Scorecard to Assess the Health and Benefits of the South Florida Coastal Marine Ecosystem

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Summary

In its final stage MARES project is developing elements of a system-wide scorecard that can provide an integrated assessment of the South Florida coastal marine ecosystem. The scorecard will be based on ecosystem indicators that evaluate conditions in the ecosystem, characterized based on quantitative data, relative to goals and attributes that people care about. The overall goal is for "a South Florida coastal marine ecosystem that is both sustainable and capable of providing the diverse ecosystem services upon which our society depends."[1]

Indicators, in this context, incorporate data on one or more variables to assess conditions in the coastal marine environment and communities of people who depend on it. In the former case, indicators use data on biological, chemical or physical attributes to assess environmental conditions. These are known as State indicators because they relate to the State element of the DPSER ecosystem model. In the latter case, indicators use data that are either economic or non-economic in character to assess the services and benefits that the ecosystem provides to people. These are known as human dimensions indicators because they relate to the human dimensions of the ecosystem.

This whitepaper reviews describes the overall approach being taken to develop a set of indices that integrate and summarize the detailed information provided by the three sets of indicators for the entire South Florida coastal marine ecosystem. Substantive progress was made on refining the approach to this end at a workshop held in February 2012. The contents that follow derive largely from that workshop.

Background

Why do we need a scorecard for the coastal marine ecosystem?

Development of the total system scorecard addresses the need to provide coastal managers, stakeholders and the general public with information about the current condition and the direction of changes occurring in the coastal marine ecosystem. The fourth and final stage of the MARES project is to develop an approach for combining the information assembled into indicators into a coastal ecosystem scorecard. The scorecard builds on previous work by the MARES project to articulate integrated conceptual ecosystem models (ICEMs), which contain information about the complex interrelationships between people and the coastal environment, and to identify quantitative indicators, which assess the condition of both the environmental and human dimensions aspects of the coastal marine ecosystem. Development of the total system scorecard for the South Florida coastal marine ecosystem follows on and extends existing efforts

[1]From the MARES project proposal; this is congruent with the NOAA ecosystem goal: *to protect, restore and manage the use of coastal and ocean resources through an ecosystem approach to management*.

to provide regional environmental managers with a system-wide assessment of the Greater Everglades ecosystem restoration program (Doren et al. 2009).

Focus on ecosystem services

The total system scorecard focuses on conditions in the coastal marine environment and in the human dimensions of the ecosystem that are most closely related to ecosystem services, that is to the benefits that the ecosystem provides to people. Ecosystem services occur where human dimensions of the ecosystem and elements of the coastal marine environment overlap, Figure 1. This defines the three types of indicators being developed by the MARES project.[2] Environmental (State) indicators provide information on the condition of major habitats, like seagrass beds, mangroves, and coral and hardbottom, and other integrative components of the environment, like the water column and fish and shellfish populations. These correspond to components of State in the MARES DPSER model framework. Economic human dimensions indicators relate to ecosystem goods and services that provide benefits, which can be evaluated using economic metrics. These correspond with Ecosystem Services in the MARES DPSER model framework. Non-economic human dimensions indicators relate to the contribution that ecosystem services make in the well-being of coastal communities.

Incorporate ecosystem goals

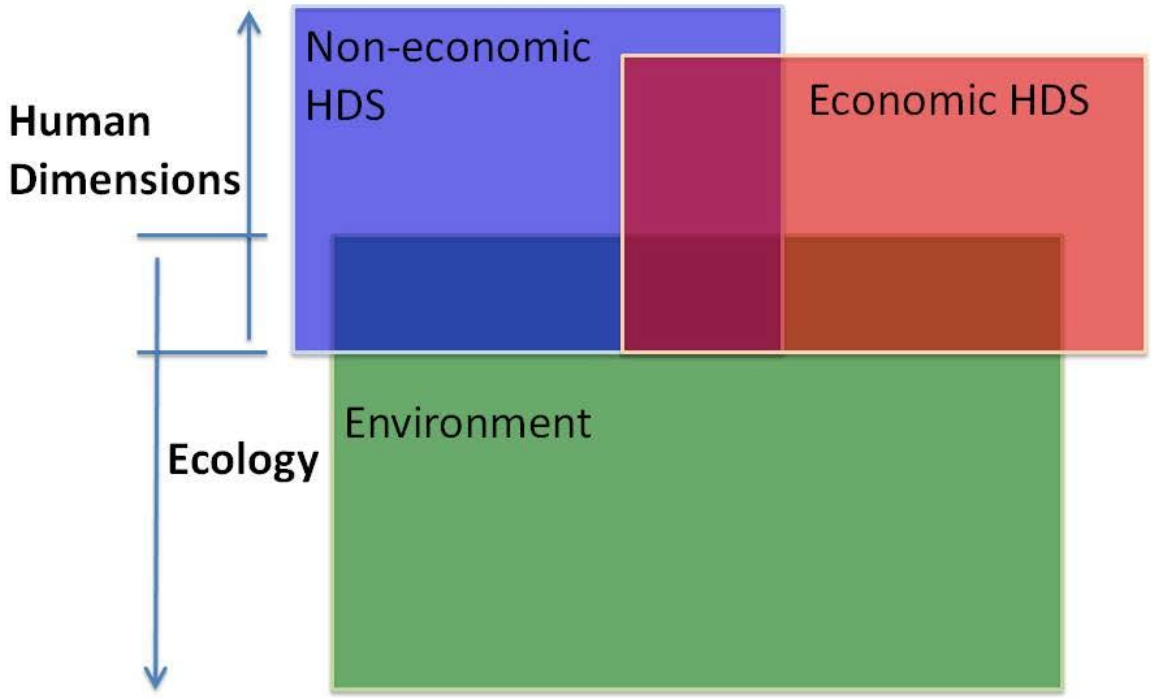
The total system scorecard combines data on conditions in the ecosystem with the goals people have for the South Florida coastal region. Assessing current conditions against the overriding goal of having a sustainable coastal marine ecosystem invokes the use of additional information/date that define the condition of sustainability in terms of the different metrics used to score the indicators and indices (Palmer and Febria 2012). Indicators combine information provided by metrics to describe conditions in major components of the ecosystem at specific locations. For example, the Report Card for the Mesoamerican Reef uses an indicator[3] of reef health calculated from data collected on coral cover, microalgae cover, and the abundance of key fish species.

A large part of the process of developing indicators involves articulating the goals people have for the coastal marine ecosystem and translating these into criteria that can be used to derive indicator scores, based on attributes that we can measure. The approach taken in developing water column indicators began by identifying a reference target value and a reference limit value for each metric. These established the basis for designating conditions as either “very good” or “critical.”

[2] See the MARES whitepapers on State indicators, economic human dimensions indicators, and non-economic human dimensions indicators for more information on the indicators that are being developed.

[3] In the different terminology used for the Mesoamerican report card, this is referred to as the “simplified integrated reef health index.” [online: http://www.healthyreefs.org/cms/; accessed 18 May 2013]

Figure 1: Ecosystem services occur where human dimensions of the ecosystem and elements of the coastal marine environment overlap



The target value corresponds to conditions that fully meet a specific goal. For example, in the case where the goal is conditions are unimpacted by human activities, then paleoecological conditions, corresponding to conditions prior to modern human development, can be used to set the target value. Where the goal is conditions that are safe for human health, such as for water quality, then water quality criteria that have been established for the protection of human health can be used. These usually vary depending on the intended use or level of human exposure.

The limit value corresponds to conditions in which the ecosystem is significantly harmed or in which the desired service is absent. Limit values can be set based on mechanisms already in place for environmental protection and protection of human health. For example, Florida water law provides for the designation of minimum flows and levels to help make sure that water management decisions take account of the needs of natural systems. As the result of implementing this regulation, water managers conduct a public process to determine limits, in terms of measurable attributes, that correspond to the onset of significant harm in affected ecosystems.

Plausibility of Success

Discussion at the February 2012 indicator workshop introduced "plausibility of success" as another focus for the total system scorecard in addition to the focus on ecosystem services that is supported by the State and human dimensions indicators. Plausibility of success relates to external factor that must be considered in determining the likelihood that any desired end-state can be achieved by a regional approach to ecosystem management in South Florida. A plausibility of success (POS) regional index (or indices) would include factors that act over a range of management-relevant time scales to either increase or decrease the likelihood of achieving a sustainable coastal marine ecosystem.

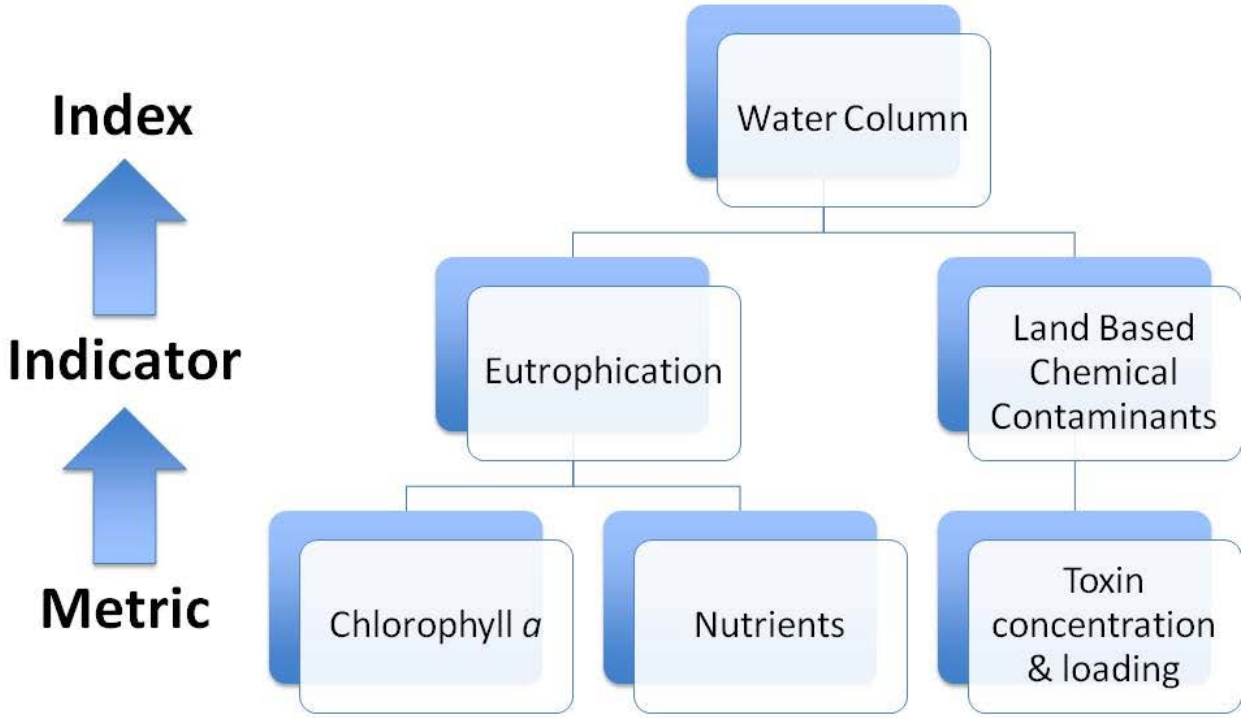
A POS index for the coastal marine ecosystem might include information on the regional effects of global climate change. Climate change is one of the main Drivers of change identified in the MARES integrated conceptual ecosystem models, and it is an external factor inasmuch as regional managers can do virtually nothing to mitigate the underlying process driving change, e.g. the increase in CO_2 concentration in the atmosphere. The best that can be done is to pursue activities that increase resilience to change in the coastal marine ecosystem. A POS index relate to climate change might track the occurrence of sea surface temperature and/or pH that exceed the tolerance limits of key organisms, such as corals. Discussion of other factors that might be included identified societal trends that contribute to changing how the coastal marine environment is valued and factors that determine the ability of managers to act effectively, such as enabling legislation, regulations and sustained support for gathering information needed for informed decision-making.

Approach to Developing a Scorecard

Metrics, Indicators, Indices

Metrics, indicators and indices provide information at different levels of detail, Figure 2. At the most detailed level, metrics are the raw data; they correspond with attributes that we can measure. Indicators synthesize information provided by metrics to assess the condition of key components of the ecosystem at specific locations within the South Florida coastal region. Indices provide an overview of conditions in the total regional ecosystem.

Figure 2: Metrics, indicators and indices provide information at different levels of detail



Metrics
Metrics consist of the raw, uninterpreted data gathered by measurement or observation. Some metrics relate to attributes of the ecosystem that we can measure or goods and services it provides. Other metrics measure characteristics of Drivers and Pressures acting on the ecosystem. During planning and assessment exercises, metrics are produced as the output from predictive models related a forecast of future conditions in the ecosystem or a simulation of conditions expected from alternative management actions.

Indicators
Indicators compare existing conditions against what is needed to sustain the ecosystem and the services it provides. Indicators combine information provided by metrics to describe conditions in major components of the ecosystem at specific locations.

Indices
Indices provide a system-wide overview of conditions related to different elements of the ecosystem. Indices combine information on localized conditions by averaging indicator scores.

Scoring

Scoring is basically a process of selecting the one category that best characterizes conditions based on available data. The assigned scores convey information about how measured conditions compare with conditions needed to achieve ecosystem management goals. For example, the Report Card for the Mesoamerican Reef uses the following scoring categories:

1 – critical (unsustainable conditions)

2 – poor

3 – fair

4 – good

5 – very good.

The objective for designing indicator scores is to convert the information contained in the raw metrics data into categorical data, such as the 1-5 scheme just discussed or the red-yellow-green "stoplight" categories. This is achieved by comparing conditions indicated by the metric data to conditions that meet criteria related to a management goal, e.g. for ecosystem sustainability, human health, aesthetics, etc. Management goals, and thus the assessment criteria may vary from location to location. For example, nutrient criteria related to estuarine water quality will be different between locations managed to maintain mesotrophic conditions and locations managed to maintain oligotrophic conditions.

Indices should provide "a standardized, quantitative, transparent, and scalable measure that can be used by scientists, managers, policy makers, and the public to better understand, track and communicate ecosystem status and design strategic actions to improve overall [ecosystem] health" (Halpern et al. 2012). In general, index scores will be calculated by averaging the scores of component indicators. Transparency requires that if a weighted averaging scheme is used, one

that assigns greater weight to some component indicators relative to others, then the difference in assigned weights must be clearly justified. The preferred approach is to design the scoring of the indicators so that index scores are calculated using a uniform weighting scheme, i.e. simple averaging.

Reporting

Following the example of establish by Doren et al (2009) working with the South Florida Ecosystem Restoration taskforce, the MARES total system scorecard will use a stoplight reporting format. As implied by the use of the term "stoplight," this approach converts the index scores into the widely-understood red-yellow-green color code. The coded scores can then be reported in a number of ways, in a summary table or on a map. The format adopted for use in South Florida in connection with the Comprehensive Everglades Restoration Plan employs a summary table that combines the red-yellow-green color code for each indicator with information on the direction of change and a short commentary identifying the major factors contributing to the indicated condition.

References

Doren, R. F., J. C. Trexler, A. D. Gottlieb, and M. C. Harwell, 2009. Ecological indicators for system-wide assessment of the greater everglades ecosystem restoration program, Ecological Indicators, 9, S2-S16.

Halpern, B. S., Longo, C., Hardy, D., McLeod, K. L., Samhouri, J. F., Katona, S. K., ... & Zeller, D. (2012). An index to assess the health and benefits of the global ocean. Nature, 488(7413), 615-620.

Palmer, M.A., and C.M. Febria, 2012. The heartbeat of ecosystems. Science 336: 1393-1394.