenarios

Opportunities

- Educational Centers
  - use refuges as educational centers to inform public of climate change effects on wildlife and ecosystem processes
- Cooperative conservation partnerships
  - Increase influence on matrix lands
- Multiagency management of species e.g. harlequin duck
- Models for energy efficient living
- Researcher/manager workshops
- Inventory current management practices to determine usefulness of response to climate change

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What can we do in the next six months?

- Evaluate possible climate scenarios and management responses
- Identify most vulnerable conservation targets
- Identify critical management-relevant research needs
- Identify most vulnerable refuges
- Develop strategic vision for National Wildlife Refuge System's future

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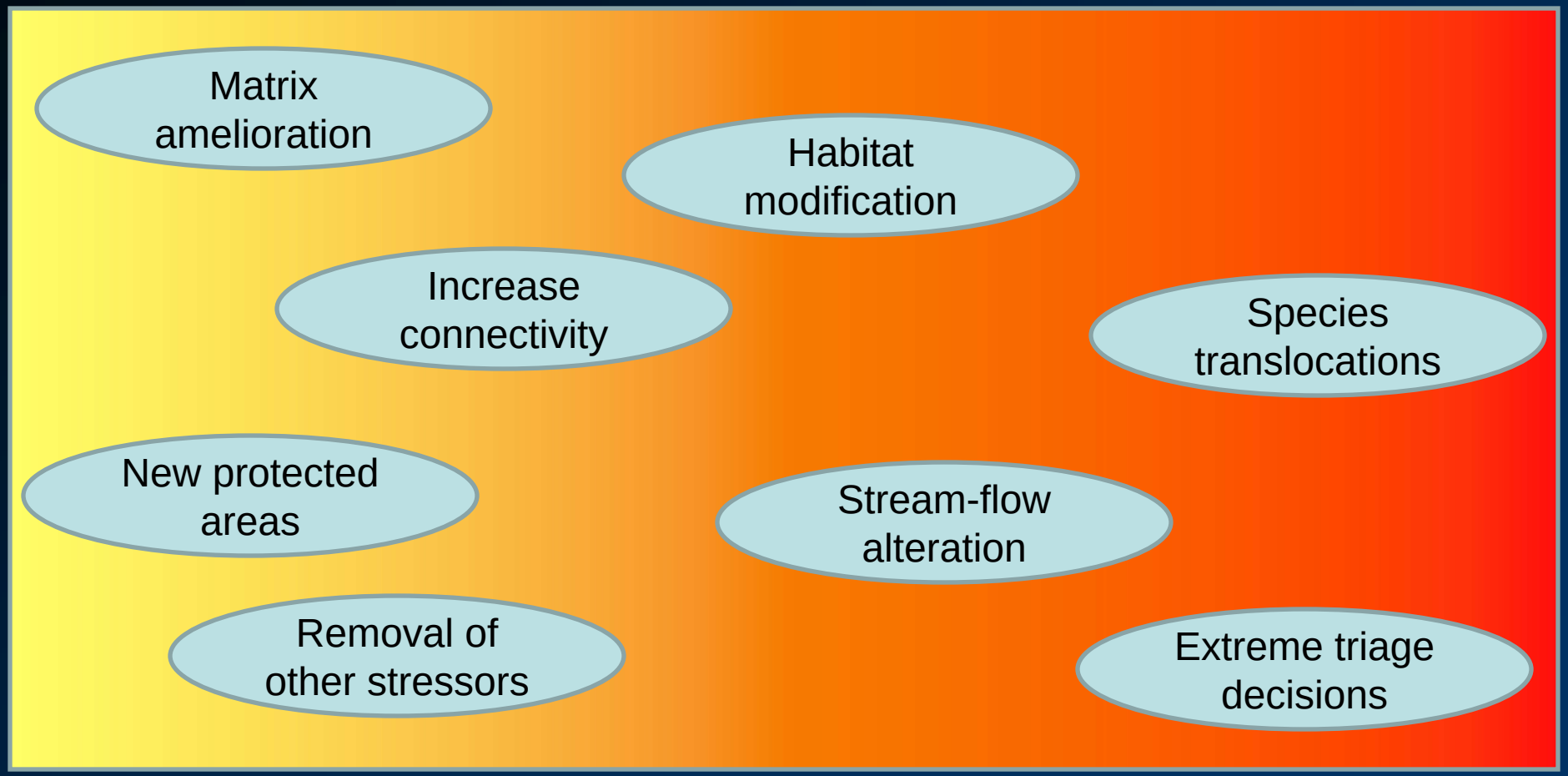
Management Strategies



Lower risk

Higher risk

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Adapted from Lawler et al. 2009

Summary

- Climate change is pervasive but will have variable effects.
- Exploit opportunities and prepare for negative effects.
- Management for static conservation targets is impractical.
- Species with limited dispersal abilities are at greatest risk.
- Acknowledge interaction among climate & other stressors.
- Act now to avoid irreversible losses (and save $$ and species).
- Model possible futures at all relevant management scales.
- Initiate comprehensive & multi-scale collaborations.
- Increase the effective conservation footprint of refuges.

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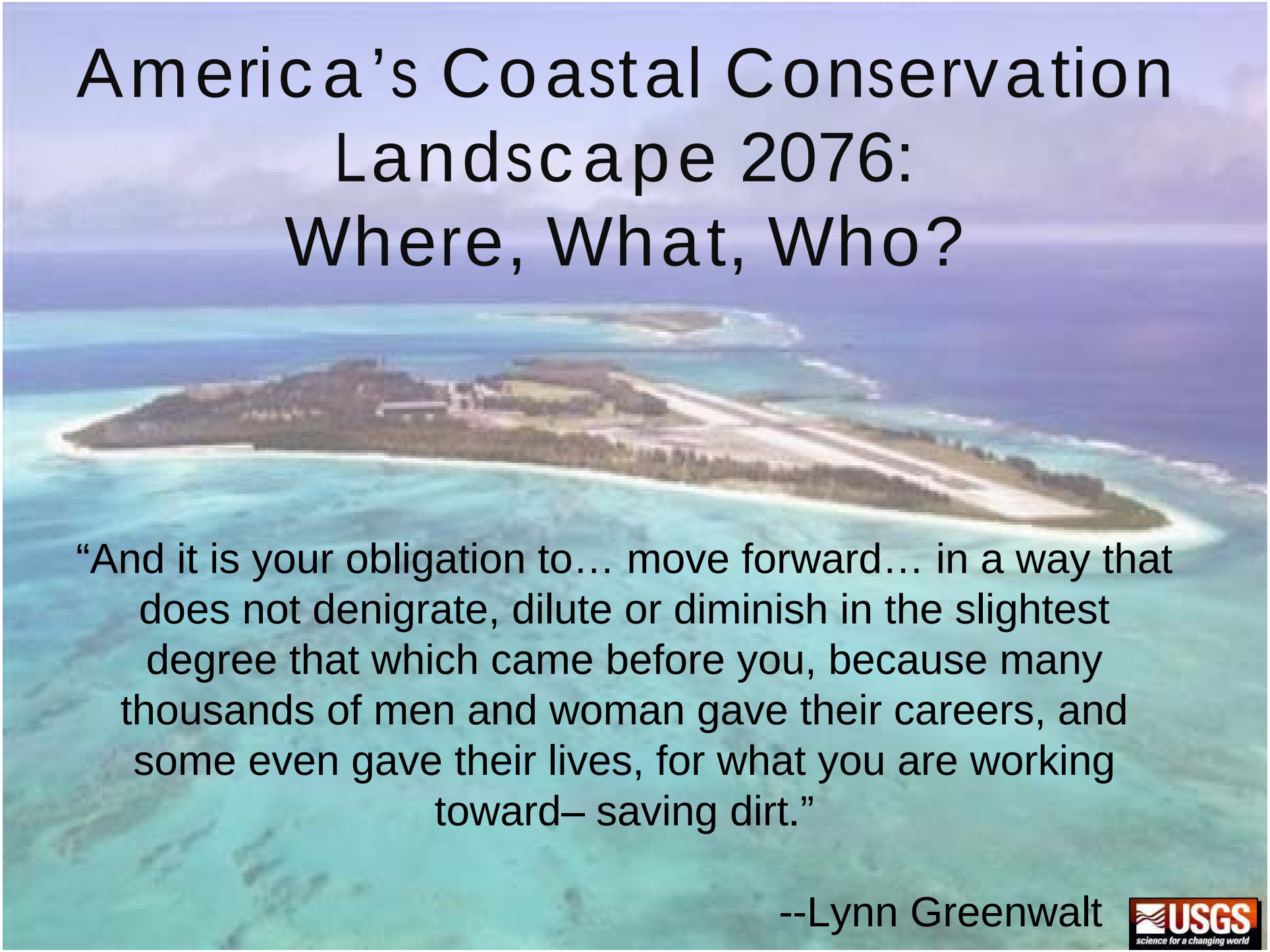
America's Coastal Conservation Landscape 2076: Where, What, Who?



"And it is your obligation to… move forward… in a way that does not denigrate, dilute or diminish in the slightest degree that which came before you, because many thousands of men and woman gave their careers, and some even gave their lives, for what you are working toward– saving dirt."

--Lynn Greenwalt

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