WHY ARE WE SO BAD AT Ecological Indicators WITH NON SCIENTISTS: ESystem wide Assessment D of the Greater Everglades **Ecosystem Restoration Program** a modest proposal

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"With the exception of a few people...we [scientists] don't know how to communicate with the public *[or* managers and policy-makers]. We don't understand our audience well enough... to understand why it's difficult for them to hear us speak. We don't know the language and we haven't practiced it enough."

Dr. Neal Lane, Former Head of the National Science Foundation (source Weigold 2001)

Large numbers of American adults appear to be scientifically illiterate (Maienschein 1999), leaving many to conclude there is a problem in science communication (Dornan 1988, 1990, Hartz and Chappell 1997)

In the 1920s the language of science would have been indistinguishable from other forms of literature, but today the language of science has "diverged from the mainstream of literary language and divided into a large number of small, winding tributaries" (Shortland and Gregory 1991)

## Some thoughts I've heard It's just "pointy-headed scientist's" stuff people express at meetings All they (*i.e., scientists*) do is make long lists of research we don't need" but that they want to do to "keep themselves employed"

Former member of the South Florida Ecosystem Restoration Task Force

"It's either a 'wicked major priority' [*referring to Everglades Restoration science projects*] or it's not a priority at all . . . and it won't get funded." Carol Wehle Executive Director SFWMD, Feb. 2008 Task Force Meeting

## On the other hand . . .

".... what goes on down here [i.e. South Florida] is an amazing connection between scientists who want to do science, and what's happening at Carol's [*i.e. Carol Wehle*] level."

Dr. Jeff Jordan University of Georgia, Feb. 2008 Task Force Meeting

So if people like Jeff Jordan (and even Lynn Scarlet) seem to think we're doing a pretty good job with science, how can we do a <u>better</u> job of communicating the results of our science to managers and policy makers?

> Built System Indicators Subgroup

# the modest proposal

A <u>small</u> set of <u>System-wide</u> Ecological Indicators with which to assess the "big-picture" of restoration and a means to synthesize and communicate summary results using an easy to understand format

This work involves too many people to name here but it is a joint effort between The Task Force Science Coordination Group

> and RECOVER

> > and

The many scientists who are working on the SFERTF Science Coordina indicators Built System Indicator



- The Task Force and RECOVER are required to report to Congress on the status of Everglades restoration
- In 2004 the Task Force requested a <u>small</u> set of <u>System-wide</u> Indicators to assess Everglades restoration
- Developed criteria and a selection process to identify a small set of system-wide indicators
- Developed a "report card system"
- Included peer review and public comment
- System-wide indicators and reports cards will be included in the Task Force 2008 Biennial Report and will be incorporated in the RECOVER System Status Report for 2009 and RECOVER 5-year report to Congress

# Four Step Process

- 1. Reviewed the scientific literature on indicators
- 2. Developed criteria to evaluate relevant concepts and indicators for Everglades Ecosystem
- 3. Used those to select system-wide indicators, and develop appropriate concepts and formats
- 4. Developed final suite of indicators to assess System-wide restoration

# **Selection Criteria**

- 1. Is the indicator relevant to the ecosystem?
- 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 set?
- 9. Does the indicator have enough specificity to be able to be used to correct or redirect restoration actions?
- **10.** Is the indicator integrative?
- 11. 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
  - Estuaries, Short-hydroperiod marshes, etc.

### > Temporal Scales

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

# **Principal Principle**

The Indicators individually and collectively integrate a vast number of ecological functions (that can not or will not be monitored) in their life stages and processes (and their life processes interrelate spatially and temporally)

## System-wide Ecological Indicators

- **1.** Periphyton-Epiphyton
- 2. Fish
- **3.** Roseate Spoonbills
- 4. Wood stork—White Ibis—Great Egret
- 5. Oysters
- 6. Juvenile Pink Shrimp
- 7. Florida Bay Algal Blooms
- 8. Florida Bay Submerged Aquatic Vegetation (SAV)
- 9. Lake Okeechobee Littoral Zone (SAV)
- **10.** Crocodilians (Alligators & Crocodiles)
- **11. Exotic Plants**

## **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
   This includes spatial and temporal aspects
  - of the Everglades
- The indicators need to be integrative



SPACE

Assessing and Communicating System-wide Indicators

## 8 Essentials

- 1. Scientific Consensus on Ecosystem Structure & Function and on what makes a good indicator – CEMS
- 2. Indicators (e.g. fish) with <u>metrics</u> for Ecosystem Structure or Function (Environmental Conditions)
  - **1.** Species that integrate numerous ecological processes
  - 2. Species whose status reflects status of key habitats
  - 3. Species that serve as an "early warning sign" of anticipated stressors
- **3. Baselines** (reference periods) to establish points of comparison
- 4. Monitoring Programs to collect the data for assessments
- 5. Performance Measures (e.g. bluefin kilifish per unit area) using <u>metrics</u> 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

**3 Tiers of Information** 

# 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.



26.0-

#### KEY FINDINGS:

- 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.
- The majority of regions assessed had chlorophyll-a and algal blooms rated as moderate (yellow).
- 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.
- The most commonly occurring condition was large spatial coverage of algal blooms and elevated chlorophyll-a concentrations.
- 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.

- Continue monitoring water quality throughout the bay and the SW coastal shelf particularly as a result of the post 2005 hurricane season.
- 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.

PERFOMANCE MEASURE	LAST STATUS	STATUS	PROSPECTS	CURRENT STATUS	2-YEAR PROSPECTS
Chiorphyll a BARNES, MANATEE & BLACKWATER SOUNDS (DMB)	•	•	0	This isgon of the bay separaterized as ansured synchrotextural blocks in 2006. The Bottom was influed by a baye gate in phosphrane from a constraination of canal indeases and lingthing constitution in response to the action butticate seasors. The Bottom has about conversion at chickneying concommittoes have not instanced to province breeks.	When read construction is completed, we separate that these area all relative to graves constrained that annual hores 1995 and 2006
Chlorphyll a NORTHEAST FLORIDA BAY (NEFB)	$\bigcirc$	$\bigcirc$	$\bigcirc$	The connect shallow is due to influence of the cyanobacterial blocm/from Dartwei. Manaleer and Dischwaier Sounds periodic expansion- and the region.	The relation to a green condition for this region of the bay depends on water management address improving flows and plue C 111 Insuit and Taylor Slough.
Chlosphyll a NORTH-CENTRAL FLORIDA BAY (NCFB)		$\bigcirc$	$\bigcirc$	The current bitles is due to the presence of a teasonal cysechiccheral bicers in both early and bide 2008. These bicers do not appear overy year, but have cocurred elementaethy over the pail 15 years.	votitical improvements in triadmater Bows to Florida Bay the area will probably remain yolice.
Chicephyll a SOUTH FLORIDA BAY (SFB)	$\bigcirc$	$\bigcirc$	$\bigcirc$	The cursort shallon is due to the enterwards of the cyclecteristical income term the meth- methic region of the larg during both years. This has occursed advantituatily one the part to years and it is autiliarly that the signifies a trap later reaction feed.	Sates blocms in this area are driven by ordered forms, if is expected that terth periodic e-setts may occur
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Chlorphyll a MANGROVE TRANSITION ZONE (MTZ)	$\bigcirc$	$\bigcirc$	$\bigcirc$	The childrephyll reconstrainers ware sightly begins in this segment for 2000. This may have been due to the active 2005 fractionan season and is unlikely to indicate a negative long lasm level.	The relates to a grown resultion for this ingen of the bay depends on order management athetics improving from into the C-111 lossin and Taylor Slough.
Chlorphyll a SOUTHWEST FLORDA SHELF (SWFS)	$\bigcirc$	$\bigcirc$	$\bigcirc$	The chlorophyll concentrations wate signify higher in this neglen for both 2006 & 2017. This may have faver due to the other 2016 farmane season and is unlikely to indicate a negative long terminent.	This region is alfavoraid primarily by Shaik Stough outputs and southerly baregord of Galt of Nexton water Conditions are therefore dependent on external timory.
Chiosphyli a NORTH BISCAYNE BAY (NBB)	$\bigcirc$	$\bigcirc$	$\bigcirc$	The childray by concernations were higher than the landing for the paid that yours,	Without any maps factions of changes in value ficus to this region is a special that this region will remain yalizer. Significant figural form cannot will remain a to attend to area until showill flow is to special.
Chlorphyll a CENTRAL BISCAYNE BAY (CBB)	$\bigcirc$	$\bigcirc$	$\bigcirc$	The chlorophyll concentrations save higher than the baseline for the pact four years	Without any maps butterares of changes in water Reset to this region is a capacited that this region will nemate yolkse
Chlorphyll a SOUTH BISCAYNE BAY (SBR)	$\bigcirc$	$\bigcirc$	$\bigcirc$	The discopingl concentrations over legisle in this region for 2008. This area was also influenced by periodic expansion of the cyanobactural block from Barress. Monutive and filteriouslier Scarch arts this region	Without any maps fasticanes or changes in order times to this region it is aspected that this region will ternaity 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.

#### ALGAL BLOOMS - SOUTHERN ESTUARIES

stoplight ratings by region

# **Tier Two Examples**

# Florida Bay Algal Blooms

## **SUMMARIZED DATA & GRAPHICS**

Stoplight "Color - Coded" Maps Simplified Stoplight "Color- Coded" Graphics Performance Measure Thresholds

SFERTF Science Coordination Group

Built System Indicators Subgroup

## 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	BMB	1704	0.306	0.526	0.910
Central Biscayne Bay	СВВ	1673	0.200	0.313	0.566
Mangrove Transition Zone	MTZ	3803	1.690	2.863	4.903
North Biscayne Bay	NBB	635	0.670	1.048	1.648
North-central Florida Bay	NCFB	1399	0.585	1.216	3.710
Northeast Florida Bay	NEFB	1979	0.254	0.417	0.790
South Biscayne Bay	SBB	2257	0.181	0.264	0.426
South Florida Bay	SFB	1695	0.327	0.533	1.059
Southwest Florida Shelf	SWFS	1297	0.739	1.180	1.976
West Florida Bay	WFB	2304	0.653	1.345	2.845



## GRAPHIC DATA SUMMARIES IN STOPLIGHT COLOR-CODED FORMAT



# **Tier Three Examples**

# Florida Bay Algal Blooms

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

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

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## The assessments and stoplight report cards provides direct and transparent links from the data to the stoplights

#### **OUR GOAL IS TO:**

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





### Task Force Biennial Report

Agency Reports are all using the same science

Partnerships CERP System Status Report







Instantion Coordination and Horification (RECOVER)



# HARMONIZED SCIENCE REPORT & REPORT CARD FORMATS

- Part 1. Develop a reporting format that will provide scientists an internally consistent template by which to construct their ecological indicator assessments
- Part 2. With a standardized reporting format reduce the number of reports scientists need to write (hopefully to one)
- Part 3. Stoplight Restoration Report Cards as Summary reports to Agencies, the Task Force and Congress
- □ Part 4. Synthesis of Assessments



## ECOLOGICAL INDICATORS

Indicators for Everglades Restoration



Editor-in-chief Felix Müller

Special faste: Evaluating sustainable lowest management An international collection of emposical and applied seasach Court Editor: Condon AL Hickey

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  - Robert F. Doren
  - Joel C. Trexler
  - Matt C. Harwell
  - G. Ronnie Best

