

# **Assessing and Communicating System-wide Indicators**

**April 28 – 29, 2008**

# Purpose

- The Task Force will report on the status of the System-wide Indicators included in the 2006 Strategy for the first time in the 2008 Biennial Report.
- A recommended approach for communicating the status of the System-wide Indicators in the Biennial Report will be presented for discussion and guidance.

**Background**

# REPORTING SYSTEM-WIDE INDICATORS

- **Every two years the Task Force prepares:**
- A Strategic plan that includes strategic goals, system-wide indicators and also outlines how restoration will occur
- A Biennial Report that describes restoration activities and progress to include the status of the System-wide Indicators

- **In 2004 the Task Force directed the SCG** to develop a small set of System-wide Indicators for Restoration (scientifically based, independently reviewed, open and transparent process with public participation)
- **The SCG developed** (in close coordination with RECOVER) a robust process to identify indicators using criteria established in the literature
  - Ecological Indicators (Goal 1 & 2)
  - Indicators of Compatibility (Goal 3)
  - Indicator Report and independent review report are available at: [www.sfrestore.org](http://www.sfrestore.org)
- These indicators are included in the **Task Force 2006 Strategic Plan**

# System-wide Indicators

1. **Periphyton-Epiphyton**
2. **Fish**
3. **Roseate Spoonbills**
4. **Wood stork & White Ibis**
5. **Oysters**
6. **Juvenile Pink Shrimp**
7. **Florida Bay Algal Blooms**
8. **Florida Bay Submerged Aquatic Vegetation (SAV)**
9. **Lake Okeechobee Littoral Zone**
10. **Crocodylians (Alligators & Crocodiles)**
11. **Exotic Plants**
12. **Water Volume**
13. **Salinity Intrusion in the Biscayne Aquifer**
14. **Flood Protection – C-111 Basin**

**How we got there**

# Four Step Process

1. The SCG did a thorough review of the scientific literature on indicators, their use and applications
2. Based on the literature the SCG developed guidelines to evaluate relevant indicators for Everglades Ecosystem applicability, and their individual and collective value and coverage of Everglades' "Features" (i.e. ecosystem Regions, Characteristics, Trophic Interactions, and Functions)
3. Using the guidelines the SCG evaluated south Florida and other national restoration programs for indicators for possible application to the Task Force suite of system-wide indicators
4. Recommended System-wide suite of indicators for the 2006 Strategy

# 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?
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

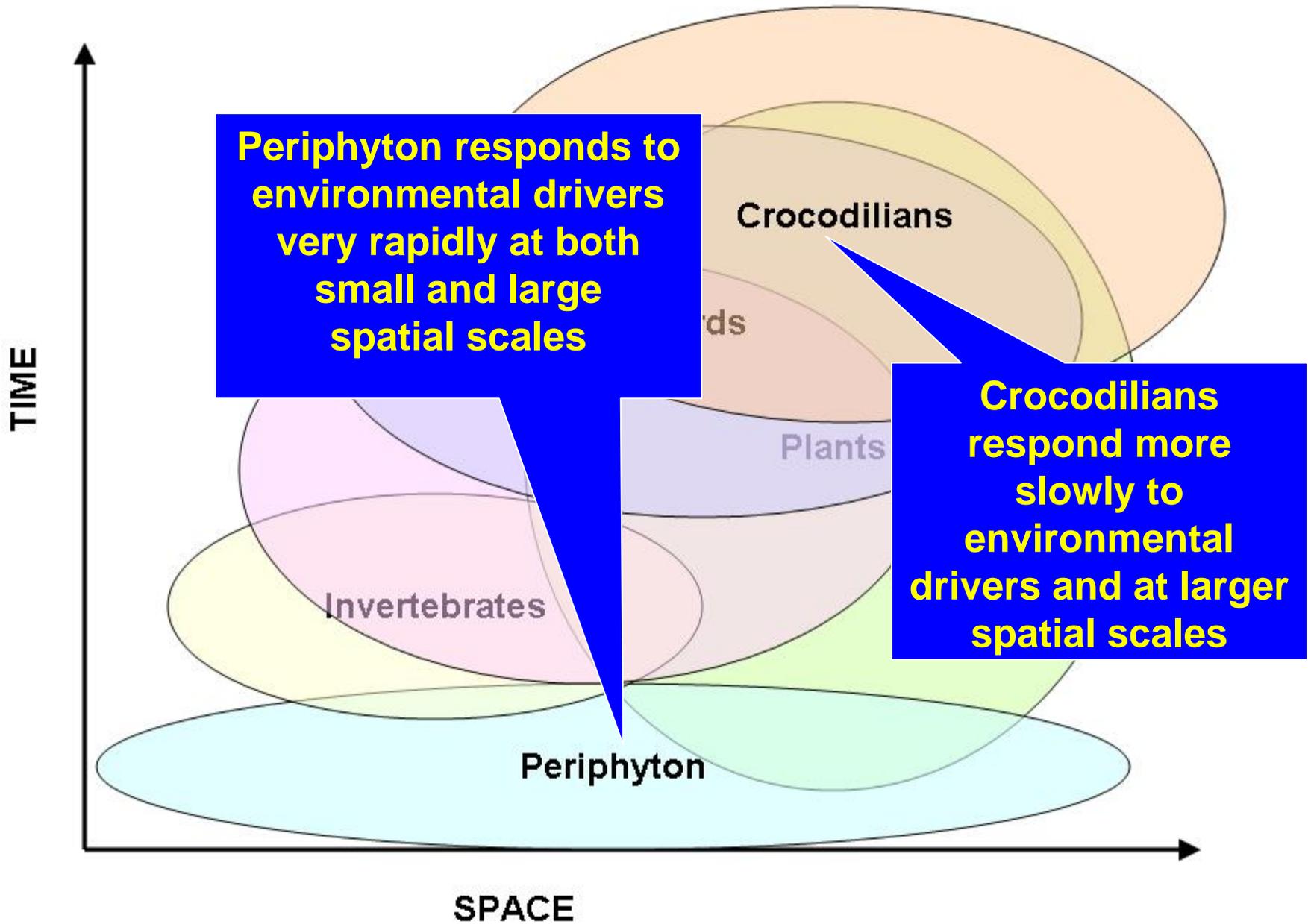
- i.e. Modules & “un-modulated” areas

## ➤ Temporal Scales

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

# How Indicators Apply System-wide

- The System-wide Ecological Indicators are populations or communities of organisms
- Indicators need to “cover” as many Everglades “Features” as possible to be considered System-wide
- The indicators should cover both the spatial and temporal aspects of the Everglades



# **Assessing and Communicating System-wide Indicators**

# 8 Essentials

1. **Scientific Consensus** on Ecosystem Structure & Function – CEMS
2. **Indicators** (e.g. fish) with metrics for Ecosystem Structure or Function (Environmental Conditions)
  1. Species whose status is indicative of larger functional groups
  2. Species whose status reflects status of key habitats
  3. Species that serve as an “early warning sign” of anticipated stressors
3. **Baselines** to establish points of comparison
4. **Monitoring Program** to collect the data for assessments
5. **Performance Measures** (e.g. bluefin kilifish per unit area) using metrics to compare interim and end point results with desired outcomes
6. **Targets** for indicators (e.g. bluefin kilifish per unit area relative to water depth) 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

# Communicating the Status of the System-wide Indicators

Linking Complex Data Analyses to the Stoplights

# Florida Bay Algal Blooms

## Chlorophyll *a*

### Tier One

## Restoration Stoplight Report Card

SFERTF Science Coordination Group

*Built System Indicators  
Subgroup*

# Restoration Stoplight Report Card

## Florida Bay Algal Blooms

### 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 within a few additional years in lieu of further significant hurricane activity and should return to predominantly green for all regions with the possible exception of BMB.

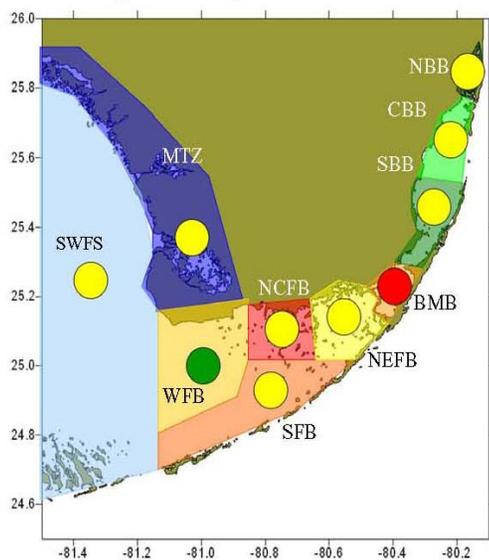


Figure 1. Map of Florida Bay regions with stoplight ratings by region

### KEY FINDINGS:

1. The majority of regions assessed had significant algal bloom activity that appears to have been predominantly influenced by the heavy 2005 hurricane season aggravated for the eastern bay by road construction on US 1.
2. The majority of regions assessed had chlorophyll-*a* and algal blooms rated as moderate (yellow).
3. The majority of regions assessed where the chlorophyll-*a* was higher than the median do not appear to be indicative of long-term negative trends.
4. The most commonly occurring condition was large spatial coverage of algal blooms and elevated chlorophyll-*a* concentrations.
5. Overall eutrophic symptom expressions were geographically variable and appear to be explainable from existing phenomenological conditions of hurricane activity overall exacerbated by

road construction along US 1 in the eastern areas of the bay.

6. Continue monitoring water quality throughout the bay and the SW coastal shelf particularly as a result of the post 2005 hurricane season.
7. Monitoring of Barnes, Manatee and Blackwater Sounds is critical while road construction along US 1 continues.
8. Monitoring long term consequences of nutrient releases into the bay from both natural (e.g. hurricanes) and human causes (e.g. road construction) and the interactions of hydrological restoration (e.g. more fresh water flow into Florida Bay) is critical to evaluating Florida Bay restoration.

### ALGAL BLOOMS – SOUTHERN ESTUARIES

PERFORMANCE MEASURE	LAST STATUS	CURRENT STATUS <sup>a</sup>	2-YEAR PROSPECTS <sup>b</sup>	CURRENT STATUS <sup>a</sup>	2-YEAR PROSPECTS <sup>b</sup>
Chlorophyll <i>a</i> BARNES, MANATEE & BLACKWATER SOUNDS (BMB)	Red	Red	Yellow	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 canal releases and highway construction in response to the active hurricane season. The bloom has abated somewhat but chlorophyll concentrations have not returned to previous levels.	When road construction is completed, we expect that this area will return to its green condition that existed from 1995 until 2006.
Chlorophyll <i>a</i> NORTHEAST FLORIDA BAY (NEFB)	Yellow	Yellow	Yellow	The current status is due to influence of the cyanobacterial bloom from Barnes, Manatee and Blackwater Sounds periodic expansion into this region.	The return to a green condition for this region of the bay depends on water management activities improving flows into the C-111 basin and Taylor Slough.
Chlorophyll <i>a</i> NORTH-CENTRAL FLORIDA BAY (NCFB)	Green	Yellow	Yellow	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 intermittently over the past 15 years.	Without improvements in freshwater flows to Florida Bay the area will probably remain yellow.
Chlorophyll <i>a</i> SOUTH FLORIDA BAY (SFB)	Yellow	Yellow	Yellow	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 intermittently over the past 15 years and it is unlikely that this signifies a long-term negative trend.	Since blooms in this area are driven by external forces, it is expected that such periodic events may occur.
Chlorophyll <i>a</i> WEST FLORIDA BAY (WFB)	Green	Green	Green	The seasonal diatom blooms in this region for both 2006 and current were not as dense or widespread as in the past.	This region is influenced primarily by Shark Slough outputs and southerly transport of Gulf of Mexico water along the SW Florida Shelf. Conditions are therefore dependent on external forcing.
Chlorophyll <i>a</i> MANGROVE TRANSITION ZONE (MTZ)	Yellow	Yellow	Yellow	The chlorophyll concentrations were slightly higher in this region for 2006. This may have been due to the active 2005 hurricane season and is unlikely to indicate a negative long-term trend.	The return to a green condition for this region of the bay depends on water management activities improving flows into the C-111 basin and Taylor Slough.
Chlorophyll <i>a</i> SOUTHWEST FLORIDA SHELF (SWFS)	Yellow	Yellow	Yellow	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.	This region is influenced primarily by Shark Slough outputs and southerly transport of Gulf of Mexico water. Conditions are therefore dependent on external forcing.
Chlorophyll <i>a</i> NORTH BISCAYNE BAY (NBB)	Yellow	Yellow	Yellow	The chlorophyll concentrations were higher than the baseline for the past four years.	Without any major hurricanes or changes in water flows to this region it is expected that this region will remain yellow. Significant inputs from canals will continue to affect this area until shut-flow is restored.
Chlorophyll <i>a</i> CENTRAL BISCAYNE BAY (CBB)	Yellow	Yellow	Yellow	The chlorophyll concentrations were higher than the baseline for the past four years.	Without any major hurricanes or changes in water flows to this region it is expected that this region will remain yellow.
Chlorophyll <i>a</i> SOUTH BISCAYNE BAY (SBB)	Yellow	Yellow	Yellow	The chlorophyll concentrations were higher in this region for 2006. This area was also influenced by periodic expansion of the cyanobacterial bloom from Barnes, Manatee and Blackwater Sounds into this region.	Without any major hurricanes or changes in water flows to this region it is expected that this region will remain yellow.

<sup>a</sup> Data in the Current Status column for the algal bloom indicator reflect data inclusive of calendar year 2006.

<sup>b</sup> The assumption being used for the 2-Year Prospects Column is: *There will be no changes in water management from the date of the current status assessment.*

# Tier Two Examples

## Florida Bay Algal Blooms

### **SUMMARIZED DATA & GRAPHICS**

Stoplight “Color - Coded” Maps  
Simplified Stoplight “Color- Coded” Graphics  
Performance Measure Criteria

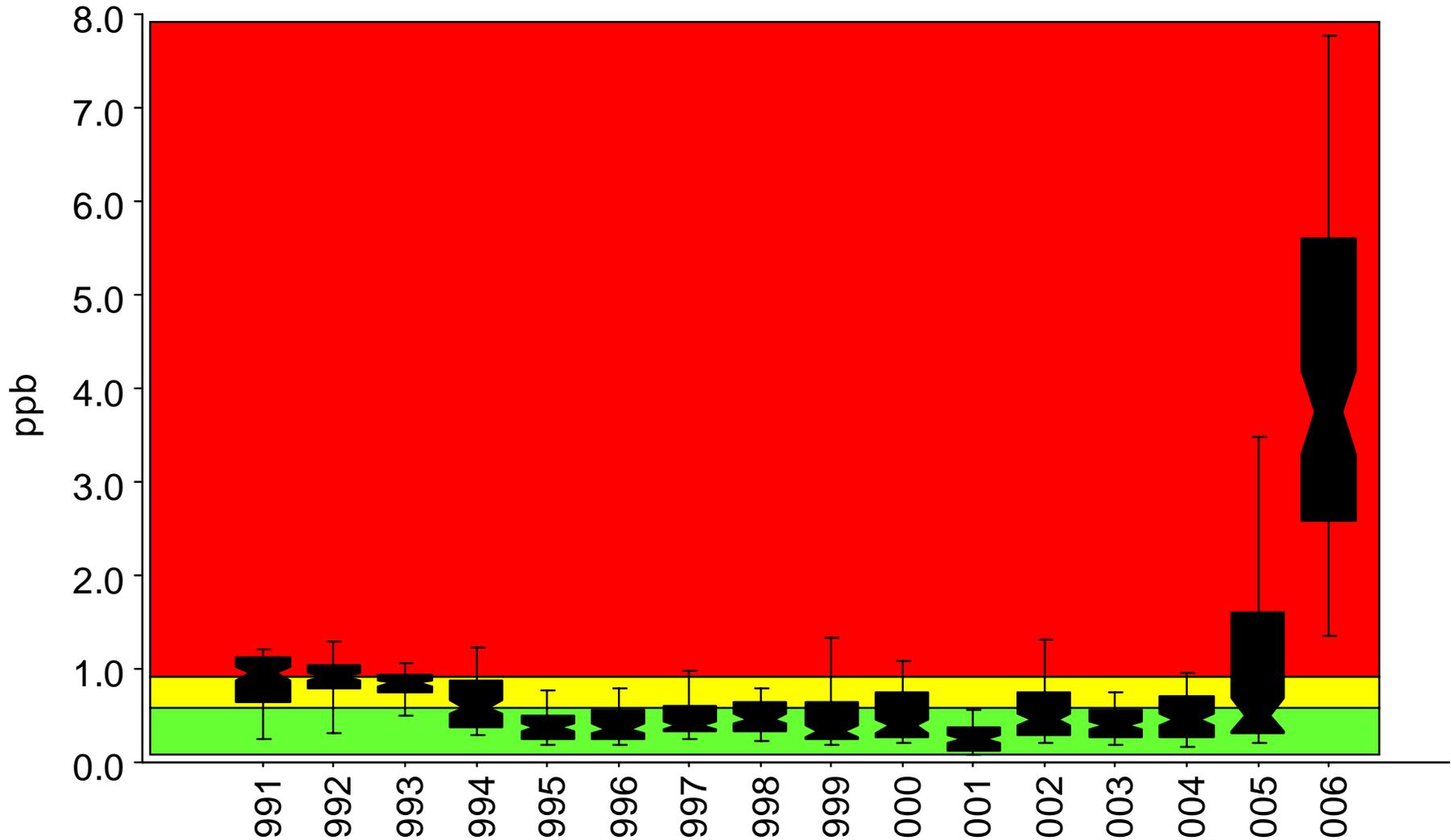
## Target thresholds for evaluating chlorophyll a (ppb) Performance Measure to determine color code

Sub-region		Valid N	25th Percentile	Median	75th Percentile
Blackwater, Manatee, Barnes	<b>BMB</b>	1704	0.306	0.526	0.910
Central Biscayne Bay	<b>CBB</b>	1673	0.200	0.313	0.566
Mangrove Transition Zone	<b>MTZ</b>	3803	1.690	2.863	4.903
North Biscayne Bay	<b>NBB</b>	635	0.670	1.048	1.648
North-central Florida Bay	<b>NCFB</b>	1399	0.585	1.216	3.710
Northeast Florida Bay	<b>NEFB</b>	1979	0.254	0.417	0.790
South Biscayne Bay	<b>SBB</b>	2257	0.181	0.264	0.426
South Florida Bay	<b>SFB</b>	1695	0.327	0.533	1.059
Southwest Florida Shelf	<b>SWFS</b>	1297	0.739	1.180	1.976
West Florida Bay	<b>WFB</b>	2304	0.653	1.345	2.845

# Thresholds for RYG

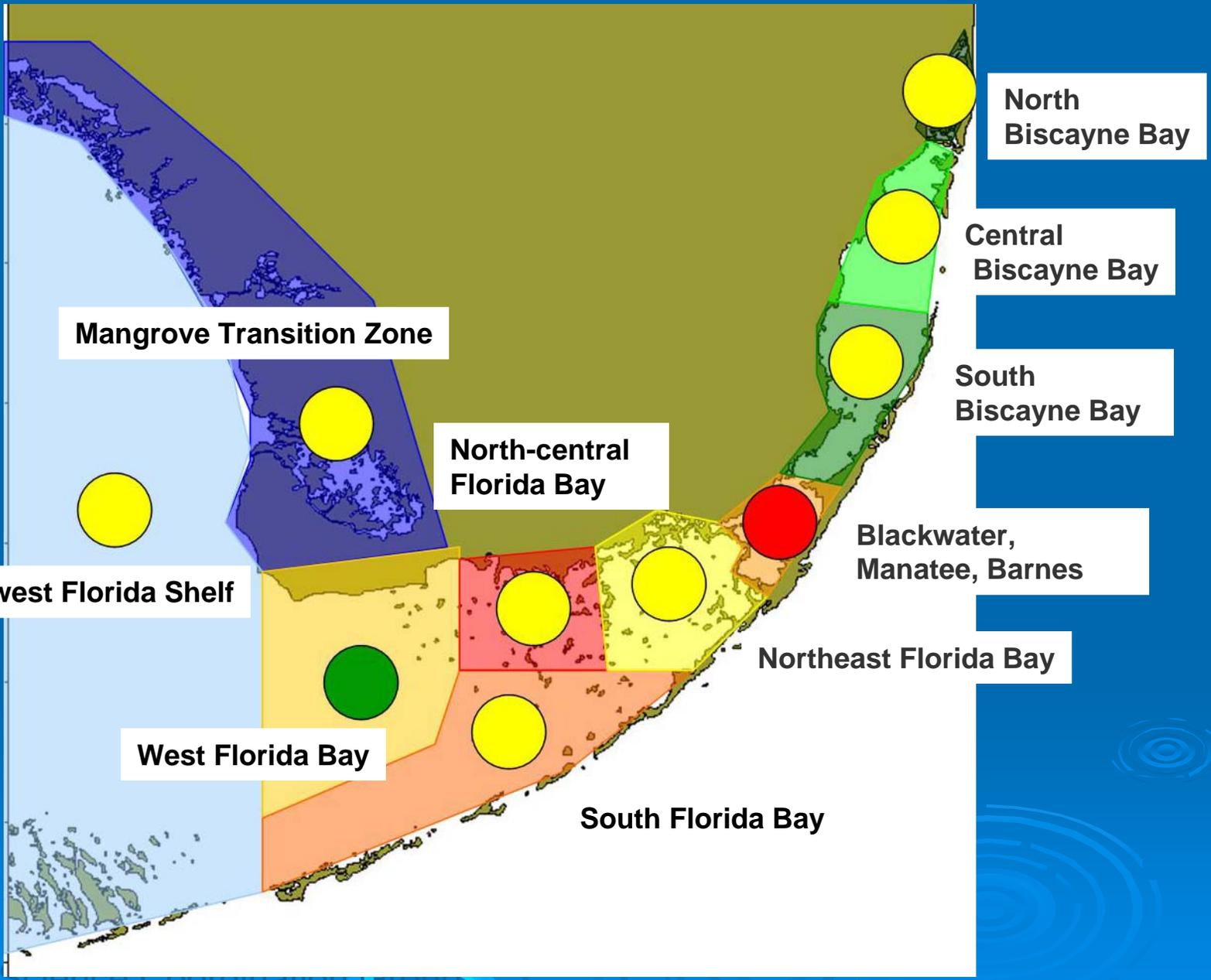
- Thresholds for indicators are determined using objective interpretations
- Each indicator may use different approaches to determine the thresholds (examples include):
  - Statistical models and relationships
  - Predictive models
  - Suitability Indexes
  - Deviations from “baseline” conditions
  - Ranking

# BARNES SOUND AND MANATEE BAY



**GRAPHIC DATA SUMMARIES  
IN STOPLIGHT COLOR - CODED FORMAT**

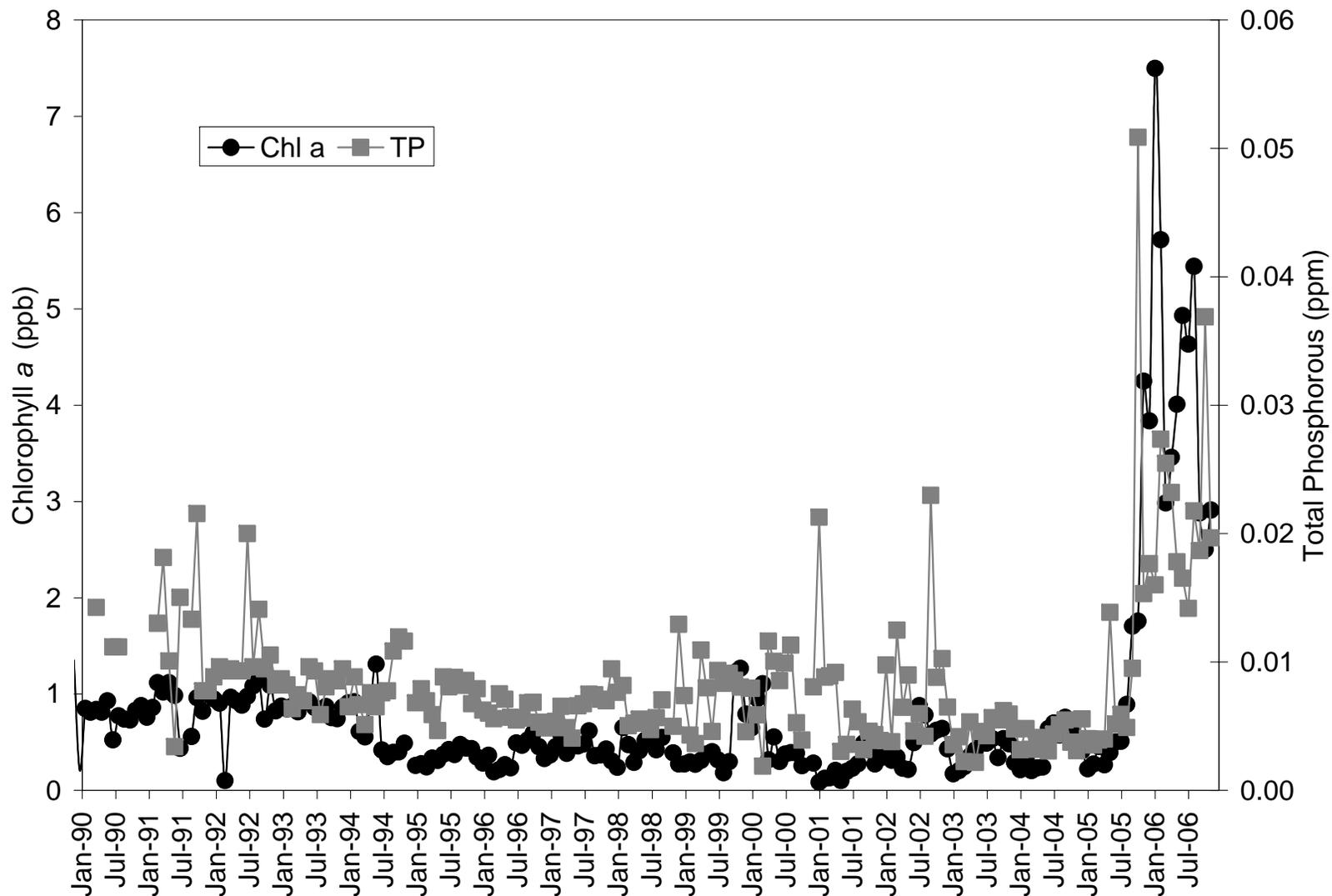
SFERTF Science Coordination Group



# Tier Three Examples

## Florida Bay Algal Blooms

Data Analyses, Theory,  
Modeling, Performance Measures,  
Metrics, Thresholds,  
Targets, Assessments, etc.



**Time series of median chlorophyll a (ppb) and total phosphorous (ppm) in the Barnes Sound Manatee Bay sub-region.**

## ALGAL BLOOMS – SOUTHERN ESTUARINE TIER ONE

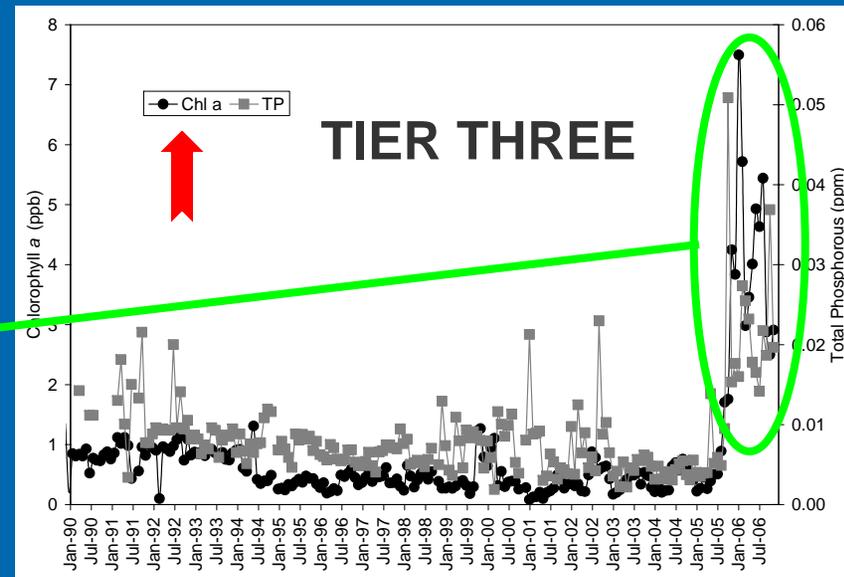
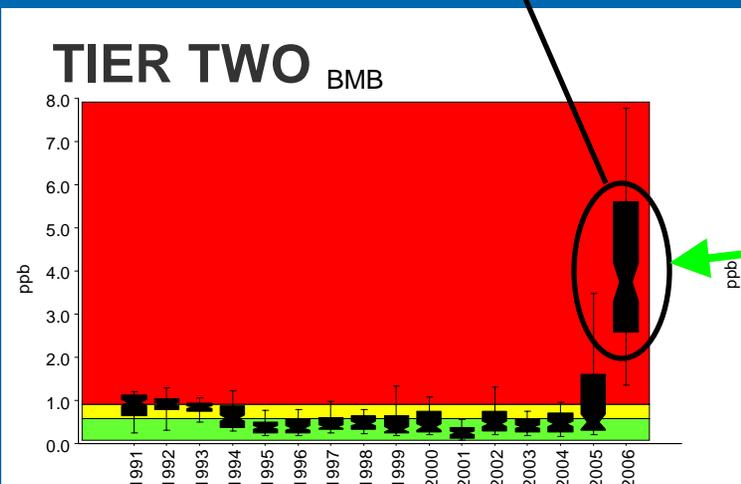
LOCATION	LAST STATUS*	CURRENT STATUS†	PROGNOSIS‡
BARNES, MANATEE & BLACKWATER SOUNDS (BMB)	Red	Red	This region of the bay experienced an unusual cyanobacterial bloom in 2006. The bloom was initiated by a large spike in phosphorus from a combination of canal releases and highway construction in response to the active hurricane season. The bloom has abated somewhat but chlorophyll concentrations have not returned to previous levels.
NORTHEAST FLORIDA BAY (NEFB)	Yellow	Yellow	The current status is due to influence of the cyanobacterial bloom from Barnes, Manatee and Blackwater Sounds periodic expansion into the region.
NORTH CENTRAL FLORIDA BAY (NCFB)	Green	Yellow	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 intermittently over the past 15 years. It is unlikely that the region has a long-term negative trend.
SOUTH FLORIDA BAY (SFB)	Yellow	Yellow	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 intermittently over the past 15 years and it is unlikely that the region has a long-term negative trend.
WEST FLORIDA BAY (WFB)	Green	Green	The seasonal status blooms in this region both 2006 and earlier were not as severe or widespread as in the past.
MANGROVE TRANSITION ZONE (MTZ)	Yellow	Yellow	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)	Yellow	Yellow	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)	Yellow	Yellow	The chlorophyll concentrations were slightly higher in this region for both 2006 & 2007. Higher peak concentrations that were significantly higher than baseline.
CENTRAL BISCAYNE BAY (CBB)	Yellow	Yellow	The chlorophyll concentrations were slightly higher in this region for both 2006 & 2007. Higher peak concentrations that were significantly higher than baseline.
SOUTH BISCAYNE BAY (SBB)	Yellow	Yellow	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.

# Science Report

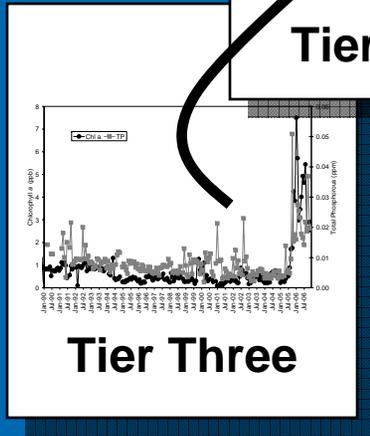
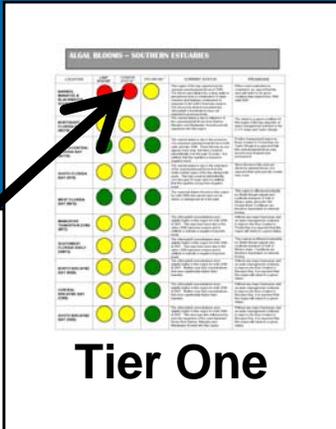
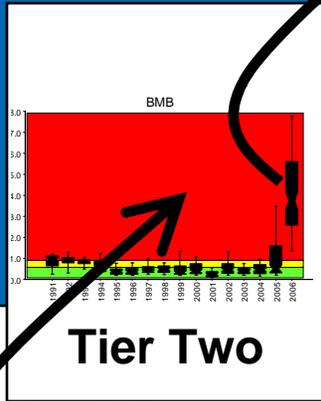
provides direct and transparent links from the data to the stoplights

OUR GOAL IS TO:

- Develop Stoplights that are empirically based
- Develop performance measures that are dynamic & reflect natural variation
- Distinguish between natural and management effects on targets where possible

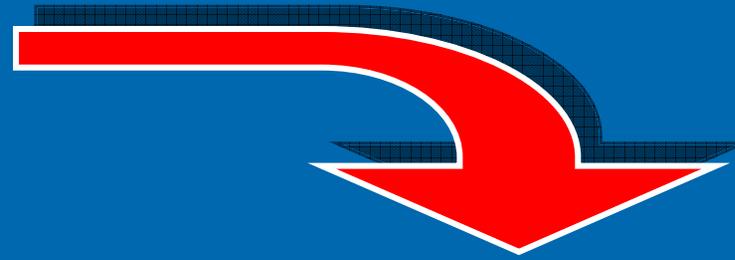


# Science Report



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

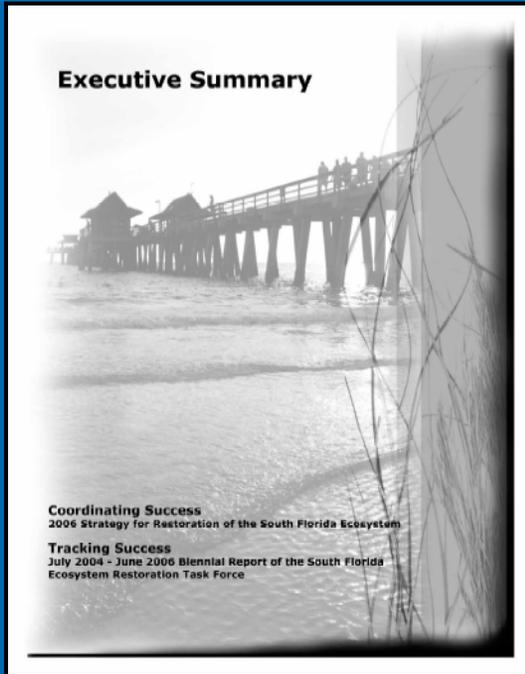
## STOPLIGHTS – ALGAL BLOOMS SOUTHERN ESTUARIES

Performance Measure Chlorophyll a	CURRENT STATUS <sup>2</sup>	CURRENT STATUS
BARNES, MANATEE & BLACKWATER SOUNDS (BMB)	Red	The region of the bay experienced an unusual cyanobacterial bloom in 2006. The bloom was related 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 somewhat but chlorophyll concentrations have not returned to previous levels.
NORTHEAST FLORIDA BAY (NEFB)	Yellow	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)	Yellow	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 intermittently over the past 15 years. It is unlikely that this signifies a long-term negative trend.
SOUTH FLORIDA BAY (SFB)	Yellow	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 intermittently over the past 15 years and it is unlikely that this signifies a long-term negative trend.
WEST FLORIDA BAY (WFB)	Green	The seasonal diatom blooms in this region for both 2006 and current were not as dense or widespread as in the past.
MANGROVE TRANSITION ZONE (MTZ)	Yellow	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)	Yellow	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)	Yellow	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)	Yellow	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)	Yellow	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 the region.

# TASK FORCE BIENNIAL REPORT – SYSTEM-WIDE INDICATOR

## TWO PARTS

## PART TWO INDIVIDUAL INDICATOR STOPLIGHT REPORTS



### 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
- Bivalves Asquifer Salinizer Invasions
- Flood Protection - C-111 Basin

## PART ONE INDICATOR EXECUTIVE SUMMARY

### Ecological Indicators

#### Fish and Macroinvertebrates

**Significance and background.** Marsh and estuarine aquatic biota, including small fishes and crustaceans, are critical to 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, southern spot) 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 Agency C-111 Annual View of the Microcosm Test "Fishing to Everglades Test and the Everglades Ecosystem" Section 12.1.5.

### 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 of further significant hurricane activity and should return to with the possible exception of BMB.

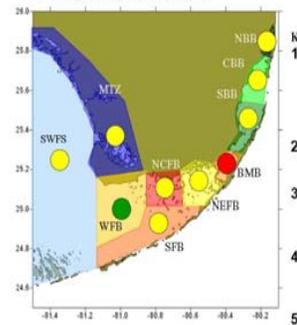


Figure 1. Map of Florida Bay regions with stoplight ratings by region

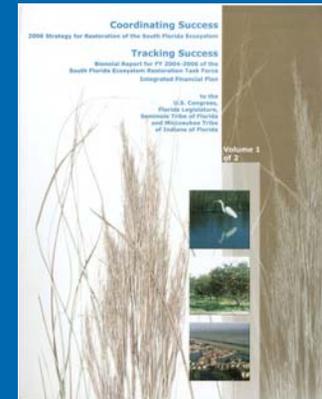
1. Continue monitoring water quality throughout the bay and the S of the post 2005 hurricane season.
2. Monitoring of Barnes, Manatee and Blackwater Sounds is critical.
3. Monitoring long term consequences of nutrient releases in hurricanes and human causes (e.g. road construction) and the (e.g. more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

### STOPLIGHTS – ALGAL BLOOMS SOUTHERN ESTUARIES

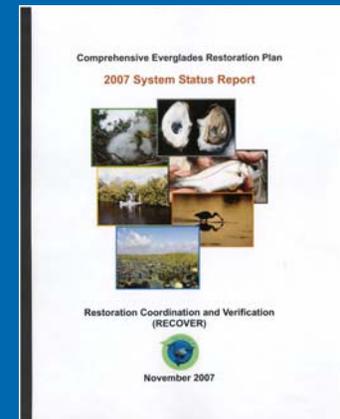
Performance Measure Chlorophyll <i>a</i>	CURRENT STATUS <sup>1</sup>	CURRENT STATUS
BARNES, MANATEE & BLACKWATER SOUNDS (BMB)	Red	This region of the bay experienced an unseasonal cyanobacterial bloom in 2005. The bloom was related to a large spike in chlorophyll <i>a</i> in a combination of higher turbidity and canal closures in response to the active hurricane season. The bloom has abated somewhat but chlorophyll concentrations have not returned to previous levels.
NORTHEAST FLORIDA BAY (NEFB)	Yellow	This current status is due to the periodic resuspension of the cyanobacterial bloom from Barnes, Manatee and Blackwater Sounds into the region.
NORTH-CENTRAL FLORIDA BAY (NCFB)	Yellow	The current status is due to the presence of a seasonal cyanobacterial bloom in both early and late 2005. These blooms do not appear every year, but have occurred sporadically over the past 10 years. It is unlikely that this region is a long term negative trend.
SOUTH FLORIDA BAY (SFB)	Yellow	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 sporadically over the past 10 years and it is unlikely that this region is a long term negative trend.
WEST FLORIDA BAY (WFB)	Green	The seasonal bloom blooms in this region for both 2004 and current were not as dense as anticipated as in the past.
MANGROVE TRANSITION ZONE (MTZ)	Yellow	The chlorophyll concentrations were slightly higher in this region for both 2005 & 2007. This may have been due to the active 2005 hurricane season and is unlikely to indicate a negative long term trend.
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**Reports are  
all using the  
same science**

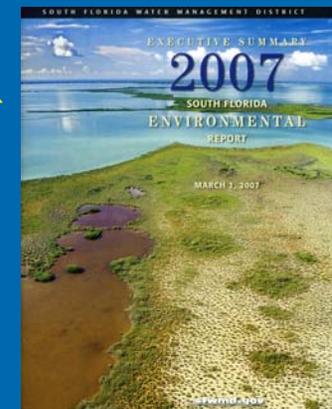
**Coordination  
Task Force, SCG**



**Partnerships  
RECOVER, CERP**



**Agencies  
SFWMD**



**NEXT STEPS**

# TIME LINE

## ➤ **May 2008**

- First draft science indicator report

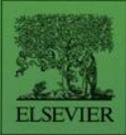
## ➤ **July 2008**

- Final science indicator report
- Incorporation of science report findings into TF Biennial Report

## ➤ **September 2008**

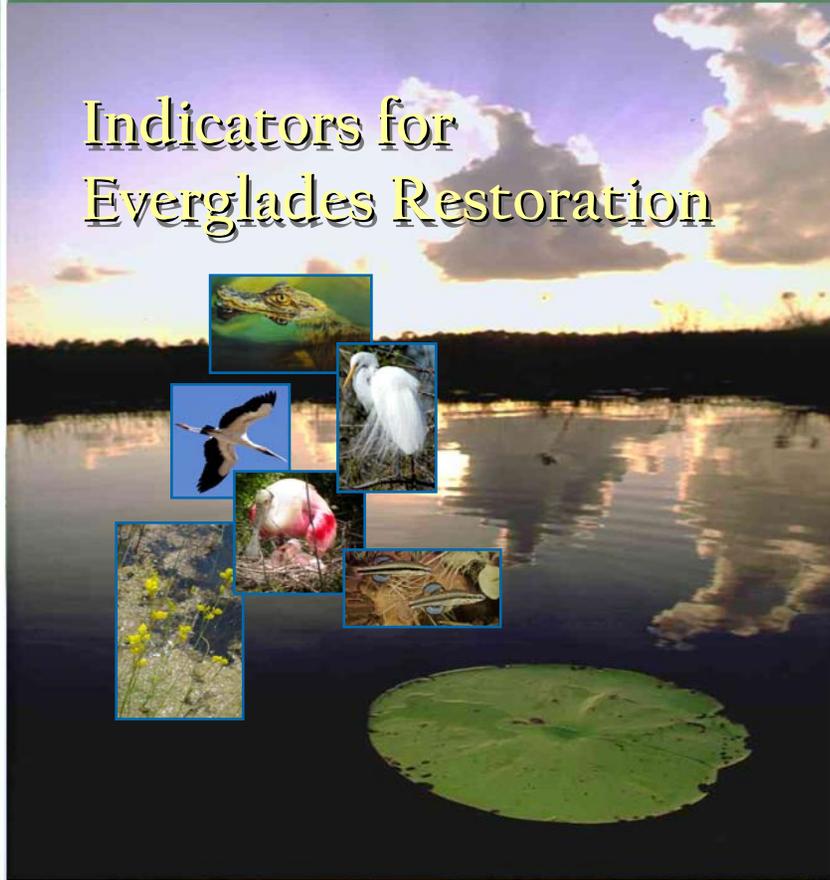
- Final draft Biennial Report presented to Task Force

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# ECOLOGICAL INDICATORS

## Indicators for Everglades Restoration



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# Questions or Comments

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