

System-wide Ecological Indicators

Briefing to the Task Force February 17, 2011

Bob Doren, Joel Trexler, Matt Harwell

Background

- **Task Force Directive – Science Coordination Group (SCG) to develop small set of System-wide Indicators for Restoration**
- **SCG developed a process to identify indicators using criteria established in the literature**
- **Provide for Independent Scientific Review (ISR) of System-wide Indicator**
- **Provide open forum**
- **Reports and ISR: www.sfrestore.org**

Selection Guidelines

1. Is the indicator relevant to the ecosystem and does it respond to variability at a scale that makes it applicable to the entire system or an important portion of it?
2. Is the indicator feasible to implement (i.e. is someone already doing it?)
3. Is the indicator sensitive to system drivers (i.e. rainfall)?
4. Is the indicator interpretable in a “common” language?
5. Are there situations where an “optimistic” trend in the indicator might suggest a “pessimistic” restoration trend?
6. Are there situations where a “pessimistic” trend in the indicator may be unrelated to restoration?
7. Is the indicator scientifically defensible?
8. Can clear measurable targets be established for the indicator to allow for evaluation of success?
9. Does the indicator have enough specificity to be able to be used to correct or redirect restoration actions?
10. Does the suite of indicators cover the critical range of ecosystem “features” including processes and structures?

Everglades Ecosystem “Features”

➤ Landscape Characteristics

- Hydro-patterns
- Vegetation Pattern/Patchiness
- Productivity
- Native Biodiversity
- Oligotrophy
- “Prinstineness”
- “Intactness”
- Trophic Balance
- Habitat Balance

➤ Trophic Constituents – Biodiversity

- Primary Producers
- Primary Consumers
- Secondary & Tertiary Consumers

➤ Physical Properties

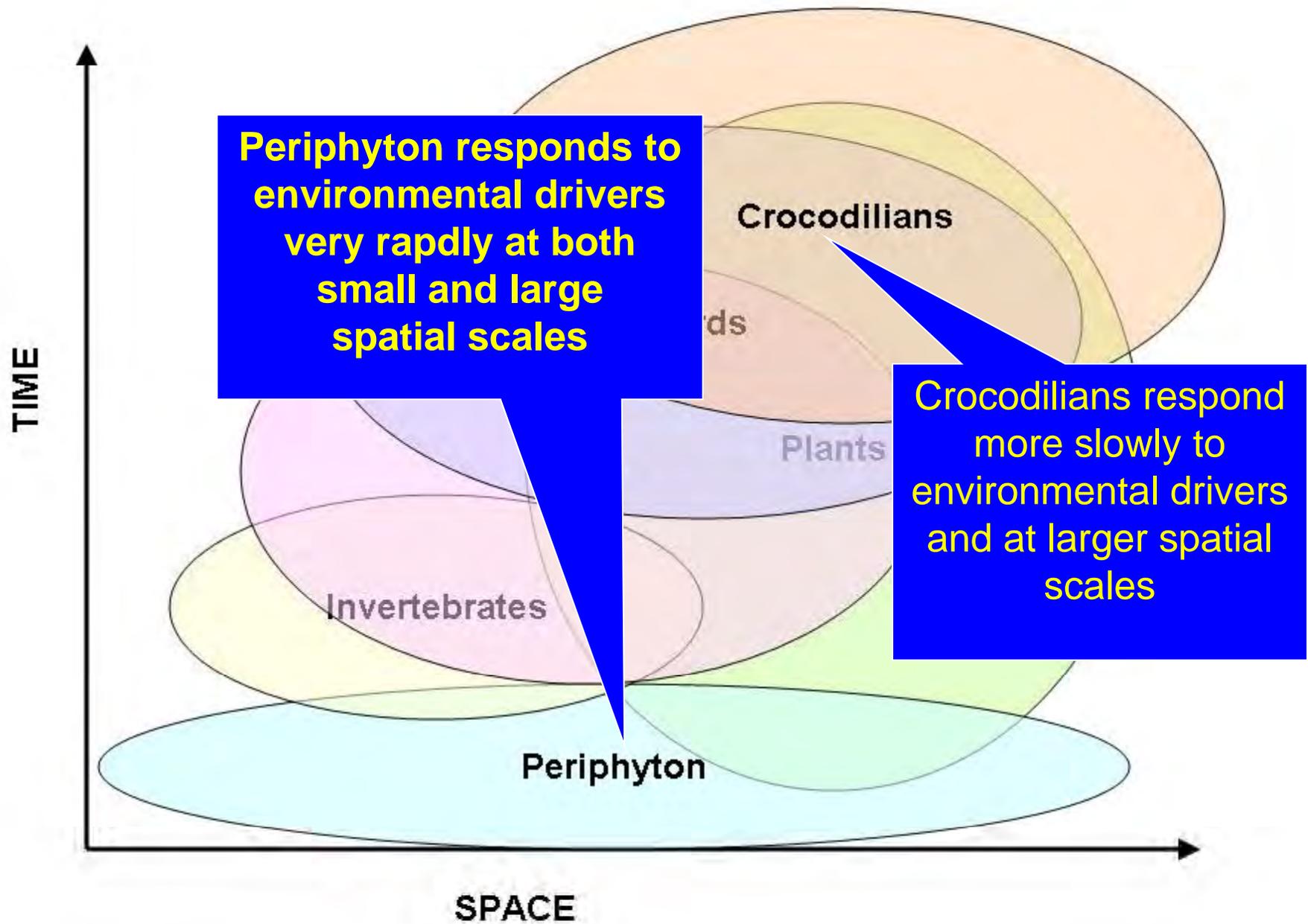
- Water Quality, Depth, Duration, Timing
- Water Management
- Exotics
- Salinity
- Nutrients
- Contaminants

➤ Ecological Regions

- i.e. Modules & “un-modulated” areas

➤ Temporal Scales

- Indicators that respond rapidly to environmental changes
- Indicators that respond more slowly to environmental changes



Ecological Indicators (Goals 1 & 2)

1. **Periphyton-Epiphyton** Evelyn Gaiser, et al.
2. **Fish & Macroinvertebrates** Joel Trexler, et al.
3. **Roseate Spoonbills** Jerry Lorenz, et al.
4. **Woodstork & White Ibis** Peter Frederick, Dale Gawlik, et al.
5. **Eastern Oysters** Aswani Voleti et al.
6. **Juvenile Pink Shrimp** Joan Browder, Mike Robblee et al.
7. **Florida Bay Algal Blooms** Joe Boyer, Chris Kelbel, et al.
8. **Florida Bay SAV** Dave Rudnick, Chris Madden et al.
9. **Lake Okeechobee Littoral Zone** Matt Harwell, et al.
10. **Crocodylians** Frank Mazzotti, Ken Rice et al.
11. **Exotic Plants** Bob Doren, Jenny Richards, John Volin

8 Essentials for Measuring Success

1. **Scientific Consensus** on Ecosystem Structure & Function – CEMS
2. **Indicators** with *metrics* for Ecosystem Structure or Function (Environmental Conditions)
3. **Baselines** to establish points of comparison
4. **Monitoring Program** to collect the data for assessments
5. **Performance Measures** using *metrics* to compare interim and end point results with desired outcomes
6. **Targets** to set interim or end points against which to measure trends
7. **Assessments** to analyze the data and evaluate the progress and results
8. **Communication Tools** to inform, advise and educate the restoration community

How do the Task Force
System-wide Indicators
Integrate and Coordinate with
RECOVER Assessments &
Adaptive Management Program
& Other Science?

Three Tiers

Providing Transparency from
Complex Data to Simplified Interpretations

- Stoplight / Key Findings Report Cards
- Simplified Graphics & Maps in Biennial Report and Individual Indicator Assessment Reports representing data in Stoplight color-coded format
- RECOVER System Status Report (SSR) serves as the Tier 2 and 3 level science for restoration, additional reports supplement (South Florida Environmental Report, biennial report, peer reviewed publications, etc.)

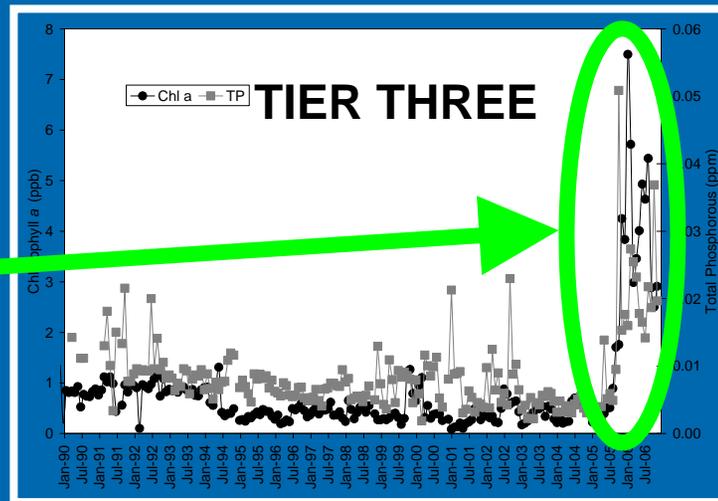
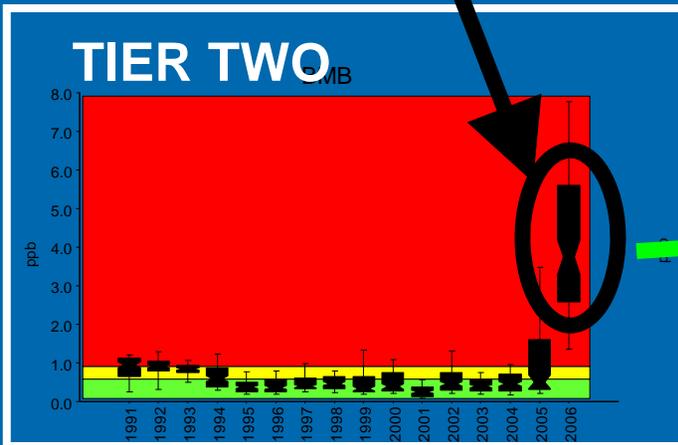
Both SSR Hypotheses and SCG Indicators use Hierarchical Data Approach

Detailed analysis, interpretation, and reporting in hierarchical manner

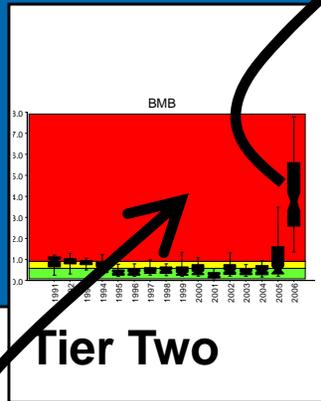
ALGAL BLOOMS – SOUTHERN ESTUARIES					
PERFORMANCE MEASURE	LAST STATUS	CURRENT STATUS	2-YEAR PROSPECTS	CURRENT STATUS*	2-YEAR PROSPECTS*
Chlorophyll <i>a</i> SAVINNE MANGROVE & BLACKWATER RICHNESS (SMR)	Red	Red	Yellow	The region is the only estuarine system in the world with a documented history of cyanobacterial blooms. The region has the highest concentration of cyanobacteria in any estuarine system. The region has the highest concentration of cyanobacteria in any estuarine system.	The region is the only estuarine system in the world with a documented history of cyanobacterial blooms. The region has the highest concentration of cyanobacteria in any estuarine system.
Chlorophyll <i>a</i> NORTHEAST FLORIDA BAY (NEFB)	Yellow	Yellow	Yellow	The current status is due to the presence of cyanobacterial blooms in 2005 and 2006. These blooms are not expected to occur in the next 2 years.	The region is a good candidate for the region of the next 2 years. The region is a good candidate for the region of the next 2 years.
Chlorophyll <i>a</i> NORTH-CENTRAL FLORIDA BAY (NCFB)	Green	Yellow	Yellow	The current status is due to the presence of cyanobacterial blooms in 2005 and 2006. These blooms are not expected to occur in the next 2 years.	The region is a good candidate for the region of the next 2 years. The region is a good candidate for the region of the next 2 years.
Chlorophyll <i>a</i> SOUTH FLORIDA BAY (SFB)	Yellow	Yellow	Yellow	The current status is due to the presence of cyanobacterial blooms in 2005 and 2006. These blooms are not expected to occur in the next 2 years.	The region is a good candidate for the region of the next 2 years. The region is a good candidate for the region of the next 2 years.
Chlorophyll <i>a</i> WEST FLORIDA BAY (WFB)	Green	Green	Green	The current status is due to the presence of cyanobacterial blooms in 2005 and 2006. These blooms are not expected to occur in the next 2 years.	The region is a good candidate for the region of the next 2 years. The region is a good candidate for the region of the next 2 years.
Chlorophyll <i>a</i> MANGROVE FOREST ZONE (MFB)	Yellow	Yellow	Yellow	The current status is due to the presence of cyanobacterial blooms in 2005 and 2006. These blooms are not expected to occur in the next 2 years.	The region is a good candidate for the region of the next 2 years. The region is a good candidate for the region of the next 2 years.
Chlorophyll <i>a</i> SCOTTSVILLE FLORIDA SHELF (SFB)	Yellow	Yellow	Yellow	The current status is due to the presence of cyanobacterial blooms in 2005 and 2006. These blooms are not expected to occur in the next 2 years.	The region is a good candidate for the region of the next 2 years. The region is a good candidate for the region of the next 2 years.
Chlorophyll <i>a</i> NORTH BISCAYNE BAY (NBB)	Yellow	Yellow	Yellow	The current status is due to the presence of cyanobacterial blooms in 2005 and 2006. These blooms are not expected to occur in the next 2 years.	The region is a good candidate for the region of the next 2 years. The region is a good candidate for the region of the next 2 years.
Chlorophyll <i>a</i> CENTRAL BISCAYNE BAY (CBB)	Yellow	Yellow	Yellow	The current status is due to the presence of cyanobacterial blooms in 2005 and 2006. These blooms are not expected to occur in the next 2 years.	The region is a good candidate for the region of the next 2 years. The region is a good candidate for the region of the next 2 years.
Chlorophyll <i>a</i> SOUTH BISCAYNE BAY (SBB)	Yellow	Yellow	Yellow	The current status is due to the presence of cyanobacterial blooms in 2005 and 2006. These blooms are not expected to occur in the next 2 years.	The region is a good candidate for the region of the next 2 years. The region is a good candidate for the region of the next 2 years.

TIER ONE

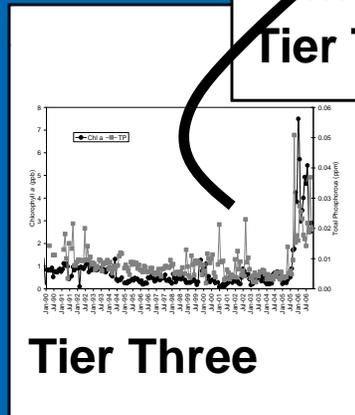
*Data in the Current Status column for the algal bloom indicator reflect data including the calendar year 2006. The assumption being used for the 2-Year Prospects Column is: There will be no change in water management from the date of the current status assessment.



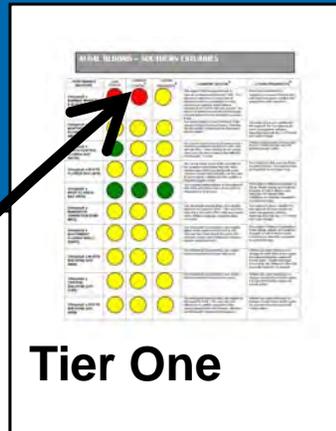
Science Report



Tier Two



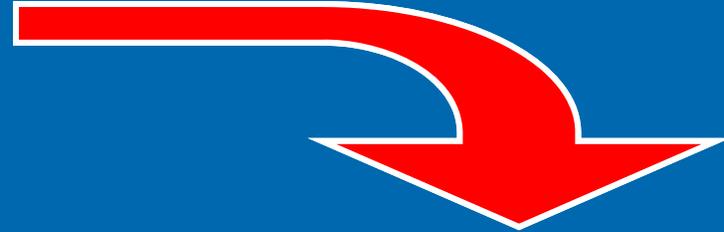
Tier Three



Tier One

Linking data to the Stoplights

- Tier 1. Stoplight Reports
- Tier 2. Summary graphics and data charts
- Tier 3. Detailed data, theory, and analyses



Task Force Biennial Report

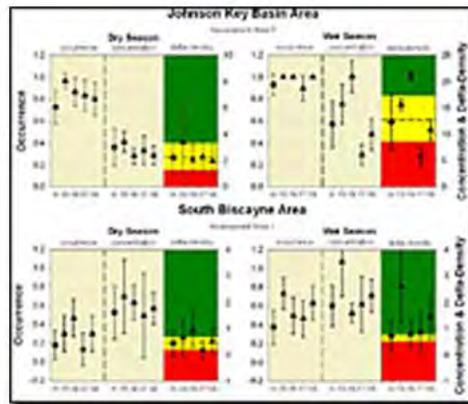
STOPLIGHTS - ALGAL BLOOMS SOUTHERN ESTUARIES		
Performance Measure Chlorophyll a	CURRENT STATUS ²	CURRENT STATUS
BARNES, MANATEE & BLACKWATER SOUNDS (BMB)		This region of the bay experienced an unusual cyanobacterial bloom in 2006. The bloom was initiated by a large spike in phosphorus from a combination of highway construction and canal releases in response to the active hurricane season. The bloom has abated, but elevated chlorophyll concentrations have not returned to previous levels.
NORTHEAST FLORIDA BAY (NEFB)		The current status is due to the periodic expansion of the cyanobacterial bloom from Barnes, Manatee and Blackwater Sounds into this region.
NORTH-CENTRAL FLORIDA BAY (NCFB)		The current status is due to the presence of a seasonal cyanobacterial bloom in both early and late 2006. These blooms do not appear every year, but have occurred infrequently over the past 15 years. It is unlikely that this signals a long term negative trend.
SOUTH FLORIDA BAY (SFB)		The current status is due to the extension of the cyanobacterial bloom from the north-central region of the bay during both years. This has occurred infrequently over the past 15 years and is unlikely that this signals a long term negative trend.
WEST FLORIDA BAY (WFB)		The seasonal diatom blooms in this region for both 2006 and 2007 were not as dense or widespread as in the past.
MANGROVE TRANSITION ZONE (MTZ)		The chlorophyll concentrations were slightly higher in this region for both 2006 & 2007. This may have been due to the active 2005 hurricane season and is unlikely to indicate a negative long term trend.
SOUTHWEST FLORIDA SHELF (SWFS)		The chlorophyll concentrations were slightly higher in this region for both 2006 & 2007. This may have been due to the active 2005 hurricane season and is unlikely to indicate a negative long term trend.
NORTH BISCAYNE BAY (NBB)		The chlorophyll concentrations were slightly higher in this region for both 2006 & 2007. Neither year had concentrations that were significantly higher than baseline.
CENTRAL BISCAYNE BAY (CBB)		The chlorophyll concentrations were slightly higher in this region for both 2006 & 2007. Neither year had concentrations that were significantly higher than baseline.
SOUTH BISCAYNE BAY (SBB)		The chlorophyll concentrations were slightly higher in this region for both 2006 & 2007. This area was also influenced by periodic expansion of the cyanobacterial bloom from Barnes, Manatee and Blackwater Sounds into this region.

Biscayne Bay Mangrove Fish

Florida Bay Juvenile Sportfish

Biscayne Bay Alongshore Epifauna Communities

Seagrass Fish & Invertebrate Assessment Network



Status of pink shrimp 2005-2008 relative to historical data.
 Click image to view full size.

intermediate years. For the five years of FIAN seasonal scoring, mean dry and wet season densities are highest in 2005.

Assessment Area	Spring (Dry Season)					Fall (Wet Season)				
	2005	2006	2007	2008	2009	2005	2006	2007	2008	2009
Johnson Key Basin Area	0.75	0.67	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
South Biscayne Area	0.75	0.67	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
North Biscayne Area	0.75	0.67	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
Southwest Florida Bay	0.75	0.67	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
Florida Bay	0.75	0.67	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
Mean	0.75	0.67	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33

Status of pink shrimp 2005-2008 relative to historical data.

Historical and FIAN data for Johnson Key Basin and south Biscayne Bay were used to calculate occurrence and concentration of pink shrimp. Relative to available historical data, pink shrimp did well in 2005, with average scores among the six assessment areas of 0.75 for the dry season and 0.67 for the wet season. In contrast, 2007 was an extremely poor year with scores among the six response areas averaging only 0.33 for both seasons. On average, 2006 and 2008 were

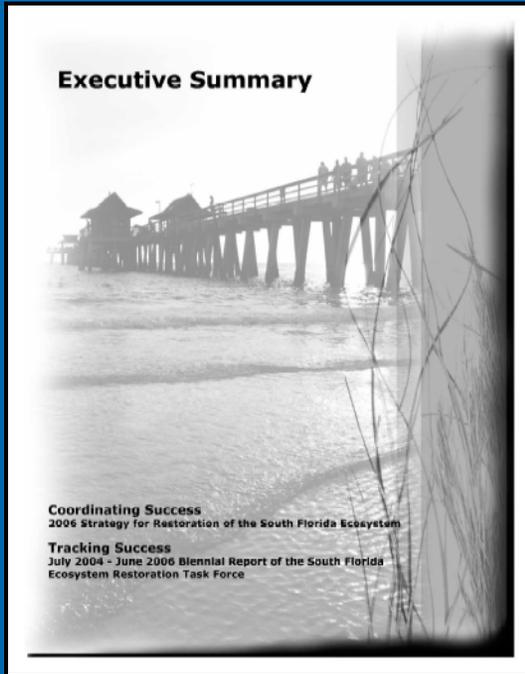
By comparison, 2006 through 2008 were poorer years, with the poorest performance overall in the in the fall of 2009. There exists a significant five-year overall downward trend in the wet

SSR also has Stoplight Linkages

TASK FORCE BIENNIAL REPORT – SYSTEM-WIDE INDICATORS STOPLIGHT LINKS

TWO PARTS

PART TWO INDIVIDUAL INDICATOR STOPLIGHT REPORTS KEY FINDINGS



Executive Summary

Coordinating Success
2006 Strategy for Restoration of the South Florida Ecosystem

Tracking Success
July 2004 – June 2006 Biennial Report of the South Florida Ecosystem Restoration Task Force

- Water Quality
- Biocycle Aquifer Salinization
- Flood Protection – C-111 Basin

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PART ONE INDICATOR EXECUTIVE SUMMARY BIENNIAL REPORT

Ecological Indicators

Fish and Macroinvertebrates

Significance and background. Marsh and estuarine aquatic biota, including small fishes and crustaceans, are critical in the food web as primary and secondary consumers and as prey for focal Everglades predators such as wading birds. This indicator uses the density (number of animals per unit area) and community composition (how many of each species per unit area) of a suite of native fishes (e.g., eastern mosquitofish, bluefin killifish, stripedhead minnow, sailfin molly) and crustaceans (dough and Everglades crayfish, riverine grass shrimp) to describe trends in their populations related to hydrology.

Fish and macroinvertebrate responses are directly related to the suitability of environmental conditions. Correlations between biological responses and environmental conditions contribute to an understanding of the species' status and trends over time. The positive or negative trends of this indicator relative to hydrological changes permit an assessment of positive or negative trends in restoration.

Factors affecting success. The most important factors affecting fish abundances regionally are the loss of habitat, hydroperiod, and water depth and frequency of drying events. Because of relatively dry hydrological conditions in the Everglades Ecosystem resulting from water management over the past several decades, and a loss of habitat to agricultural and urban uses, fish and macroinvertebrate densities have decreased and community structure has changed.

Toward restoration. The broad restoration goals for this indicator are to enhance population density and community composition of fish and macroinvertebrates through hydrologic restoration and improved water management.

Wading Birds (White Ibis, Wood Stork, and Roseate Spoonbill)
Significance and background. Extremely large numbers of wading birds were one of the defining characteristics of the pre-drainage wetlands of south Florida. Of particular relevance to understanding the population dynamics of wading birds in the pre-drainage system are the combined features of large

* See Appendix C-111 Biennial View of the Microcosm Test "Wading Bird Population Test and Ecological Indicators" Section 11.1.5.

KEY FINDINGS – SOUTHERN ESTUARIES

SUMMARY FINDING: Re-suspension of nutrients from the 2005 hurricane season resulted in algal blooms in many regions of the southern estuaries and may cause continued algal blooms in the bay for some time. However, this is expected to subside if further significant hurricane activity and should return to with the possible exception of BMB.

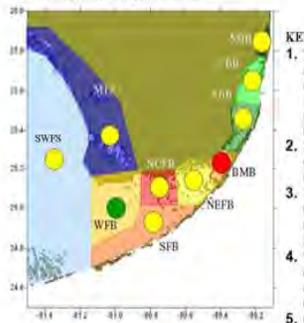


Figure 1. Map of Florida Bay regions with stoplight ratings by region

1. Continue monitoring water quality throughout the bay and the S of the post 2005 hurricane season.
2. Monitoring of Barnes, Manatee and Blackwater Sounds is critical and continues.
3. Monitoring long term consequences of nutrient releases in hurricanes and human causes (e.g. road construction) and the (e.g. more fresh water flow into Florida Bay) is critical to evalu

STOPLIGHTS – ALGAL BLOOMS SOUTHERN ESTUARIES

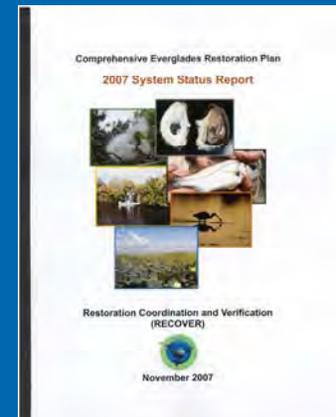
Performance Measure Chlorophyll <i>a</i>	CURRENT STATUS ¹	CURRENT STATUS
BARNES, MANATEE & BLACKWATER SOUNDS (BMB)	Red	The region of the bay experienced an unusual cyanobacterial bloom in 2005. The bloom was initiated by a large water discharge from a combination of hydrologic conditions and concentrations of nutrients in the southern estuarine system. The duration of most cyanobacteria blooms (BMB) is generally short and related to specific flows.
NORTHEAST FLORIDA BAY (NEFB)	Yellow	The current status of NEFB is the periodic resuspension of the cyanobacteria bloom from Barnes, Manatee and Blackwater Sounds into the region.
NORTH-CENTRAL FLORIDA BAY (NCFB)	Yellow	The current status of NEFB is the presence of a seasonal cyanobacterial bloom in the north and late 2005. These blooms do not appear every year, but have occurred intermittently over the past 15 years. It is unclear how the system is being managed to avoid.
SOUTH FLORIDA BAY (SFB)	Yellow	The current status of SFB is the initiation of the cyanobacterial bloom from the north and late 2005. These blooms do not appear every year, but have occurred intermittently over the past 15 years and it is unclear how the system is being managed to avoid.
WEST FLORIDA BAY (WFB)	Green	The seasonal algal blooms in this region for 2004, 2005 and current were not as dense as experienced in the past.
MANGROVE TRANSITION ZONE (MTZ)	Yellow	The chlorophyll concentrations were slightly higher in this region for both 2004 & 2005. This may have been due to the 2005 hurricane season and a related increase in freshwater inflows.
SOUTHWEST FLORIDA SHELF (SWFS)	Yellow	The chlorophyll concentrations were slightly higher in this region for both 2004 & 2005. This may have been due to the 2005 hurricane season and a related increase in freshwater inflows.
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**Reports are
all using the
same science**

Task Force
Biennial Report



Partnerships
RECOVER System
Status Report



Agencies
South Florida
Environmental Report



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ECOLOGICAL INDICATORS

Indicators for Everglades Restoration



Editor-in-chief
Felix Müller

Special Issue:
Evaluating sustainable forest management
An international collection of empirical and applied research
Guest Editor: Gordon M. Hickey

ECOLOGICAL INDICATORS JOURNAL

SPECIAL EVERGLADES INDICATOR ISSUE

Tier Three

- Published November 2009
- Eds. Robert Doren, Joel Trexler, Matt Harwell and Ronnie Best

Thank You

Any Questions?