Science Coordination Group System-wide Indicators

Briefing to the RECOVER Leadership Group
Tuesday, January 8, 2008

Bob Doren, Joel Trexler

Background

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

Four Steps

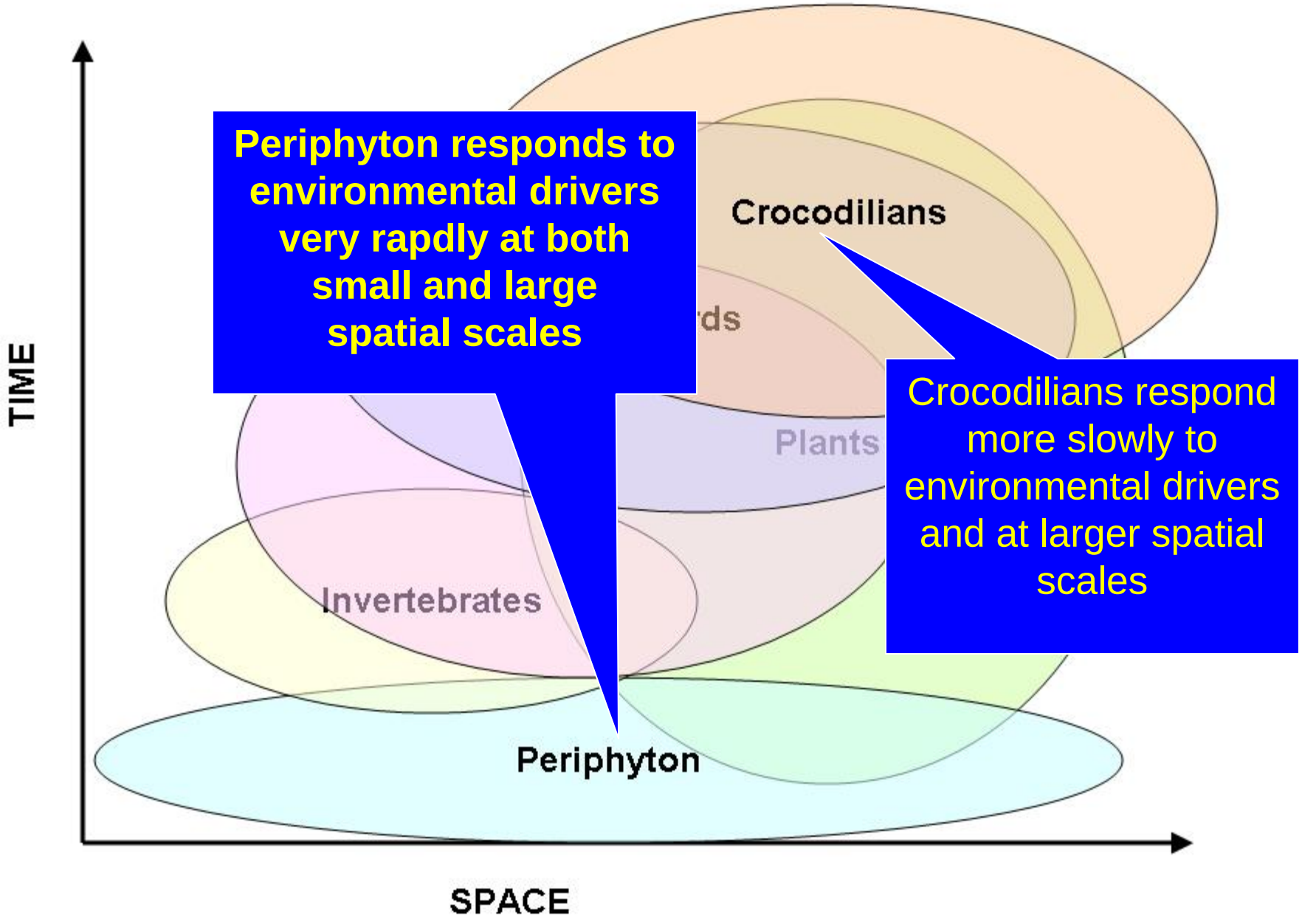
1. Evaluate existing restoration efforts from various sources for indicators for possible application to the Task Force suite of system-wide indicators
2. Using established guidelines select relevant indicators for Everglades Ecosystem applicability, evaluate the list of Indicators for individual and 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

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**


Periphyton responds to environmental drivers very rapdly at both small and large spatial scales
Crocodilians
Crocodilians respond more slowly to environmental drivers and at larger spatial scales
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, 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.	Crocodilians	Frank Mazzotti, Ken Rice et al.
11.	Exotic Plants	Bob Doren, Jenny Richards, John Volin

Gaps in Ecological Indicators

- Native Vegetation Pattern-Patchiness
- Contaminants
- Water Management (how much water gets moved where and when?)
- Exotic animals
- Need additional hydrological indicators of compatibility

8 Essentials for Measuring Success

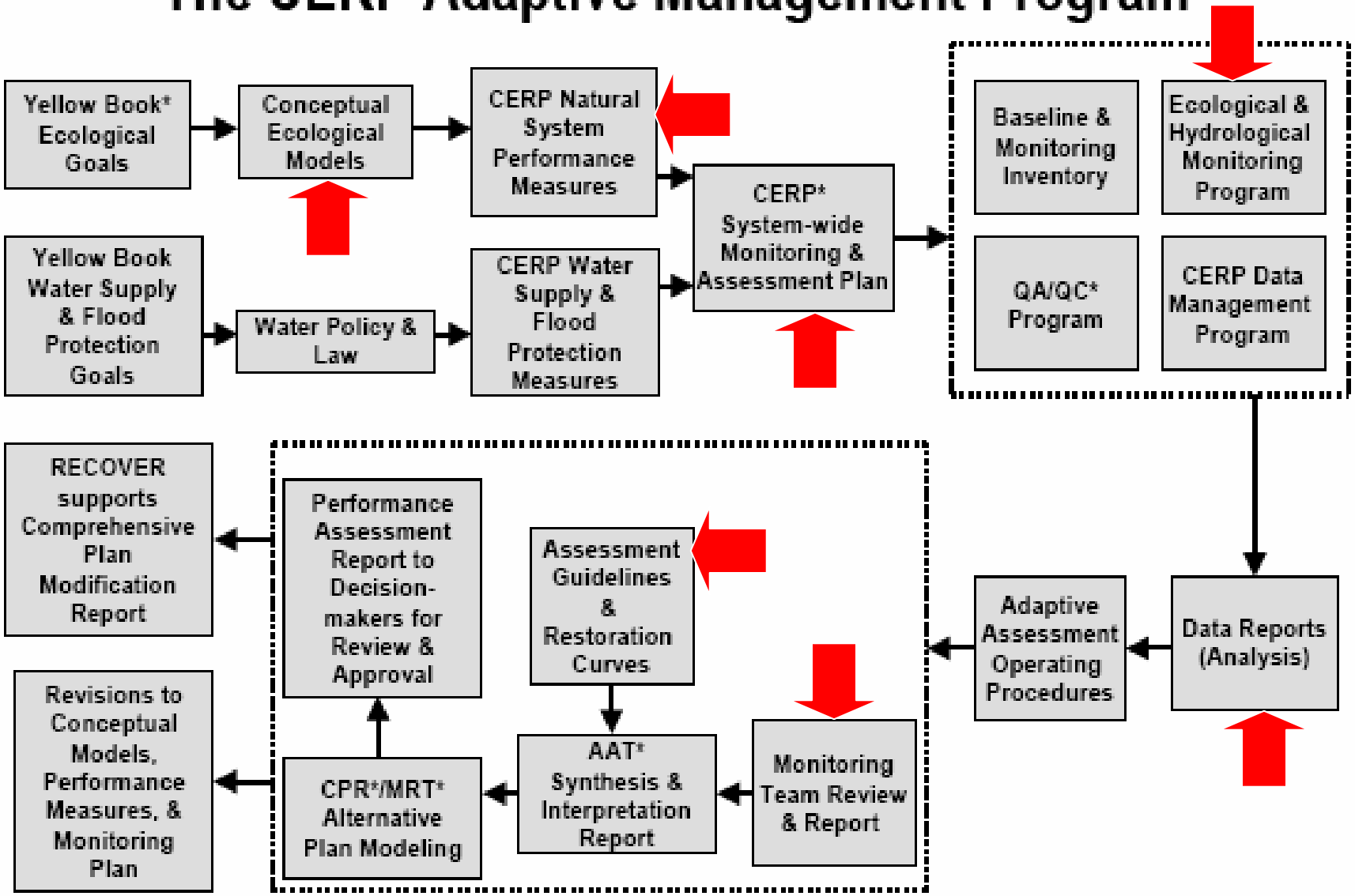
1. **Scientific Consensus** on Ecosystem Structure & Function – CEMS
2. **Indicators** with *metrics* for Ecosystem Structure or Function (Environmental Conditions)
3. **Baselines** to establish points of comparison
4. **Monitoring Program** to collect the data for assessments
5. **Performance Measures** 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 & Applied Science Strategy?

TF BIENNIAL ASSESSMENTS

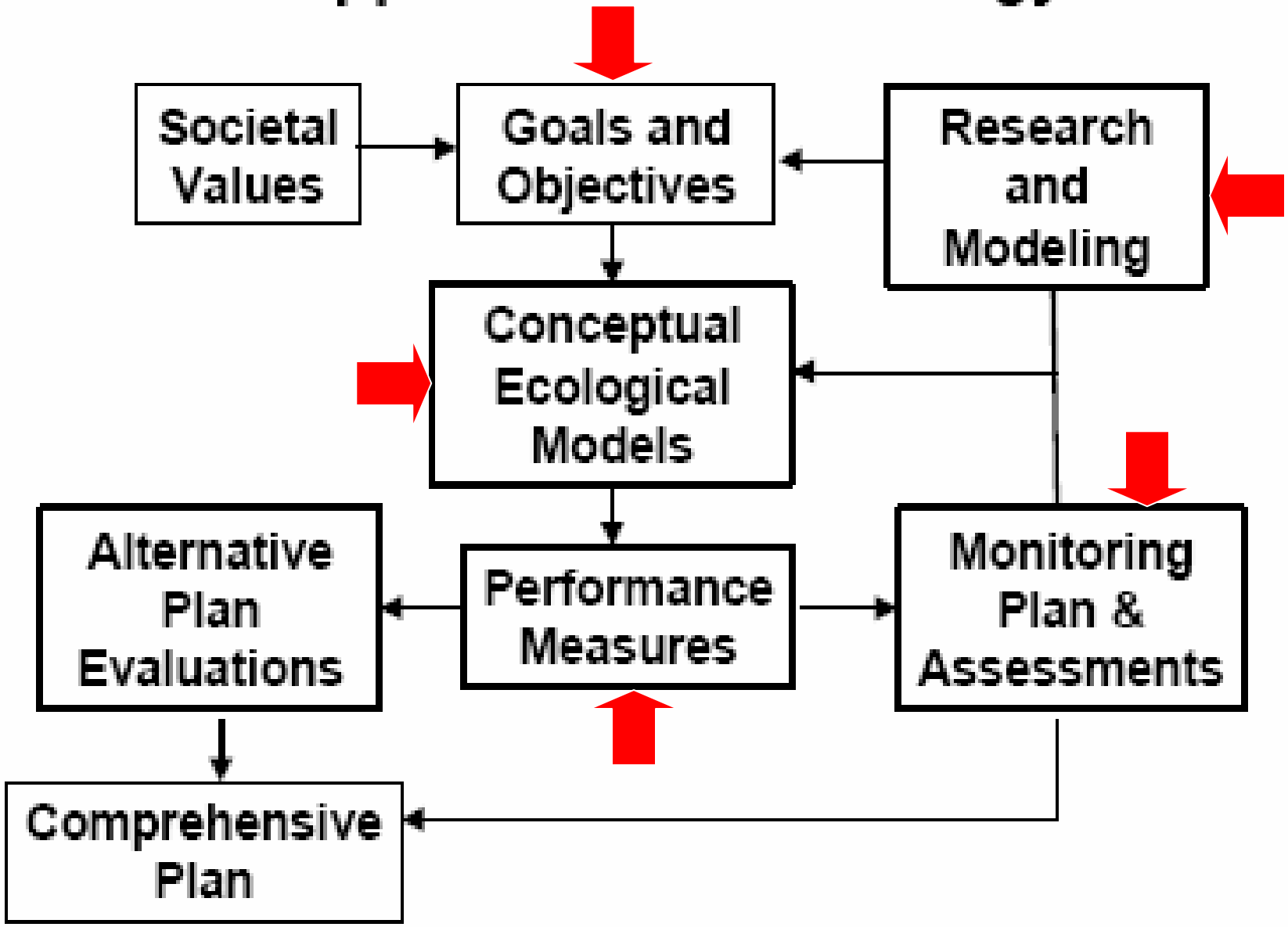
- The TF will be using
  - Either the same data and information the scientists provide RECOVER (e.g. SSR)
  - Or, other existing reporting systems (e.g. Annual Wading Bird Report)
  - The only new element will be the Restoration Stoplight Report Card and a Synthesis Report
    - This format is already being used in the South Florida Environmental Report, accepted by RECOVER for their report card system, and is being considered by the NPS for their vital signs program in south Florida
  - Invasive Exotic Plants is a not currently a CERP or RECOVER indicator but is considered critical to restoration and is part of the RECOVER CEM's.

The CERP Adaptive Management Program



Red Arrows Indicate Critical Points of Inclusion or Consideration for SCG System-wide Indicator Functions

Applied Science Strategy



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
- Biennial Individual Indicator Assessment Reports will present full data analysis and scientific theory and Publications (SFER format as the example)

Fish Example

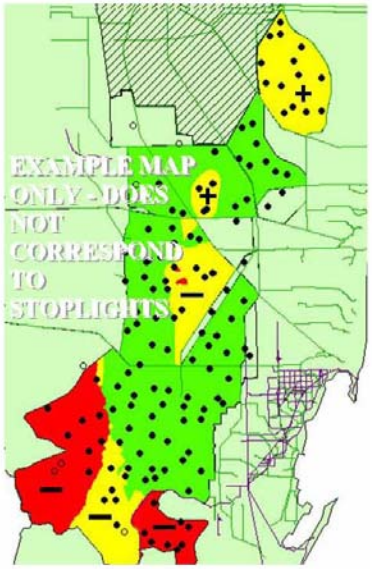
Tier One Example

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	Green	Red	Red	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	Green	Red	Red	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	Green	Red	Red	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	Green	Red	Red	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	Yellow	Yellow	Yellow	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	Yellow	Yellow	Yellow	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	White	White	White	No information on Loxahatchee at this time.	
BLUEFIN KILIFISH DENSITY WATER CONSERVATION AREA 1	White	White	White	No information on Loxahatchee at this time.	

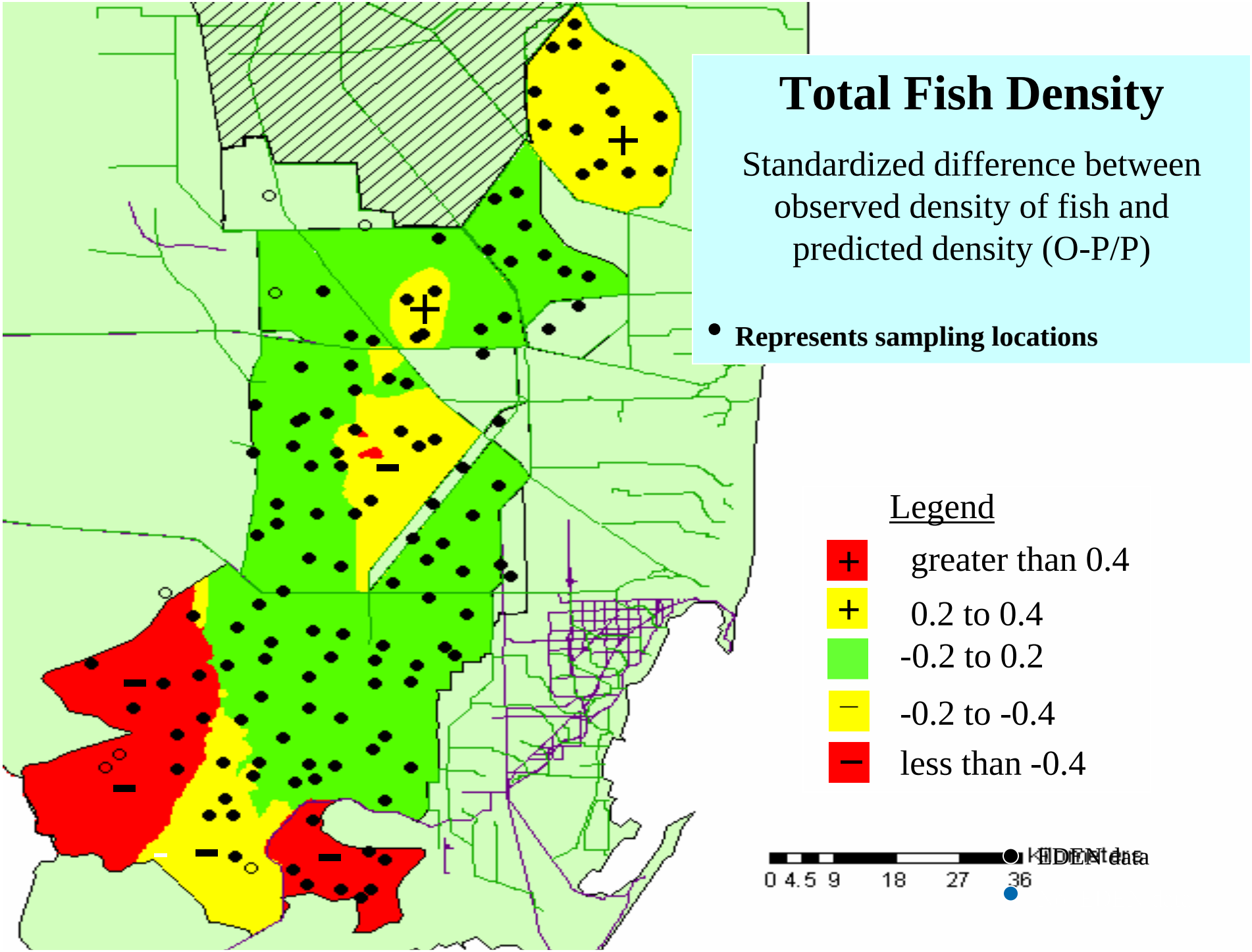
Tier Two Examples

Fish

Stoplight "Coded" Maps

&

Simplified Stoplight "Coded" Graphics

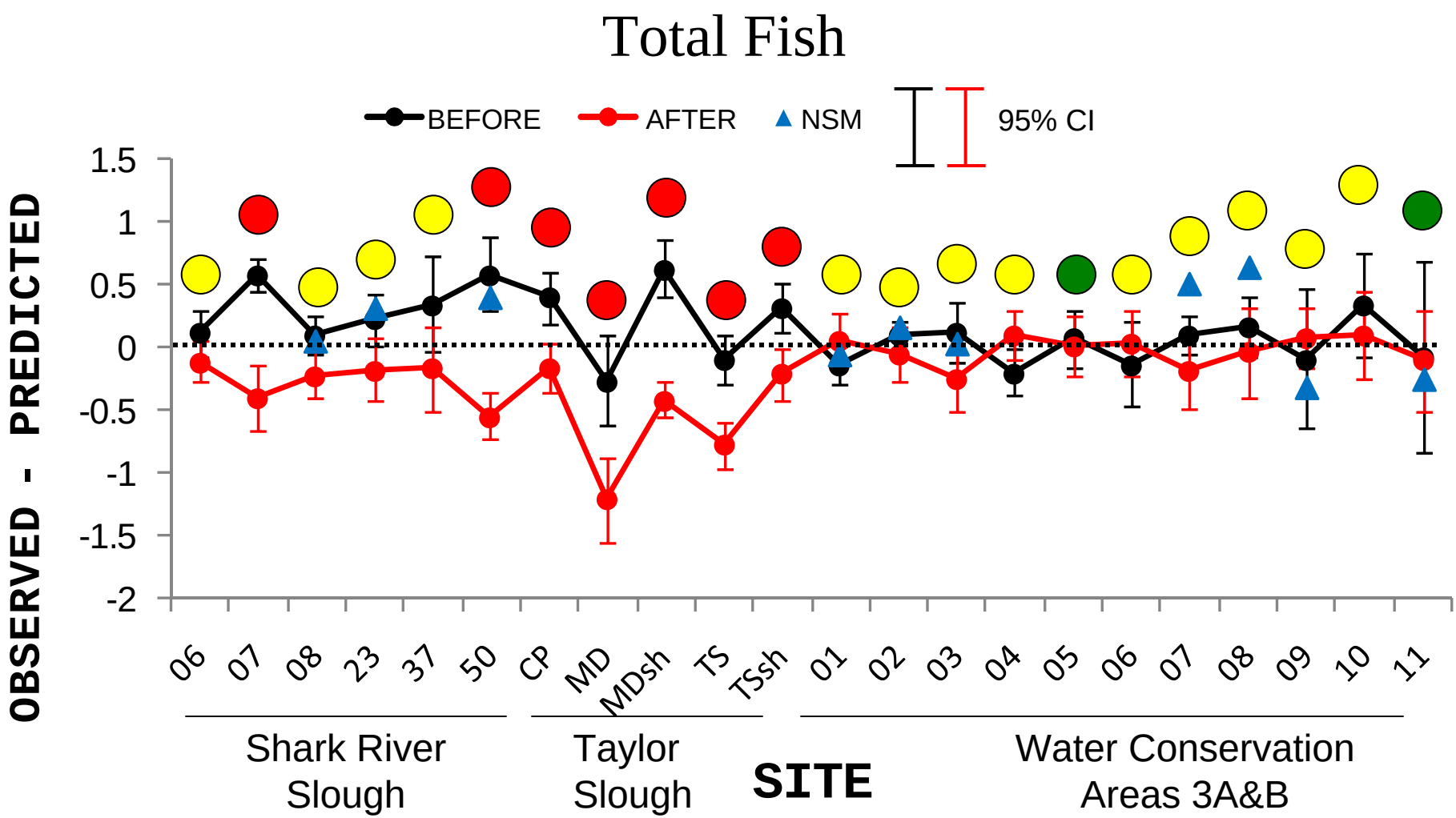

Total Fish Density
Standardized difference between observed density of fish and predicted density (O-P/P)
Represents sampling locations
Legend
greater than 0.4
0.2 to 0.4
-0.2 to 0.2
-0.2 to -0.4
less than -0.4
0 4.5 9 18 27 36
IDEN data

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

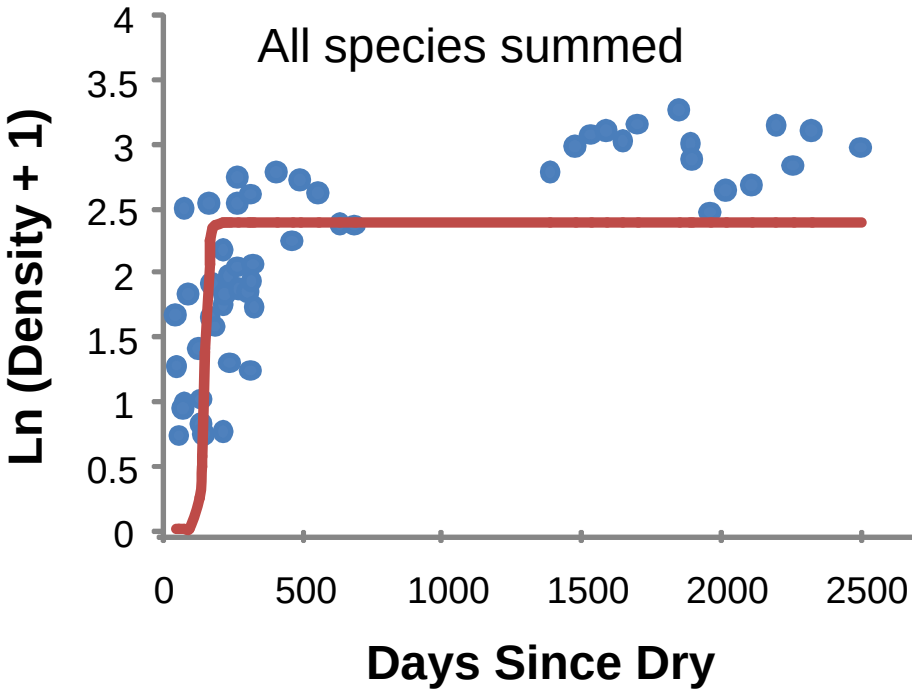
Fish

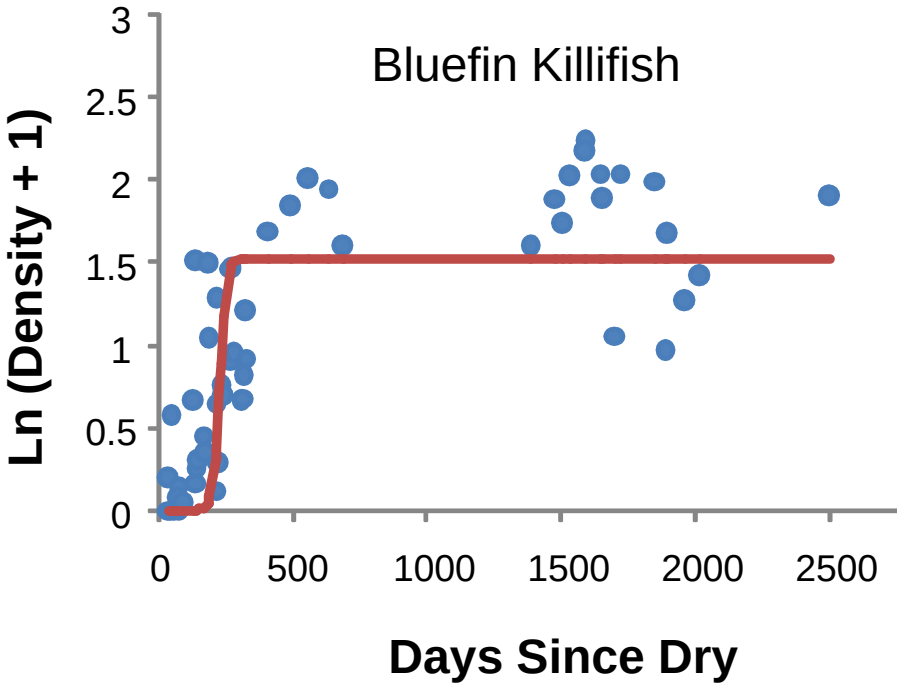
Data Analyses, Theory, Modeling, Performance Measures, Metrics, Targets & Assessments

Logistic Model Density with DSD

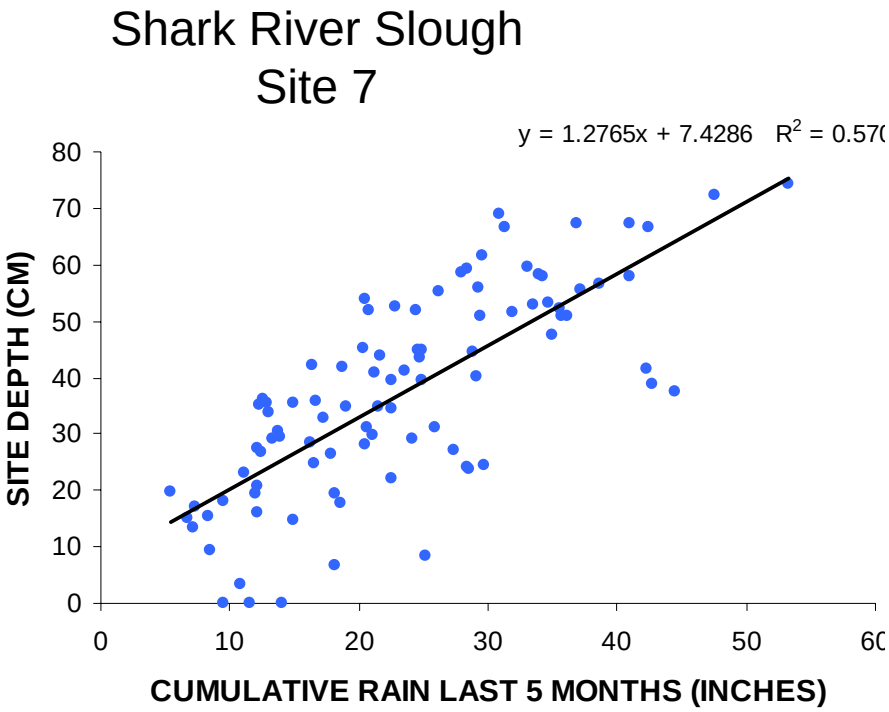
Example of relationship between a performance measure (All Species & Bluefin Killifish density) and days since rewetting after last dry down

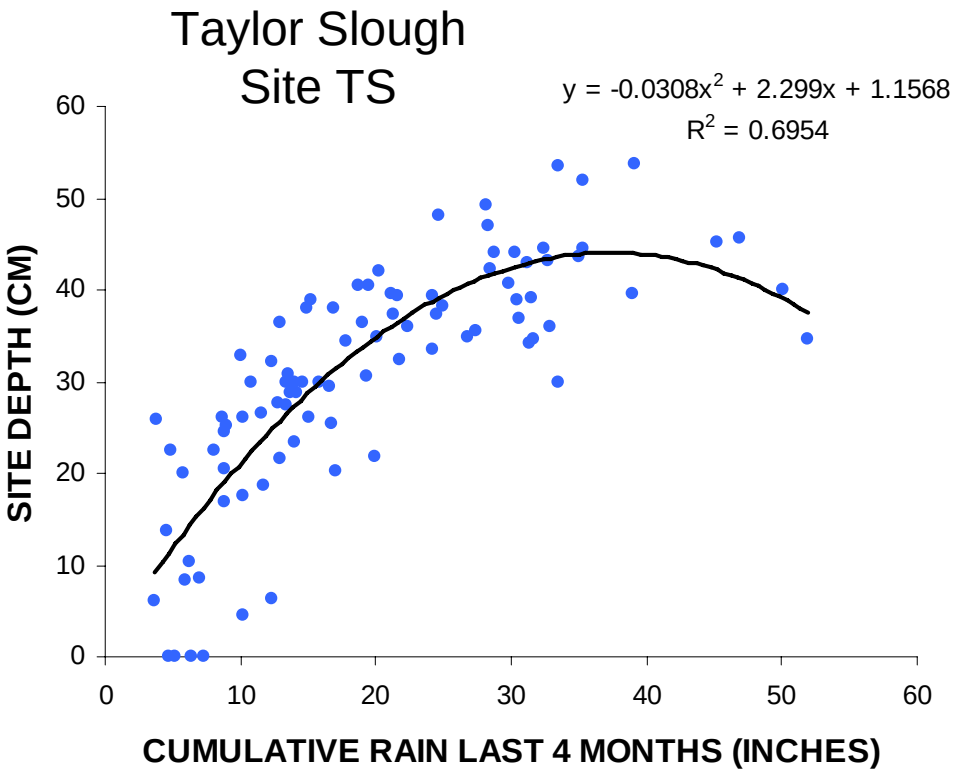
We have 12 year time series for fishes and macroinvertebrates at 20 sites
Taylor Slough
Site TS

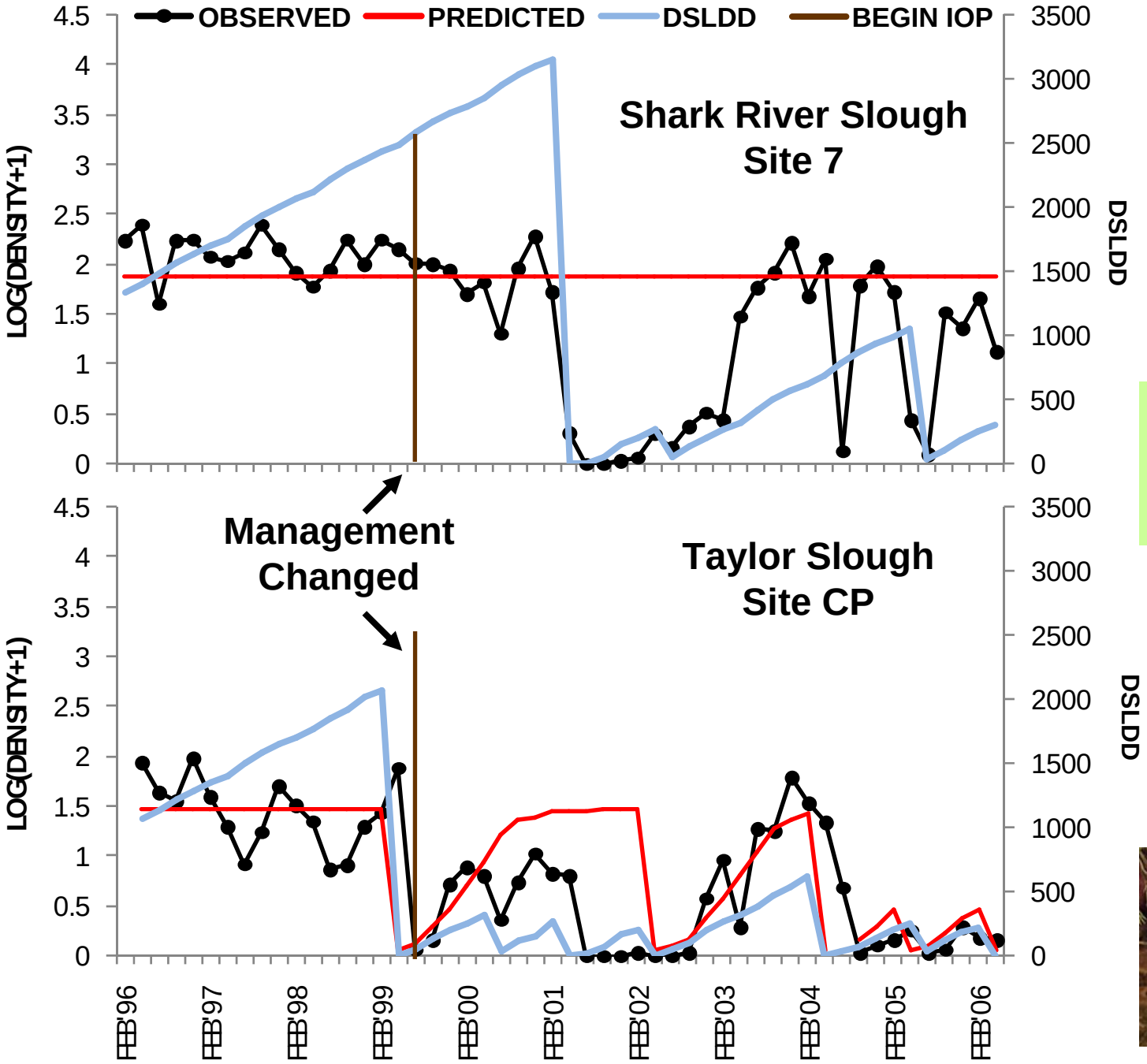




Depth vs. Cumulative Rain (Before Period)

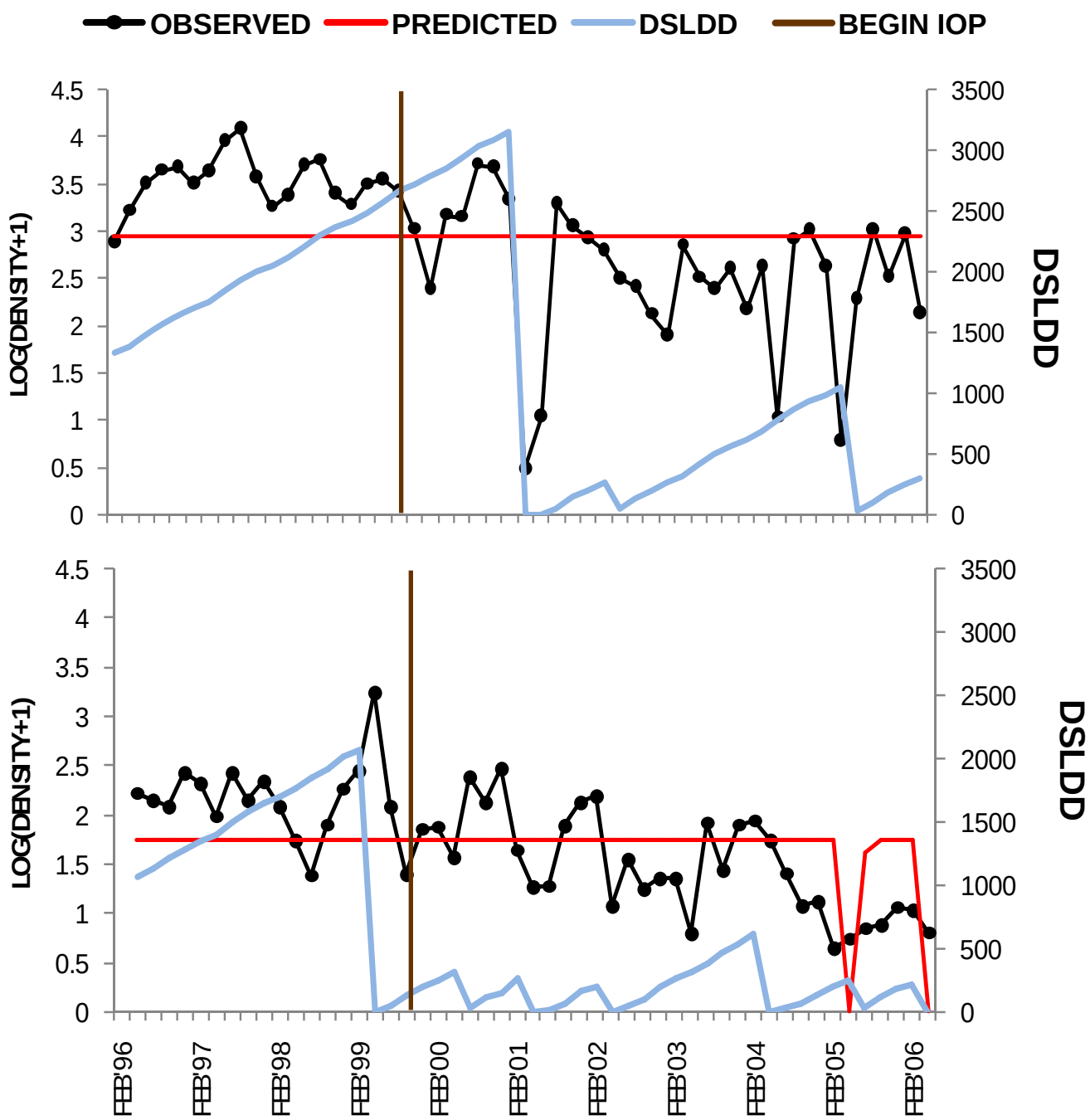






Bluefin Killifish

All Fish Summed



Shark River Slough Site 7

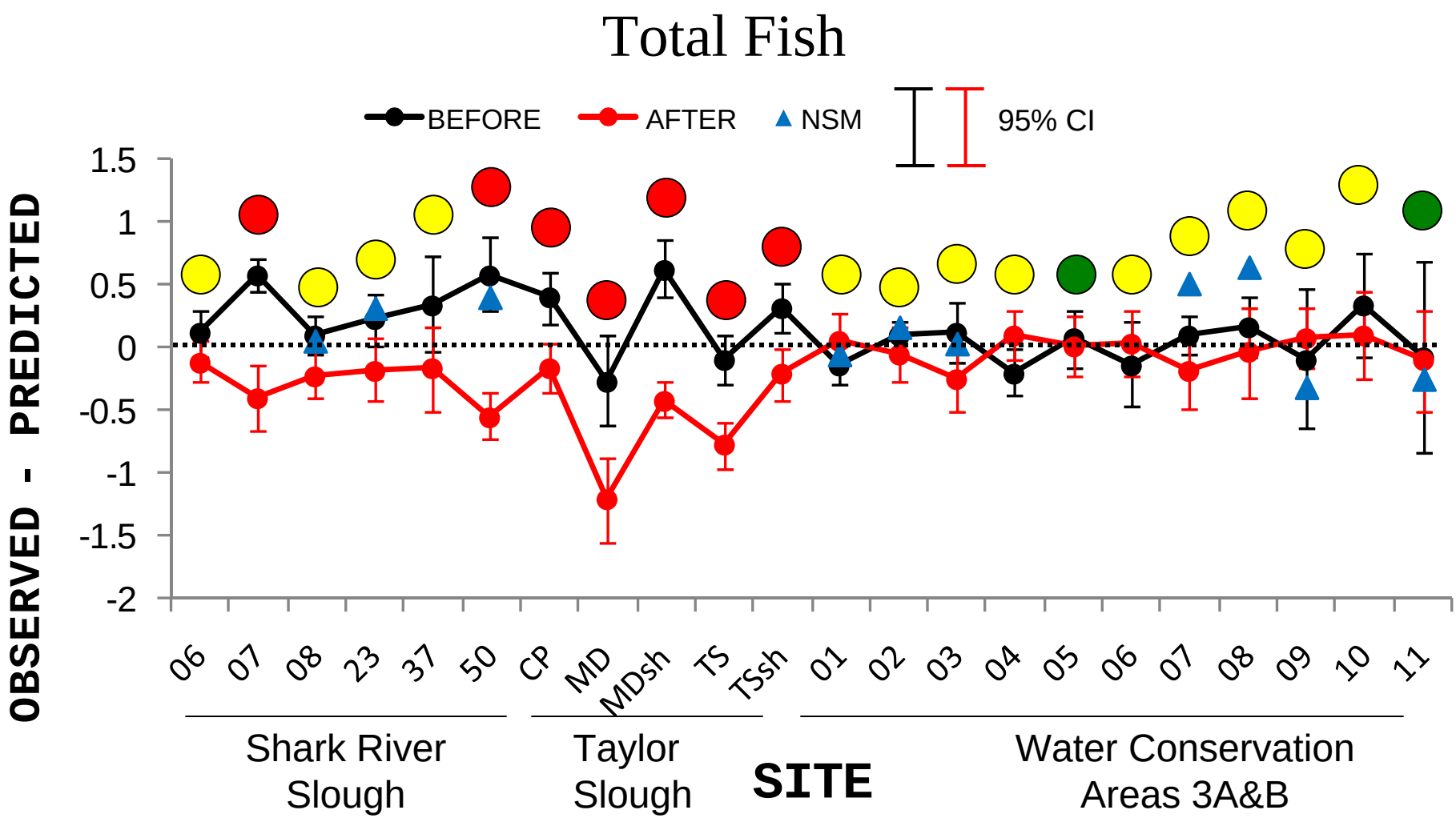
Taylor Slough Site CP

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



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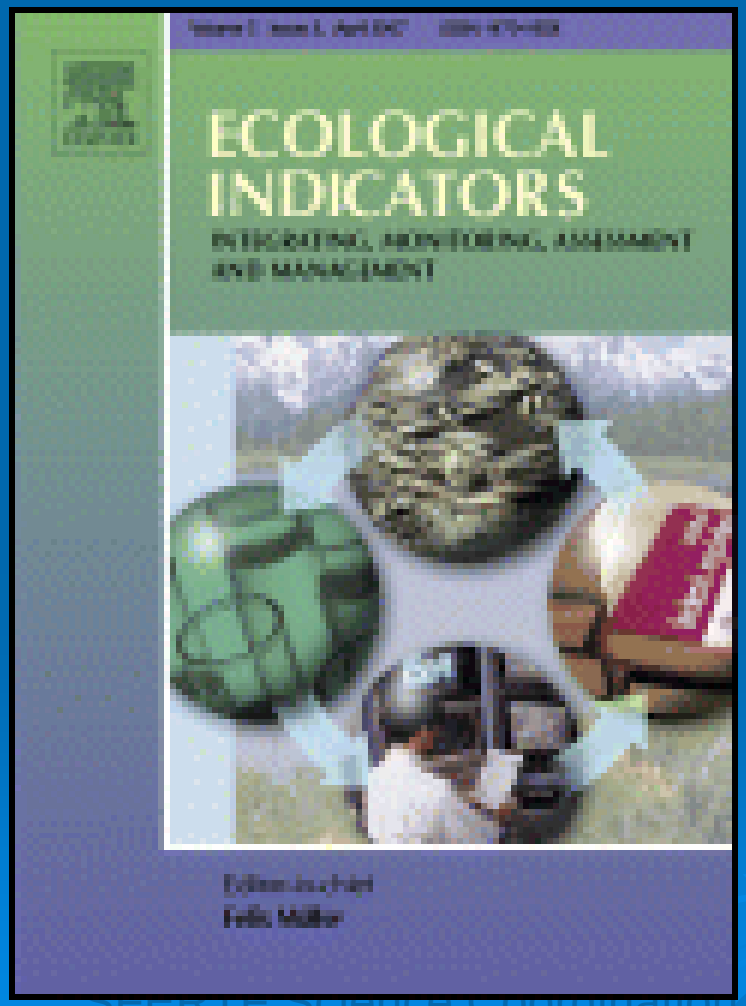

- **Publication date Sept-Oct 2008**
- **Peer review of all 11 ecological indicators**
- **Guest editors: Joel Trexler, Bob Doren, Ronnie Best**
- **Publisher: Elsevier**

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.**
- **January 15, 2008**
  - **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.**
- **January 22, 2008 Indicator Scientists Meeting**
  - **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?