Joint
Science Coordination Group
& Working Group

System-wide Indicators Update
Thursday, October 18, 2007

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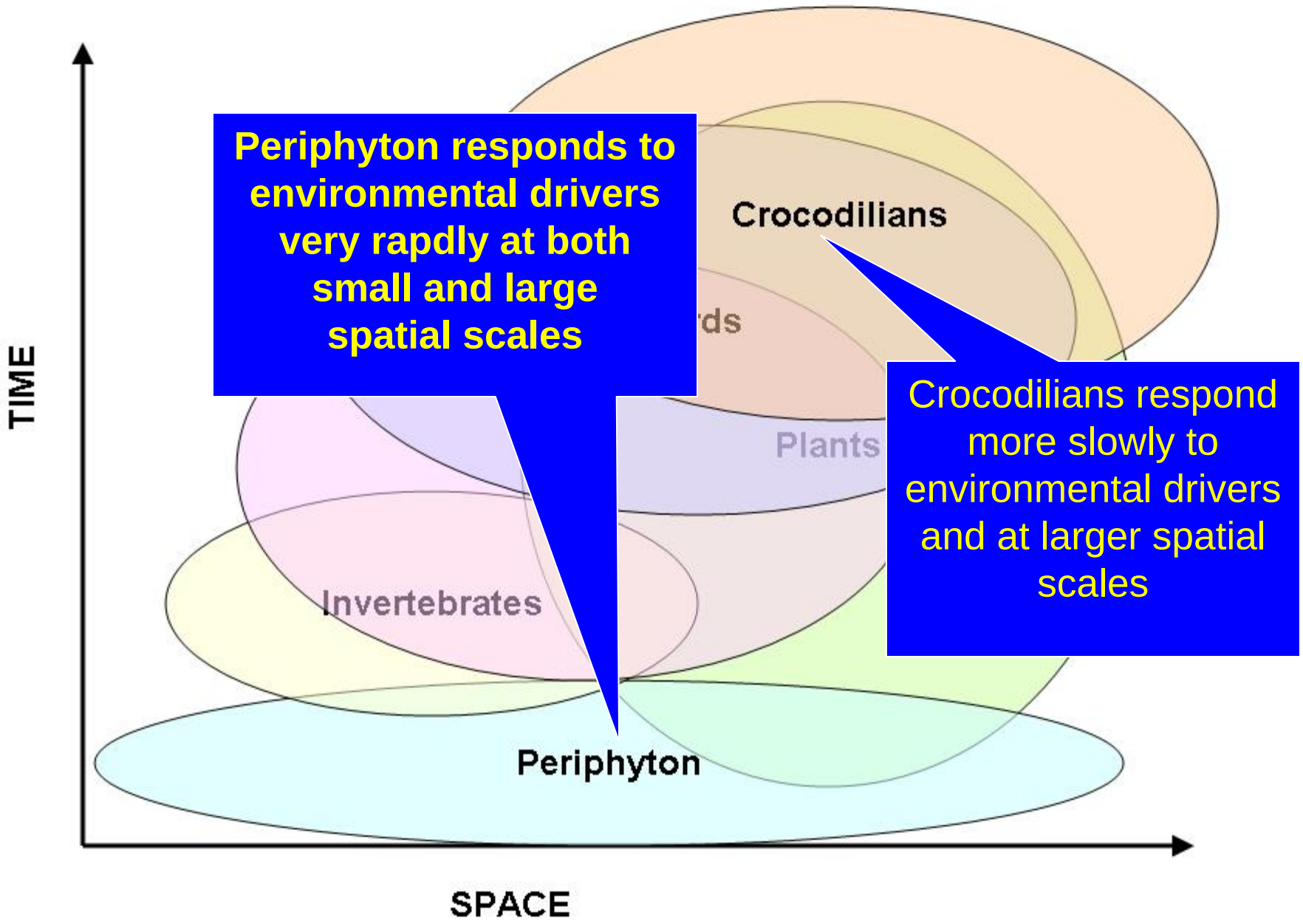
Indicator Refresher

- **Task Force Directive – SCG to develop small set of System-wide Indicators for Restoration**
- **SCG developed a process to identify indicators using well established selection criteria**
- **Ecological Indicators (Goal 1 & 2)**
- **Indicators of Compatibility (Goal 3)**
- **Indicator Gaps**
- **Provide for Independent Scientific Review (ISR) of Indicators**
- **Report and ISR: www.sfrestore.org**

Four Steps

1. **Evaluate existing restoration efforts from various sources for indicators for possible application to the Task Force suite of system-wide indicators**
2. **Using established guidelines select relevant indicators for Everglades Ecosystem applicability, evaluate the list of Indicators for individual and collective value and coverage of Everglades' "FEATURES" i.e. ecosystem Regions, Characteristics, Trophic Interactions, and Functions**
3. **Identify "indicator gaps", and where feasible for the 2006 report, develop new indicators to fill identified gaps**
4. **Select final system-wide suite of indicators for the 2006 biennial report and develop indicator documentation and communication proposal and identify "indicator gaps" to be filled by 2008 or beyond**


Periphyton responds to environmental drivers very rapdly at both small and large spatial scales
Crocodilians respond more slowly to environmental drivers and at larger spatial scales
Crocodilians
Plants
Invertebrates
Periphyton
TIME
SPACE

Ecological Indicators (Goals 1 & 2)

1.	Periphyton-Epiphyton	Evelyn Gaiser, et al.
2.	Fish	Joel Trexler, et al.
3.	Roseate Spoonbills	Jerry Lorenz
4.	Woodstork & White Ibis	John Ogden 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.	Crocodilians	Frank Mazzotti, Ken Rice et al.
11.	Exotic Plants	Bob Doren, Jenny Richards

Over 30 scientists are involved in this collaborative effort and receive no compensation for this work

Gaps in Ecological Indicators

1. **Contaminants**
2. **Vegetation Landscape Pattern**

Goal 3 Indicators for 2006

1. **Water Volume** – the amount of “new” water that is captured by the system and its subsequent distribution
2. **Salinity Intrusion in the Biscayne Aquifer** – the location of the isohalines in relation to the coast and canal stages
3. **Flood Protection South Dade Agriculture** – root zone groundwater levels related to flood risk in the area just east of the L-31N canal north of where it meets the C-111

We have identified several gaps in goal 3 indicators as well

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

COMMUNICATION EXAMPLES

FLORIDA BAY ALGAL BLOOMS

&

FISH

Three Tiers

From Simple to Complex

- Stoplight / Key Findings Report Cards
- Simplified Graphics & Maps in Biennial Assessment Reports representing data in Report Card format
- Biennial Assessment Reports presenting full data analysis and scientific theory and Publications (SFER Format – see example)

(See Handouts)

Tier One Example

Florida Bay Algal Blooms

Stoplight - Key Findings

KEY FINDINGS – ALGAL BLOOMS SOUTHERN ESTUARIES

SUMMARY FINDING: Elevated 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 years barring further significant hurricane activity and should return to predominantly green for all regions with the possible exception of BMB.

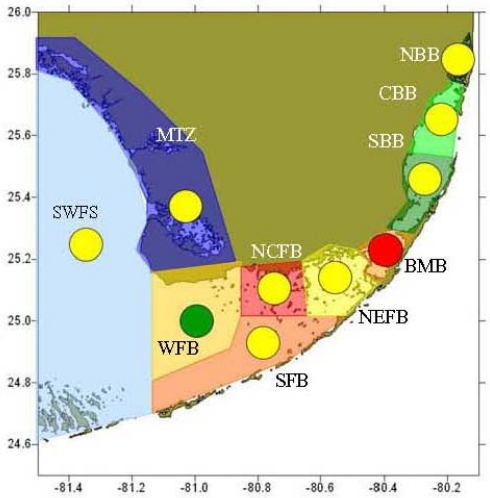


Figure 1. Map of Florida Bay regions with stoplight ratings by region

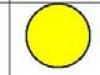
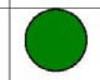
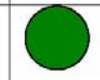
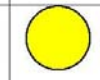
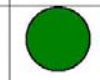
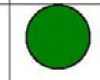
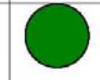
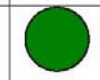
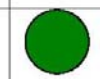
KEY FINDINGS:

1. The majority of regions assessed had significant algal bloom activity that appears to have been predominantly influenced by the active 2005 hurricane season aggravated for eastern Florida 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 exacerbated by road construction along US 1 in the eastern areas of Florida Bay.

KEY RECOMMENDATIONS:

1. Continue monitoring water quality throughout the bay and the SW coastal shelf particularly as a result of the post 2005 hurricane season.
2. Monitoring of Barnes, Manatee and Blackwater Sounds is critical while road construction along US 1 continues.
3. 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.

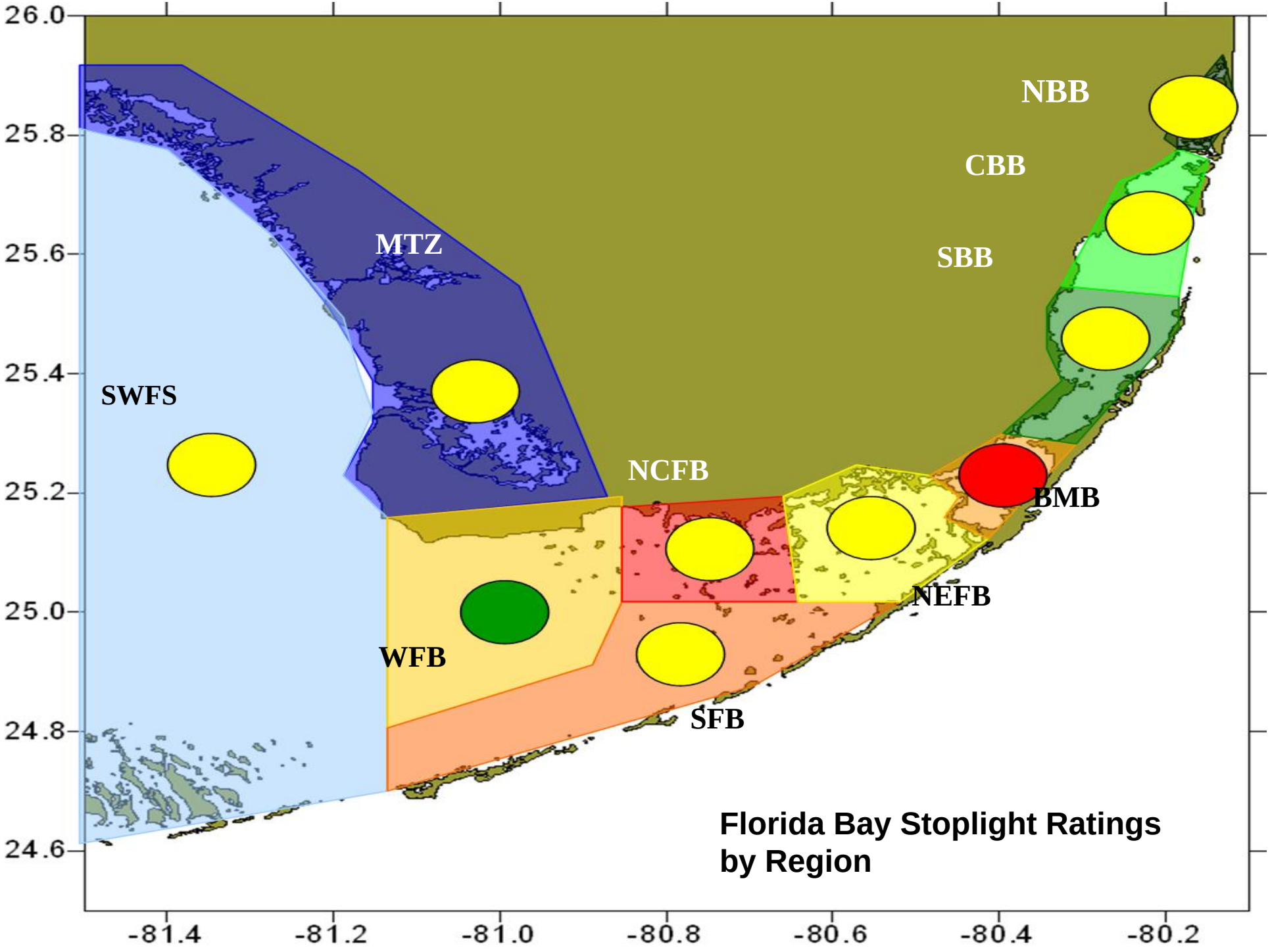
STOPLIGHTS – ALGAL BLOOMS SOUTHERN ESTUARIES

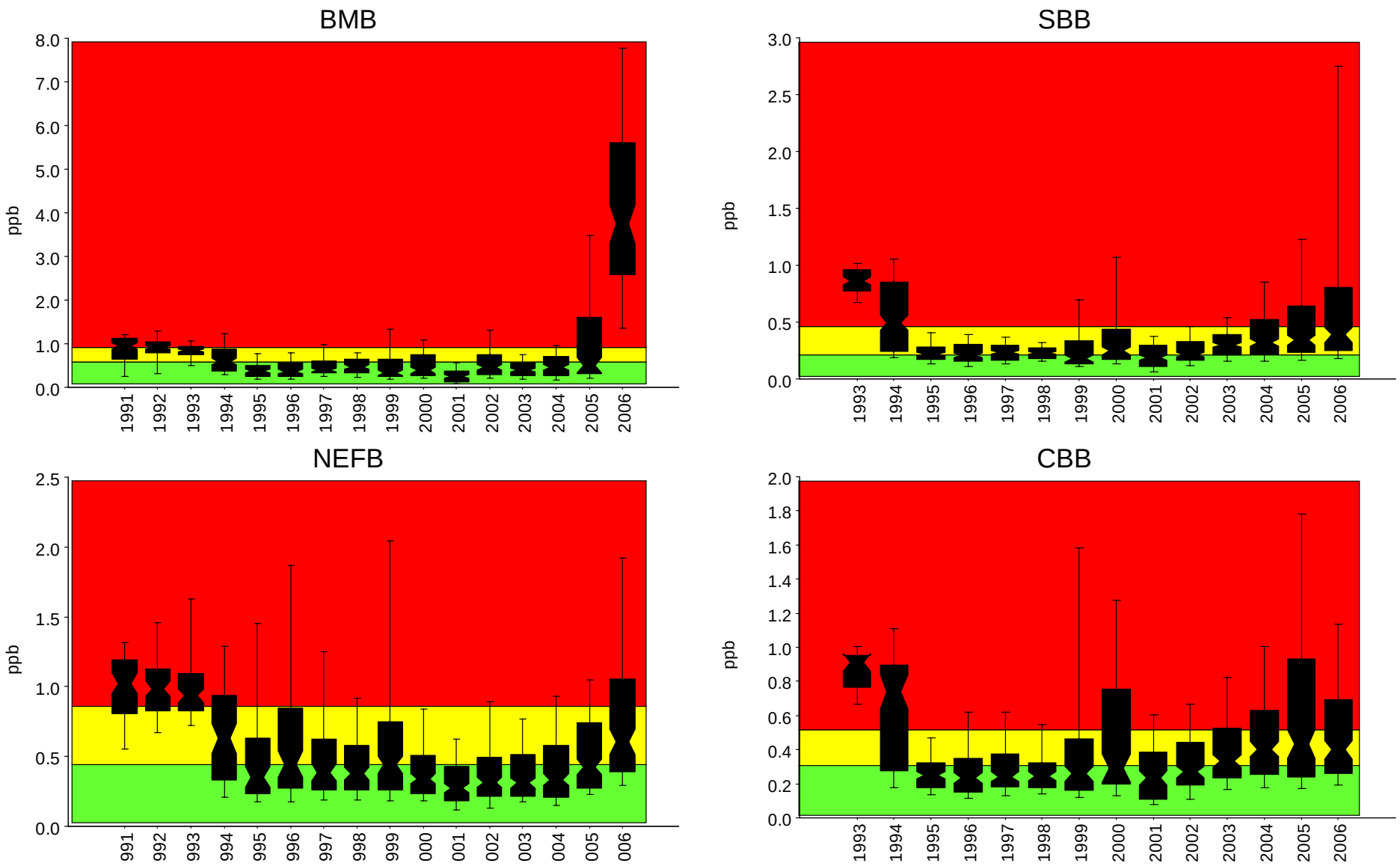
LOCATION	LAST STATUS[1]	CURRENT STATUS[2]	PROGNOSIS[3]	CURRENT STATUS	PROGNOSIS
BARNES, MANATEE & BLACKWATER SOUNDS (BMB)				This region of the bay experienced an unusual cyanobacterial bloom in 2006. The bloom was initiated by a large spike in phosphorus from a combination of highway construction and canal releases in response to the active hurricane season. The bloom has abated 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.
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.	The return to a green condition for this region of the bay depends on water management activities in the C-111 basin and Taylor Slough.
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 intermittently over the past 15 years. It is unlikely that this signifies a long-term negative trend.	If water management improves flows of water to Florida Bay via McCormick Creek it is expected that this cyanobacterial bloom may become less frequent and pronounced.
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 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.
WEST FLORIDA BAY (WFB)				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, as well as water management along the southwest coast.
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.	Without any major hurricanes and as water management continues to improve the flow of water to Florida Bay it is expected that this region will return to a green status.
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.	This region is influenced primarily by Shark Slough outputs and southerly transport of Gulf of Mexico water. Conditions are therefore dependent on external forcing.
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.	Without any major hurricanes and as water management continues to improve the flow of water to Biscayne Bay, it is expected that this region will return to a green status.
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.	Without any major hurricanes and as water management continues to improve the flow of water to Biscayne Bay, it is expected that this region will return to a green status.
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.	Without any major hurricanes and as water management continues to improve the flow of water to Biscayne Bay, it is expected that this region will return to a green status.

Tier Two Examples

Florida Bay Algal Blooms

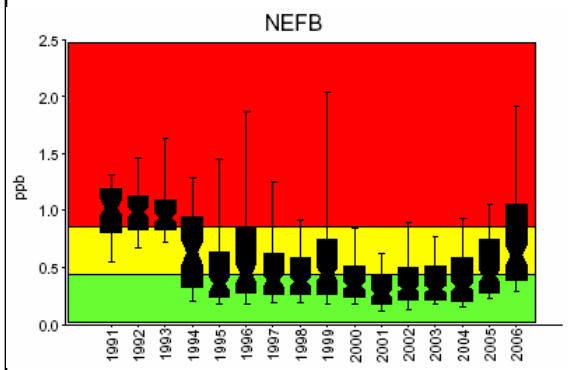
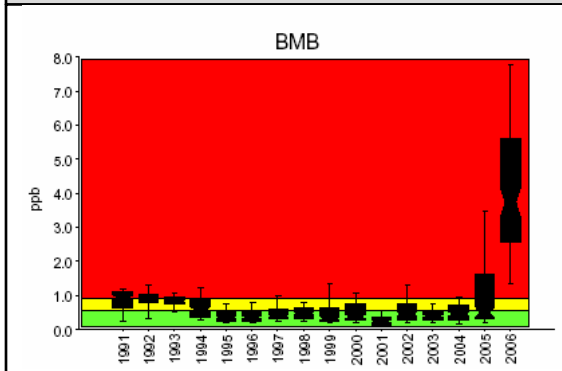
Stoplight “Coded” Maps
&
Simplified Stoplight “Coded” Graphics


26.0
25.8
25.6
25.4
25.2
25.0
24.8
24.6
-81.4
-81.2
-81.0
-80.8
-80.6
-80.4
-80.2
NBB
CBB
SBB
MTZ
SWFS
NCFB
BMB
NEFB
WFB
SFB
Florida Bay Stoplight Ratings
by Region



Example Simplified Graphs Illustrating Data in Stoplight Coded Format.

Box notches = 95% Confidence Interval; Box edges = 25th & 75th percentiles; Whiskers = 10th & 90th percentiles

Blackwater, Manatee, Barns Sound	
	Annual *chlorophyll a* results from 1991 to 2006 show a relatively steady level of *chlorophyll a* from 1991 until 2005-2006, indicating a generally "green" stable condition with regard to algal blooms in this region (see map). However, recent activity including construction along US 1 in the upper keys, perhaps combined with an active hurricane season caused *chlorophyll a* levels to spike late in 2005 and throughout 2006. Similar hurricane activity in the past, without concomitant road construction has not caused spikes in *chlorophyll a* suggesting that the road construction was the mechanism creating conditions for the spikes seen in 2005-2006. Current data (May 2007) indicates that the *chlorophyll a* levels are back down in the "green" zone and have been so for X months.
Northeast Florida Bay	
	Annual *chlorophyll a* data from 1991 to 2006 show that in the early 1990s Florida Bay was experiencing significant algal blooms that since approximately 1994 have been less severe (and other data also indicate less frequent). The early 1990s blooms were preceded by blooms that were much worse, as result of the initial die-off of turtle grasses in the bay that began in 198?. The recent trends in *chlorophyll a* are not atypical of natural variation expected in this region of the bay and suggest that algal blooms in NE Florida Bay are within normal "restoration" limits.
North-central Florida Bay	

Tier Three Examples

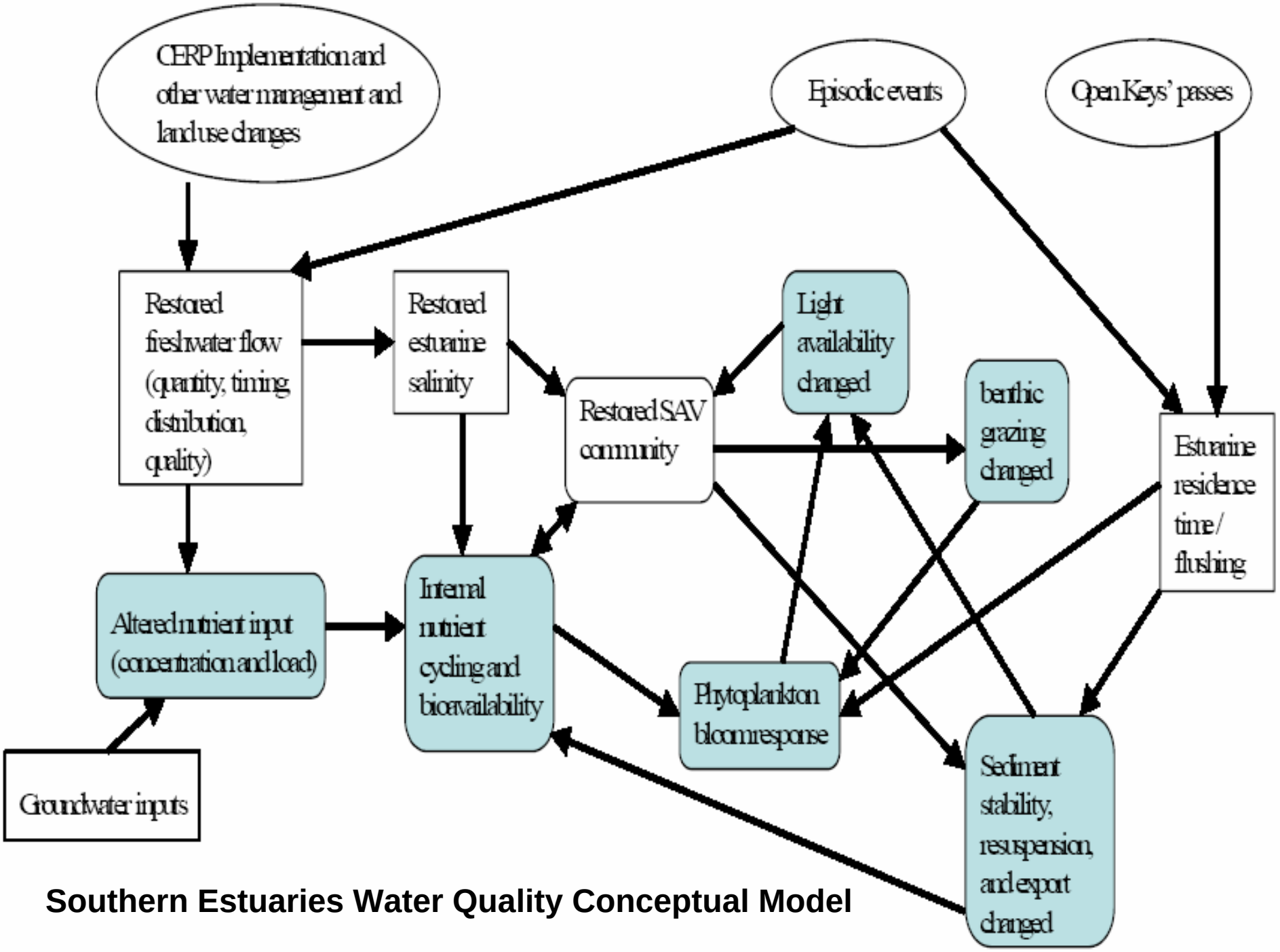
Biennial Reports

Florida Bay Algal Blooms

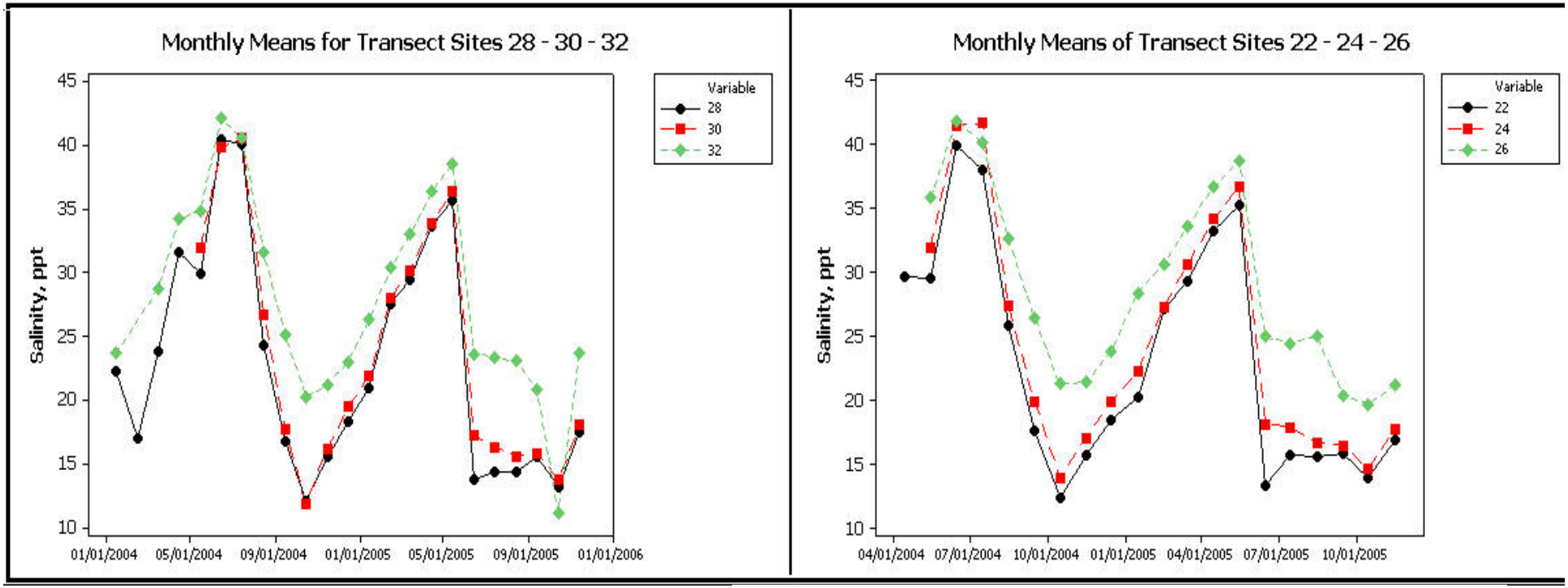
Data Analyses, Theory,

Modeling, Performance Measures,

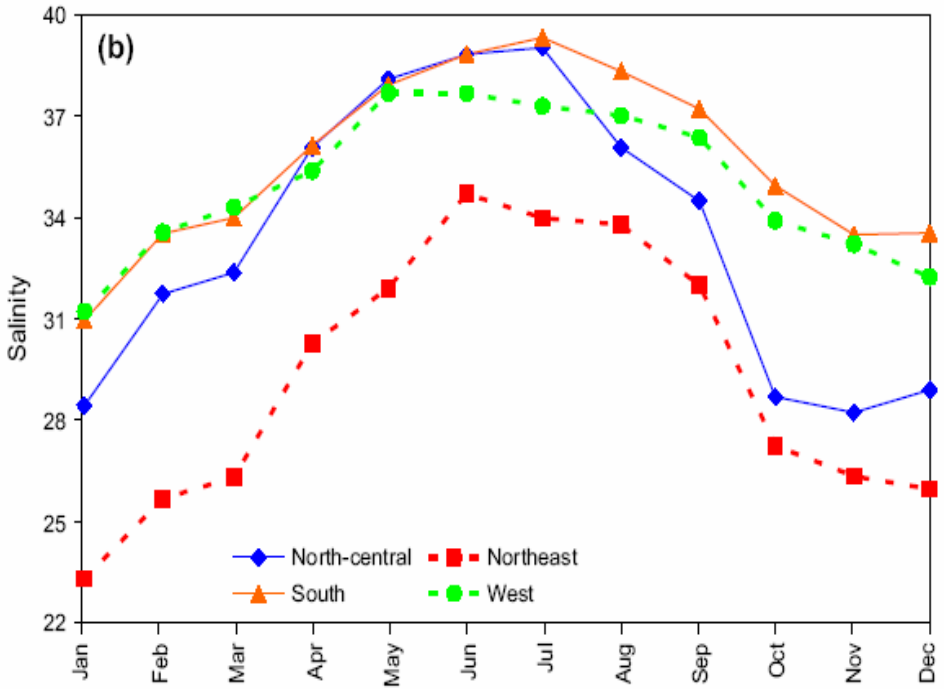
Metrics, Targets & Assessments



Southern Estuaries Water Quality Conceptual Model



Salinity cycles in Biscayne Bay (top two panels) and Florida Bay (bottom panel)



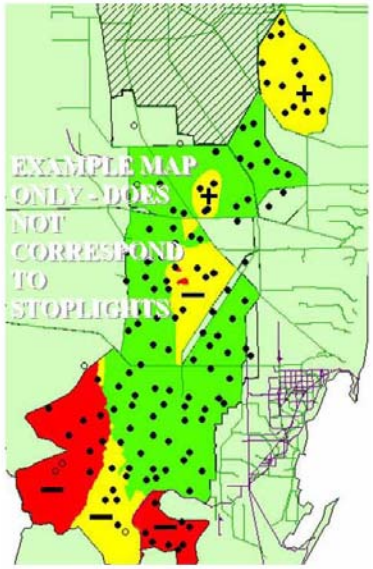
Tier One Example

Fish

Stoplight - Key Findings

KEY FINDINGS – FISH

SUMMARY FINDING: Fish density was lower than expected—based on rainfall—throughout Shark and Taylor Sloughs since 2000, coinciding with the outset of the IOP water management program. Several dry-downs have occurred that were not predicted from rainfall patterns and appear to have resulted from operation schedules. Starting with each drying event, fish populations decline and remain lower than expected for two or more years. Fish density in WCA-3A and 3B was less affected by IOP than in Everglades National Park. There was a slight increase in fish density consistent with a movement of fish into the area of WCA-3A which held water while the surrounding marshes did not.



Legend. Standardized difference between Observed Density and Predicted Density. Plus sign = too many fish; minus sign = too few fish. Green is the target range.

RED + (greater than 0.4)
YELLOW + (0.2 to 0.4)
GREEN (-0.2 to 0.2)
YELLOW – (-0.2 to -0.4)
RED – (less than -0.4)

KEY FINDINGS:

1. Taylor Slough had the largest decrease in fish density overall.
2. Shark Slough also had statistically significant decreases in fish density at most monitoring sites.
3. The Pre-IOP versus Post-IOP conditions show that fish densities have decreased significantly in much of the southern Everglades because of dry-downs that would not have occurred prior to IOP, as predicted by rainfall.
4. Fish density in Water Conservation Areas 3A and 3B were less affected by IOP, though they are inconsistent with expectations from NSM conditions because of ponding in 3A and drainage of 3B. Fish are more sensitive to drying frequency than water depth, which explains why the high-water conditions of 3A during IOP had little impact.
5. Overall fish densities (and crustaceans) were lower than expected for the much of the 6 year post-IOP period as compared to the Pre-IOP period.

KEY RECOMMENDATIONS:

1. Water management operations in regions that showed significant decreases in fish densities from the expected should be evaluated by managers and hydrologists to determine hydrological operations that would improve fish densities toward target (predicted) levels.
2. Additional water is needed for Taylor Slough; the aquatic fauna there is dramatically changed since implementation of IOP.
3. Implementation of DECOMP should lead to greater densities of small fish in WCA-3A and 3B, and will probably also shift large-fish populations from WCA-3A to 3B.

STOPLIGHTS - FISH

PERFORMANCE MEASURE	LAST STATUS[1]	CURRENT STATUS[2]	PROGNOSIS[3]	CURRENT STATUS	PROGNOSIS
TOTAL FISH DENSITY TAYLOR SLOUGH				All five monitoring sites in Taylor Slough showed a lower fish density than would be expected based on rainfall. Two sites had deviations indicative of a significant trend of lower fish densities overall. Pre-IOP fish densities were within the green range and Post-IOP fish densities decreased into the red range.	Pre-IOP water conditions were more favorable for fish populations than Post-IOP hydrologic conditions. Without significant changes in water management we expect the lowered fish density to continue. This may be a long term decreasing trend without improvements in water management.
BLUEFIN KILIFISH DENSITY TAYLOR SLOUGH				Bluefin Killifish also displayed a lower than predicted density in all sites in Taylor Slough during the Post-IOP period. This corresponds to several dry-downs that, based on rainfall, should not have occurred under the Pre-IOP water management operations. Killifish are particularly well correlated with water levels and Days Since Rewetting (from a drydown), and are well suited for predicting fish density.	Bluefin Killifish are expected to continue lower than predicted populations as noted above without significant changes in water management (IOP) that has been creating dry-downs that based on rainfall should not have occurred.
TOTAL FISH DENSITY SHARK RIVER SHOUGH				Five of six monitoring sites in Shark Slough showed lower fish density than would be expected based on rainfall. Only site 6 showed no change from Last Status condition or from predictions (green) and it is located such that water management actions have no impact on that site. We consider site six to be an index, or reference, of overall aquatic faunal productivity.	We expect to see the same patterns in fish density for Shark Slough that we found in Taylor Slough (see above) without changes in water management.
BLUEFIN KILIFISH SHARKRIVER SLOUGH				Bluefin Killifish densities were much less than predicted for Shark Slough beginning in July 2001. This corresponds to several dry-downs that, based on rainfall, should not have occurred under the Pre-IOP water management operations.	See Bluefin Killifish noted for Taylor Slough above.
TOTAL FISH DENSITY WATER CONSERVATION AREA 3				Fish density was indistinguishable from rainfall-based expectations at all 11 monitoring sites during the Post-IOP period. However, Pre-IOP and Post-IOP conditions are not consistent with expectations from the historical ecosystem because of ponding in WCA-3A and over-drying in WCA-3B. Both conditions lead to fewer small fish than expected: Ponding supports more predatory fishes and over-drying kills fish.	We expect this area to remain in the yellow light for the foreseeable future, pending action on management programs such as DECOMP.
BLUEFIN KILIFISH DENSITY WATER CONSERVATION AREA 3				Bluefin Killifish density was lower than expected based on rainfall at one monitoring site in western WCA-3A and one in southern WCA-3B. Their density was consistent with expectations at 9 other monitoring sites during the Post-IOP period. Pre-IOP and Post-IOP conditions earned a yellow status because of ponding in southern WCA-3A and over-drying in WCA-3A compared to historical conditions.	We expect this area to remain in the yellow light for the foreseeable future, pending action on management programs such as DECOMP.
TOTAL FISH DENSITY WATER CONSERVATION AREA 1				No information on Loxahatchee at this time.	
BLUEFIN KILIFISH DENSITY WATER CONSERVATION AREA 1				No information on Loxahatchee at this time.	

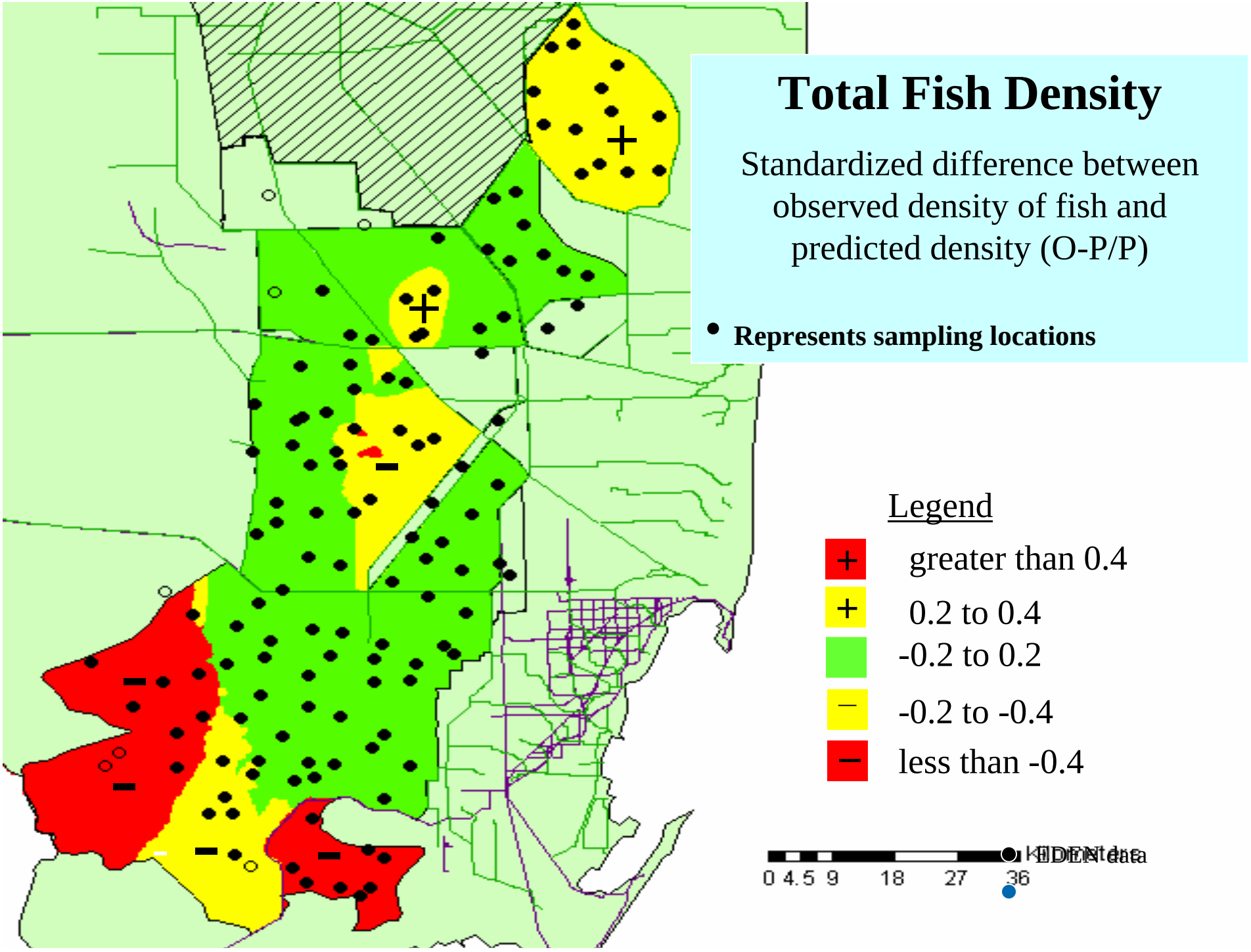
Tier Two Examples

Fish

Stoplight “Coded” Maps

&

Simplified Stoplight “Coded” Graphics

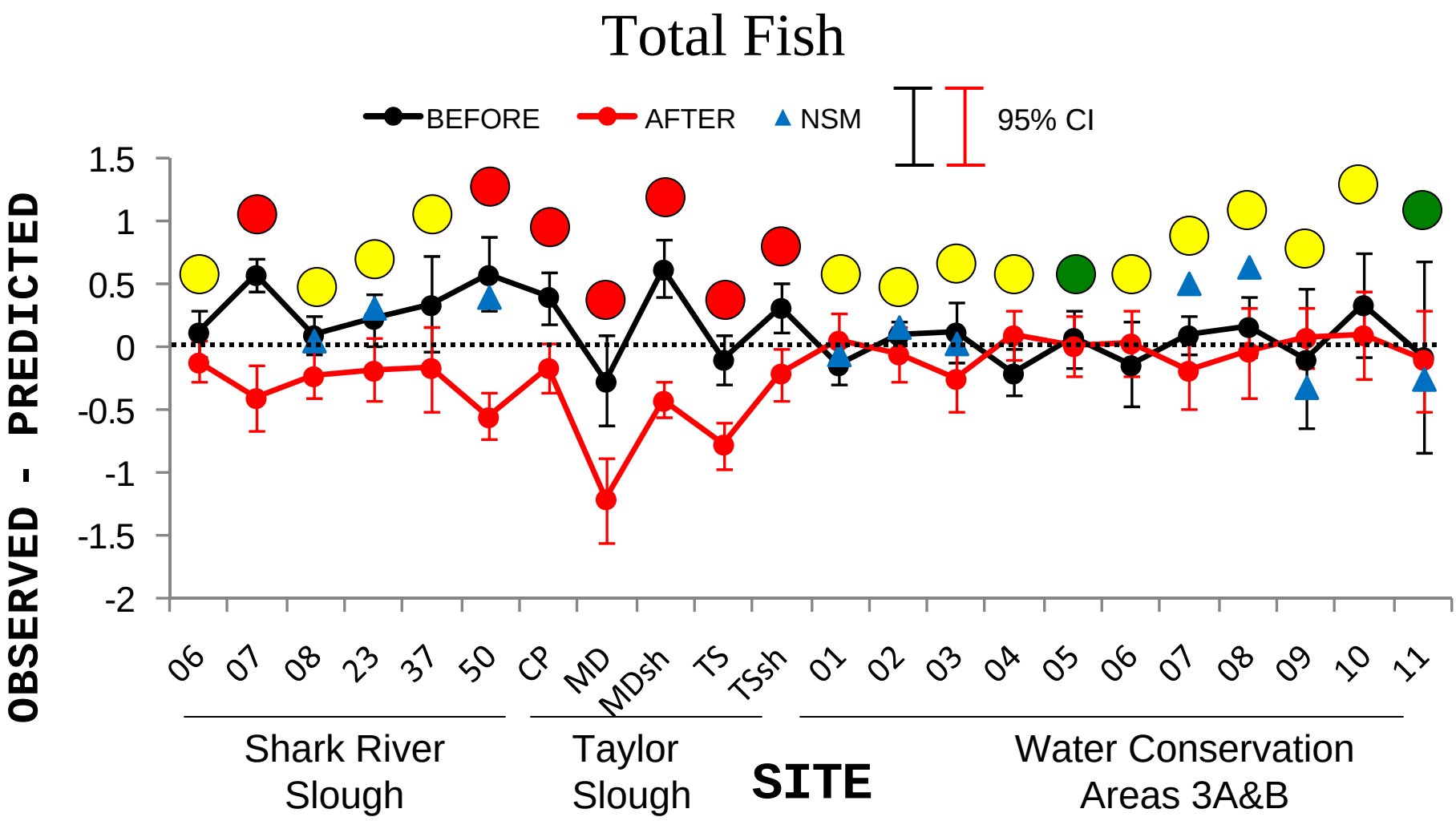

Total Fish Density
Standardized difference between observed density of fish and predicted density (O-P/P)
• Represents sampling locations
Legend
greater than 0.4
0.2 to 0.4
-0.2 to 0.2
-0.2 to -0.4
less than -0.4
0 4.5 9 18 27 36

Differences Between Predicted and Observed Before, Natural System Model, and After

Where 95% confidence intervals completely overlap = green

Where 95% confidence intervals partially overlap = yellow

Where 95% confidence intervals do not overlap = red



Tier Three Examples

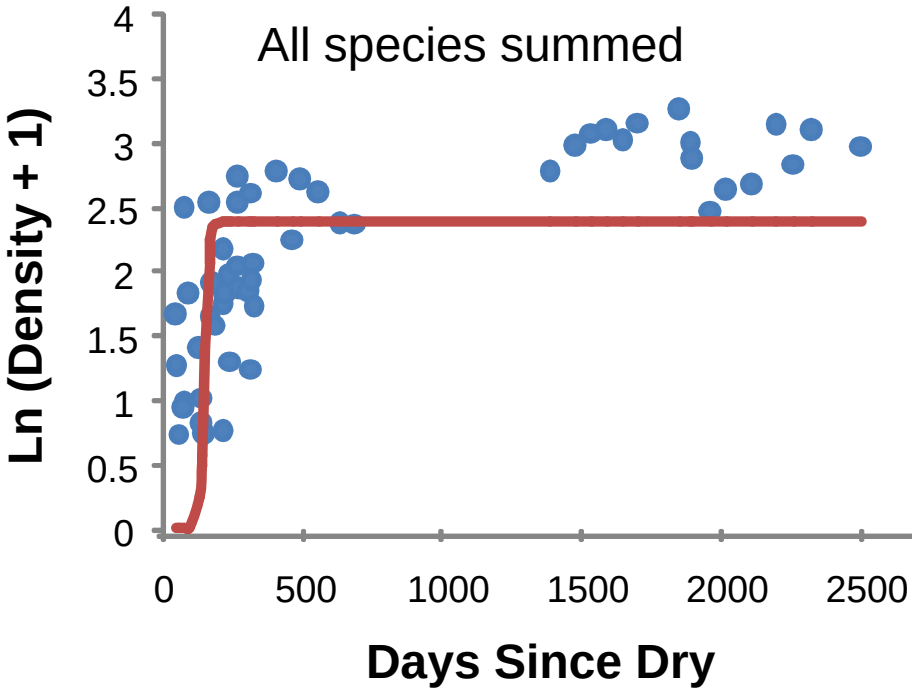
Fish

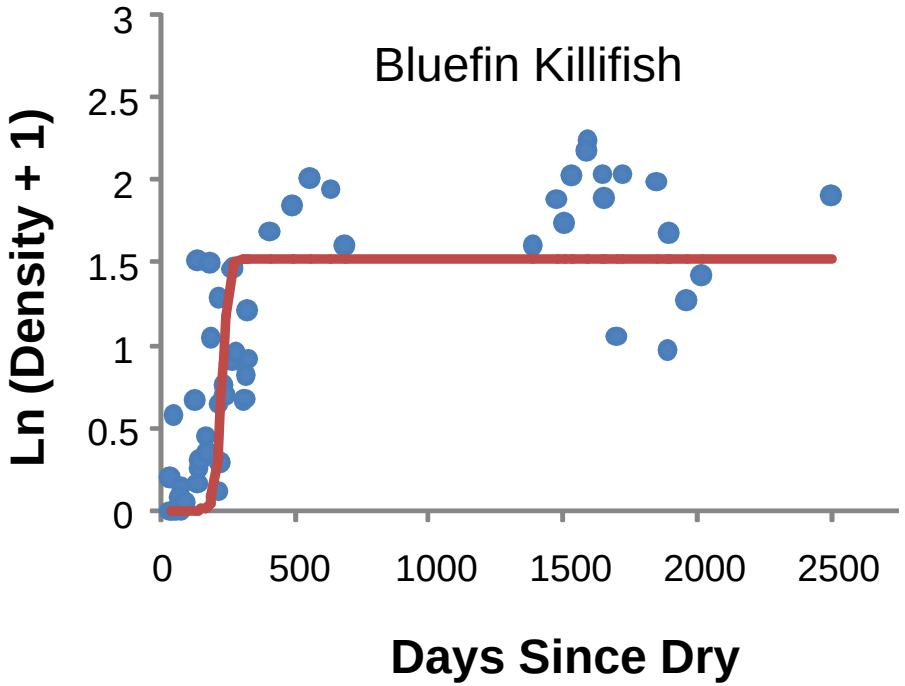
Data Analyses, Theory,
Modeling, Performance Measures,
Metrics, Targets & Assessments

Logistic Model Density with DSD

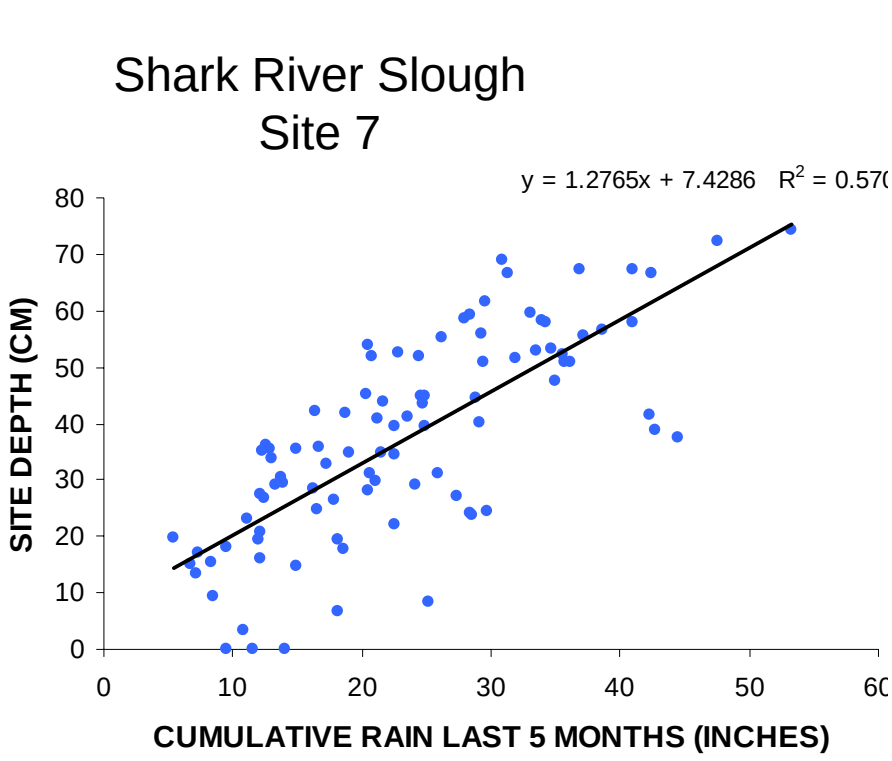
Example of relationship between a performance measure (All Species & Bluefin Killifish density) and days since rewetting after last dry down

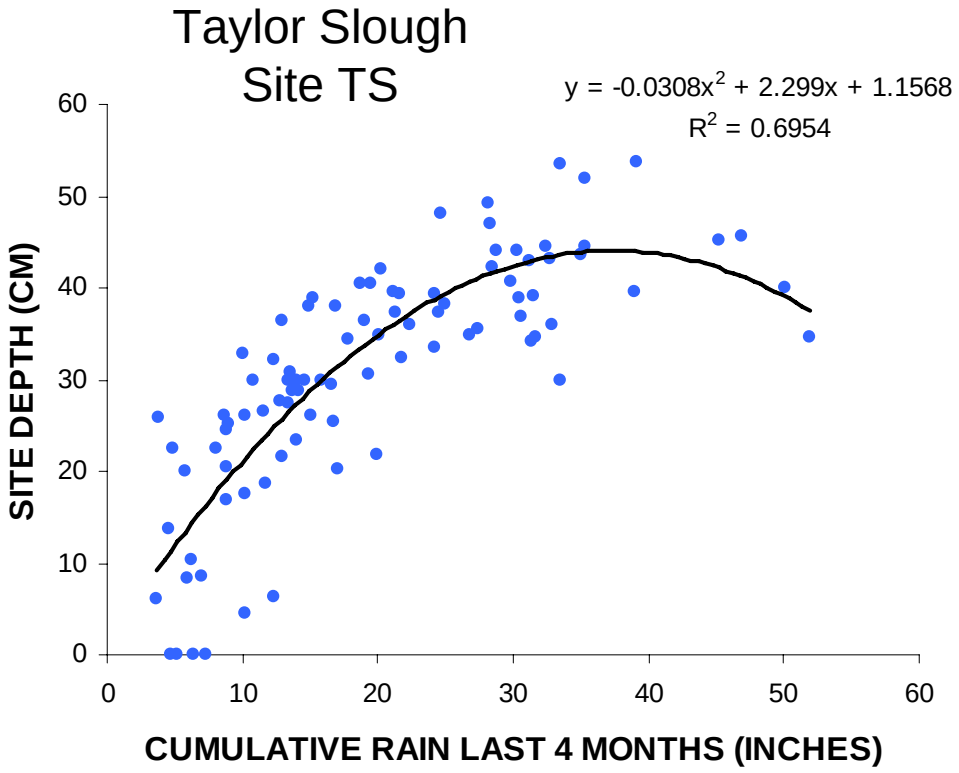
We have 12 year time series for fishes and macroinvertebrates at 20 sites
Taylor Slough
Site TS

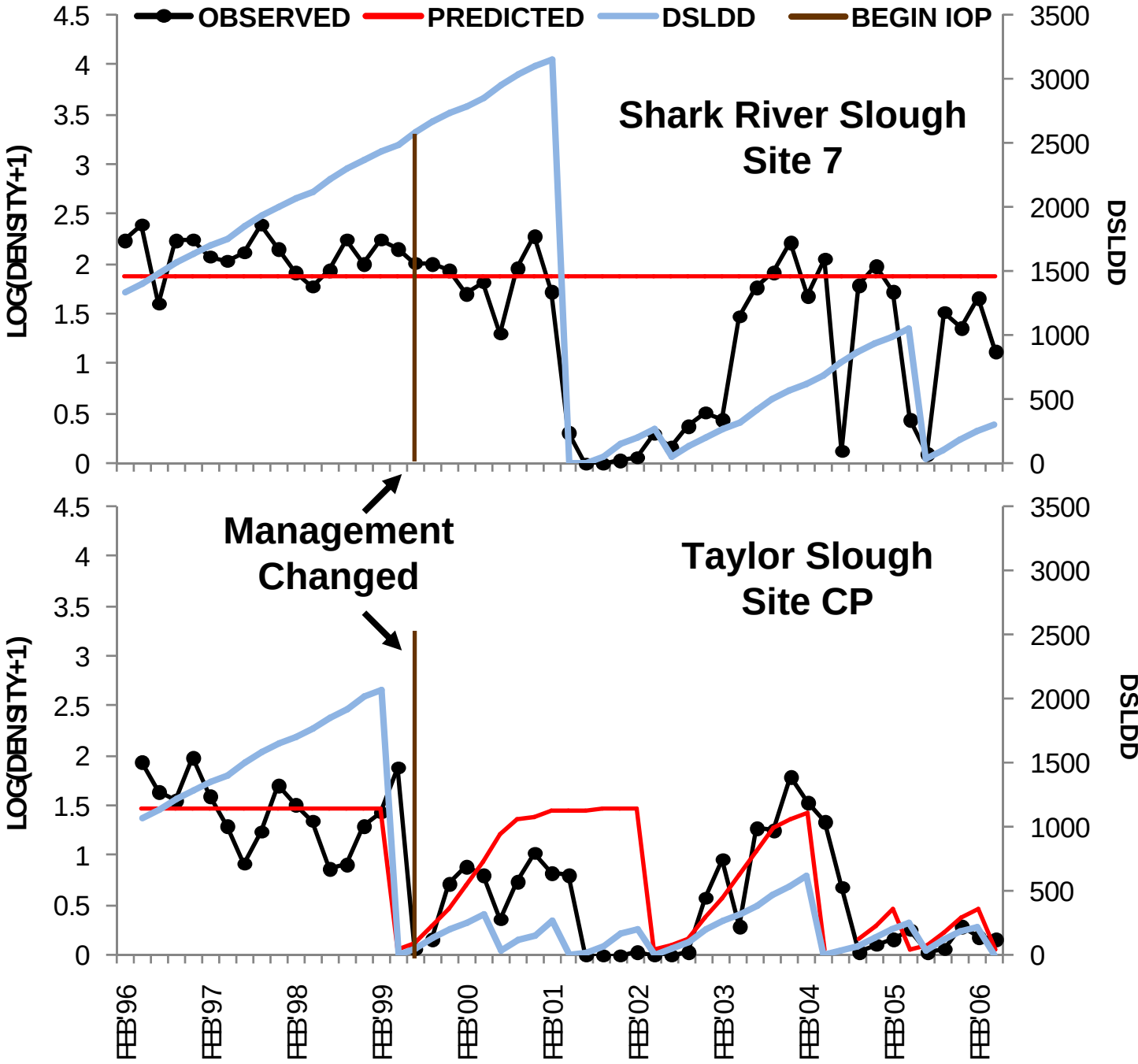




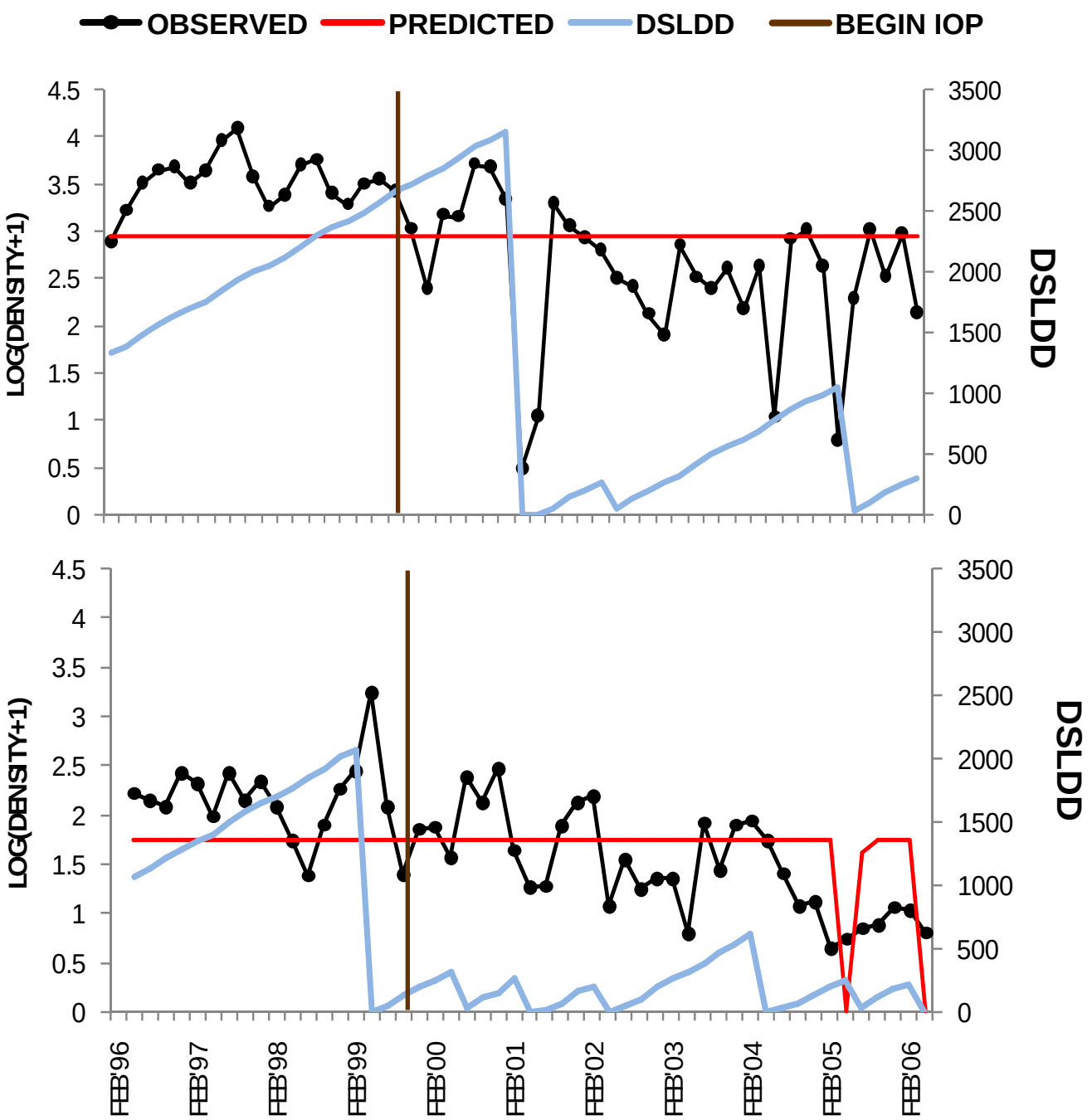
Depth vs. Cumulative Rain (Before Period)







Bluefin Killifish



All Fish Summed

Shark River Slough Site 7

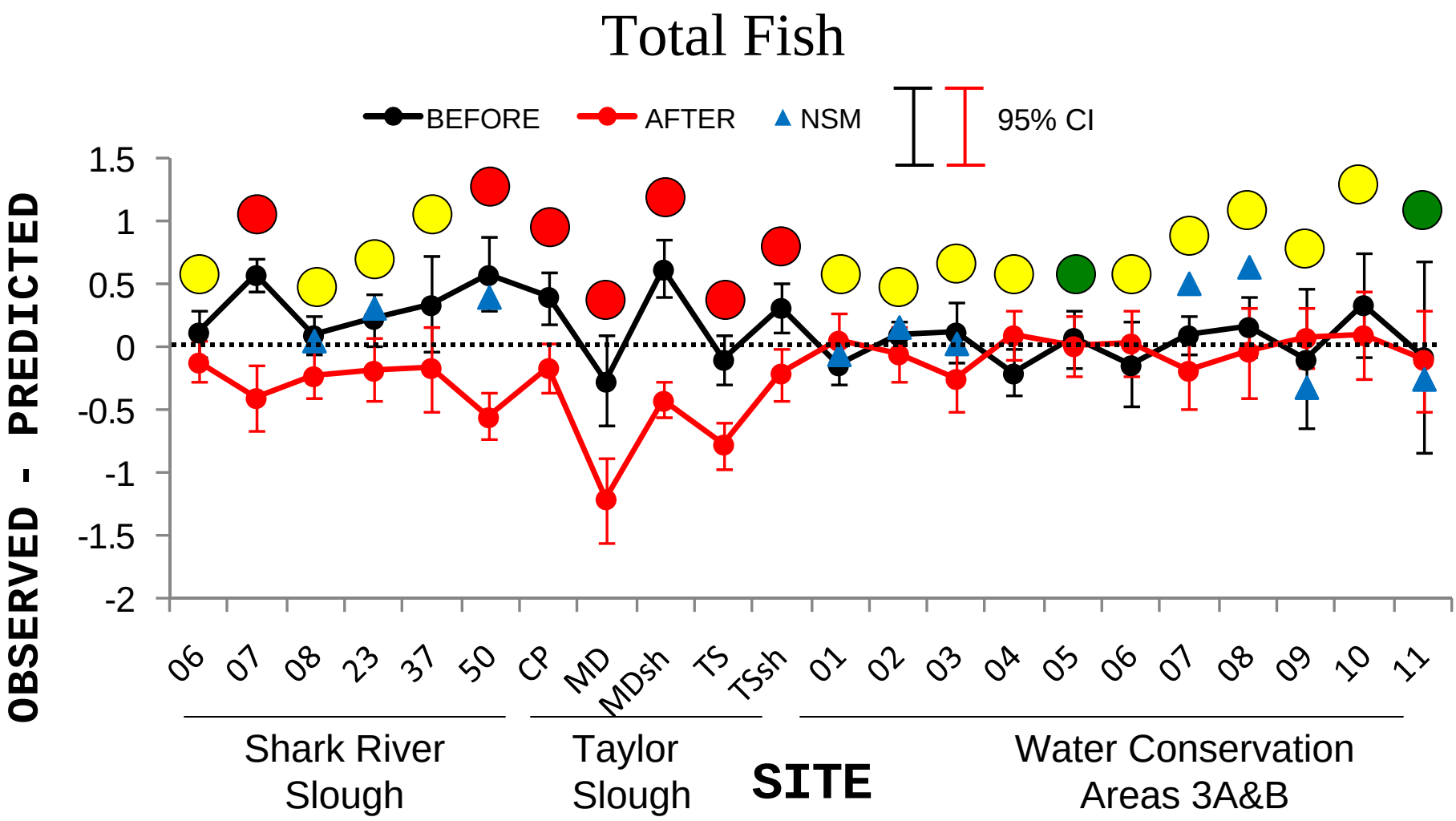
Taylor Slough Site CP

Differences Between Predicted and Observed Before, Natural System Model, and After

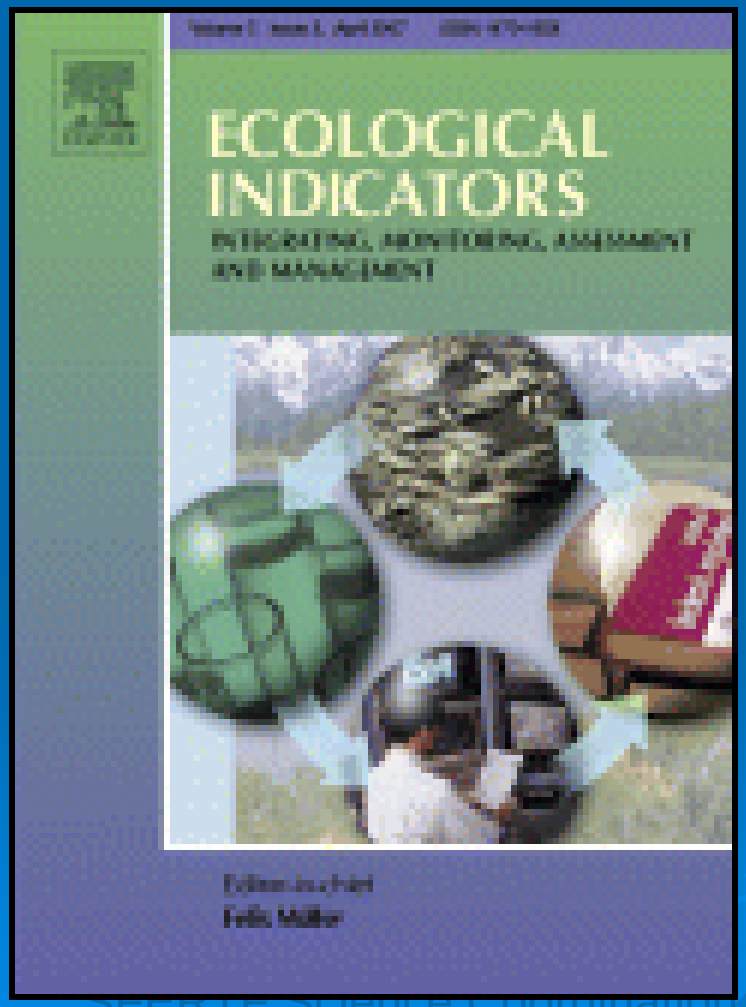
Where 95% confidence intervals completely overlap = green

Where 95% confidence intervals partially overlap = yellow

Where 95% confidence intervals do not overlap = red



ECOLOGICAL INDICATORS SPECIAL ISSUE JOURNAL



- **Publication date Sept-Oct 2008**
- **Peer review of all 11 ecological indicators**
- **Guest editors: Joel Trexler, Bob Doren, Ronnie Best**
- **Publisher: Elsevier**

Next Steps

- **October 22, 2007**
  - First completed draft of the indicators document (using the template I sent you for Crocodilians but developing the document according to the journal format if you want to save some time).
  - Key Findings double sided page (I sent an example (Florida Bay Algal Blooms) with the last email – also see copy of email below)
- **November 1, 2007**
  - Names and contact information for two reviewers who have already agreed to review your JOURNAL MANUSCRIPT.
- **December 1, 2007**
  - Input to all authors regarding formats and color images for JOURNAL MANUSCRIPT. This will be our last opportunity to discuss as a group what the manuscripts should look like and include and to harmonize them and the stoplight tables etc. as much as possible. Once you get all the comments you will have until March 17, 2008 to work on the manuscript.
- **December Indicator Scientists Meeting (TBD)**
  - Develop guidelines for Independent Scientific Review Panel members for review of the ASSESSMENT REPORT

- **March 17, 2008 (CRITICAL DEADLINE)**
  - **Online submission deadline for Elsevier publication in the special issue JOURNAL MANUSCRIPT for Ecological Indicators – unfortunately if you don't meet this deadline you won't get published.**
- **April 1, 2008**
  - **This is the date that your first draft ASSESSMENT REPORT is due for your indicator. All ASSESSMENT REPORTS will be sent to a copy editor for format and compilation on this date.**
- **May 1, 2008**
  - **Return of the first reviews of the JOURNAL MANUSCRIPTS to authors for revision to address reviewer comments.**
  - **First collation of each indicator ASSESSMENT REPORT with synthesis section into compiled ASSESSMENT by copy editor.**
  - **Compiled ASSESSMENT REPORT sent to Independent Scientific Review Panel for review.**
- **May 15, 2008**
  - **Independent Scientific Review Panel of ASSESSMENT REPORT recommendations returned to authors for comment and revisions.**

- **June 16, 2008**
  - Second submission of JOURNAL MANUSCRIPT for authors after revisions based on reviewer comments
  - ASSESSMENT REPORT due from authors with revisions from Independent Scientific Review Panel's comments.
  - ASSESSMENT REPORT sent to copy editor for final compilation.
- **July 16, 2008**
  - Final editorial review and revisions, questions, concerns resolved with guest editors and authors for JOURNAL MANUSCRIPTS.
  - Authors get final draft of the ASSESSMENT REPORT for final fact check and minor editorial changes.
- **August 1, 2008**
  - Final submission of all JOURNAL MANUSCRIPTS to Elsevier special issue journal editor by guest editors.
  - Final submission of ASSESSMENT REPORT to copy editor for final digital master prior to submission to the Task Force.
- **September 2008 (TBD)**
  - Final JOURNAL publication (hard copy and online journal versions)
  - Final ASSESSMENT REPORT presented to Task Force

Thank You

Any Questions?