Using Ecological Indicators to Evaluate Progress Toward Restoration: An Example From the Everglades

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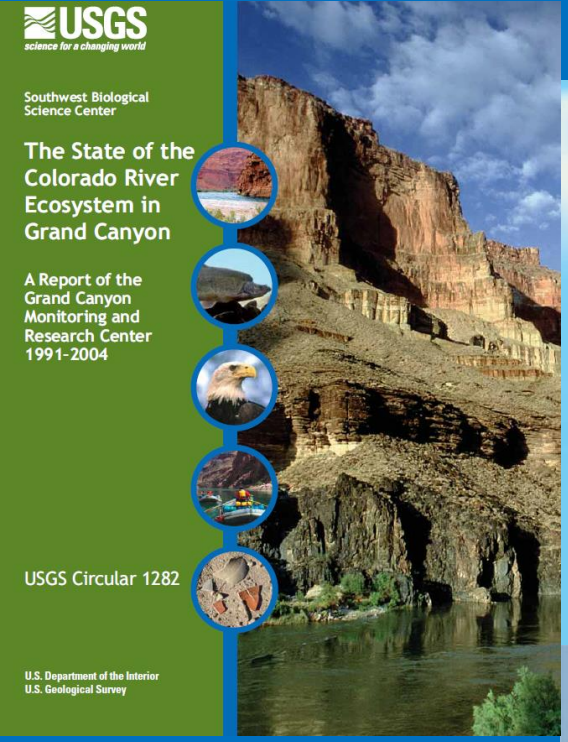
- Ecological Indicators
- Greater Everglades Restoration
- Use of Indicators in Greater Everglades Restoration

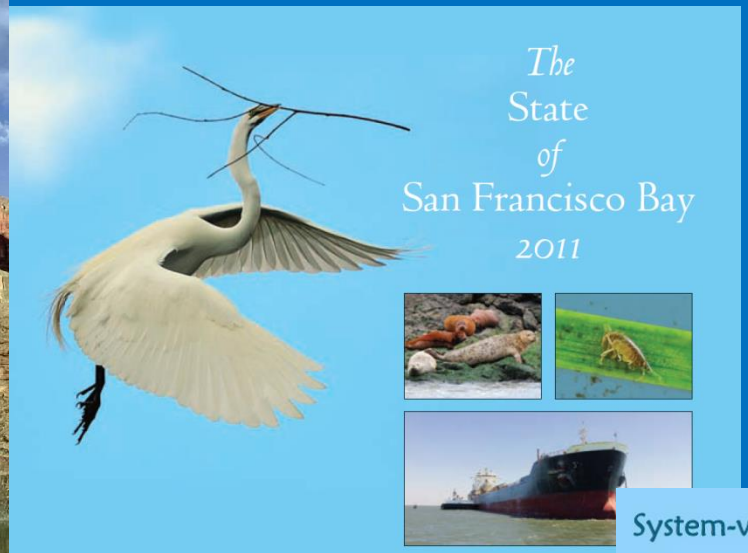
Ecological Indicators

- Inform us easily and quickly about the conditions of an ecosystem
- Simplify the complex
- Assumed to be cost effective and accurate alternative to measuring everything
- Understandable and accepted
- Easily communicated

Ecological Indicators

- Planning and design
  - What to fix
  - Evaluation of alternatives
- Track responses
  - Claim success
  - Learn from Failures (and successes)
- Communication
  - Researchers
  - Project managers
  - Public
  - Congress


USGS
science for a changing world
Southwest Biological Science Center
The State of the Colorado River Ecosystem in Grand Canyon
A Report of the Grand Canyon Monitoring and Research Center 1991-2004
USGS Circular 1282
U.S. Department of the Interior
U.S. Geological Survey


The State of San Francisco Bay 2011

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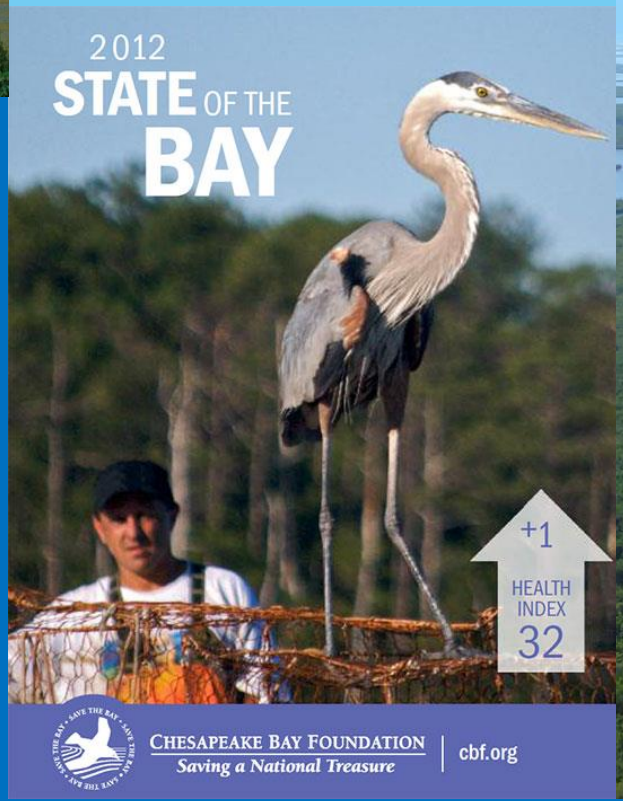
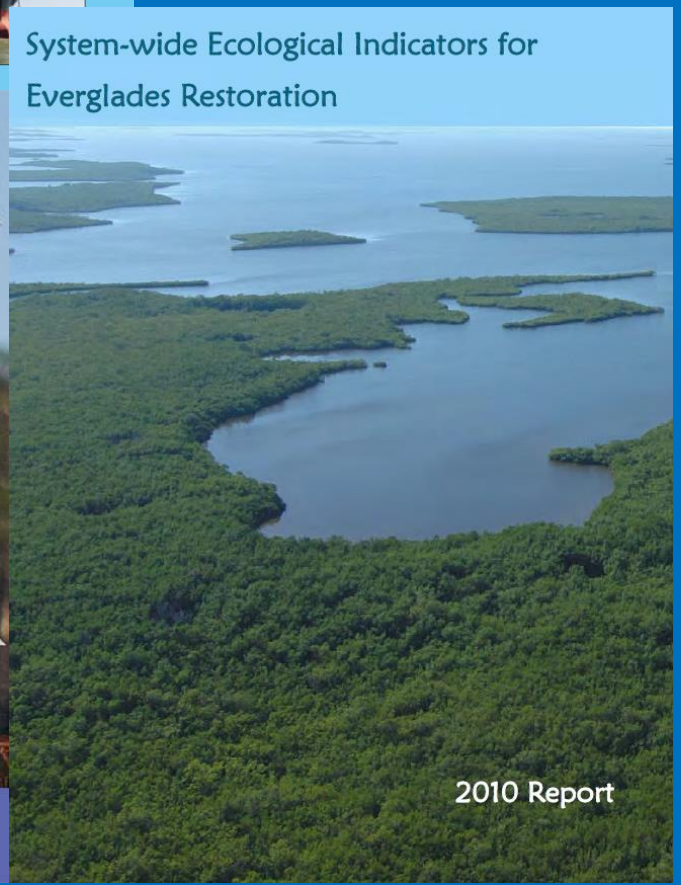

2012
STATE OF THE BAY
+1
HEALTH INDEX
32
CHESAPEAKE BAY FOUNDATION
Saving a National Treasure
cbf.org


System-wide Ecological Indicators for Everglades Restoration
2010 Report

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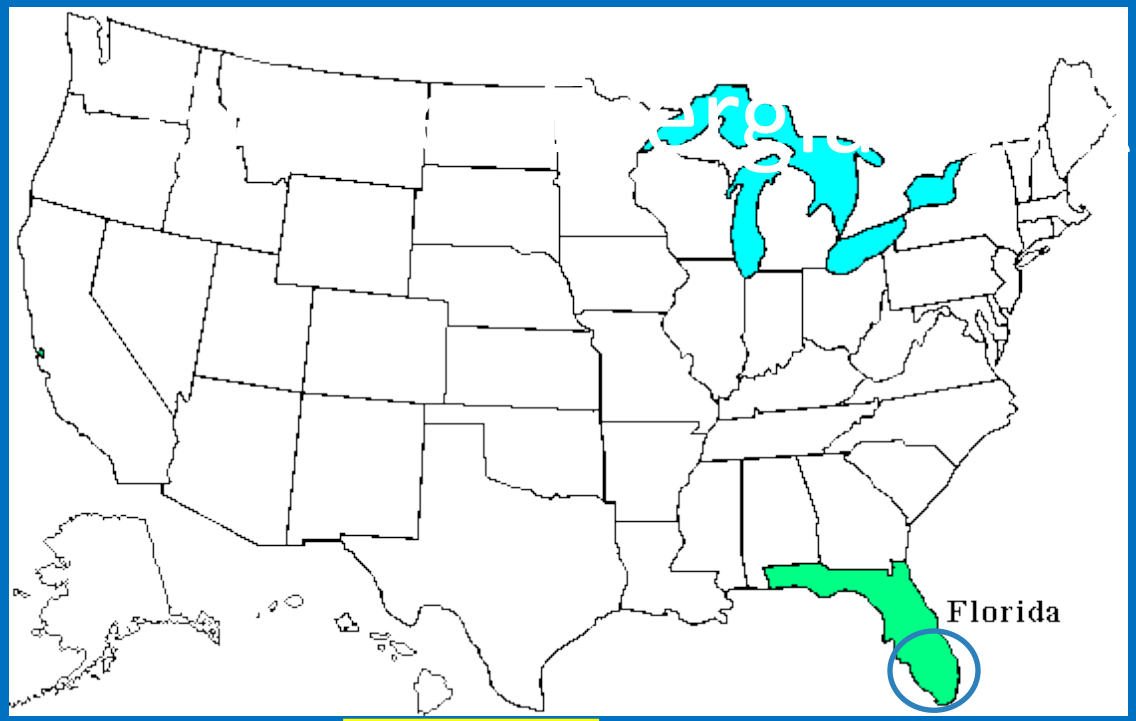
Large Scale Restoration



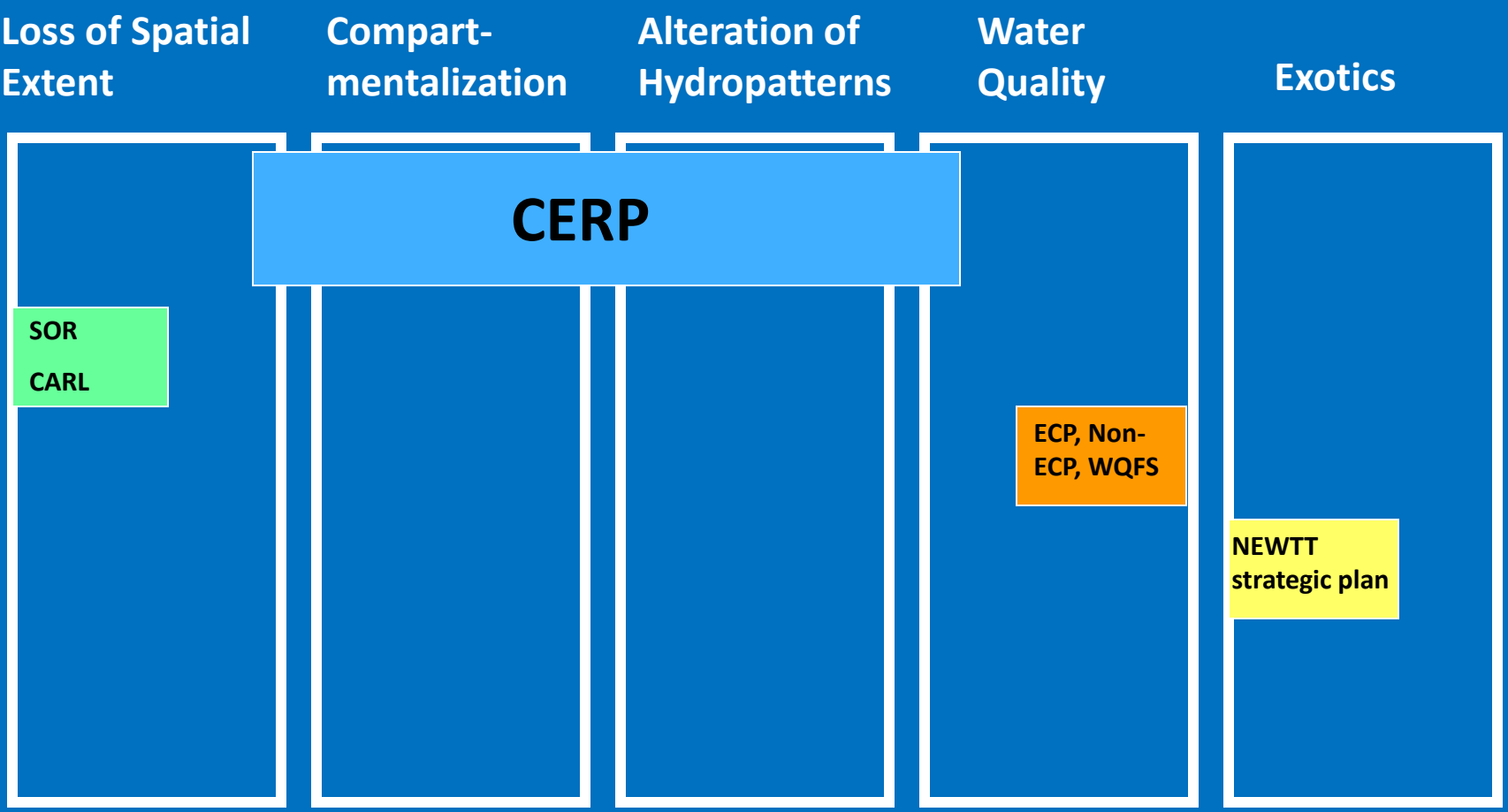
Pre-drainage Flow

Everglades Restoration Goals

(South Florida Ecosystem Restoration Task Force)

- Get the Water Right
- Restore, Preserve, and Protect Natural Habitats and Species
- Foster Compatibility of the Built and Natural Systems

Scope



CERP- Comprehensive Everglades Restoration Plan

CARL- Conservation and Recreational Lands

WQFS- Water Quality Feasibility Study Team

SOR- Save Our Rivers

ECP- Everglades Construction Project

NEWTT- Noxious Exotic Weed Task

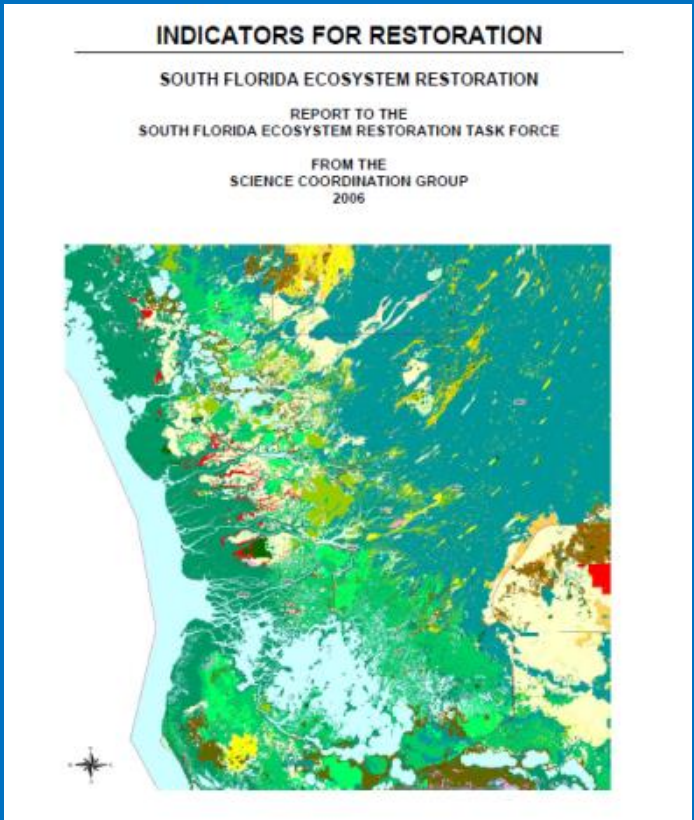
South Florida Ecosystem Restoration Task Force

- Established by WRDA 1996
- 14 member organizations
- Secretary of Department of Interior as Chair

- Biennial Report to Congress
  - Summarize activities
  - Report on progress toward restoration

System-wide Ecological Indicators

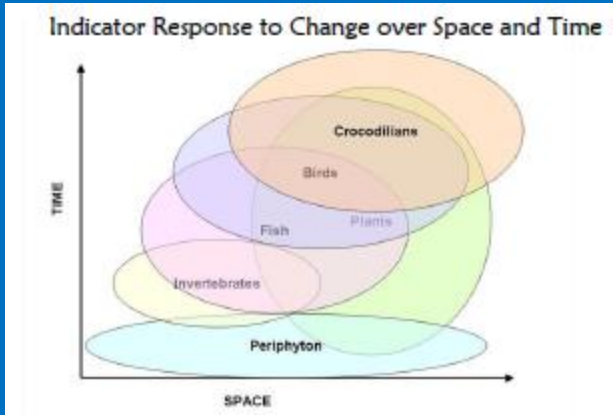
- 2005 Initiated development of a “suite” of system-wide indicators for restoration



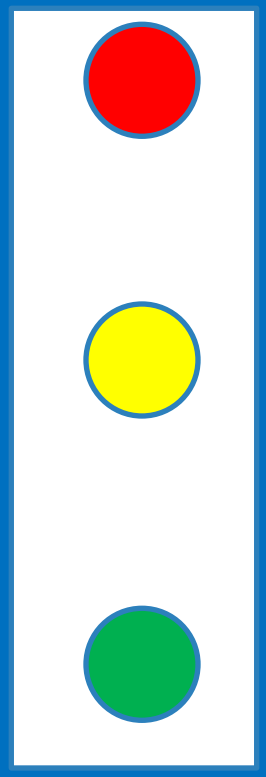
- Reviewed existing indicators
- Reviewed criteria for selecting indicators
- Established criteria
- Selected indicators
- Peer review

System-wide Ecological Indicators

- *Invasive Exotic Plants*
- *Lake Okeechobee Nearshore Zone Submersed Aquatic Vegetation*
- *Eastern Oysters*
- *Crocodilians (American Alligators and Crocodiles)*
- *Fish and Macroinvertebrates*
- *Periphyton and Epiphyton*
- *Wading Birds (White Ibis and Wood Stork)*
- *Southern Estuaries Algal Blooms*
- *Florida Bay Submersed Aquatic Vegetation*
- *Juvenile Pink Shrimp*
- *Wading Birds (Roseate Spoonbill)*



Stoplights as Communication Tool



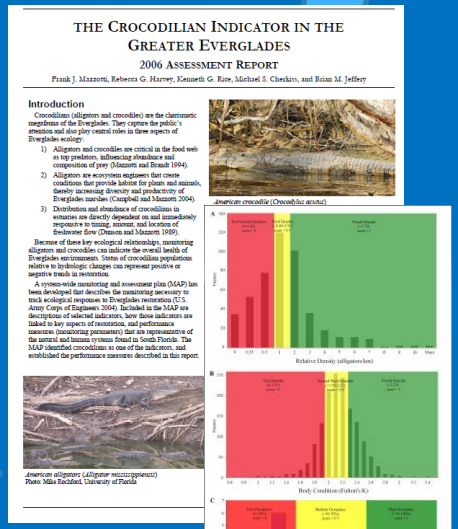
Red-Substantial deviations from restoration targets creating severe negative condition that merits action

Yellow-Current situation does not meet restoration targets and may require additional restoration action

Green-Situation is within the range expected for a healthy ecosystem within the natural variability of rainfall. Continuation of management and monitoring effort is essential to maintain and be able to assess “green” status

Tier 2- Summary Graphics

Tier 1- Stoplight Report



THE CROCODILIAN INDICATOR IN THE GREATER EVERGLADES

2006 ASSESSMENT REPORT

Frank J. Mazzotti, Rebecca G. Harvey, Kenneth G. Rice, Michael S. Cherkiss, and Brian M. Jeffery

Introduction

Crocodilians (alligators and crocodiles) are the charismatic megafauna of the Everglades. They capture the public's attention and also play central roles in three aspects of Everglades ecology:

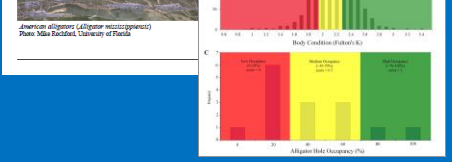
1) Alligators and crocodiles are critical in the food web as top predators, influencing abundance and composition of prey (Mazzotti and Brandt 1994).
2) Alligators are ecosystem engineers that create conditions that provide habitat for plants and animals, thereby increasing diversity and productivity of Everglades marshes (Campbell and Mazzotti 2004).
3) Distribution and abundance of crocodilians in estuaries are directly dependent on and immediately responsive to timing, amount, and location of freshwater flow (Dunson and Mazzotti 1989).

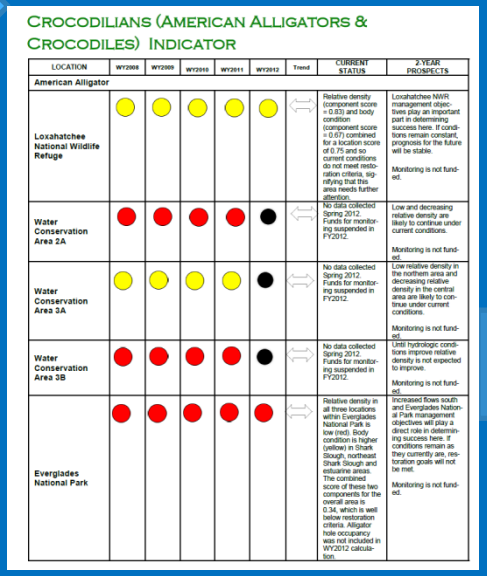
Because of these key ecological relationships, monitoring alligators and crocodiles can indicate the overall health of Everglades environments. Status of crocodilian populations relative to hydrologic changes can represent positive or negative trends in restoration.

A system-wide monitoring and assessment plan (MAP) has been developed that describes the monitoring necessary to track ecological responses to Everglades restoration (U.S. Army Corps of Engineers 2004). Included in the MAP are descriptions of selected indicators, how those indicators are linked to key aspects of restoration, and performance measures (monitoring parameters) that are representative of the natural and human systems found in South Florida. The MAP identified crocodilians as one of the indicators, and established the performance measures described in this report.

American crocodile (*Crocodilus acutus*)

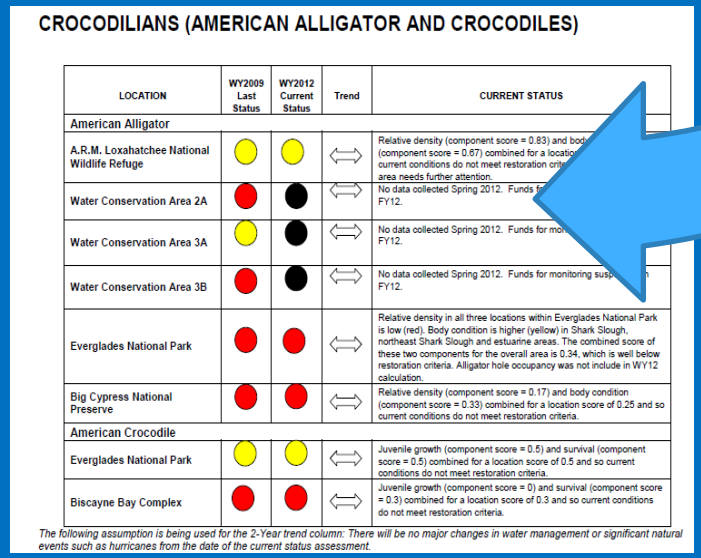
American alligators (*Alligator mississippiensis*)
Photo: Mike Rochford, University of Florida





CROCODILIANS (AMERICAN ALLIGATORS & CROCODILES) INDICATOR

LOCATION	WY2008	WY2009	WY2010	WY2011	WY2012	Trend	CURRENT STATUS	2-YEAR PROSPECTS
American Alligator								
Loxahatchee National Wildlife Refuge							Relative density (component score = 0.83) and body condition (component score = 0.67) combined for a location score of 0.75 and so current conditions do not meet restoration criteria, signifying that this area needs further attention.	Loxahatchee NWR management objectives play an important part in determining success here. If conditions remain constant, prognosis for the future will be stable. Monitoring is not funded.
Water Conservation Area 2A							No data collected Spring 2012. Funds for monitoring suspended in FY2012.	Low and decreasing relative density are likely to continue under current conditions. Monitoring is not funded.
Water Conservation Area 3A							No data collected Spring 2012. Funds for monitoring suspended in FY2012.	Low relative density in the northern area and decreasing relative density in the central area are likely to continue under current conditions. Monitoring is not funded.
Water Conservation Area 3B							No data collected Spring 2012. Funds for monitoring suspended in FY2012.	Until hydrologic conditions improve relative density is not expected to improve. Monitoring is not funded.
Everglades National Park							Relative density in all three locations within Everglades National Park is low (red). Body condition is higher (yellow) in Shark Slough, northeast Shark Slough and estuarine areas. The combined score of these two components for the overall area is 0.34, which is well below restoration criteria. Alligator hole occupancy was not included in WY2012 calculation.	Increased flows south and Everglades National Park management objectives will play a direct role in determining success here. If conditions remain as they currently are, restoration goals will not be met. Monitoring is not funded.



CROCODILIANS (AMERICAN ALLIGATOR AND CROCODILES)

LOCATION	WY2009 Last Status	WY2012 Current Status	Trend	CURRENT STATUS
American Alligator				
A.R.M. Loxahatchee National Wildlife Refuge				Relative density (component score = 0.83) and body (component score = 0.67) combined for a locati current conditions do not meet restoration cri area needs further attention.
Water Conservation Area 2A				No data collected Spring 2012. Funds f FY12.
Water Conservation Area 3A				No data collected Spring 2012. Funds for mo FY12.
Water Conservation Area 3B				No data collected Spring 2012. Funds for monitoring susp FY12.
Everglades National Park				Relative density in all three locations within Everglades National Park is low (red). Body condition is higher (yellow) in Shark Slough, northeast Shark Slough and estuarine areas. The combined score of these two components for the overall area is 0.34, which is well below restoration criteria. Alligator hole occupancy was not include in WY12 calculation.
Big Cypress National Preserve				Relative density (component score = 0.17) and body condition (component score = 0.33) combined for a location score of 0.25 and so current conditions do not meet restoration criteria.
American Crocodile				
Everglades National Park				Juvenile growth (component score = 0.5) and survival (component score = 0.5) combined for a location score of 0.5 and so current conditions do not meet restoration criteria.
Biscayne Bay Complex				Juvenile growth (component score = 0) and survival (component score = 0.3) combined for a location score of 0.3 and so current conditions do not meet restoration criteria.

The following assumption is being used for the 2-Year trend column: There will be no major changes in water management or significant natural events such as hurricanes from the date of the current status assessment.

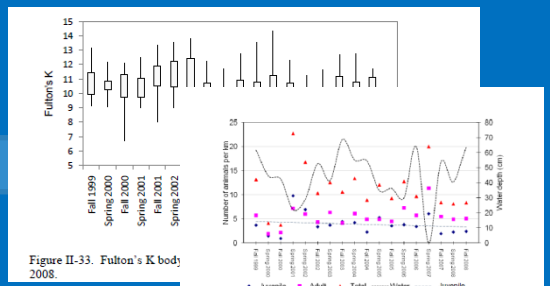


Figure II-33. Fulton's K body
2008.

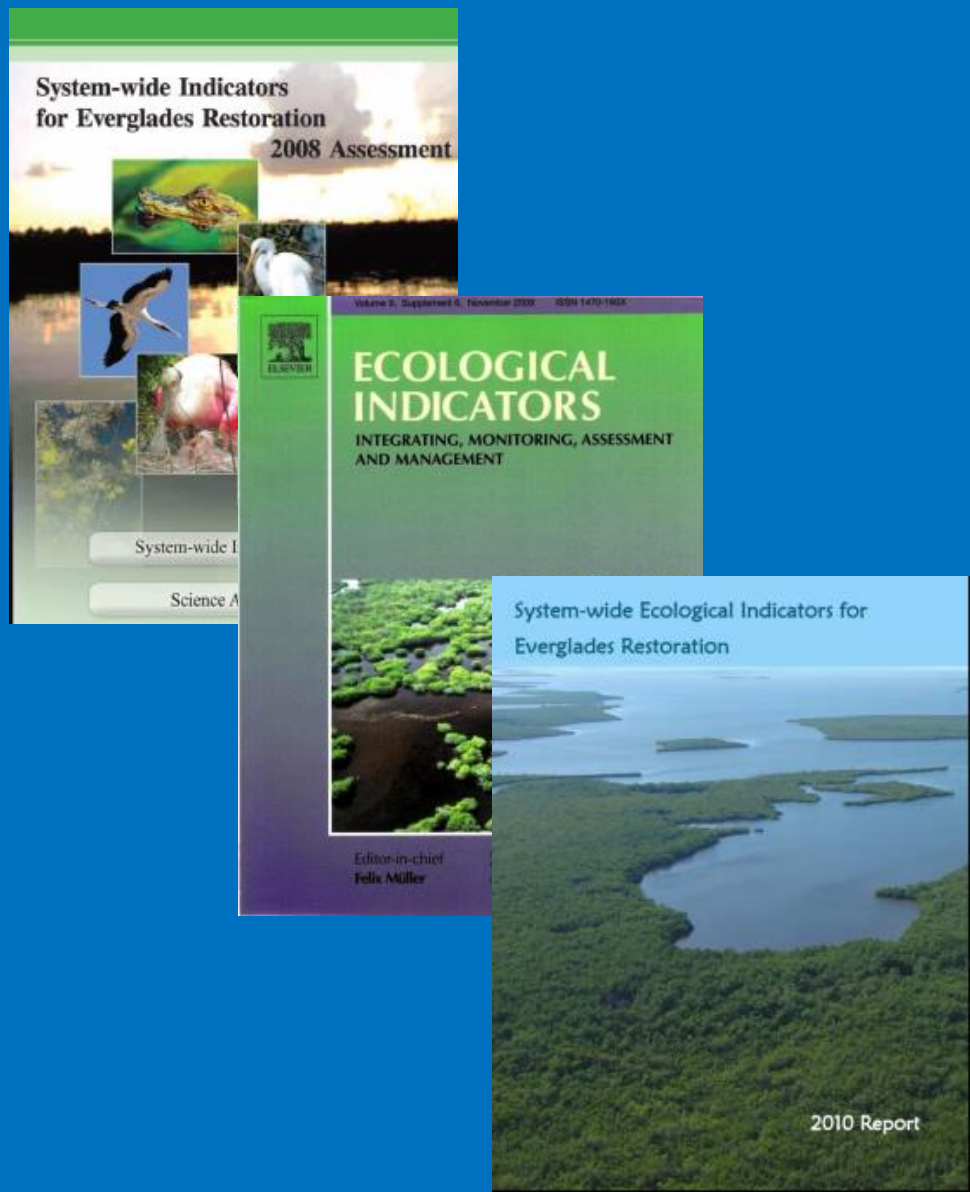
Figure II-15. Mean count densities (alligators/km) for 3 TL size classes: (1) ≥25 cm ("total population"), (2) 25-124 cm ("juvenile"), and (3) ≥175 cm ("adult") during night-light survey in LOX March, 1999-2008. A trend line indicates a significant trend ($p < 0.05$) in the annual mean count was detected. Water depths are mean measurements taken during survey.

Tier 3- Detailed Data

Task Force Biennial Report

System-wide Ecological Indicators

- 2008 System-wide Indicators for Everglades Restoration 2008 Assessment
- 2009 Special issue of the journal Ecological Indicators
- 2010 System-wide Ecological Indicators for Everglades Restoration

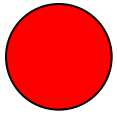
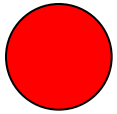


SYSTEM - WIDE ECOLOGICAL INDICATORS FOR EVERGLADES RESTORATION 2012

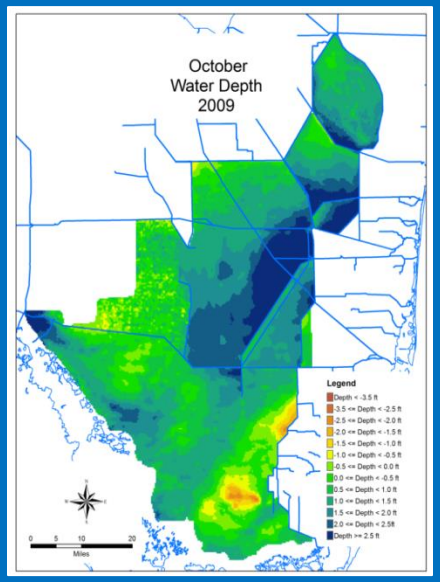
Challenge	Solution	Status
More consistency and common reporting year	Use SFWMD Water Year	Done
Need big picture management implications	Provide hydrologic context	Done
Integrated summary	Indicators at a glance	Done
Integrated summary	Interaction among scientists to prepare summary	Conversations started
Integrated with other reports	Coordination with RECOVER on SSR	Conversations started
Need big picture management implications	Tie results to management actions Explain the “so what”	Planned for 2014 report Planned for 2014 report
Do we have the right indicators?	Review what we have learned since 2006	Need to initiate conversation
Funding to continue monitoring to allow consistent reporting	Document value of indicators	Ongoing

More Consistency

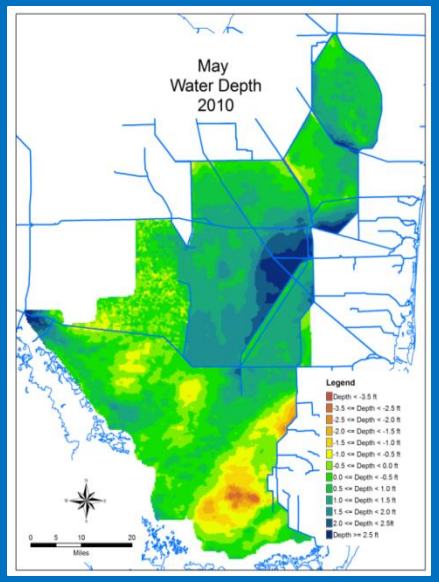
- All on Water Year (May 1-April 30)
- Standardization of location names
- Use WY09 as last status, WY12 as current status
- Added Trend arrows

Location/ Performance Measure	WY 2009 Last Status	WY 2012 Current Status	Trend	CURRENT STATUS
NEARSHORE REGION **Submerged Aquatic Vegetation Areal Coverage**				Submerged aquatic vegetation (SAV) coverage has varied between approximately 28,000 and 46,000 acres since WY 2008. During this period, the Lake achieved its targets of 40,000 acres of SAV with 50% or more consisting of vascular species only once, in WY2011. In WY 2008, 2009, and 2012 neither of the two performance targets were met, while in WY 2010, the total acres target was met but the % vascular target was missed. If Lake Stages continue to remain near the lower end of the desired stage envelope or lower, the enlarged marsh habitat likely will continue to occupy formerly open-water SAV habitat while SAV colonizes areas offshore which were previously too deep and light limited to support substantial underwater plant growth.

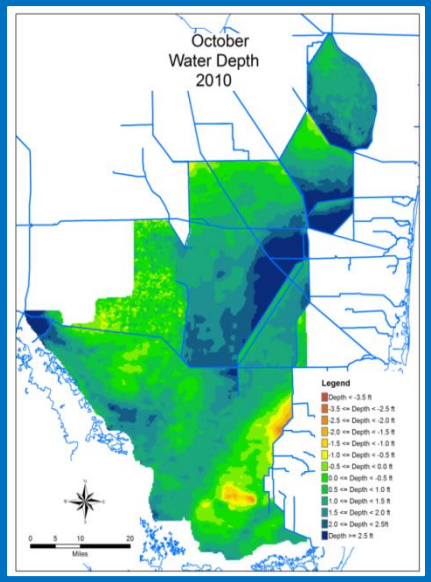
Added Hydrologic Context



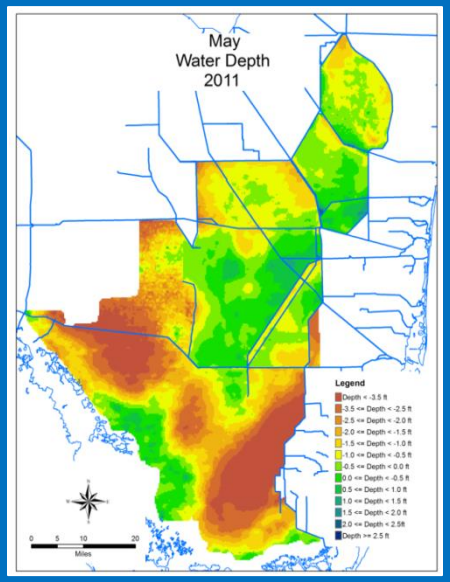
Water Year 2010
End of Wet Season



Water Year 2010
End of Dry Season

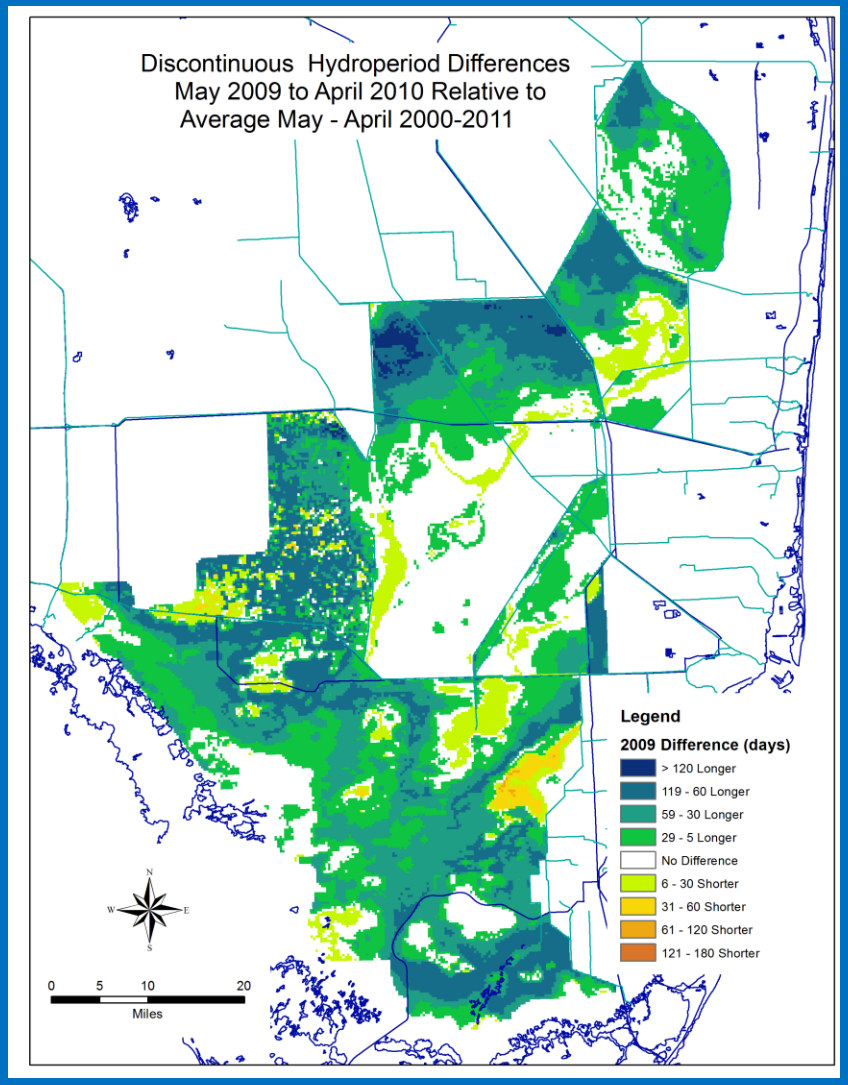


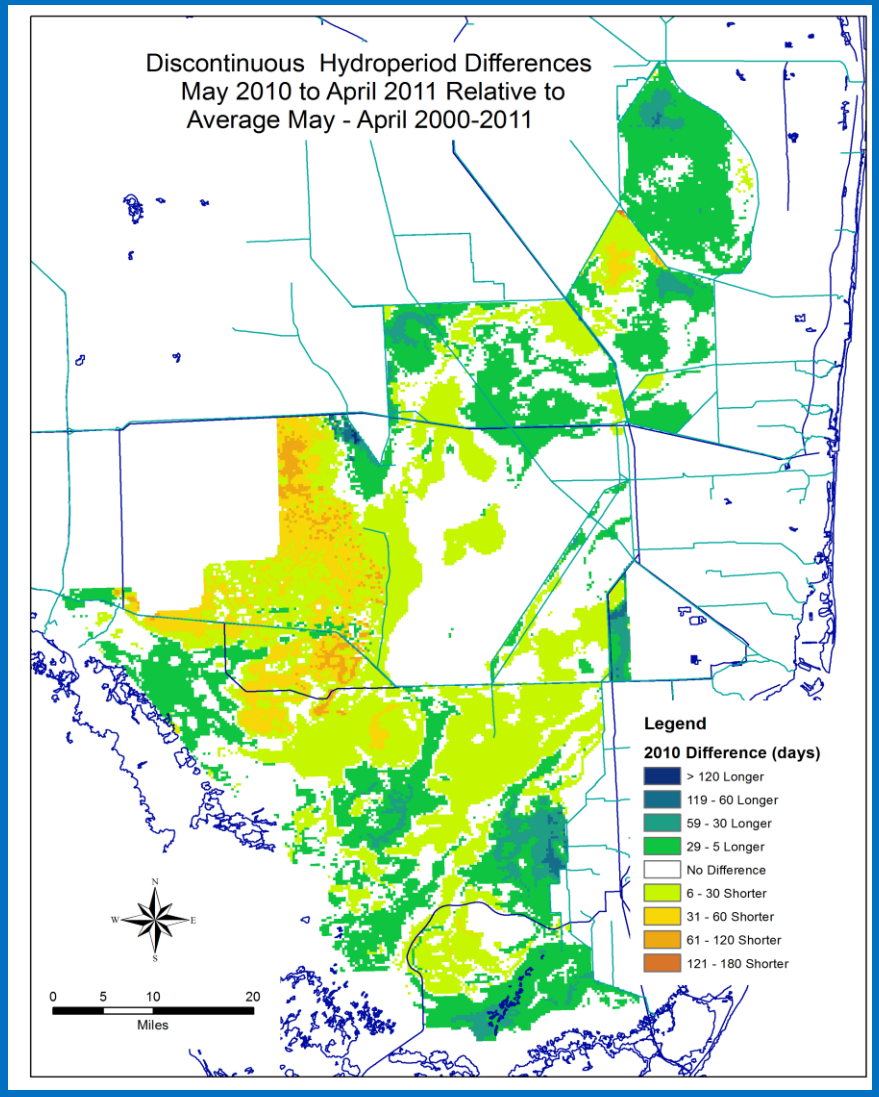
Water Year 2011
End of Wet Season



Water Year 2011
End of Dry Season

Greens and blues are wetter, yellows and oranges drier


Discontinuous Hydroperiod Differences
May 2009 to April 2010 Relative to
Average May - April 2000-2011
Legend
2009 Difference (days)
> 120 Longer
119 - 60 Longer
59 - 30 Longer
29 - 5 Longer
No Difference
6 - 30 Shorter
31 - 60 Shorter
61 - 120 Shorter
121 - 180 Shorter
N
W
E
S
0 5 10 20
Miles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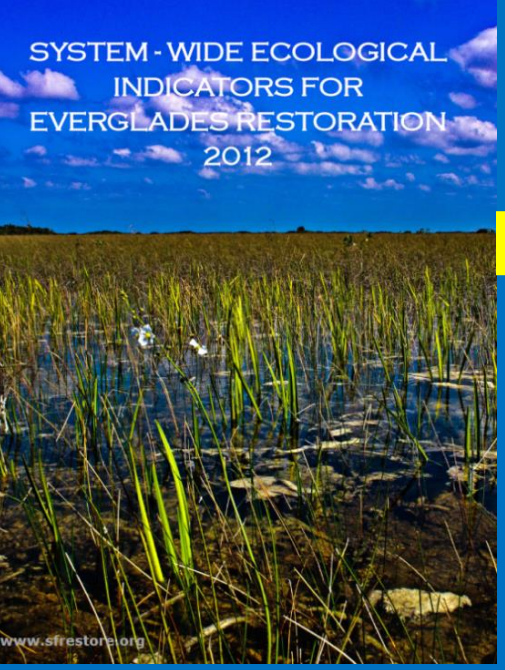
No Difference
6 - 30 Shorter
31 - 60 Shorter
61 - 120 Shorter
121 - 180 Shorter
N
W
E
S
0 5 10 20
Miles

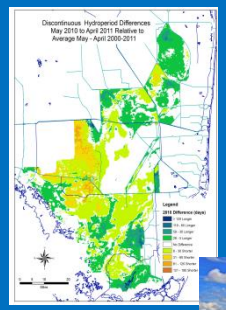
Added Indicators at a Glance

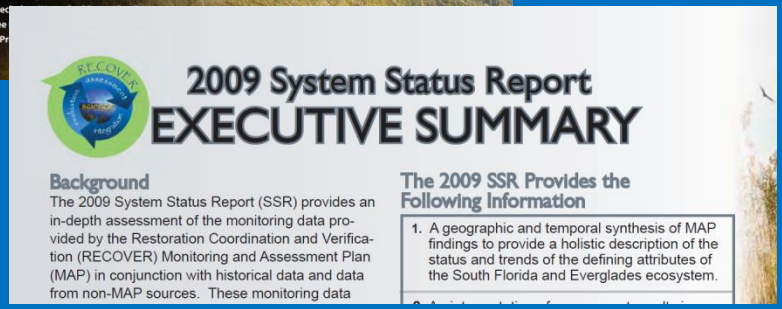
	Water Year 2008	Water Year 2009	Water Year 2010	Water Year 2011	Water Year 2012
Lake Okeechobee					
Invasive Exotic Plants					
Lake Okeechobee Nearshore Zone Submersed Aquatic Vegetation					
Northern Estuaries					
Invasive Exotic Plant Species					
Eastern Oysters					
Greater Everglades					
Crocodilians					
Fish and Macroinvertebrates (WCA 3 and ENP only)					
Invasive Exotic Plants					
Periphyton and Epiphyton					No species composition data
Wading Birds (White Ibis and Wood Stork)					
Southern Coastal System					
Crocodilians					
Southern Estuaries Algal Blooms**					
Florida Bay Submersed Aquatic Vegetation					
Invasive Exotic Plants					
Juvenile Pink Shrimp*	Data used as base	Data used as base	Data used as base		
Wading Birds (Roseate Spoonbill)					Prey community data not yet processed
Wading Birds (White Ibis and Wood Stork)					

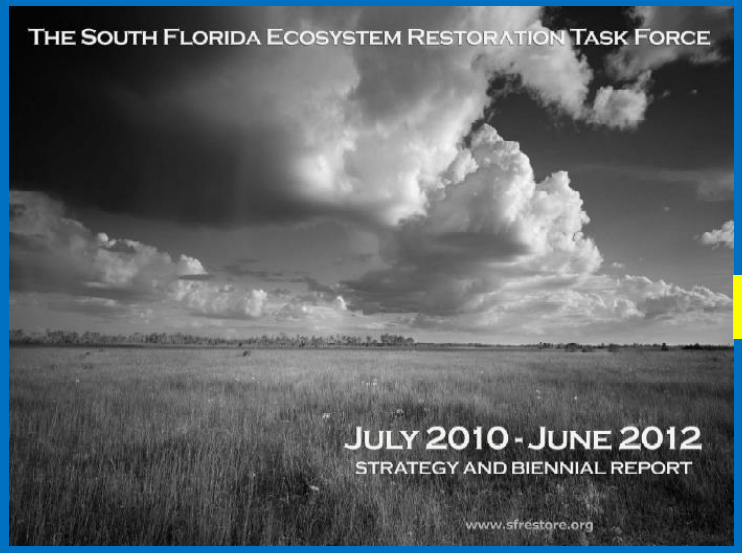
Challenge	Solution	Status
Integrated summary	Interaction among scientists to prepare summary	Conversations started
Integrated with other reports	Coordination with RECOVER on SSR	Conversations started
Need big picture management implications	Tie results to management actions Explain the “so what”	Planned for 2014 report Planned for 2014 report
Do we have the right indicators?	Review what we have learned since 2006	Need to initiate conversation
Funding to continue monitoring to allow consistent reporting	Document value of indicators	Ongoing



2014 Integration







2014

- Highlights of how restoration investments have resulted in improvements to ecological conditions
  - Kissimmee River sand bars
  - Small fish and changes in hydroperiods
  - Crocodiles and freshwater flows