Strategic Habitat Conservation Workshop

Gulf Coastal Plains and Ozarks

Science-based Management: Challenges in Contemporary Conservation

Jean Brennan PhD
Defenders of Wildlife

Context

Pearl, Mississippi. March 16, 2010

6th Extinction

Global change: drivers of change

- Converging Technologies
- Energy
- Money, Wealth, Economy
- Governance
- Demographics
- Resources
- Marine
- Climate Change
- Food Security
- Mobility
- Disease

Source: naturalengland.org.uk 2009

Global change: drivers of change

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Listed Species (US)

Group	T&E species
Mammals	85
Reptiles	37
Amphibians	25
Fishes	139
Invertebrates^	198
Birds	90
Total *(animal)*	574
Total *(plants)*	749

Source: USFWS [^invertebrates incl. insects(57), arachnids(12), clams(70), snails(35), corals(2), crustaceans (22)]

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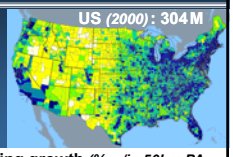
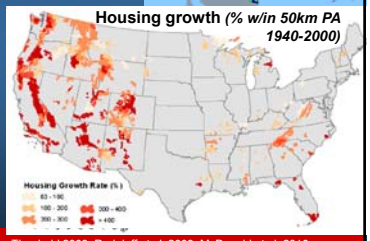
US *(2000)*: 304 M



US Projected population: 1B by 2100

Housing growth *(% w/in 50km PA 1940-2000)*



Source: Resources for the Future; Theobald 2009; Radeloff et al. 2009; McDonald et al. 2010

Global change: drivers of change

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Rising population (ha) land available / person

25% Earth's land area undergoing degradation
50% wetlands have been drained

75% of the World's fishing grounds have been fully- or over-exploited

Source: UNDP

Global change: drivers of change

Converging Technologies
Energy
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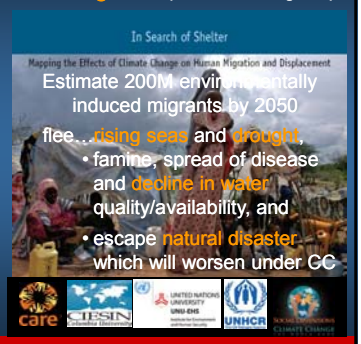
Mass Migration *(even stable regions)*



Estimate 200M environmentally induced migrants by 2050

flee…rising seas and drought,
- famine, spread of disease and decline in water quality/availability, and
- escape natural disaster which will worsen under GC

Source: UNHCR Report 2009

Outline: The Challenge

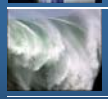
- Context ("*givens*") – New Reality
- Re-examine Traditional Approaches
- Redefine Science-based Management
- New Paradigm

'Givens' Traditional Redefine Facilitate

1. Climate change is already occurring, *(all indications)* it will continue, projected changes/rates larger/more rapid

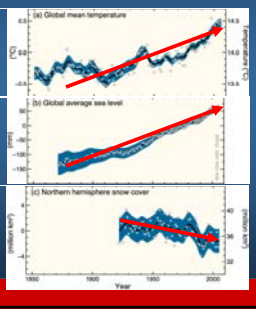
(GHG conc., previously slower growth)

– observations ↑ global av. air and ocean T.,



– rising global mean sea level, and

– widespread melting of snow and ice."



Source: IPCC 2007

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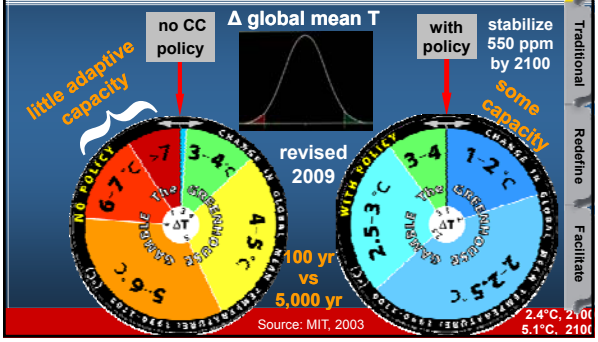
2. Take Herculean effort Gov. to limit GW to 2°C *(preind.)* – predicted range likely cause extinctions/disruptive shift ecosystems



Source: MIT, 2003

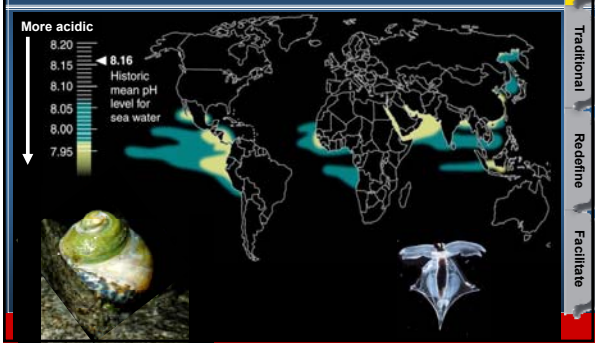
'Givens' Traditional Redefine Facilitate

3. Change pose significant challenge to adaptation – (abrupt changes) may trigger tipping pts – thresholds irreversible changes

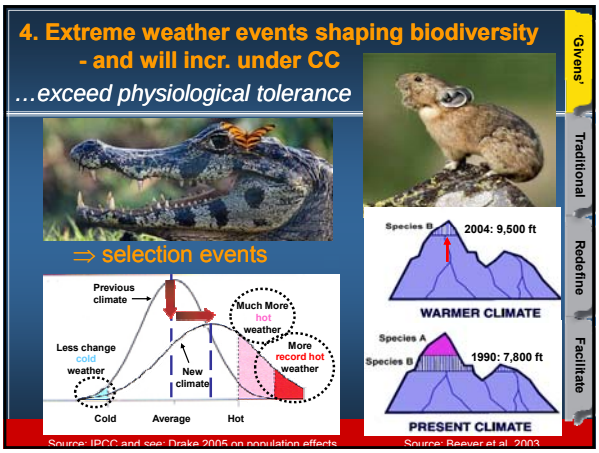
Source: Sampoyo et al. 2008

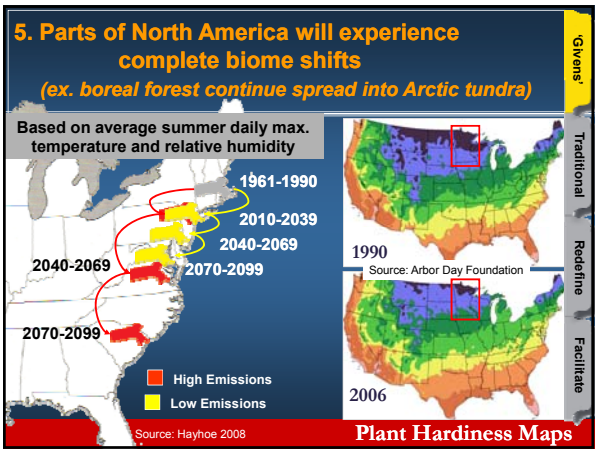
'Givens' Traditional Redefine Facilitate

may trigger tipping pts – thresholds irreversible changes



'Givens' Traditional Redefine Facilitate


4. Extreme weather events shaping biodiversity
- and will incr. under CC
…exceed physiological tolerance
⇒ selection events
Previous climate
Much More hot weather
Less change cold weather
More record hot weather
New climate
Cold
Average
Hot
Species B
2004: 9,500 ft
WARMER CLIMATE
Species A
Species B
1990: 7,800 ft
PRESENT CLIMATE
Source: IPCC and see: Drake 2005 on population effects
Source: Beever et al. 2003
'Givens'
Traditional
Redefine
Facilitate


5. Parts of North America will experience
complete biome shifts
(ex. boreal forest continue spread into Arctic tundra)
Based on average summer daily max. temperature and relative humidity
1961-1990
2010-2039
2040-2069
2070-2099
2040-2069
2070-2099
High Emissions
Low Emissions
Source: Hayhoe 2008
1990
Source: Arbor Day Foundation
2006
Plant Hardiness Maps
'Givens'
Traditional
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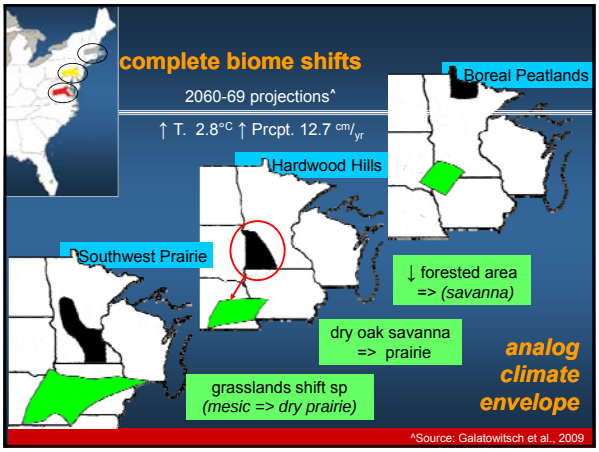
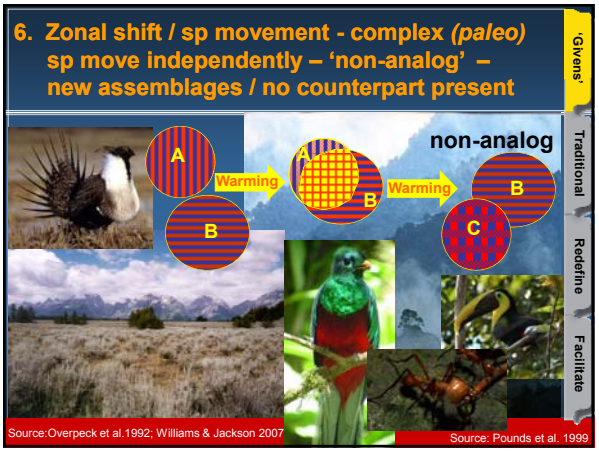
Facilitate


complete biome shifts
2060-69 projections^
↑ T. 2.8°C ↑ Prcpt. 12.7 cm/yr
Boreal Peatlands
Hardwood Hills
Southwest Prairie
↓ forested area
=> (savanna)
dry oak savanna
=> prairie
grasslands shift sp
(mesic => dry prairie)
analog
climate
envelope
^Source: Galatowitsch et al., 2009


6. Zonal shift / sp movement - complex (paleo)
sp move independently – 'non-analog' –
new assemblages / no counterpart present
non-analog
A
B
Warming
A
B
Warming
B
C
Source:Overpeck et al.1992; Williams & Jackson 2007
Source: Pounds et al. 1999
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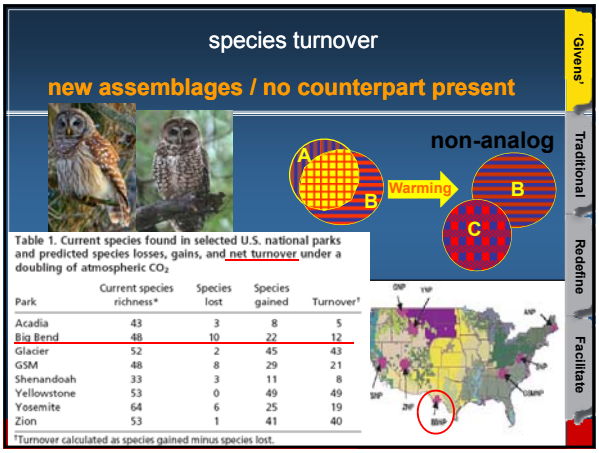
species turnover
new assemblages / no counterpart present
non-analog
A
B
Warming
B
C
Table 1. Current species found in selected U.S. national parks and predicted species losses, gains, and net turnover under a doubling of atmospheric CO_2
Park | Current species richness* | Species lost | Species gained | Turnover†
Acadia | 43 | 3 | 8 | 5
Big Bend | 48 | 10 | 22 | 12
Glacier | 52 | 2 | 45 | 43
GSM | 48 | 8 | 29 | 21
Shenandoah | 33 | 3 | 11 | 8
Yellowstone | 53 | 0 | 49 | 49
Yosemite | 64 | 6 | 25 | 19
Zion | 53 | 1 | 41 | 40
†Turnover calculated as species gained minus species lost.
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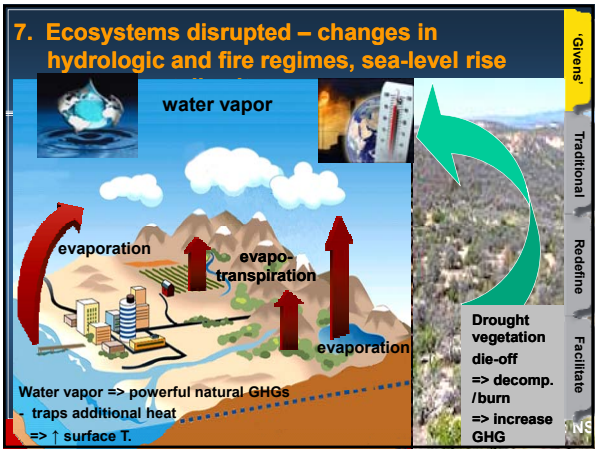
7. Ecosystems disrupted – changes in
hydrologic and fire regimes, sea-level rise
water vapor
evaporation
evapo-
transpiration
evaporation
Water vapor => powerful natural GHGs
- traps additional heat
=> ↑ surface T.
Drought
vegetation
die-off
=> decomp.
/burn
=> increase
GHG
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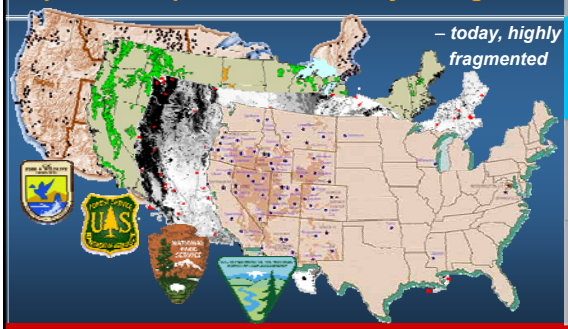
'Givens' | Traditional | Redefine | Facilitate

System of protection based - historic vision – refuges (PAs) islands/safe haven – in dynamic equilibrium, sp able to move freely among these



*representation, redundancy, across env. gradient …& expand conserv.network

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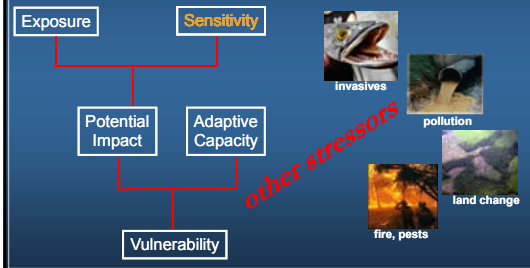
CC adds forcing trend to all other stressors – likely complex non-linear / exceptionally difficult to understand and mitigate

Vulnerability is a function of Exposure, Sensitivity, and Adaptive Capacity



…enhance sensitivity to CC impacts

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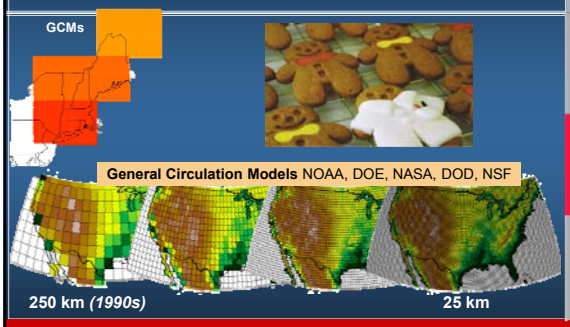
"Uncertainty paralysis" – consider range of plausible climate futures – alleviating pressure to immediately "get it right"*...iterative process*



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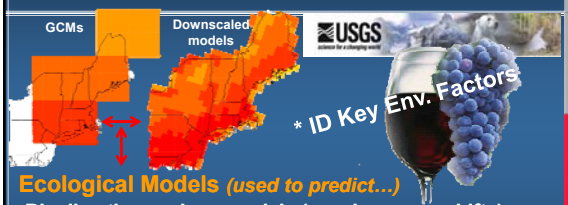
– consider range of plausible climate futures



Ecological Models *(used to predict…)*

- Bioclimatic envelope models (species range shifts)
- Dynamic global veg. models (Δ large-scale veg. patterns)
- Forest gap models (Δ in stand structure)
- Population models (Δ in abundance or persistence)

require process-based – both climate & ecosystem responses all scales

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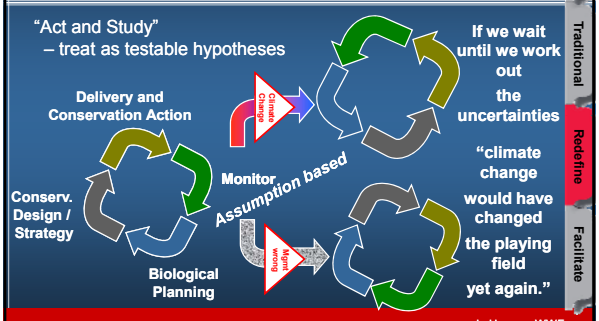
Practice *True Active* Adaptive Management

– alleviating pressure to immediately "get it right"...*iterative process*



L. Hansen, WWF

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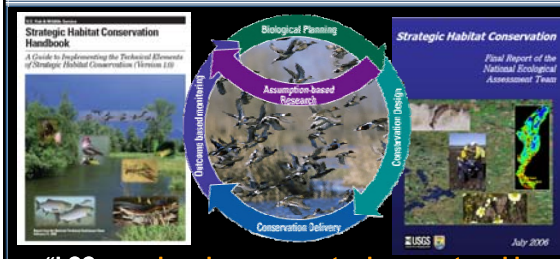
Challenges require...system-wide responses, new tools, business model, partnerships, way of thinking to maintain integrity, diversity, & health



"LCCs are shared management-science partnerships involving fed. agencies, states, tribes, NGOs, & Univ.

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Actions taken now may help avoid irreversible losses. Lost opportunities cannot be regained.

way of thinking to maintain integrity, diversity, & health

Two Broad Categories of Adaptation Measures

1st category: sustaining response – ↑ system resistance boost resilience *(transition)*

- Conserve in current or past state *("buying time")* => may be effective only over a short term.
- Should only be applied preferentially to high-value or priority species/ systems or to those with low sensitivity to CC

Refuges with broad mission statements ... will have the greatest flexibility to accommodate future change in sp composition

Integrated using: Lawler et al. in press; Locatelli et al., 2008 Heller and Zavaleta 2009; WWF 1993

'Givens' | Traditional | Redefine | Facilitate

Actions taken now may help avoid irreversible losses. Lost opportunities cannot be regained.

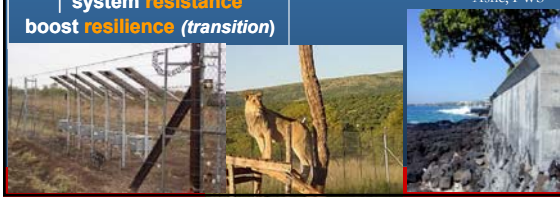
way of thinking to maintain integrity, diversity, & health

Two Broad Categories of Adaptation Measures

1st category: sustaining response – ↑ system resistance boost resilience *(transition)*

"Anything, any concept founded on assumptions of stability -- must now be questioned."

Ashe, FWS



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"Existing species' compositions in refuges may change;

however, it will be possible to maintain the integrity, diversity, and environmental health of the NWRS, albeit

with a focus on the composition, structure, and function of the habit as supported by the refuges,

rather than any particular species or group of species that uses that habitat."

- New Paradigm

ecological and evolutionary

2008 SAP 4.4 "Preliminary Review of Adaptation Options for Climate-Sensitive Ecosystems and Resources"

'Givens' | Traditional | Redefine | Facilitate

"focus on the composition, structure, & function of the habitat rather than any particular species or group of species that uses that habitat."

'Givens' | Traditional | Redefine | Facilitate

Two Broad Categories of Adaptation Measures

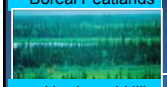
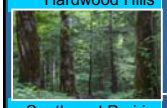
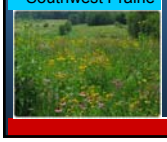
2ND category: active adaptation response – facilitate a shift or evolution of the system

(toward a new state that meets altered conditions)

- Objective not to resist changes, but to ease and manage natural adaptation processes.
- However resilience of the ecosystem is key in this process *(function/ process)*

Integrated using: Lawler et al. in press; Locatelli et al., 2008 Heller and Zavaleta 2009; WWF 1993

"focus on the composition, structure, & function

Source: Galatowitsch et al., 2009	Climate Change Impacts	Adaptation Response
Boreal Peatlands 	• lower water table • ↑ peat fires • ↑ shrub growth • ↑ tree mortality*	[Resist] prohibit drainage improvements in vicinity • control peat fires
Hardwood Hills 	• ↑ tree mortality* • shorter hydro-periods in wetlands • expansion weedy grassland species	[Resilience] FM ↓ water stress • use fire to reduce weedy grassland species [Facilitate] transition to grassland (*vs* invasives)
Southwest Prairie 	• ↑ exotic invasion • loss rare wet- sp. • shorter hydro-periods • ↑ brackish + alkaline conditions	[Resilience] intensify invasive removal • prohibit groundwater withdrawal (recharg. area) [Facilitate] restore/expand reserves (Ag lands)

* due to drought, disease, insects, disturbance

"focus on the composition, structure, & function

ex. assisted migration?

AKA (*managed relocation*)

"Future conservation challenges under climate change will require action when inaction carries a real risk of extinction."

Pulliam, U. GA

The New York Times

A Radical Step to Preserve a Species: Assisted Migration

By CARL ZIMMER

Opinion:

- only by professionals
- within legal framework
- 1st on non-threatened
- integrated long-term monitoring (*target sp. and new community* for 'collateral damage')
- *(reality: few species)... "remain in the toolbox"*

*initiate small reversible pilot studies

"focus on the composition, structure, & function

'Givens' | Traditional | Redefine | Facilitate

New *paradigm* ...redefining "restoration ecology"

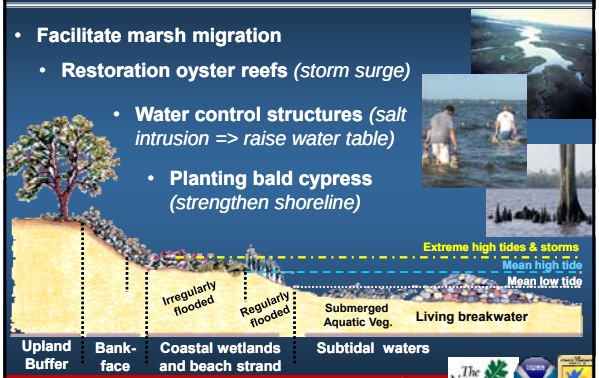
➔ need to determine how, where, and when to deploy – to respond to or anticipate projected CC impacts

- Respond: creating PA buffers, wildlife corridors, reestablish ecological function (environmental services)
- Anticipate: actively facilitate the ability of species, habitats and ecosystems to accommodate climate change

(ex. marsh/wetland accretion, planting more appropriate species to projected climate conditions following disturbance/preventing perturbations)

"focus on the composition, structure, & function

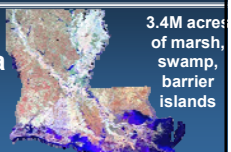
- Facilitate marsh migration
  - Restoration oyster reefs *(storm surge)*
    - Water control structures *(salt intrusion => raise water table)*
      - Planting bald cypress *(strengthen shoreline)*



+ partners

"focus on ...maintaining *ecological processes*

Coastal Louisiana



3.4M acres of marsh, swamp, barrier islands

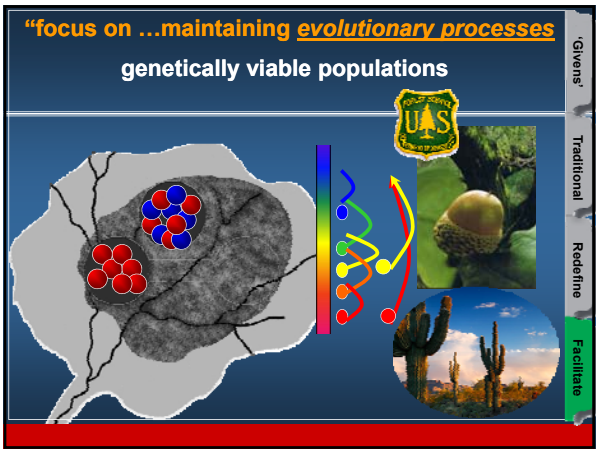
Restoration:

Reconnecting River to the Delta

LA coastline highest rate of land loss In US => ↑ V hurricane & storm damage

Source: Susan Kaderka, SC Regional Ex Dir, NWF

+ partners


"focus on …maintaining evolutionary processes
genetically viable populations
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USGS
nbii
npn
National Phenology Network
National Monitoring Efforts
EARLY WARNING SYSTEM
apex
professional, research
Intensive, long-term, small # areas
mid-level
coordinated, moderate #
probability of occupancy, species richness, env. stress
base
citizen science
inventory, collect course data (critical – Nat'l picture)

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jbrennan@defenders.org