WHY ARE WE SO BAD AT TALKING SCIENCE WITH NON-SCIENTISTS: ESPECIALLY MANAGERS AND POLICY MAKERS?

Ecological Indicators for System-wide Assessment 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 people express at meetings

It’s just “pointy-headed scientist’s” stuff

(and I’ll bet you have too)

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 better job of communicating the results of our science to managers and policy makers?
the modest proposal

A small set of System-wide 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 indicators
Why?
The Task Force and RECOVER are required to report to Congress on the status of Everglades restoration.

In 2004 the Task Force requested a small set of System-wide 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)

SFERTF Science Coordination Group
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.
Periphyton responds to environmental drivers very rapidly at both small and large spatial scales.

Crocodilians respond more slowly to environmental drivers and at larger spatial scales.
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 *metrics* 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 *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

3 Tiers of Information
Florida Bay Algal Blooms
Chlorophyll $a$

Tier One
Restoration Stoplight Report Card
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.

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 phenological 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 interections of hydrological restoration (e.g., more fresh water flow into Florida Bay) is critical to evaluating Florida Bay restoration.

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

**KEY FINDINGS – SOUTHERN ESTUARIES**

**ALGAL BLOOMS – SOUTHERN ESTUARIES**

**Data in the Current Status column for the algal bloom indicator reflect data inclusive of calendar year 2006.**

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

<table>
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<tr>
<th>Sub-region</th>
<th>Valid N</th>
<th>25th Percentile</th>
<th>Median</th>
<th>75th Percentile</th>
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<tr>
<td>Blackwater, Manatee, Barnes</td>
<td>BMB</td>
<td>1704</td>
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Tier Three Examples

Florida Bay Algal Blooms
Data Analyses, Theory, Modeling, Performance Measures, Metrics, Thresholds, Targets, Assessments
Time series of median chlorophyll a (ppb) and total phosphorous (ppm) in the Barnes Sound Manatee Bay sub-region.
The assessments and stoplight report cards provide direct and transparent links from the data to the stoplights.

**OUR GOAL IS TO:**

- Develop Stoplights that are empirically based
- Develop performance measures and targets that are dynamic & reflect natural variation
- Distinguish between natural and management effects on performance measures and targets where possible
Agency Reports are all using the same science.

- Task Force Biennial Report
- Partnerships CERP System Status Report
- Agencies South Florida Environmental Report
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
The End