



NATIONAL
ESTUARINE
RESEARCH
RESERVE
SYSTEM



NATIONAL ESTUARINE RESEARCH RESERVE SYSTEM

Assessing Habitat and Community Sensitivity to Climate Change Impacts

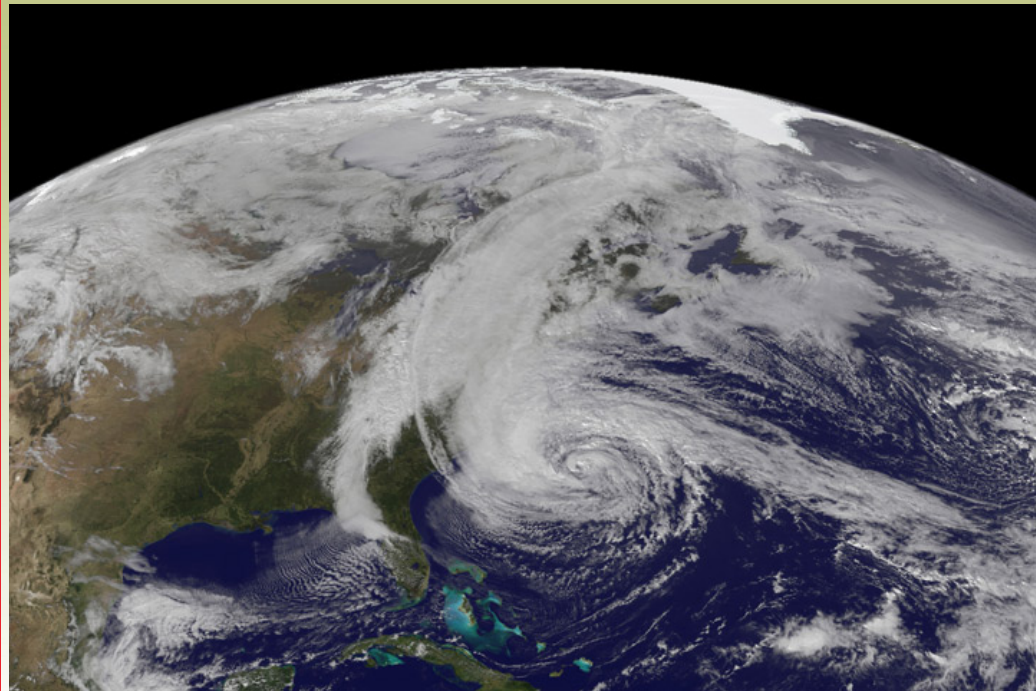
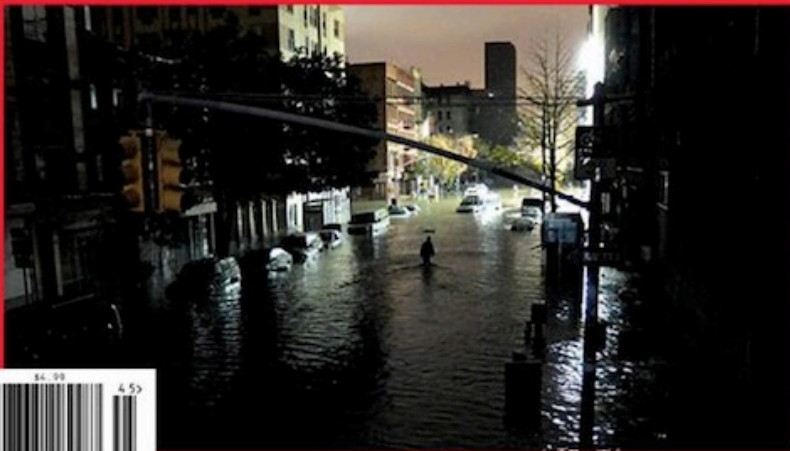
Dr. Dwight Trueblood (NOAA)
Dr. Jeff Crooks (Tijuana NERR)
Dani Boudreau (Tijuana NERR)

December 12, 2013



**Bloomberg
Businessweek**
**IT'S GLOBAL
WARMING,
STUPID**

November 5 - November 11, 2012 | bloomberg.com



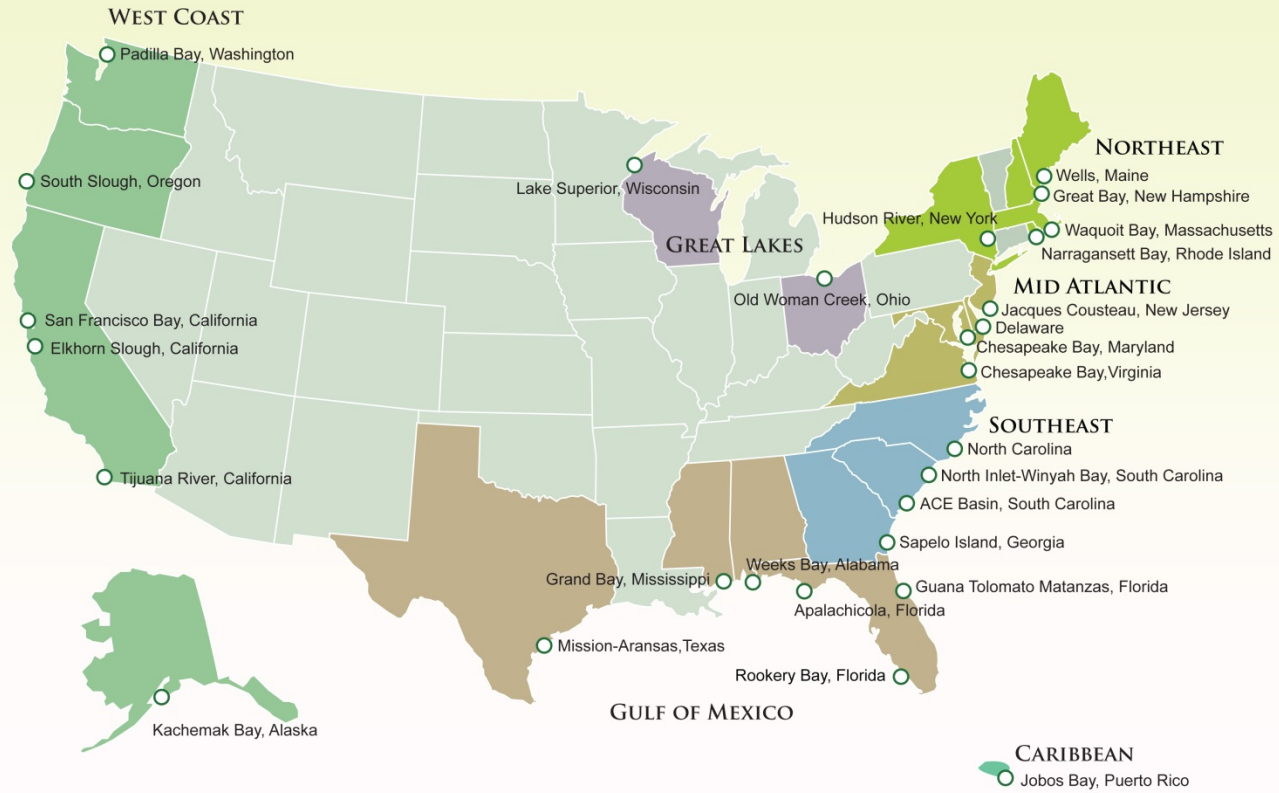
Hurricane Sandy

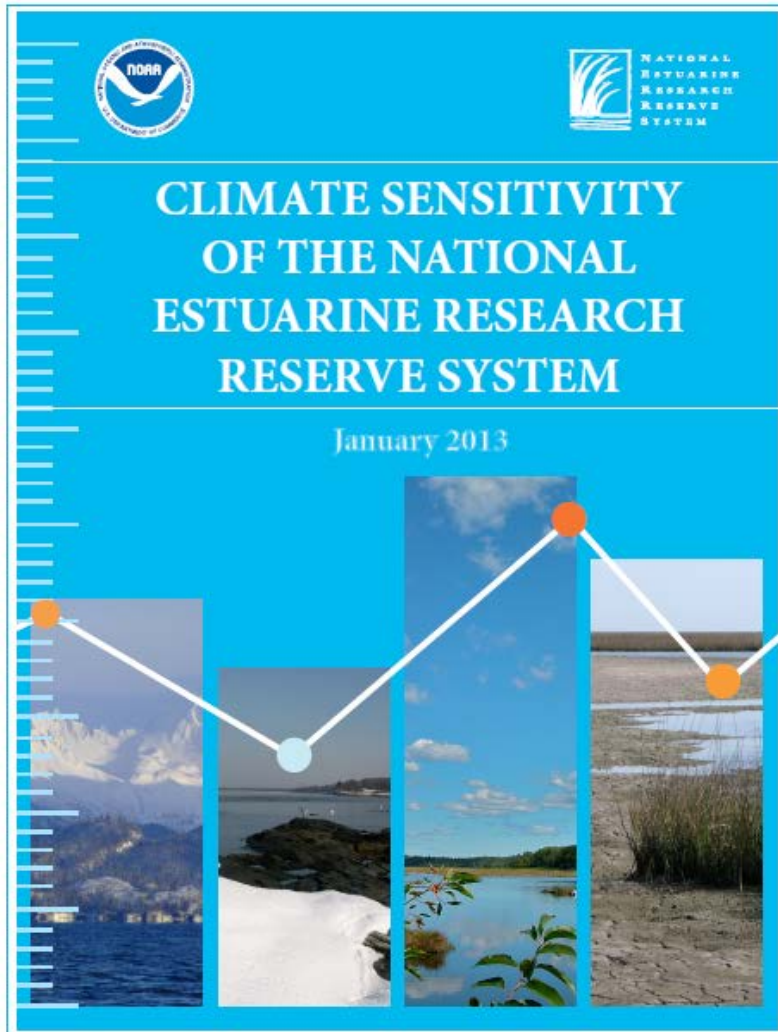
- Oct. 22-31, 2012
- 285 fatalities
- 650,000 homes damaged or destroyed
- \$75 billion in damages





NATIONAL ESTUARINE RESEARCH RESERVE SYSTEM





<http://nerrs.noaa.gov/News.aspx?id=405>



NERRS Climate Sensitivity Project Goals and Objectives

Project Goal

- Understand reserves sensitivity to climate change from an integrated ecological and social perspective

Project Objectives

- Synthesize data and information about biophysical and social attributes of reserves
- Identify the stressors and climate hazards that impact reserves
- Categorize reserves based on their attributes, climate hazards, and stressors
- Assess overall climate sensitivity based upon integrated analysis of attributes, climate hazards, and stressors



Project Team

- **Biophysical Team**

- AK Leight and Bob Wood, NOAA/NCCOS/Cooperative Oxford Lab

- **Social Science Team**

- Patrick Robinson (Lead), Katherine Curtis, Ken Genskow, Dan Veroff, Jing Gao, and Jerrett Jones, University of Wisconsin

- **NOAA NERRS Team**

- Dwight Trueblood (Lead), Laurie McGilvray, Marie Bundy, and Erica Seiden



Social Sensitivity Methodology

- Define geographic unit for social analysis
- Quantify social sensitivity
- Develop ecological stressor and integrity rating
- Examine economic contributions from reserves
- Data integration with biophysical team (noting that this project has been integrated throughout)



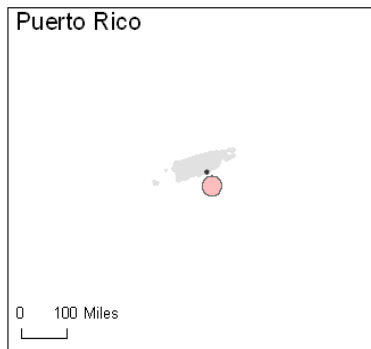
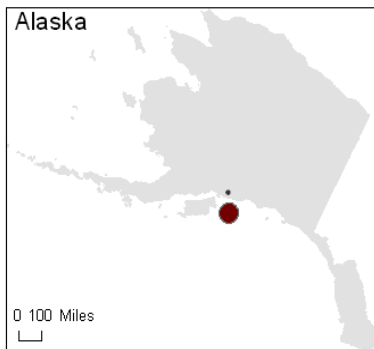
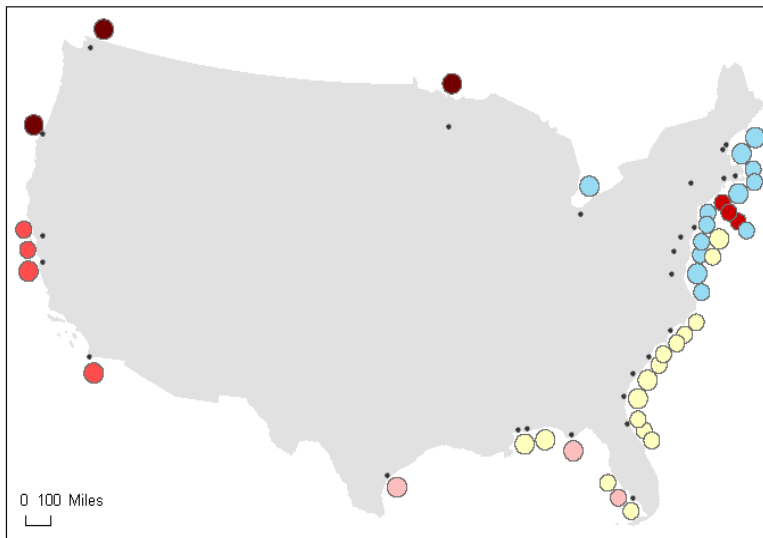
Socio-Economic Variables

Selected variables represented:

- Race and ethnicity
- Social dependence
- Socio-economic status
- Education
- Employment
- Family structure
- Gender
- Residential infrastructure



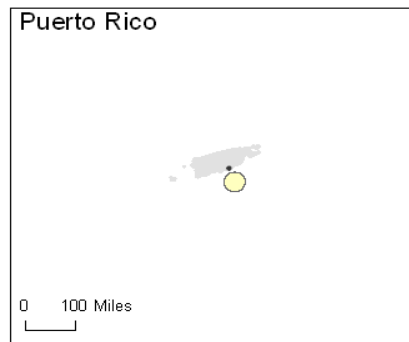
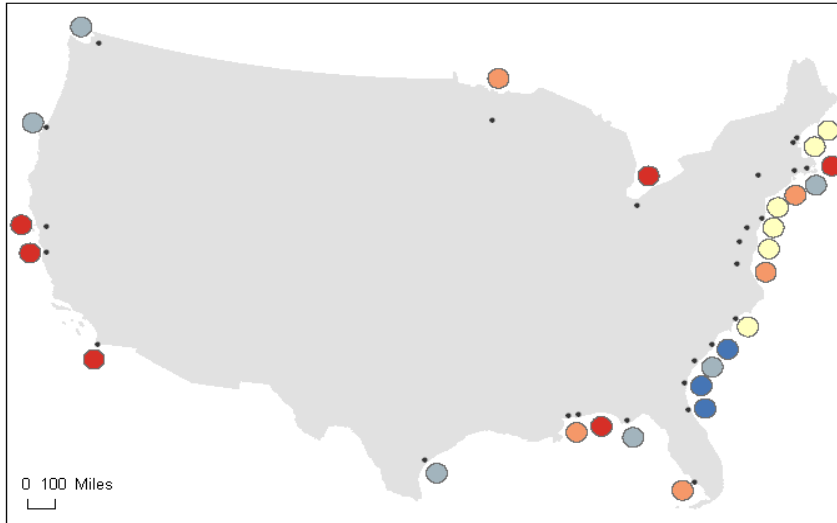
Reserve Social Sensitivity Clusters



High Social Sensitivity if:

- High employment in natural resource-dependent industries
- Low per capita income
- Low median home values
- High percentage of minority populations
- Lack of high school education





Relative Ecological Resiliency



Reserve Ecological Resilience

Stressors

- Toxic pollutants
- Storm Impacts
- Invasive Species
- Habitat Fragmentation
- Sedimentation
- Shoreline Erosion

Factors:

- Development
- Land use
- Population growth
- Wastewater treatment
- Sea level rise



Biophysical Sensitivity Analysis

Climate Data (NCDC)

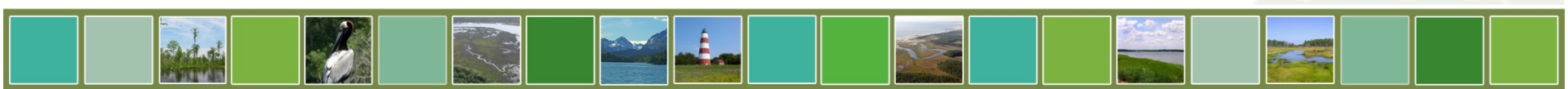
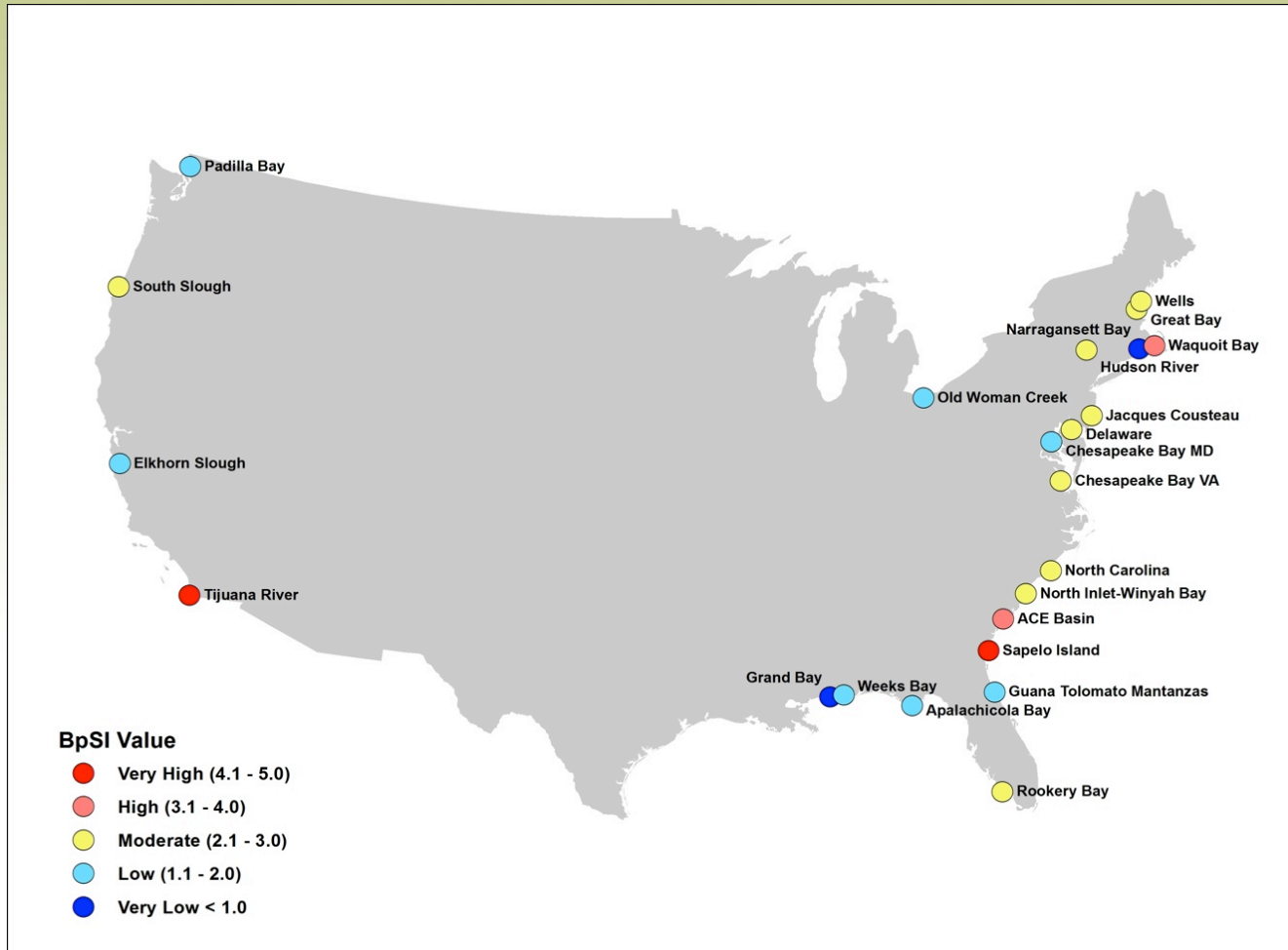
- Precipitation
- Air Temperature

Biophysical Data

- SWMP Water Quality
 - Water Temp
 - Specific Conductivity
 - pH
 - DO
 - Turbidity

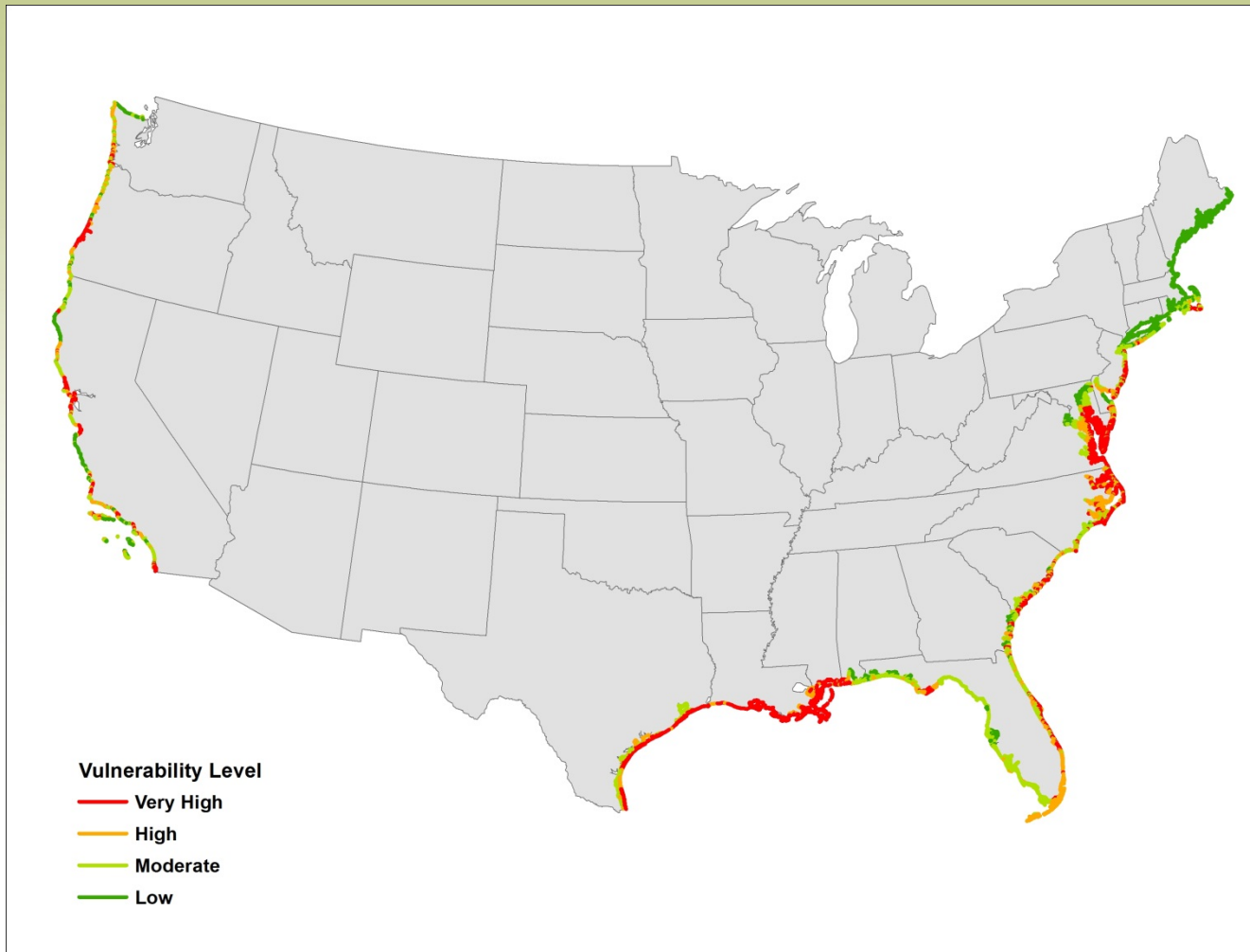


Biophysical Sensitivity





USGS Coastal Vulnerability Index



Projected Temperature Increase by 2050

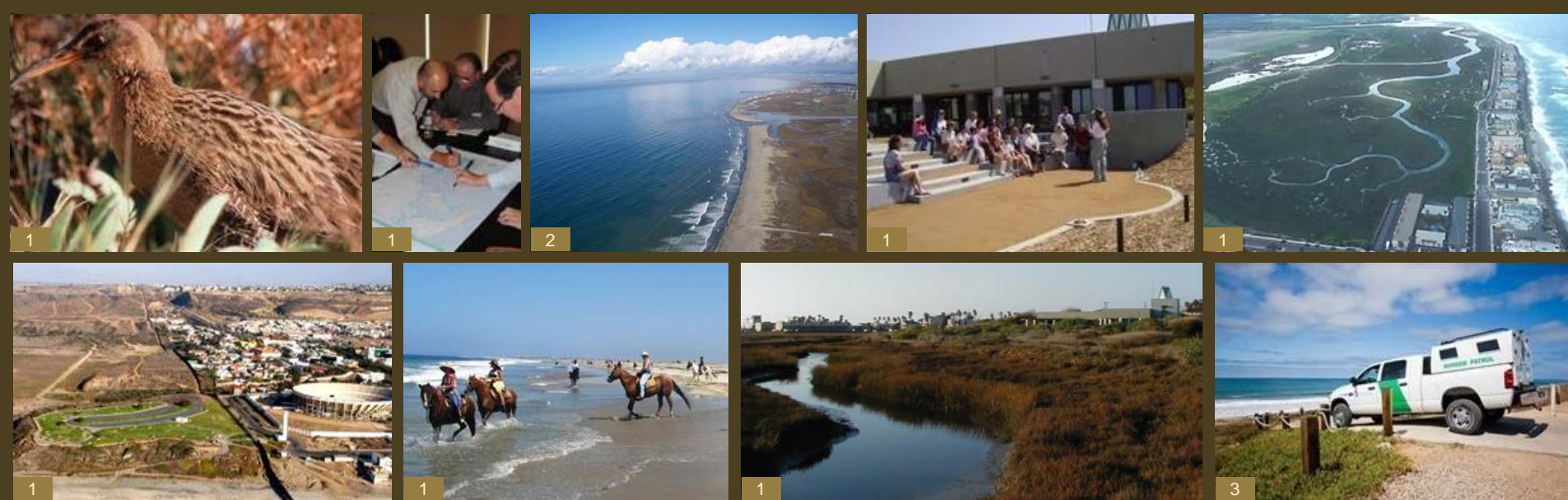
www.climatewizard.org

Reserve	Projected Change in Annual Average Temperature by the 2050s (°F)
Lake Superior, WI	5.4
Old Woman Creek, OH	5.1
Great Bay, NH	4.8
Wells, ME	4.8
Hudson River, NY	4.7
Narragansett Bay, RI	4.5
Jacques Cousteau, NJ	4.5
Delaware	4.4
Waquoit Bay, MA	4.4
Chesapeake Bay, MD	4.3
Chesapeake Bay, VA	4.1
Mission-Aransas, TX	4.1
Grand Bay, MS	4.0
Tijuana River, CA	4.0
Weeks Bay, AL	4.0
ACE Basin, SC	3.8
Sapelo Island, GA	3.8
North Carolina	3.8
Apalachicola, FL	3.7
Elkhorn Slough, CA	3.7
San Francisco Bay, CA	3.7
Padilla Bay, WA	3.7
North Inlet-Winyah, SC	3.6
Guana Tolomato Matanzas, FL	3.6
South Slough, OR	3.3
Rookery Bay, FL	3.2
Kachemak Bay, AK	2.3
Jobos Bay, Puerto Rico	1.6



NERRS Climate Sensitivity Synthesis

Region	Reserves	Social Sensitivity to Climate Impacts	Biophysical Sensitivity to Climate Impacts	Ecological Resiliency	Temperature Change Exposure	Sea Level Rise Exposure
Caribbean	Jobos Bay (PR)		---			---
Great Lakes	Lake Superior (WI)		---			---
	Old Woman Creek (OH)					---
Gulf of Mexico	Apalachicola (FL)					
	Grand Bay (MS)					
	Mission Aransas (TX)		---			
	Rookery Bay (FL)					
	Weeks Bay (AL)					
Mid-Atlantic	Chesapeake Bay (MD)					
	Chesapeake Bay (VA)					
	Delaware (DE)					
	Jacques Cousteau (NJ)					
Northeast	Great Bay (NH)					
	Hudson River (NY)					---
	Narragansett Bay (RI)					
	Waquoit Bay (MA)					
	Wells (ME)					
Southeast	ACE Basin (SC)					
	Guana Tolomato Metanzas (FL)					
	North Carolina (NC)					
	North Inlet-Winyah Bay (SC)					
	Sapelo Island (GA)					
West Coast	Elkhorn Slough (CA)					
	Kachemak Bay (AK)		---			---
	Padilla Bay (WA)					---
	San Francisco Bay (CA)		---			
	South Slough (OR)					
	Tijuana River (CA)					



Climate Understanding & Resilience in the River Valley



Danielle Boudreau & Dr. Jeff Crooks ♦ December 2013 ♦ EBM



Presentation Overview

- Tijuana River Valley
- Living with the Water
 - CURRV Project
- Responding to Climate Change
 - Climate Adaptation & Vulnerability Assessment
- Wrap-up
 - Lessons Learned



TIJUANA RIVER VALLEY



Tijuana River Watershed

Straddles US/ Mexico border

Nearly 75% of watershed is located in Mexico

Drains to the Pacific Ocean through the Tijuana River Valley



Tijuana River Valley

Between two major metropolitan areas- San Diego and Tijuana

Contains contiguous beach, dune, salt marsh, riparian, and upland ecosystems

One of the largest remaining examples of coastal wetland habitats in southern California

Habitats are largely in public ownership



Ecosystem Management Focus

Sediment



Trash



Sewage



Invasive Species



LIVING WITH THE WATER

CURRV PROJECT



Project Scope

Vulnerability Assessment

Climate Adaptation Strategy

Process Framework &
Science Transfer



Project Scope

- Flooding & Inundation from
- Sea Level Rise
 - Riverine Flooding



Management Targets

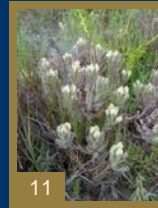
Built Infrastructure

- Cultural & historical resources
- Parks, recreation, & public access
- Agriculture
- Security & defense
- Stormwater management
- Wastewater management
- Transportation
- Residential & commercial property

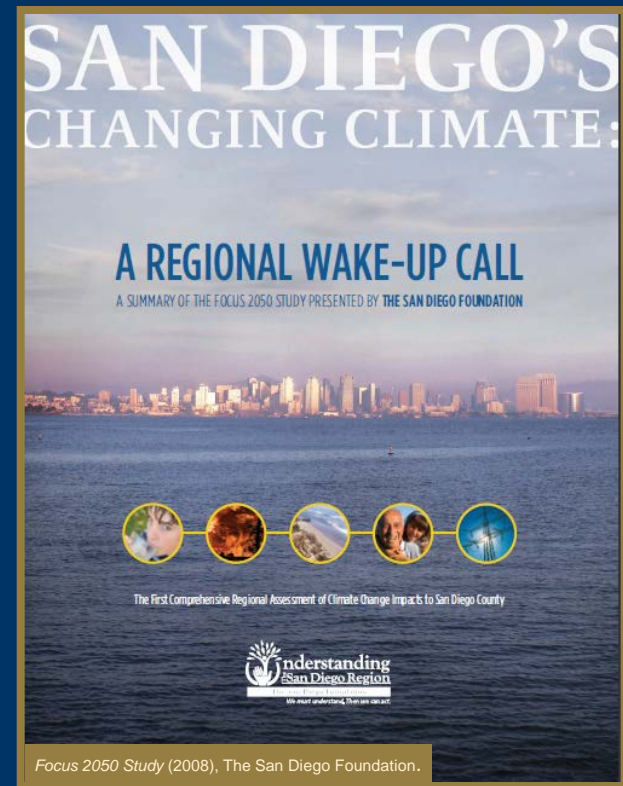
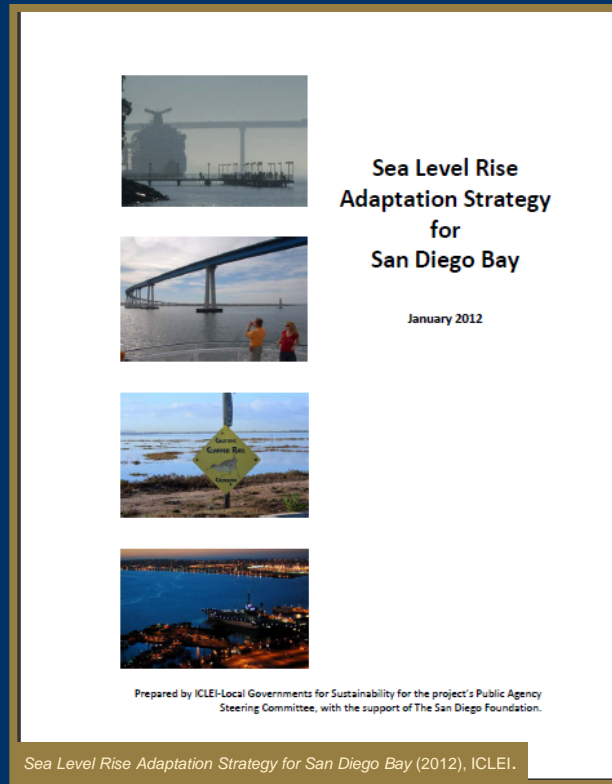


Natural Environment

- Sand dunes & beaches
- Tidal channels & mudflats
- Salt marsh
- Fresh-brackish marsh
- Riparian
- Coastal sage scrub
- Upland transition zone
- Vernal pools



Climate Adaptation in San Diego



Timeline

2013

2014

2015

Convene
Project Team
& Scope

Vulnerability
Assessment

Climate
Adaptation
Strategy

Implement
& Monitor

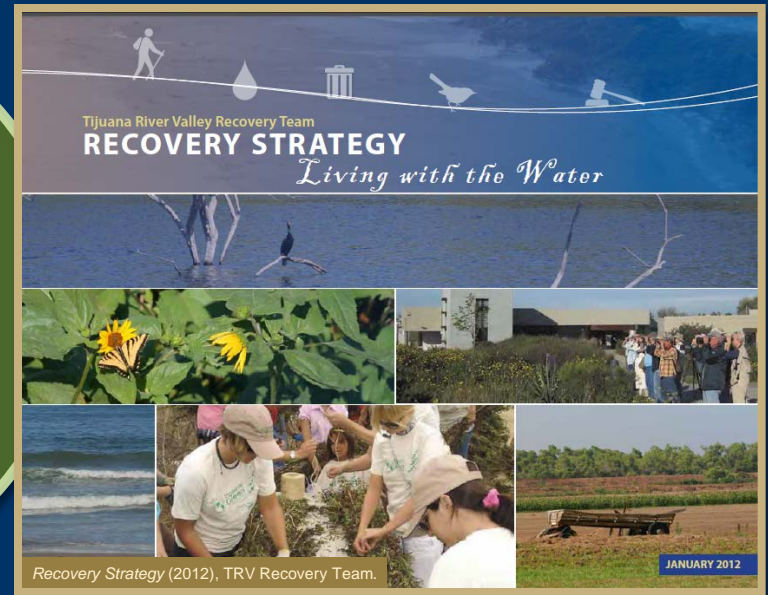
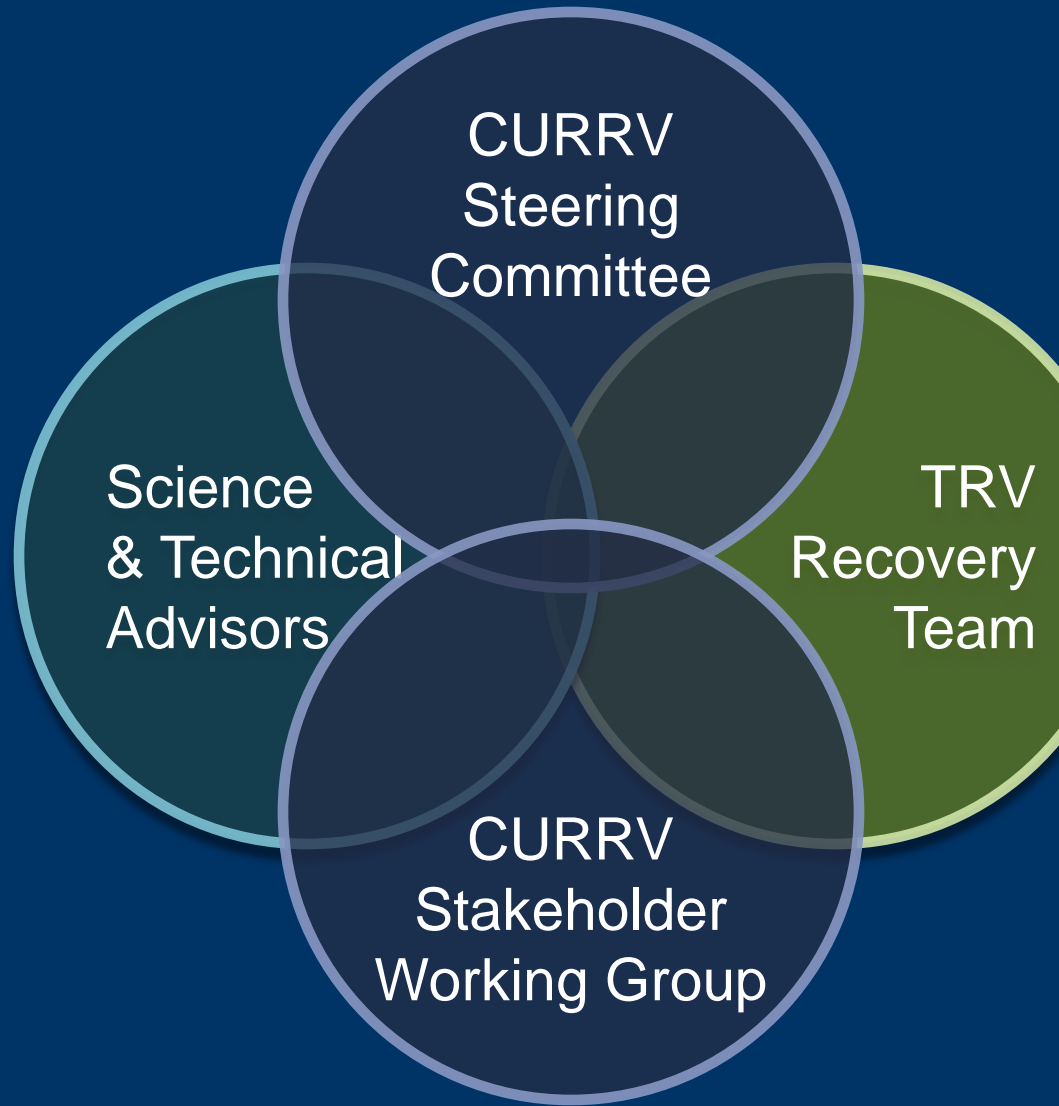
Stakeholder Engagement



Modified timeline from: *Adapting to Rising Tides: Assessing Climate Change Vulnerability* (2011). BCDC.



Stakeholder Engagement

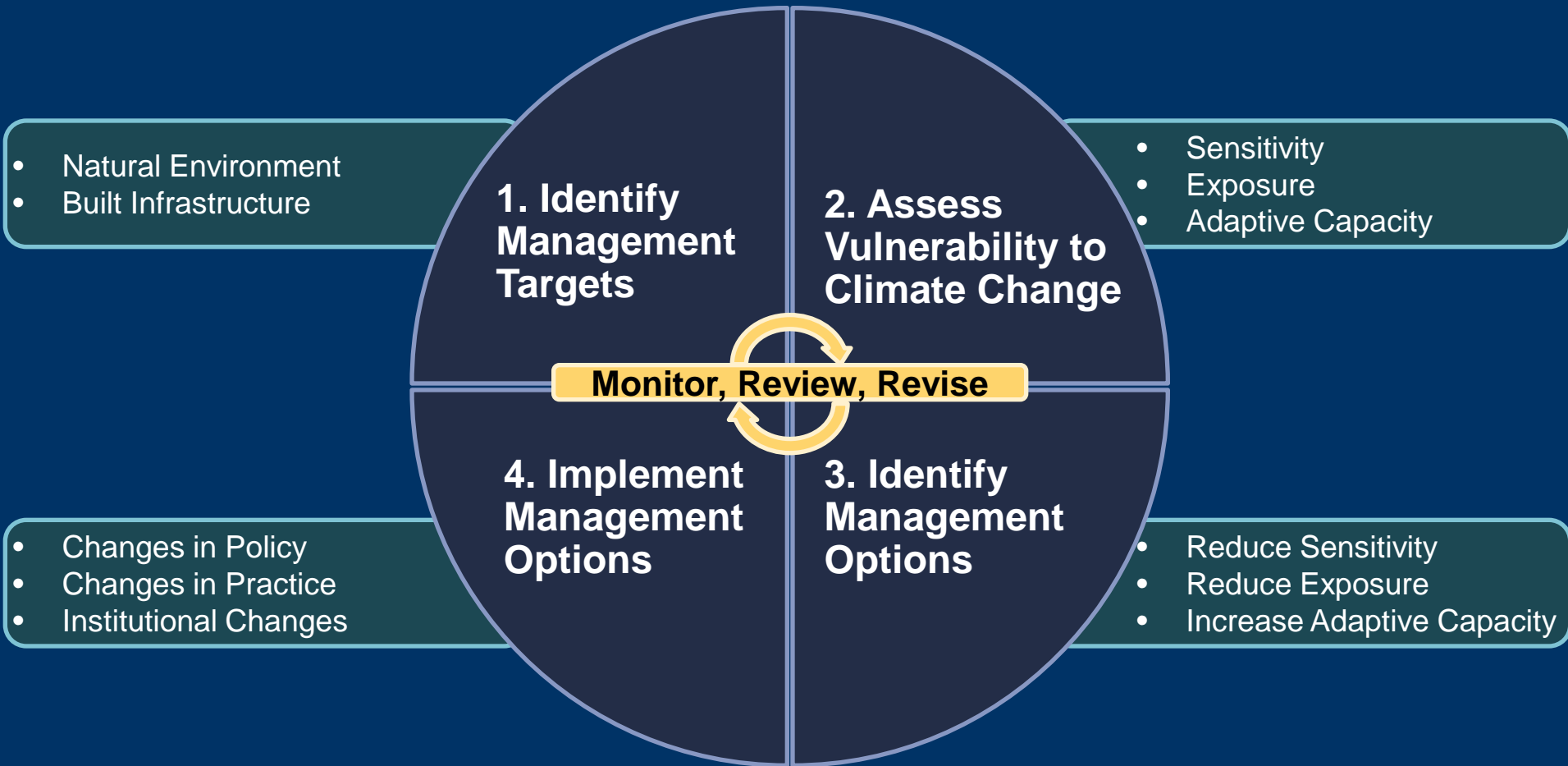


RESPONDING TO CLIMATE CHANGE

CLIMATE ADAPTATION & VULNERABILITY ASSESSMENT



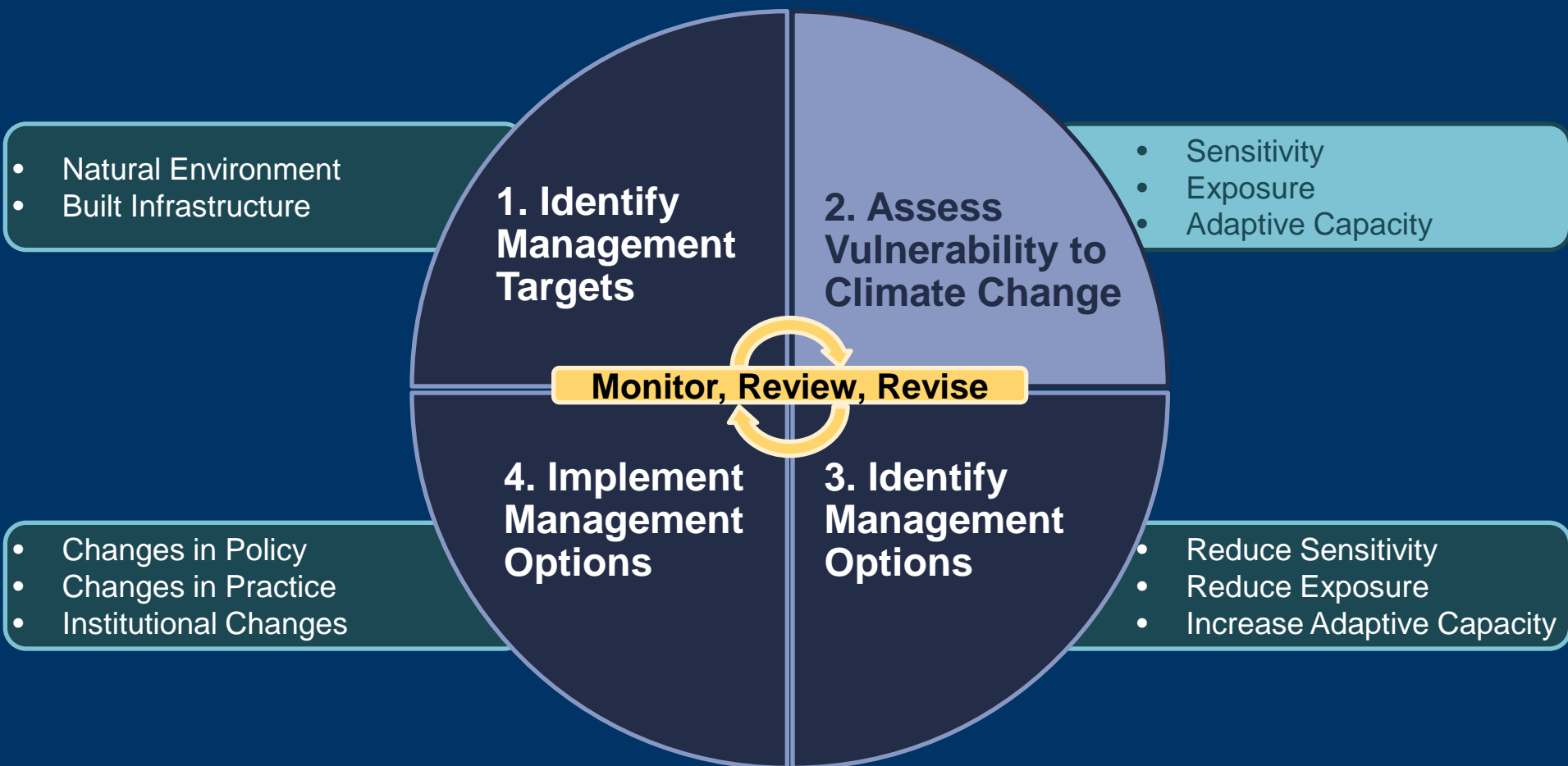
Climate Adaptation Framework



Scanning the Conservation Horizon (2011), National Wildlife Federation.



Climate Adaptation Framework



Scanning the Conservation Horizon (2011), National Wildlife Federation.



Vulnerability Assessment

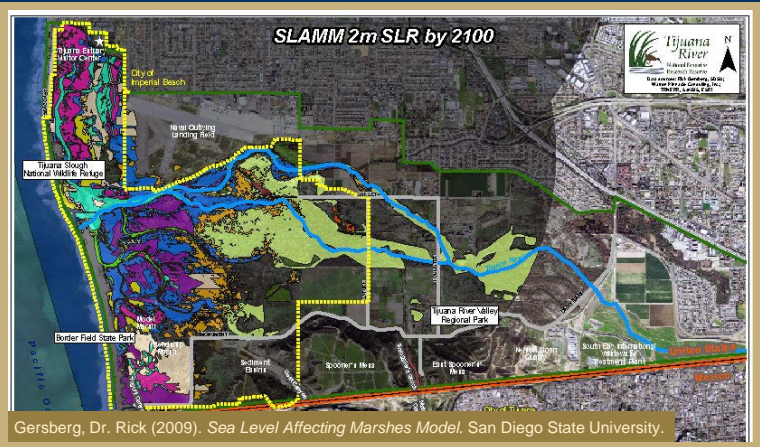
Exposure

Sensitivity

Potential Impact

Adaptive Capacity

Vulnerability



Gersberg, Dr. Rick (2009). *Sea Level Affecting Marshes Model*. San Diego State University.

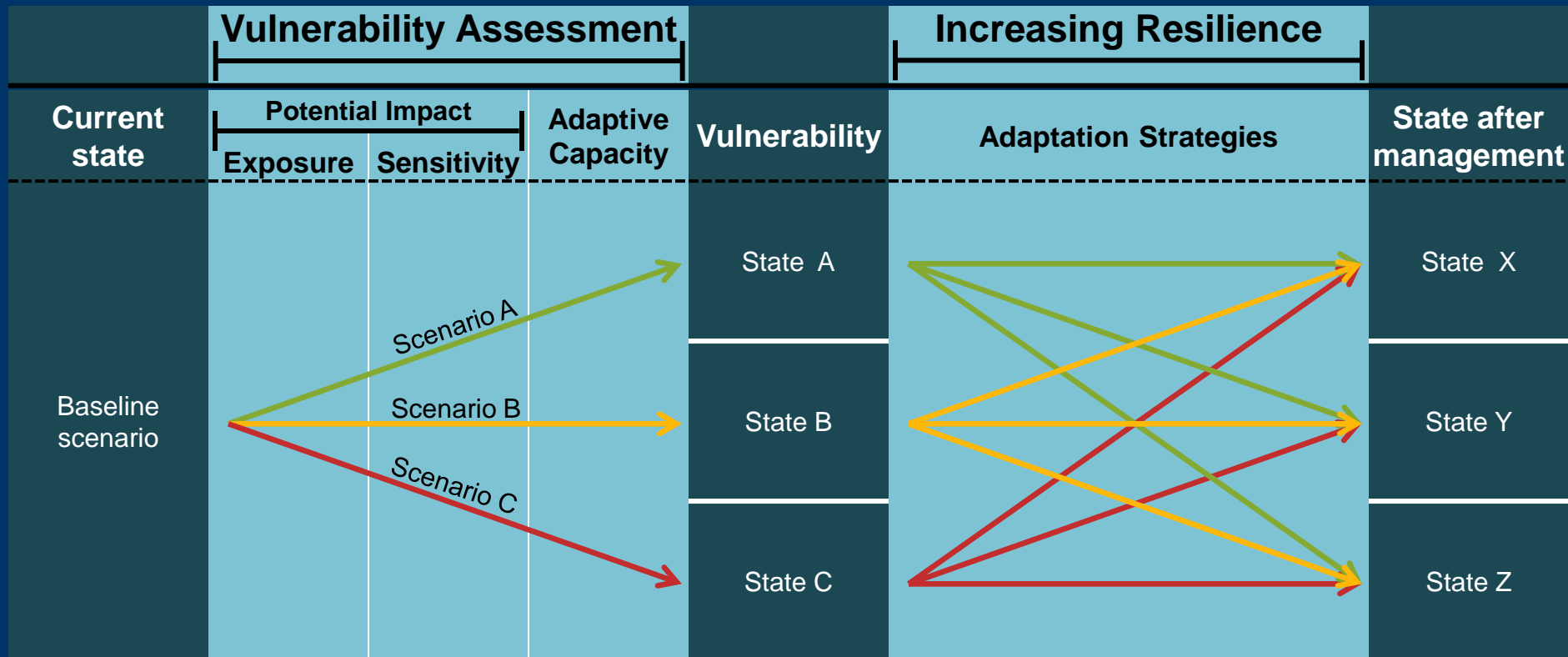
***7. What level of resources does your system have in the following areas that will enhance its ability to be flexible and adapt in the long term?**

	Very low	Low	Medium	High	Very high
Economic	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Environmental	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Governance	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Social	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Technology / Infrastructure	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Adapting to Rising Tides: Assessing Climate Change Vulnerability (2011). BCDC.

Scanning the Conservation Horizon (2011), National Wildlife Federation.

Integrating Scenarios



Modified graphic from: *Assessing vulnerability of wetlands to change*. WETwin. European Commission.



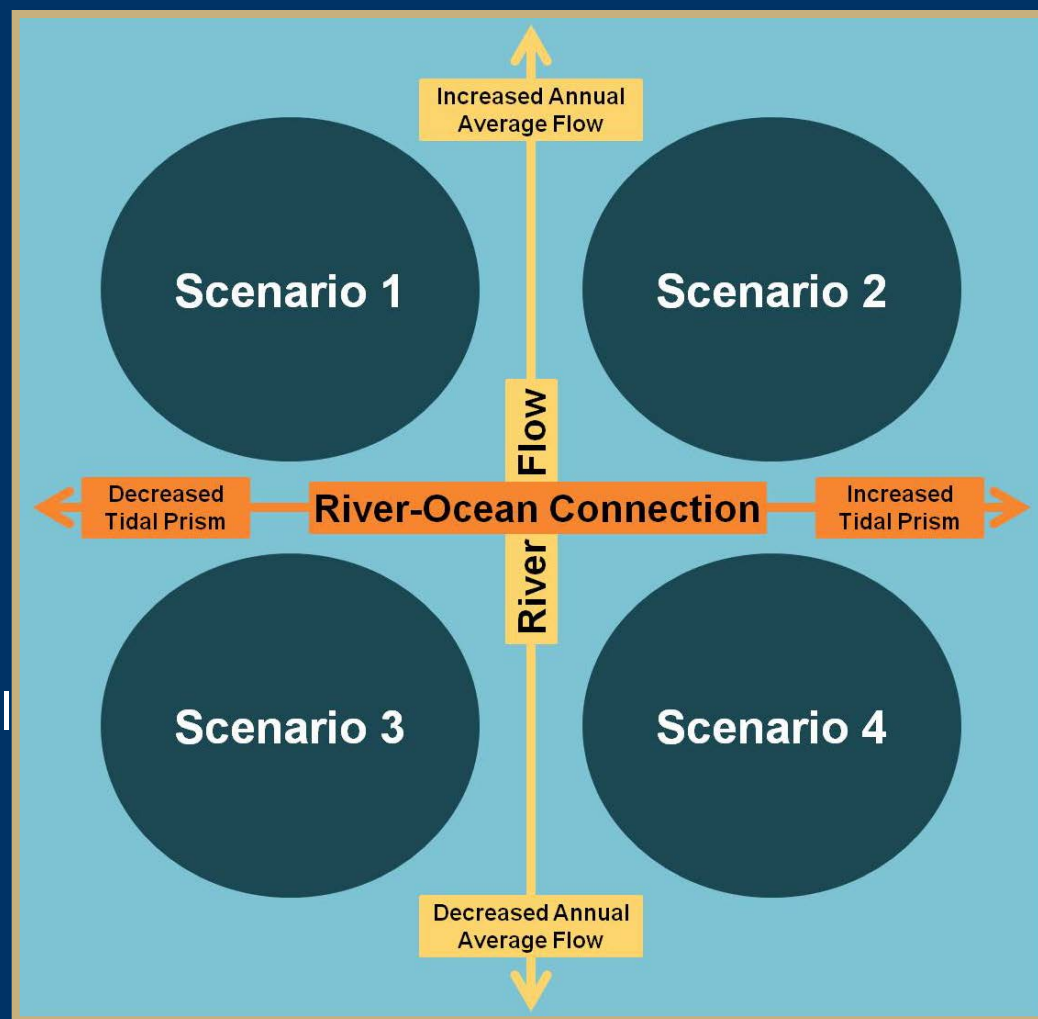
CURRV Scenarios

River Inputs

- *Assumption:* Extreme river flow events will be comparable to present day or increase as climate change occurs
- *Uncertainty (axis):* Will annual average river flow increase or decrease?

Marine Inputs

- *Assumption:* Climate change will cause sea levels to rise
- *Uncertainty (axis):* Will tidal prism increase or decrease?

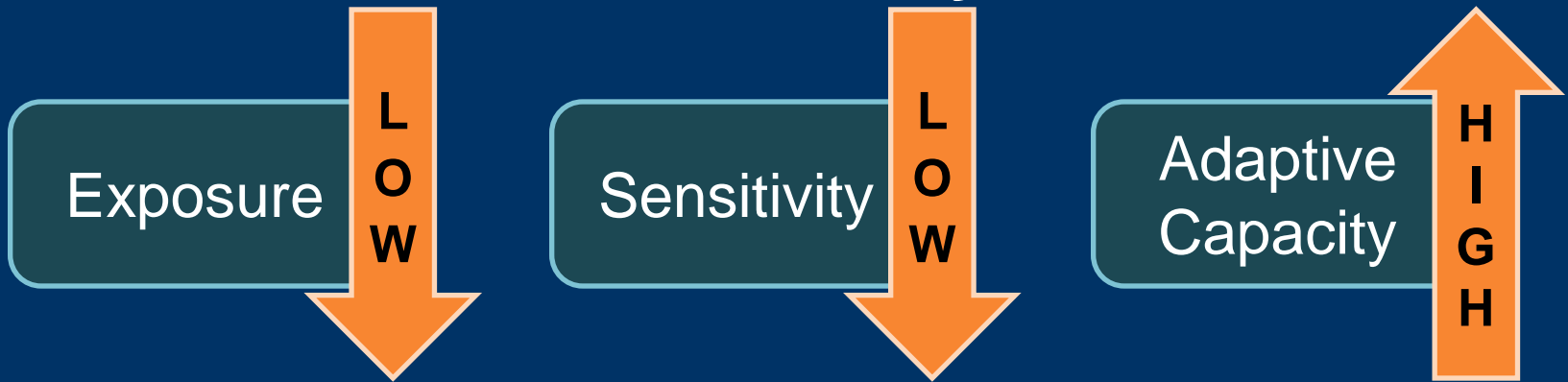


Moore et al. (2013). *Scenario planning for climate change adaptation.*

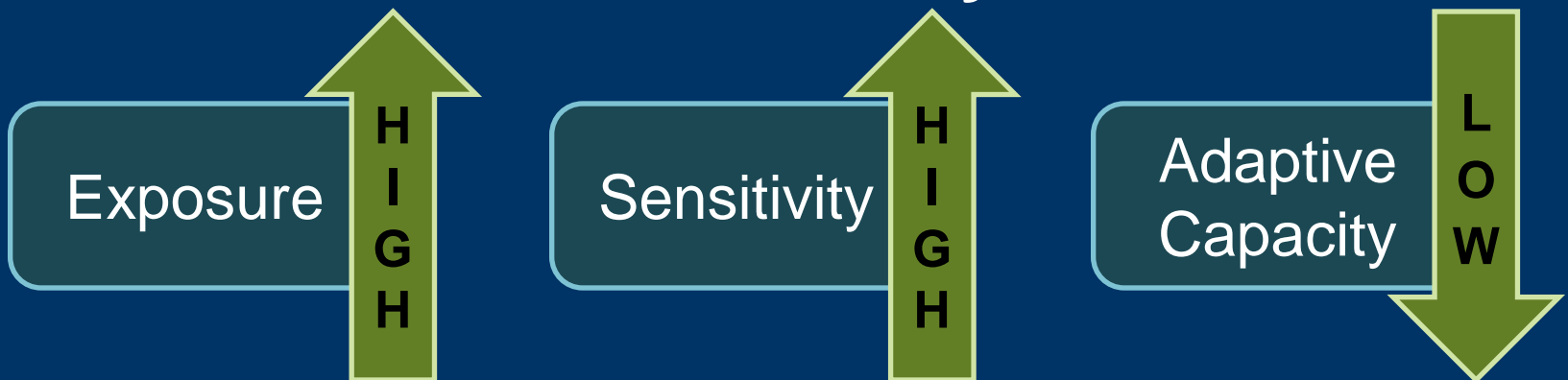


Resilience

Most Resilient Systems

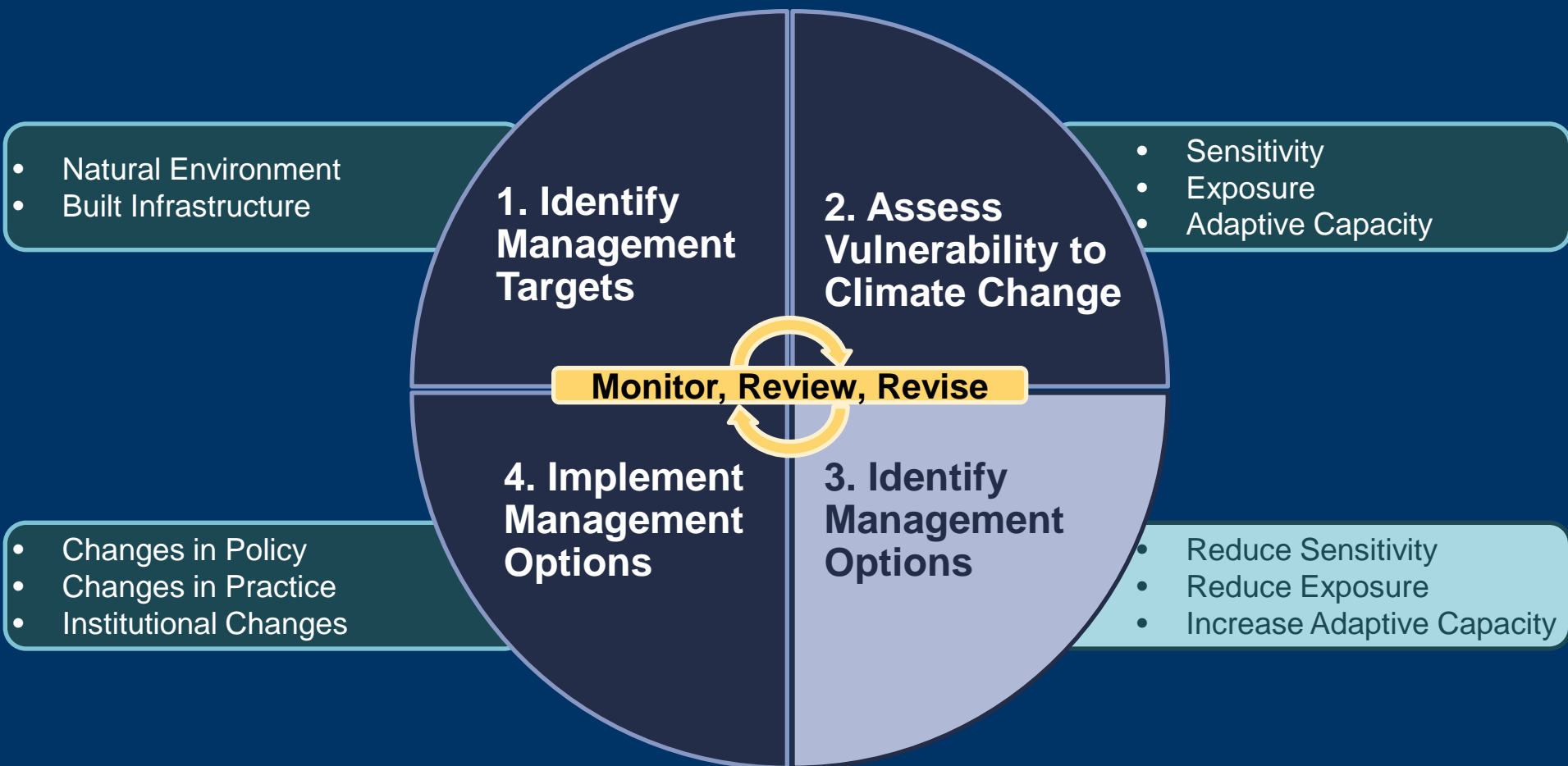


Least Resilient Systems



Scanning the Conservation Horizon (2011), National Wildlife Federation.

Climate Adaptation Framework



Scanning the Conservation Horizon (2011). National Wildlife Federation.



Natural Adaptation Strategies

Wetland Restoration



Dune Restoration



WRAP-UP



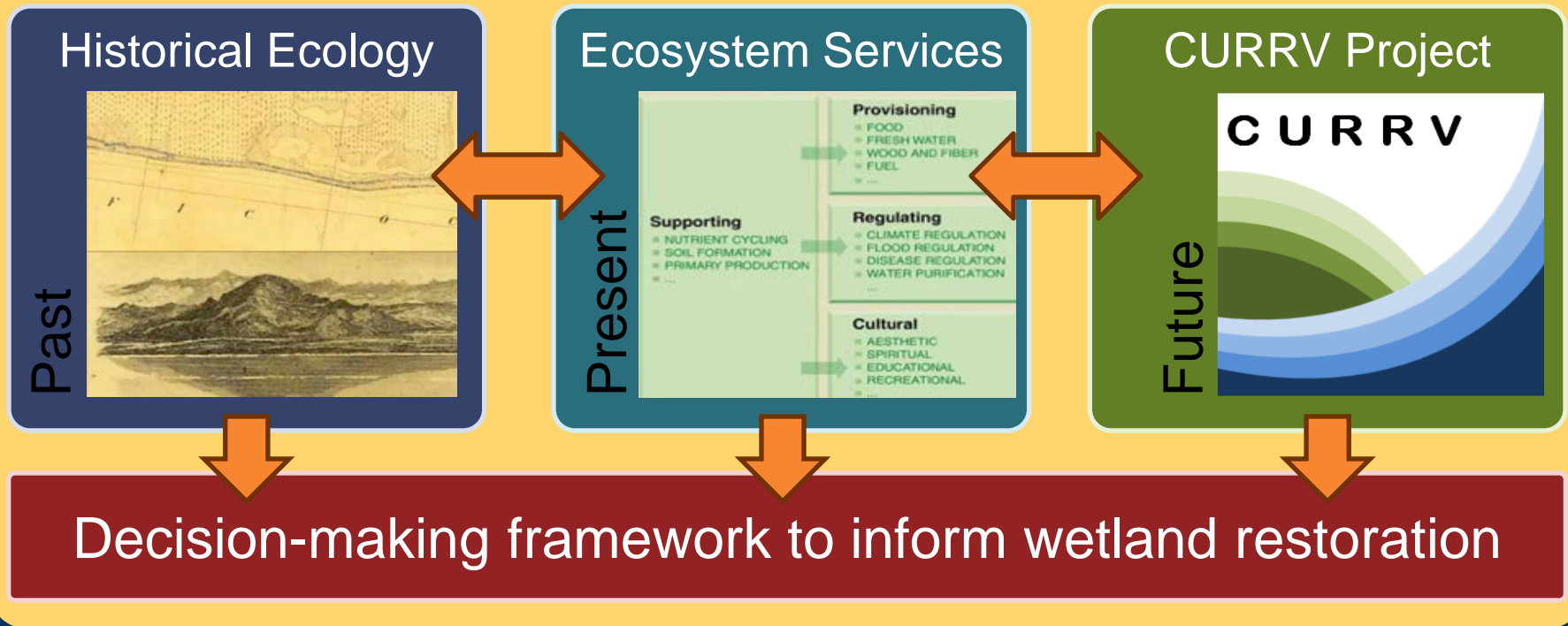
Lessons Learned

- Establish bidirectional communication among stakeholders
- Scenarios help planners to move forward in light of uncertainties
- Natural & built environments need to be considered as a connected system but require variations in methodology



TIME Project

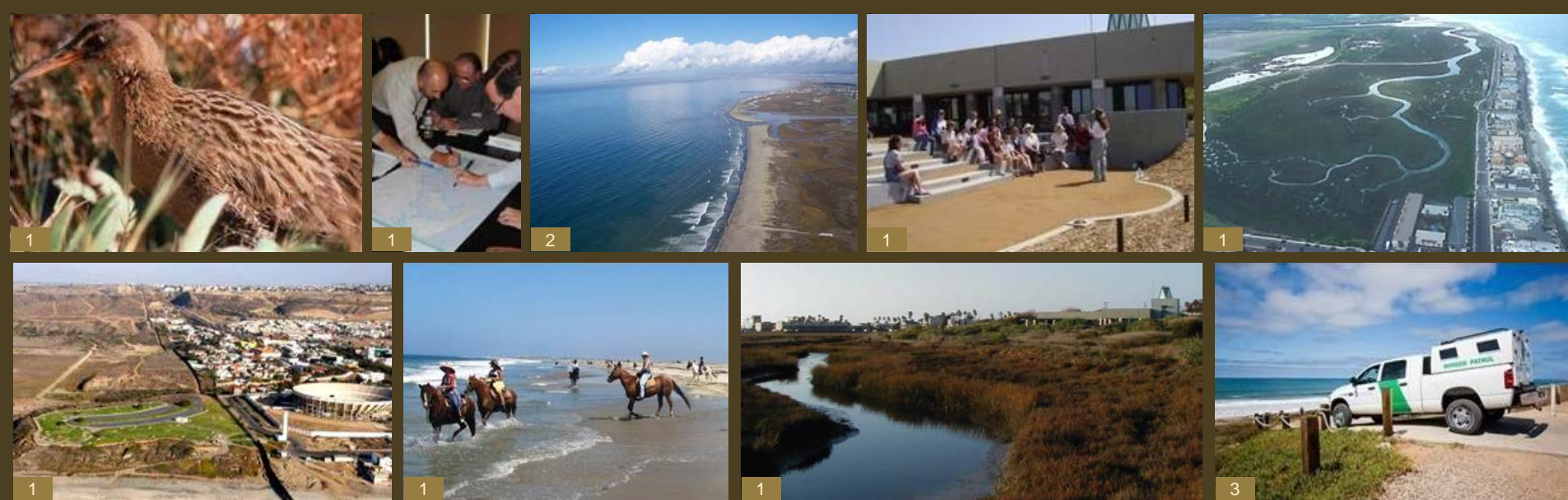
Temporal Investigations of Marsh Ecosystems



NERRS Science Collaborative:

Tijuana River National Estuarine Research Reserve, California Coastal Conservancy,
 Southern California Coastal Water Research Project, Sacramento State University Center for Collaborative Policy,
 San Francisco Estuary Institute





Danielle Boudreau ♦ Tijuana River NERR ♦
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Thank you to all our collaborators, including...



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7. *Sea Level Rise Adaptation Strategy for San Diego Bay* (Jan 2012). ICLEI-Local governments for Sustainability. <http://www.icleiusa.org/static/San_Diego_Bay_SLR_Adaptation_Strategy_Complete.pdf>
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9. Walker, Brian; and David Salt (2006). *Resilience Thinking: Sustaining Ecosystems and People in a Changing World*. Island Press; Washington, D.C.



Image Citations

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2. <http://www.wildcoast.net/media-center/news/590-wildcoast-asks-state-senate-to-oppose-regional-water-board-consolidation> (Visited November 2013)
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6. California King Tides Initiative (December 2012). Tijuana River National Estuarine Research Reserve.
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