System-wide Indicators for Everglades Restoration 2008 Assessment

Alligator and Background Lake image on front cover –
Courtesy of the South Florida Water Management District
Periphyton/Utricularia on front cover – **Courtesy of Evelyn Gaiser**
Roseate Spoonbill on front cover – **Courtesy of Brynne Langan-Mulrooney**
Bluefin Kilifish on the front cover – **Courtesy of The Calypso Ichtyological Photolobrary**
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"An Ecological Indicator is a metric that is designed to inform us easily and quickly about the conditions of an ecosystem"

Bennet 2000

FOREWORD:

What are ecological indicators and why do we need them?

"An Ecological Indicator is a metric that is designed to inform us easily and quickly about the conditions of an ecosystem" (Bennet 2000).

"A useful Ecological Indicator must produce results that are clearly understood and accepted by scientists, policy makers, and the public" (Jackson et al., 2000).

Ecological indicators are used to communicate information about ecosystems and the impact human activity has on them. Ecosystems are complex and ecological indicators can help describe them in simpler terms. For example, the total number of different fish species found in an area can be used as an indicator of biodiversity.

There are many different types of indicators. They can be used to reflect a variety of aspects of ecosystems, including biological, chemical and physical. Due to this diversity, the development and selection of ecological indicators is a complex process.

National indicators for pollution (for example the ozone index one sees on the daily news) and the economy (for example the gross domestic product (GDP) reported daily in the news as the measure of national income and output) have been used for decades to convey complex scientific and economic principles and data into easily understandable concepts.

Many ecological restoration initiatives globally and nationally are either currently using or developing ecological indicators to assist them in grading ecological conditions. A few of the larger US restoration programs that are developing and using ecological indicators include Chesapeake Bay, Maryland; San Francisco Bay-Delta-River System, California; Yellowstone National Park, Montana; Columbia River, Oregon; and the South Florida Ecosystem Restoration Program.

Indicators make understanding an ecosystem possible in terms of management, time and costs. For example, it would be far too expensive, perhaps even impossible, to count every animal and plant in the Everglades to see if the restoration was a success. Instead, a few indicator species can be monitored in a relatively few locations to determine the success of the restoration. Indicators can be developed to evaluate very specific things or regions, or to evaluate broad system-wide aspects of an ecosystem.

This report is a digest of scientific findings about eleven system-wide ecological indicators in the south Florida ecosystem. These eleven indicators have been carefully selected in order to focus our ability to assess the success of the Everglades restoration program from a system-wide perspective. The eleven indicators are: Crocodilians (Alligators and Crocodiles), Periphyton/Epiphyton, Juvenile Pink Shrimp, Florida Bay Algal Blooms, Florida Bay Submerged Aquatic Vegetation (SAV), Lake Okeechobee Littoral Zone, Roseate Spoonbills, Wood Stork and White Ibis, Fish and Macroinvertebrates, Oysters, and Exotic Plants. These ecological indicators are organisms that integrate innumerable ecological functions in their life processes. For example, hydrology (water depth, timing and duration) and water quality affect the types and quantities of periphyton, which affect the types and quantities and availability of fish that feed on periphyton, which affect the amount and availability of fish as food for alligators and wading birds. They're all interconnected, and indicators provide a more pragmatic means to understand those complex interconnections.

Ecological indicators are used because we cannot measure everything all the time. Scientists measure a few attributes of a few indicators precisely because they integrate many ecological and biological functions that either we cannot measure because it would be too expensive and time consuming, or simply because some things are too difficult to measure. Thus—through measuring more simple aspects of the lives of key organisms—we are able to take into account the innumerable biogeochemical and environmental processes they integrate and, through more simple and affordable research and monitoring, we can accurately determine how and why they respond to ecosystem drivers and stressors such as rainfall, hydrology, salinity, water management, nutrients and exotic species.

What We Hope the Reader Will Learn From This Report

Studies have shown that by identifying a limited number of focal conservation targets and their key ecological attributes, we can improve the successful use and interpretation of ecological information for managers and policy makers and enhance decision-making. The purpose of this report is to provide a synopsis of highly technical and complex topics in a manner that is easy to read and interpret. The target audiences of the report are the lay reader and decision makers. We hope that this synopsis and accompanying scientific assessment reports (available on the attached CD) will further the understanding and appreciation of the Everglades and its restoration, and provide policy makers science information in a form that will be useful to them in making important restoration decisions. This report should provide the reader with a straightforward understanding of the most important problems in Everglades Restoration as told to us through the science of these eleven ecological indicators. Your comments and suggestions for improving this report are welcome. You may send your comments to Robert F. Doren at dorenr@fiu.edu. An interactive version of this report is available online at www.sfrestore.org.

What The System-wide Ecological Indicators Collectively Tell Us About The Everglades . . . The REALLY BIG PICTURE

These indicators are key organisms that we know (through research and monitoring) respond to environmental conditions in ways that allow us to measure their responses in relation to restoration activities. Because of this, we also may expect to see similar ecological responses among indicators. This logical agreement among indicators—a collective response, if you will—helps us understand how drivers and stressors act on more than one indicator and provides a better system-wide awareness of the overall status of restoration as reflected in the ecological responses of these indicators. The more indicators that collectively respond to the drivers and stressors, the stronger the signal that the underlying problem is ubiquitous to the system and is affecting the fundamental ecological and biological nature of the Everglades ecosystem. Fixing these things is key to fixing the Everglades.

The BIG PICTURE findings below stem from these collective responses and are clustered according to the organisms that responded to environmental conditions similarly. While Spoonbills, Alligators and Periphyton—as noted in item #1 below—may appear to be unrelated, they are directly related through their biological and ecological responses to environmental drivers.

The following are six “big-picture” findings that were common to more than one indicator, and to large, important regions of the natural system.

1. **Water Management and Water Structures Matter.** As shown by the indicators *Roseate Spoonbills, Alligators, and Periphyton*, the regions of the Everglades that are most removed from the actions or impacts of water management and water management structures appear to be relatively more stable biologically, biogeochemically and hydrologically. Important to note, however, are that 1) these areas still show negative impacts for some of the indicator species, particularly white ibis and wood stork; 2) even though more removed from impacts of water management these areas are still negatively impacted by water management, just more slowly or less frequently; and 3) relying only on small, less impacted portions of the remnant natural areas to support populations that research suggests may be at the edge of sustainability does not represent restoration.

2. **Excess Phosphorus has Negatively Impacted the Everglades.** As shown by the indicators *Periphyton, and Lake Okeechobee Littoral Zone Submerged Aquatic Vegetation (SAV)* excess phosphorus has impacted the Everglades most heavily in the northern areas and least in the southern areas of the Everglades, and areas more impacted by phosphorus are those closest to water management structures.

    a. **Periphyton** also indicates that, so far—apparently a result of its southerly location—Taylor Slough is still pristine in relation to phosphorous in spite of being dramatically impacted by water management and contiguous to many water control structures. This indicates that future water management activities intended to increase flows to Taylor Slough must carefully take into account the need to ensure that only water with very low (~ 10 ppb) phosphorus content is allowed to enter Taylor Slough.

3. **Littoral Zone Vegetation of Lake Okeechobee and the Northern Estuaries have been Seriously Affected by Restricted Outflow from the Lake.** As shown by the indicators *Lake Okeechobee Littoral Zone SAV, Fish and Macroinvertebrates, Wood Stork and White Ibis, Oysters, and Periphyton* restricted outflow from the lake due to the Herbert Hoover Dike, and water management operations, including both water storage and water releases, have a serious negative impact on the littoral zone vegetation of the lake and the areas of the Everglades directly connected to lake management. Prolonged excessively high or low lake stages, usually exacerbated by extreme natural events such as heavy regionwide rainfall or serious droughts, can cause a significant loss of littoral zone vegetation and aquatic fauna. Water storage and water releases in Lake Okeechobee also are documented to have serious negative effects on oyster populations in the Caloosahatchee Estuaries and similar effects have been seen in the St. Lucie-Indian River estuaries.

4. **Natural Events on Top of Human Impacts Cause Serious Negative Consequences.** As shown by the *Lake Okeechobee Littoral Zone SAV, Oysters, and Florida Bay Algal Blooms*, natural events such as hurricanes or other large storms superimposed with human-caused perturbations (such as nutrient addition, road construction, water movement, etc.) can cause serious negative consequences. For example, the re-suspension of large amounts of nutrients (typically phosphorus) from urban and agricultural runoff has caused algal blooms that resulted in significant light attenuation. This results in the subsequent loss of submerged aquatic plants and aquatic animals.

5. **There Is Too Little Water in Both the Wet and Dry Seasons Over Most of the Everglades.** As shown by the indicators *Alligators, Crocodiles, White Ibis, Wood Stork, Roseate Spoonbill, Pink Shrimp, Fish and Macroinvertebrates, Oysters, and Periphyton*, and emblematic of the current hydrological system, most of the Everglades are negatively impacted by too little water in both the wet and dry seasons. These indicators also tell us (usually as a result of heavy rainfall events, or rapid drainage events in either the dry or wet seasons) that flood control operations can cause rapid and prolonged increases or decreases of water levels that negatively impact these species. Flood releases and drainage can cause water levels to be too high or too low, depending on how and where the water is moved.

a. **Oysters, Alligators, Crocodiles, White Ibis, Wood Stork, and Roseate Spoonbill,** in particular, reflect the seriousness of this second problem related to water operations which results in periods of too much or too little water during extreme events. These operations alter both the timing and duration of hydrological conditions causing negative ecological impacts in regions that are affected by these actions.

b. **Alligators, Roseate Spoonbills, and Periphyton** again confirm that the areas more distant from water management impacts, such as central areas of Water Conservation Area 1, and Southwestern parts of Florida Bay, are more biologically and hydrologically stable. Most of the indicators in these areas show either improvements or are relatively stable. However, even though populations of some of these indicators may be stable, they are still below overall restoration targets for the species and indicate that small portions of the remaining natural areas are insufficient to support population levels that would be able to meet system-wide targets that represent biological restoration.

c. **Oysters** also indicate the same pattern for the northern estuaries as too much freshwater is released into the northern estuaries in the wet season and too little during the dry season. The timing and duration of these regulatory release patterns are not natural and negatively affect the oyster populations.

6. **The Southern Estuaries Receive Insufficient Flows of Fresh Water During Both the Wet and Dry Seasons.** As shown by the indicators *Pink Shrimp, Florida Bay Submerged Aquatic Vegetation (SAV), Roseate Spoonbill, White Ibis, Wood Stork, Alligators, Crocodiles, Fish and Macroinvertebrates and Florida Bay Algal Blooms* all of the southern estuaries receive insufficient flows of fresh water (including surface and groundwater flows) during both the wet and dry seasons. The shortage is particularly acute during the dry season. We see an unambiguous convergence of data related to shrimp, fish and macroinvertebrates and crocodilian populations, Florida Bay SAV, and locations of nesting wading bird colonies, indicating an extreme shortage of fresh water inflows.

a. **Roseate Spoonbill and Crocodiles** indicate that the southeastern estuaries of Florida Bay, at the southern terminus of Taylor Slough, are impacted by insufficient flows of water during the wet season and most especially during the dry season.

b. **Florida Bay Algal Blooms** indicate that the southern estuaries are still oligotrophic (very low in nutrients) and extremely sensitive to small increases in nutrient loading (phosphorous). This is likely related to insufficient flows to this region, keeping nutrient loads low. Care must be taken to ensure that any increased freshwater flows delivered to the southern estuaries do not increase anthropogenic (human generated) sources of nutrients to these areas (see also item 2a above).

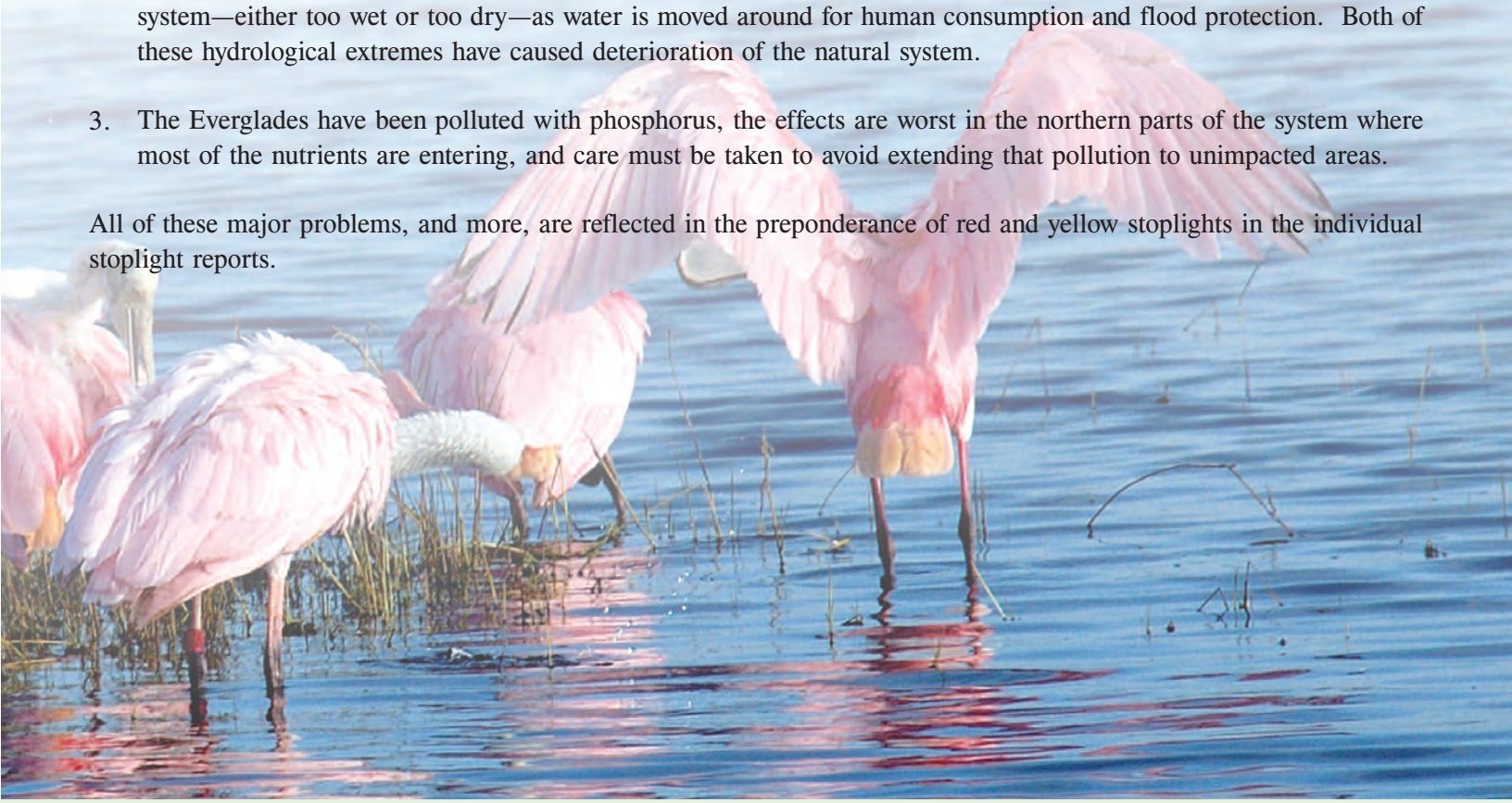
The REALLY BIG predominant themes we can discern from the collective responses of these indicators include the following:

1. Due to water management not delivering enough water, and also draining needed water away, the Everglades, as a whole, is not getting nearly enough water in either the wet or dry seasons and the southern portions of the Everglades system are most affected in this regard.

2. Water management often causes extremes, and reversals, in water levels in both the wet and dry seasons in the natural system—either too wet or too dry—as water is moved around for human consumption and flood protection. Both of these hydrological extremes have caused deterioration of the natural system.

3. The Everglades have been polluted with phosphorus, the effects are worst in the northern parts of the system where most of the nutrients are entering, and care must be taken to avoid extending that pollution to unimpacted areas.

All of these major problems, and more, are reflected in the preponderance of red and yellow stoplights in the individual stoplight reports.



Background

Any method of communicating complex scientific issues and findings to non-scientists must: 1) be developed with consideration for the specific audience, 2) be transparent as to how the science was used to generate the summary findings, 3) be reasonably easy to follow the simplified results back through the analyses and data to see a clear and unambiguous connection to the information used to roll-up the results, 4) maintain the credibility of the scientific results without either minimizing or distorting the science, and 5) should not be, or appear to be, simply a judgement call (Norton 1998, Dale and Beyeler 2001, Niemi and McDonald 2004, Dennison et al. 2007). In reviewing the literature on communicating science to non-scientists we realized that the system of communication we developed for this suite of system-wide indicators must be effective in quickly and accurately getting the point across to our audience in order for our information to be used effectively (Rowan 1991, 1992, Dunwoody 1992, Weigold 2004, Thomas et al. 2006, Dennison et al. 2007).

This suite of system-wide indicators has been developed specifically to provide a mountaintop view of restoration for the South Florida Ecosystem Restoration Task Force and Congress. The approach we used to select these indicators focused on individual indicators that integrated numerous physical, biological and ecological properties, scales, processes, and interactions to try to capture that sweeping mountaintop view. Based on the available science, we made the underlying assumption that these indicators integrated many additional ecological and biological functions that were not or could not be measured and thus provided an assessment of innumerable ecological components that these indicators integrated in their life processes.

Having too many indicators is recognized as one of the more important problems with using and communicating them (National Research Council 2000, Parrish et al. 2003). Identifying a limited number of focal conservation targets and their key ecological attributes improves the successful use and interpretation of ecological information for managers and policy makers and enhances decision-making (Schiller et al. 2001, Parrish et al. 2003, Dennison et al. 2007).

The South Florida Ecosystem Restoration Task Force (Task Force) (see: www.sfrestore.org), established by section 528(f) of the Water Resources Development Act (WRDA) (see: http://www.evergladesplan.org/wrda2000/wrda_1996.aspx) of 1996 consists of 14 members. There are seven federal, two tribal, and five state and local government representatives. The main duties of the Task Force are to provide a coordinating organization to help harmonize the activities of the agencies involved with Everglades restoration. The Task Force requested that the Science Coordination Group (SCG -- a team of scientists and managers) develop a small set of system-wide indicators (Table 1) that will help them understand *in the broadest terms* how the ecosystem, and key components, are responding to restoration and management activities via implementation of the Comprehensive Everglades Restoration Program (CERP) (see: www.evergladesplan.org), guided by the Restoration Coordination and Verification (RECOVER) team (see: http://www.evergladesplan.org/pm/recover/recover.aspx), and other non-CERP restoration teams and projects (see: www.sfrestore.org).

The CERP and RECOVER programs are and will be monitoring many additional aspects of the ecosystem, including such things as: rare and endangered species, mercury, water levels, water flows, storm-water releases, dissolved oxygen, soil accretion and loss, phosphorus concentrations in soil and water, algal blooms in Lake Okeechobee, hydrologic sheet flow, increased spatial extent of flooded areas through land purchases, percent of

landscape inundated, tree islands, salinity, and many more. The set of indicators included here are a sub-set from a larger monitoring and assessment program. They are intended to provide a system-wide, big-picture appraisal of restoration. Many additional indicators have been established that provide a broader array of parameters. Some of these are intended to evaluate sub-regional elements of the ecosystem (e.g., individual habitat types), and others are designed to evaluate individual CERP projects (e.g., water treatment areas). This combination of indicators will afford managers information for adjusting restoration activities at both large and small scales.

Our goal has been to develop a suite of indicators composed of an elegant few (Table 1) that would achieve a balance among: feasibility of collecting information, sufficient and suitable information to accurately assess ecological conditions, and relevance for communicating the information in an effective, credible, and persuasive manner to decision makers. For the purposes of this set of indicators, "system-wide" is characterized by both the physiographic and ecological elements that include: the boundary of the South Florida Water Management District and assessment modules (Figure 1), and the ecological links among key organisms (see Wetlands special issue 2005 for examples of the Conceptual Ecological Models (CEM)) (Figure 2).

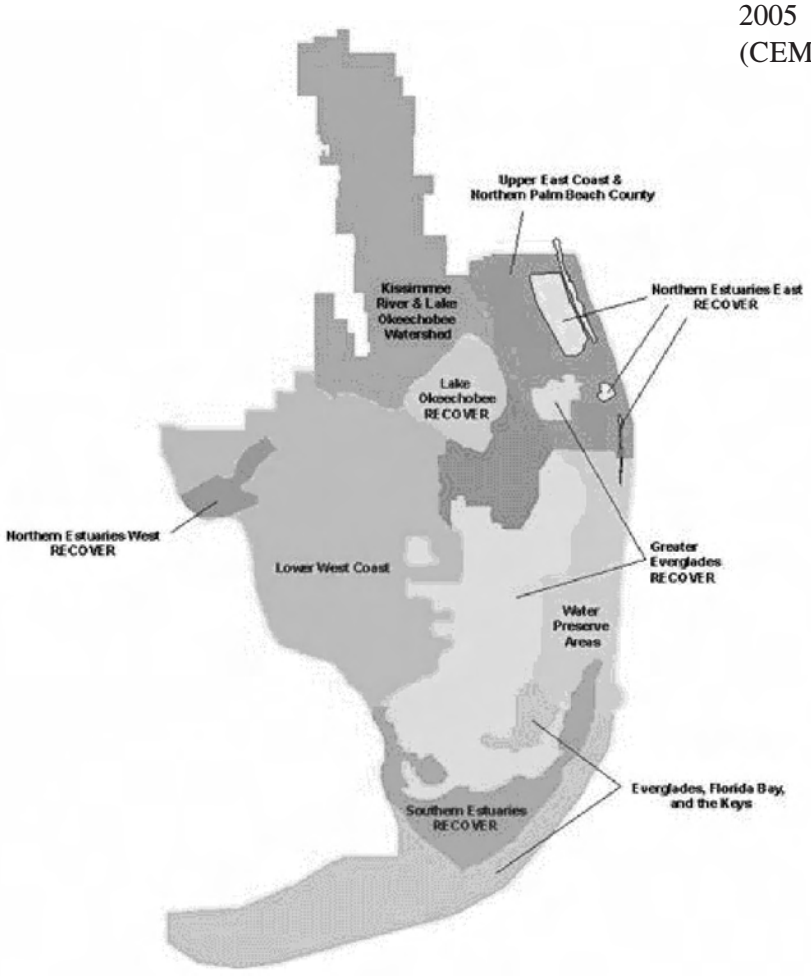


Figure 1. Map of south Florida illustrating the boundary of the South Florida Water Management District, and the regional assessment modules.

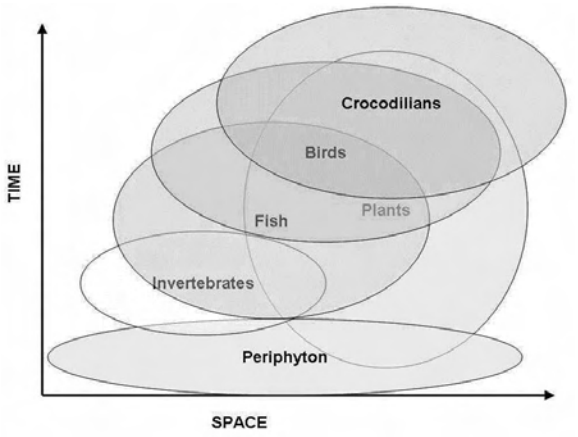


Figure 2. Figure 2 is a representation of how indicators may interrelate and collectively integrate with the temporal and spatial aspects of the ecosystem and the drivers that affect these indicators. The suite of indicators integrates innumerable biogeochemical and environmental processes in the lives of indicator species through both space (regions of the Everglades) and time. This figure shows the overlapping and integrated nature of the individual indicators and how they help integrate ecological information across the regional and temporal aspects of the Everglades. This figure shows only six of the indicators presented in this special issue and is not meant to capture the literal aspects of spatial and temporal interactions with any precision.

In addition, these indicators will help evaluate the ecological changes resulting from the implementation of the restoration projects and provide information and context by which to adapt and improve, add, replace or remove indicators as new scientific information and findings become available. Indicator responses will also help determine appropriate system operations necessary to attain structural and functional goals for multiple habitat types among varying components of the Everglades system.

Using a suite of system-wide indicators (Table 1) to present highly aggregated ecological information requires indicators that cover the spatial and temporal scales and features of the ecosystem they are intended to represent and characterize (Table 2). While individual indicators can help decision makers adaptively manage at the local scale or for particular restoration projects, collectively, indicators can help decision makers assess restoration at the system scale.

Table 1. List of System-wide Indicators

• Fish and Macroinvertebrates
• Wading Birds (Wood Stork and White Ibis)
• Wading Birds (Roseate Spoonbill)
• Florida Bay Submerged Aquatic Vegetation
• Florida Bay Algal Blooms
• Crocodilians (Alligators and Crocodiles)
• Oysters
• Periphyton-Epiphyton (communities of microscopic algae and bacteria)
• Juvenile Pink Shrimp
• Lake Okeechobee Littoral Zone
• Invasive Exotic Plants

Table 2. List of South Florida Ecosystem Features
Landscape Characteristics
Hydropatterns
Hydroperiods
Vegetation Pattern and Patchiness
Productivity
Native Biodiversity
Oligotrophy (low in nutrients)
Pristine-ness
Intactness (connectivity/spatial extent)
Trophic Balance
Habitat Balance/Heterogeneity
Trophic Constituents and Biodiversity
Primary producers (autotrophs - organisms that obtain energy from light or inorganic compounds; and detritus - dead organic material)
Primary consumers (herbivores and detritivores - animals that eat plants or detritus)
Secondary consumers (animals that feed upon herbivores and detritivores)
Tertiary consumers (animals that feed upon secondary consumers)
Physical Properties
Water quality
Water management (i.e., when, where, and how much water is moved)
Invasive exotic species
Salinity
Nutrients (e.g., Nitrogen, Phosphorus, Sulphur)
Contaminants (e.g., pesticides, pharmaceutical chemicals)
Soils
Ecological Regions (see Figure 1)
Greater Everglades
Southern Estuaries
Northern Estuaries
Big Cypress
Kissimmee River Basin
Lake Okeechobee
Florida Keys
Temporal Scales (see Figure 2)
Indicators that respond rapidly to environmental changes (e.g., periphyton)
Indicators that respond more slowly to environmental changes (e.g., crocodilians)

Stoplight-Key Findings Report Cards

We chose stoplights to depict indicator status. There are many different methods that are being used to communicate scientific information in easier-to-understand formats. We evaluated numerous methods and ideas on organizing and communicating complex science and found many helpful ideas. We also noted that most methods were, in the end, still quite complex, and it took more information and explanation to understand the method than we felt made sense if the goal was to make things easier to understand. Therefore, we chose to use one of the most clear-cut and universally understood symbols—the stoplight—with a simple and straightforward "findings" page to provide a reasonable context for the stoplights.

Our integrated summary is presented in a 2-page format using colored traffic light symbols that have a message that is instantly recognizable, easy to comprehend, and is universally understood. We used this stoplight restoration report card communication system as a common format for all eleven indicators noted in this assessment to provide a uniform and harmonious method of rolling-up the science into an uncomplicated synthesis. This report card effectively evaluates and presents indicator data to managers, policy makers, and the public in a format that is easily understood, provides information-rich visual elements, and is uniform to help standardize assessments among the indicators in order to provide more of an apples-to-apples comparison that managers and policy-makers seem to prefer (Schiller et al. 2001, Dennison et al. 2007).

Research and monitoring data are used to develop a set of metrics for each indicator that can be used as performance measures (for example, the number of alligators per square kilometer) for the indicator, and to develop targets (for example, 2.7 alligators per square kilometer) that can be used to link indicator performance to restoration goals. These metrics and targets are different for each indicator.

The stoplight colors are determined for each indicator using 3 steps. First, the ecological status of the indicator is determined by analysis of quantifiable data collected for each performance measure for each indicator (for example, the data might show that on average there are 0.75 alligators per square kilometer). The status of each performance measure is then compared to the restoration targets for the indicators (for example, our target for restoration might be 2.7 alligators per square kilometer). The level of performance is then compared to the thresholds for success or failure in meeting the targets and a stoplight color is assigned (for example, 0.75 alligators per square kilometer indicates a low number of alligators compared to the target of 2.7 per square kilometer and might result in a red stoplight being assigned for this performance measure). These numbers are used for example purposes only.

This 2008 Assessment of the suite of system-wide indicators includes: 1) a 2-page stoplight/key summary report for each indicator summarizing the status of the indicators, 2) a more detailed set of science assessment reports (on the attached CD) on the status of each indicator and 3) an executive summary or synthesis that evaluates the collective information for the suite of indicators. For more detailed information on these indicators please also refer to the Special Issue of Ecological Indicators; Indicators for Everglades Restoration, 2008, and the Indicators for Restoration Report (2006) available online at www.sfrestore.org.

The assessment reports on the attached CD provide the detailed science behind the summary findings in the 2-page stoplight reports. All of the stoplights were developed directly from the scientific data and the colors of the stoplights—red, yellow or green—were determined using clear criteria from the results of the data. The performance

measures and targets for each indicator are also described in great detail in the assessments. Because the 2-page report is purposely short and succinct, it was not possible to provide information on the approaches used for each indicator in determining thresholds for the individual colors. However, the assessments clearly show how the scientific findings relate directly to the color of the stoplights, providing a transparency from empirical field data to summary data and graphics and then to the stoplight color.

Stoplight-Color Legend

R

Red – Substantial deviations from restoration targets, creating severe negative condition that merits action.

Y

Yellow – Current situation does not meet restoration targets and merits attention.

G

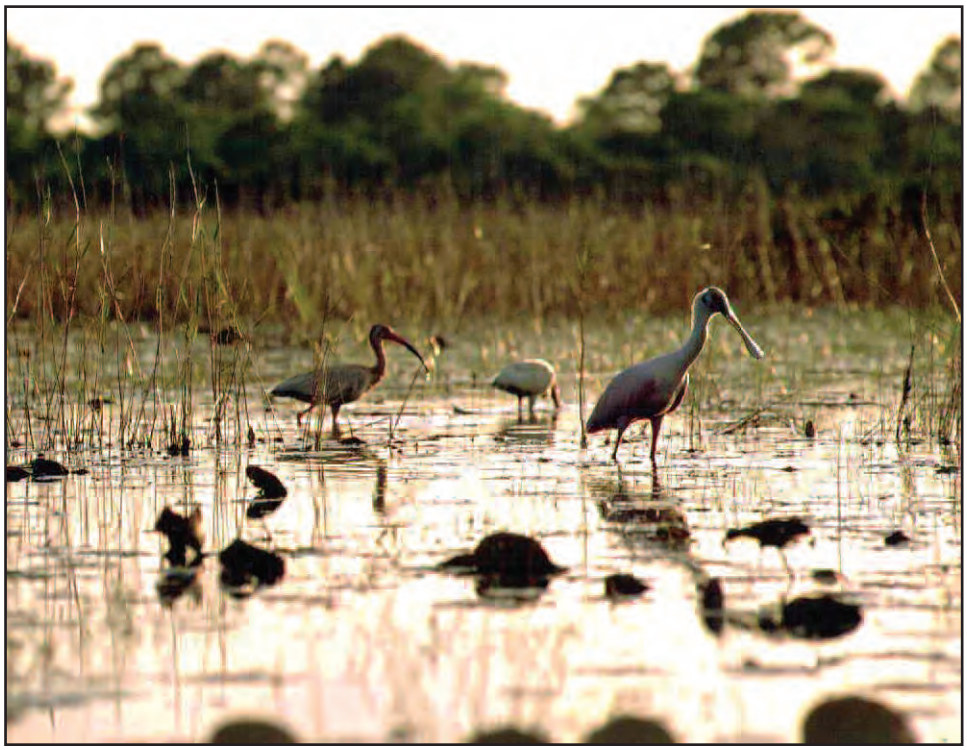
Green - Situation is good and restoration goals or trends have been reached. Continuation of management and monitoring effort is essential to maintain and be able to assess "green" status.

Why These Organisms are Important as Ecological Indicators for System-wide Assessment of Restoration

FISH AND MACROINVERTEBRATES

- They are critical as a food for predators such as wading birds and alligators.
- Their density and community composition are correlated with hydrology.
- They integrate the effects of hydrology in all their life stages.
- The positive or negative trends of this indicator relative to hydrological changes permit an assessment of positive or negative trends in restoration.

WHITE IBIS AND WOOD STORKS

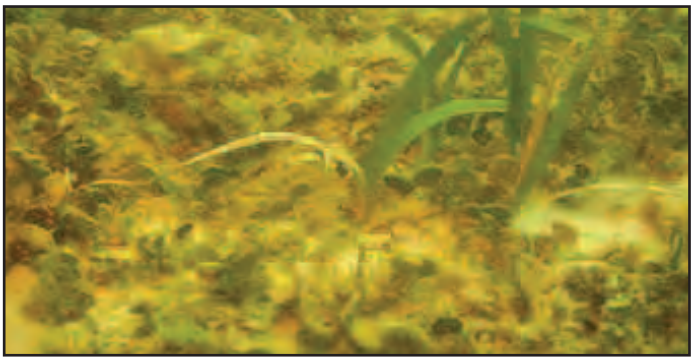


- Large numbers of wading birds were a defining characteristic of the Everglades.
- Their different foraging strategies indicate that large spatial extent and seasonal hydrology made it possible for the historic Everglades to support vast numbers of wading birds.
- Timing of nesting is directly correlated with water levels.
- Nesting success is directly correlated with water levels and prey density.
- Restoration goals for ibis and storks include recovering spatial and temporal variability to support large numbers of wading birds.

ROSEATE SPOONBILLS

- Spoonbill responses are directly correlated to hydrology and prey availability.
- Spoonbills time their nesting to water levels that result in concentrated prey.
- Availability of Spoonbill prey is directly correlated with hydrology.
- Positive or negative trends of this indicator relative to hydrological changes permit an assessment of positive or negative trends in restoration.

FLORIDA BAY SUBMERGED AQUATIC VEGETATION (SAV)



- Florida Bay has one of the largest seagrass beds in the world, covering 90% of the 180,000 hectares of the bay.
- Submerged aquatic vegetation (SAV) serves many critical functions within estuarine and coastal ecosystems, such as habitat, food, and water quality.
- The SAV community is correlated to upstream hydrology and water quality.
- Florida Bay SAV condition is an important indicator for ecosystem restoration because the bay is located at the bottom of the hydrological system.

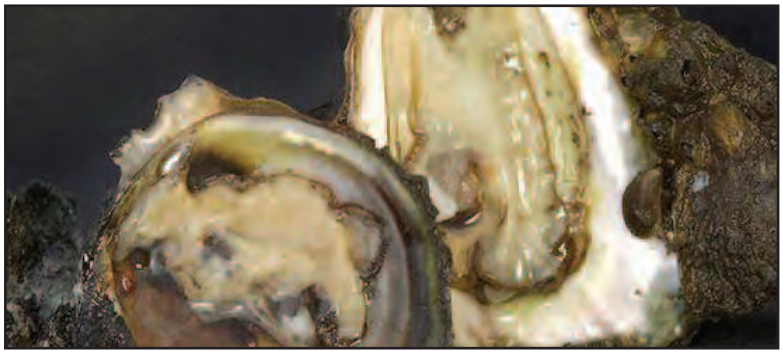
FLORIDA BAY ALGAL BLOOMS

- The algal bloom indicator reflects the overall water quality of the Bay.
- Improved freshwater flows and healthy SAV are expected to significantly reduce the number, scale, and time-span of algal blooms and provide an important indicator of the overall health of the Bay.

CROCODILIANS

- Crocodilians are top predators in the food web affecting prey populations.
- Alligators are a keystone species and ecosystem engineers.
- Survival rates of crocodilians are directly correlated with hydrology.
- Crocodilians integrate the effects of hydrology in all their life stages.

OYSTERS



- Oysters provide essential habitat for many other estuarine species.
- Oysters improve water quality by filtering particles from the water.
- Water quality, particularly salinity, is directly correlated to the physical health, density, and distribution of oysters in the estuaries.
- Hydrological restoration in the estuaries should improve the overall distribution and health of oyster reefs.

PERIPHYTON-EPIPHYTON

- Periphyton is a major, system-wide feature of Everglades marshes.
- Periphyton accounts for over half of the primary production in the Everglades.
- It is the primary food source for small fish, crayfish, grass shrimp, etc.
- Periphyton production is directly linked to hydrology and water quality.
- It plays a critical role in determining the underlying causes for changes in other plant and animal communities linked in the food web.
- Periphyton influences many other features of the Everglades ecosystem such as soil quality, concentration of nutrients, and dissolved gasses.
- Periphyton responds very quickly (days) and predictably to changes in environmental conditions and serves as an “early-warning-indicator”.

JUVENILE PINK SHRIMP

- Pink shrimp are an important and characteristic component of the estuarine fauna of the Everglades.
- Pink shrimp abundance is correlated to freshwater flow from the Everglades.
- Growth and survival of juvenile pink shrimp are influenced by salinity and are good indicators of hydrological restoration for the estuaries.
- Pink Shrimp were found to be more closely correlated with salinity and seagrass (SAV) conditions than 29 other estuarine species evaluated.

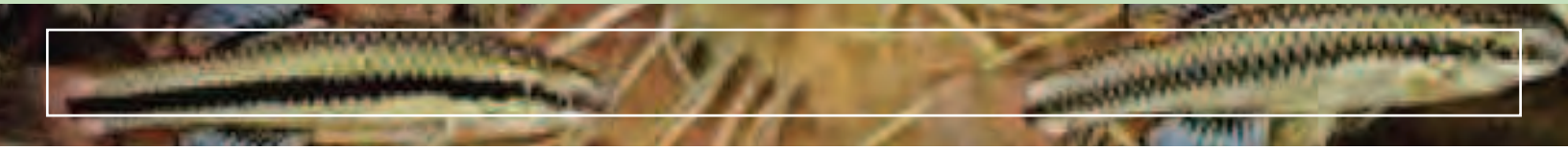
LAKE OKEECHOBEE LITTORAL ZONE

- The Lake's SAV community provides habitat for fish and wildlife, stability for sediments, and improves water quality.
- A healthy SAV community directly corresponds to healthy lake conditions.
- The SAV community is directly influenced by hydroperiod, nutrients, and water quality.

EXOTIC PLANTS

- Exotic plants are an indicator of the status of the spread of invasive exotic plants and an indicator of progress in their control and management.
- Exotic plant distribution is used as an assessment of the integrity of the natural system and native vegetation.
- Exotic plants can cause ecological changes; therefore, prevention, control, and management are key to restoration of the ecosystem.
- Monitoring exotic plants allows us to monitor the success of their control and management for restoration.

KEY FINDINGS



SUMMARY FINDING:

Shark River Slough and Taylor Slough monitoring sites did not meet restoration targets (red) because of drier conditions than expected based on rainfall. These conditions resulted in more Everglades crayfish (*Procambarus alleni*, which prefers drier conditions), and fewer fish than expected. Water management is causing drier conditions in these areas than would be expected based on the amount of rainfall and water depth patterns in our baseline hydrological period (baseline) of 1993 through 1999. Results were mixed in Water Conversation Areas (WCA) 3A and 3B, where there was a greater deal of variation between long- and short-hydroperiod regions than would be expected from observed rainfall. Water management has caused a re-distribution of fish in these areas, though it is not currently possible to determine if the net effect is more or fewer fish. This long-term monitoring program indicates that the current hydrological impacts have existed at least since 2002. Monitoring data indicate that non-native taxa are most common at edge habitats, though widespread in Everglades marshes. There was no evidence of changes in the relative abundance of non-native taxa at our monitoring sites between 2000 and present.

KEY FINDINGS:

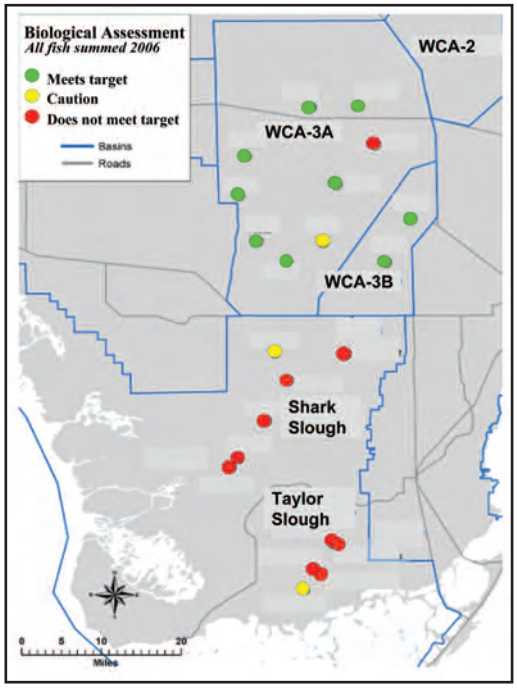
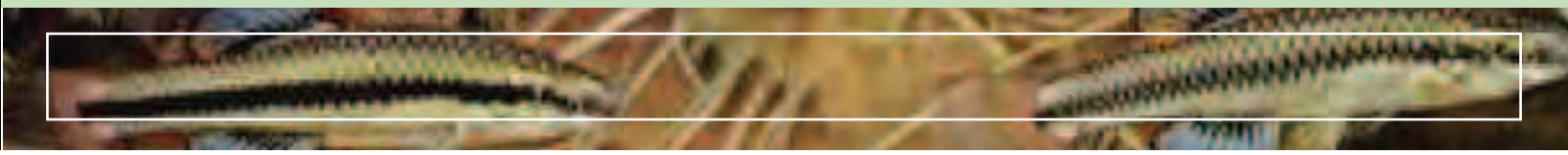


Figure 1. The target hydrological years for this assessment include 1993-1999. Forecasting models (statistical models derived by cross-validation methodology) that link regional rainfall to surface water-depth at our monitoring sites were used to model hydrology. Alternative hydrological model outputs, such as those derived by the Natural System Model, generally yield longer hydroperiods than used here leading to more impacts.

1. All of the sites coded red for fish density resulted from fewer fish than expected based on observed rainfall, and most fish are in Everglades National Park.
2. Of the 3 long-term monitoring sites coded yellow, 1 was for greater fish density than expected and two for less. The lone site with more fish was in WCA 3A.
3. Everglades crayfish and one species of fish, which both prefer short-hydroperiod conditions, were more abundant in Taylor Slough than expected, as well as in some parts of Shark River Slough.
4. Results were mixed in WCA 3A. There was evidence of more frequent drying than expected from observed rainfall in the western area. There were more fish than expected in the southeastern corner of WCA 3A. Data suggest this is due to fishes moving into this section of 3A when western portions of the area dried. Everglades crayfish were infrequently collected in WCA 3A in the hydrological baseline period and afterwards.
5. There were no systematic deviations from rainfall-based expectations in WCA 3B for all fish summed. Flagfish and eastern mosquitofish indicated a potential impact from drier conditions than baseline. Everglades crayfish were infrequently collected in WCA 3A in the baseline period and afterwards.
6. Non-native fish are generally 2% or fewer of the fishes collected at all monitoring sites. However, higher numbers, particularly of Mayan cichlids, have been noted at the mangrove edge of Shark River Slough and Taylor Slough, in the Rocky Glades, and in canals in general. Plans to increase ecosystem connectivity may increase dispersion of such taxa and should be monitored.

STOPLIGHTS



PERFORMANCE MEASURE	`00	`01	`02	`03	`04	`05	CURRENT STATUS	CURRENT STATUS	2-YEAR PROSPECTS
SHARK RIVER SLOUGH									
eastern mosquitofish	G	G	Y	R	R	Y	Y	Fewer than expected because of regional drying.	No expectations for change.
flagfish	G	G	G	Y	G	G	G	Two of 18 plots with more than expected.	No expectations for change.
bluefin killifish	G	Y	Y	R	Y	Y	Y	Fewer than expected because of local and regional drying.	No expectations for change.
total fish	G	G	R	R	R	R	R	Fewer than expected because of local and regional drying.	No expectations for change.
Everglades crayfish	G	Y	G	Y	R	Y	Y	More than expected because hydroperiod was shorter than expected.	No expectations for change.
Non-native fishes	Y	Y	Y	Y	Y	Y	Y	Present at all monitoring sites. None more than 2% of all fish collected; numbers highest at mangrove boundary.	New projects may permit greater access to northern Shark River Slough.
TAYLOR SLOUGH									
eastern mosquitofish	G	G	G	Y	Y	Y	Y	Fewer than expected because of local and regional drying.	No expectations for change.
flagfish								No assessment; model did not converge.	No expectations for change.
bluefin killifish	G	Y	R	R	R	R	R	Fewer than expected because of local and regional drying.	No expectations for change.
total fish	G	G	Y	Y	R	R	R	Fewer than expected because of local and regional drying.	No expectations for change.
Everglades crayfish	G	G	G	Y	R	Y	Y	More than expected because hydroperiod was shorter than expected.	No expectations for change.
Non-native fishes	Y	Y	Y	Y	Y	Y	Y	Present at all monitoring sites. None more than 2% of all fish collected; numbers highest at mangrove boundary.	No expectations for change.
WATER CONSERVATION AREA 3A									
eastern mosquitofish	G	G	Y	Y	Y	G	G	7 of 27 plots with more than expected because of regional drying.	No expectations for change.
flagfish	G	G	G	G	G	Y	Y	More than expected at sites affected by regional drying.	No expectations for change.
bluefin killifish	G	G	Y	Y	Y	Y	Y	Fewer than expected because of local and regional drying.	No expectations for change.
total fish	G	G	G	G	G	G	G	Meets target.	No expectations for change.
Non-native fishes	Y	Y	Y	Y	Y	Y	Y	Present at all monitoring sites. All less than 2% of total and fewer than in Everglades National Park.	No expectations for change.
WATER CONSERVATION AREA 3B									
eastern mosquitofish	G	G	R	R	R	R	Y	More than expected because of regional drying.	No expectations for change.
flagfish	G	Y	Y	Y	Y	Y	Y	More than expected because of regional drying.	No expectations for change.
bluefin killifish	G	R	R	Y	G	G	G	No deviations from expectations.	No expectations for change.
total fish	G	G	G	G	G	G	G	No deviations from expectations.	No expectations for change.
Non-native fishes	Y	Y	Y	Y	Y	Y	Y	Present at all monitoring sites. All less than 2% of total and fewer than in Everglades National Park.	No expectations for change.

Blank – No data are available.

The 2-Year Prospect forecast assumes that no large-scale hydrological restoration projects are implemented during this time period, which would result in significant ecological response of this indicator. The occurrence of significant climatological events during this period may affect the forecast.

KEY FINDINGS

SUMMARY FINDING:

Conditions for nesting were suboptimal for wading birds in 2007, with poor conditions for production of prey preceding the nesting season, and dry to very dry conditions prevailing during much of the nesting season. Annual conditions are notoriously variable, however, and a longer term view of trends is important when evaluating wading bird responses. Three of the four indicators are well below thresholds for restoration – timing of stork nesting, proportion of all nesting taking place in the coastal regions, and ratio of ibis/stork nests to Great Egret nests. However, each of these indicators has shown some degree of improvement over the past ten years. The interval between exceptionally large ibis nesting events has improved markedly, and is now well in the range of restored conditions, though none of the large nestings has occurred in the ecotone region. Taken together, these indicators suggest only slight progress towards desired restoration goals, though the trend appears to be positive.

KEY FINDINGS:

1. Dry to very dry nesting conditions were exhibited in 2007, preceded by low water levels. This created poor conditions for the production and availablity of prey animals throughout the system. Numbers of breeding wading birds were considerably reduced in 2007 by comparison with recent averages, and nest success was poor to very poor in nearly all locations. However, recent research has linked food availability, body condition of adults, and nest initiation and success, which is a crucial step in understanding and managing populations of these birds.
2. Wood Storks did not nest at many locations and initiated nesting late (February) by historical standards where they did nest. Over the past decade, there is some indication of earlier breeding (January and December), providing weak evidence of an improving trend. Thresholds for recovery correspond to nest initiation dates earlier than December 30.
3. The proportion of nesting birds occurring in the headwaters/ecotone was only 7%, far below restoration goals. This suggests that conditions in the coastal zone have not improved appreciably for nesting wading birds. Larger freshwater flows are likely to create conditions more conducive to nesting in the estuarine zone. Over the past ten years, there is evidence of an increasing trend in the proportion of birds nesting in the headwaters. Restored conditions are expected to generate greater than 70 percent of nesting in the ecotone.
4. The ratio of ibis+stork nests to Great Egret nests (4:1) is still far below the 30:1 characteristic of predrainage conditions. Over the ten-year period, there has been considerable improvement in this ratio, suggesting that the system may be becoming more attractive to shallow water tactile foragers such as white ibis and wood stork, and less so to deep water sight foragers such as great egrets.
5. The frequency of exceptionally large ibis nesting events has improved dramatically since the late 1990s, and the mean interval between these events has changed from over 40 years to less than three. Recent research strongly supports the hypothesis that the change is due to increased production and availability of prey to ibises. All of the large nestings, however, have been in freshwater areas, and not in the estuarine headwaters. Restored conditions are expected to generate a mean interval of 2.8 years or less between large ibis nestings – that condition has been met.

Wading Birds (Wood Stork and White Ibis)

STOPLIGHTS

PERFORMANCE MEASURE	CURRENT STATUS[a]	2-YEAR PROSPECTS[b]	CURRENT STATUS[a]	2-YEAR PROSPECTS[b]
Wading bird Indicator Summary	R	Y	Three out of the four Wading Bird Indicators are Red based on the most current data available. Overall, wading bird populations and indicators are well below recovery goals.	All four indicators have positive trends, suggesting they will move closer to recovery goals in the near future.
Ratio of Wood Stork + White Ibis nests to Great Egret nests	R	Y	Current ratio is well below 30:1 considered representative of healthy nesting conditions.	This ratio appears to have stabilized and improved in some years over the past two decades.
Month of Wood Stork nest initiation	R	Y	2007 initiation was in February, and mean initiation dates in past five years are well below the recovery goal of November or December.	December and January nestings have been recorded recently, suggesting improvement. Stork nests continue to fail routinely because of late initiation.
Proportion of nesting in headwaters	R	Y	Proportion nesting in the headwaters was 7% in 2007, and average proportions in last five years remain well below yellow or green thresholds.	Trends in the past two decades suggest mild improvement in nesting in the headwaters.
Mean interval between exceptional ibis nesting years	G	G	This interval is now very close to the target for restoration, and has shown dramatic improvement in last decade.	The trend is positive and fairly consistent in recent years.

[a]Data in the Current Status column for the wading bird indicator reflect data inclusive of calendar year 2007. [b]The 2-Year Prospect forecast assumes that no large-scale hydrological restoration projects are implemented during this time period, which would result in significant ecological response of this indicator. The occurrence of significant climatological events during this period may affect the forecast.

KEY FINDINGS

SUMMARY FINDING:

Roseate spoonbill nesting results in Florida Bay indicate that conditions in Florida Bay and Taylor Slough are still unable to support colonies with target numbers of spoonbills bay-wide. The colonies in the northwestern portion of the bay seem to be doing well and have been stable both in numbers and nest success for the last 10 years. However, the total numbers in the NW part of the bay are relatively low, and numbers bay-wide are still not meeting targets. Northeastern bay colonies are in serious decline. Although the bay-wide spoonbill population remained stable in 2007, there was no sign of recovery toward targets. It appears that restoration actions to date have had no ecologically significant effects for the southern estuaries, and particularly the NE region of Florida Bay. We expect the spoonbill performance measures may begin to improve after proposed changes to the South Dade Conveyance System (SDCS) (i.e., Modified Water Deliveries Project (MOD Waters) and C-111 Spreader Canal Phase 1) are completed. However, unless we experience some very wet years in the meantime, we can expect no improvement in these performance measures until these management changes occur.

KEY FINDINGS:

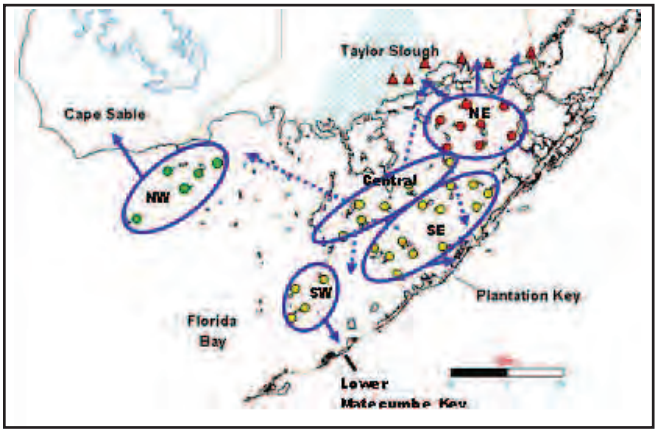


Figure 1. Location of all known spoonbill nesting colonies within Florida Bay (blue ovals) and prey fish sampling sites in the Taylor Slough and C-111 Basin foraging grounds (red triangles). Colonies are grouped into five regions of the bay based on important foraging grounds for the colonies. Arrows from each region indicate the primary foraging ground. Colors of colonies and prey sampling sites are based on stoplight scores for various performance measures.

1. Northeastern Florida Bay is in need of immediate action in order keep spoonbill numbers from continuing to decline. The threshold of at least 1 chick per nest was not met in 2007 and was therefore considered a failed year. The NW Florida Bay colonies produced 1.66 chicks per nest, well above the target, suggesting that the NE colonies may have failed due to the influence of water management in Taylor Slough. The number of nests in the NE bay remained very low in 2007, with only 106 nests out of a target of 688 nests in this region.
2. Taylor Slough and the C-111 basin remain less productive than under historic conditions based on prey fish data.
   There were 452 nests bay-wide in 2007. This was well below the target of 1258 nests. However, the bay-wide numbers are stable.
3. Number of nests and nest production continue to exceed targets in northwestern Florida Bay. Data suggest this is probably because this area is less affected by water management and provides a more stable habitat condition.
4. The NE Florida Bay colonies forage in estuaries that rely on water from Taylor Slough (see map). Their continued failure to meet restoration targets indicates that water timing, quantity and distribution in Taylor Slough and NE
5. Florida Bay are not meeting criteria necessary for proper estuary function in these locations.

Wading Birds (Roseate Spoonbill)

STOPLIGHTS

PERFORMANCE MEASURE	LAST STATUS[a]	CURRENT STATUS[b]	2-YEAR PROSPECTS	CURRENT STATUS[b]	2-YEAR PROSPECTS[c]
TOTAL NUMBER OF NESTS					
Number of nests in FL Bay (5-yr mean)	Y	Y	R	The target number of nests for the whole bay is 1258. The 5-year mean number of nests was 474 or 38% of target. This indicates that the FL Bay spoonbill population is not recovering.	The 5-year trend of the mean has declined from 41% to 38% and is approaching the 33% threshold which would change the stoplight from yellow to red. Based on the trend, we expect this to happen within 2 years.
NESTING LOCATION					
Number of nests in NE FL Bay (5-yr mean)	R	R	R	The target number of nests is 688. The 5-year mean number of nests was 109 nests or 16% of target, indicating that the NE FL Bay spoonbill population is in jeopardy.	The 5-year trend of the mean has remained stable (between 16 and 17%). This suggests that, under current conditions, numbers will remain at critically low levels.
Number of nests in NW FL Bay (5-yr mean)	G	G	G	The target for the number of nests in NW FL Bay is 210. The average number of nests for the last five years was 241 exceeding the target.	The 5-year trend for the number of nests has been above 210 for most of the last 10 years indicating that the NW colonies are doing well. There is no expected reason for this to change in the next 2 years.
Number of Nests in SW FL Bay				No data is being collected in the SW estuaries.	No data is being collected in the SW estuaries.
Nesting Location Overall	R	R	R	The overall score for nesting location is the lowest of the three component scores. In this case the number of nests in NE FL Bay is red therefore the overall score is red.	Until the C-111 canal is managed so as to not disrupt spoonbill foraging grounds, the declining trend will continue. Although there are plans to rectify this situation, it is highly unlikely to occur within 2 years.
NESTING PRODUCTION AND SUCCESS					
Chick Production in NE FL Bay	R	R	R	The 5-year mean of NE production was 0.67 chicks/nest (c/n). For nesting to be considered successful, production needs to be >1 c/n with the overall target of 1.38 c/n based on pre-SDCS conditions.	The trend in the 5-year mean has been below the 1 c/n threshold since 1994 and the trend is negative. Correcting the changes in flow caused by SDCS will need to be implemented before these conditions improve.
Chick Production in NW FL Bay	Y	Y	G	Nest production of >1 c/n in NW FL Bay is being maintained. In 2007, the 5-year mean of NW colonies production was 1.29 chicks per nest indicating that the NW continues to perform well but not at the level of Pre-SDCS NE colonies.	The trend has been above average production in 4 of the last 5 years indicating that the NW colonies continue are being maintained. The 5-year mean of 1.29 c/n is steady and is very close to the target of 1.38 c/n.
Percent successful years in NE FL Bay	R	R	R	In NE FL Bay, only 2 of the last 10 years have been successful at >1 c/n. Current conditions are well below restoration targets.	Freshwater flows into Taylor Slough are not expected to increase for at least the next 2 years. As a result spoonbills will most likely continue to be unsuccessful in NE FL Bay.
Percent successful years in NW FL Bay	Y	G	G	In NW FL Bay, spoonbills have been successful 8 of the last 10 years. The mean for the last 5 years has been 66% successful.	The trend is increasing and there is no expected reason for this to change in the next 2 years.
Overall Nest Production and Success	R	R	R	The overall score for nesting location is the lowest score of the four component metrics. In this case, both the nesting success and nesting production in NE FL Bay are red. Therefore the overall score is red.	Until the C-111 canal is managed so as to not disrupt spoonbill foraging grounds, the declining trend will continue. Although there are plans to rectify this situation, it is highly unlikely to occur within 2 years.
PREY FISH COMMUNITY NE FL BAY					
Prey Community Structure NE FL Bay	R	R	R	Prey fishes classified as freshwater species made up less than 1% of the total catch at the sampled spoonbill foraging sites in NE FL Bay. The target is 40% suggesting that the prey base for nesting spoonbills remains very low.	Freshwater flows into Taylor Slough are not expected to increase for at least the next 2 years. As a result spoonbills will most likely continue to be unsuccessful in NE FL Bay.

Blank – No data are available.

[a]Data in the Last Status column reflect data prior to 2007. [b]Data in the Current Status column reflect data collected in the 2006-2007 nesting cycle.
[c]The 2-Year Prospect forecast assumes that no large-scale hydrological restoration projects are implemented during this time period, which would result in significant ecological response of this indicator. The occurrence of significant climatological events during this period may affect the forecast.

KEY FINDINGS

SUMMARY FINDING:

Most indicators show good (green) Submerged Aquatic Vegetation (SAV) Abundance Indices in 2007 improving against 2006 and the 10-year trend with exceptions in the Central Zone and the Southern Zone. The Target Species index (see stoplight table) in the Transition Zone is poor (red), reflecting the absence of *Ruppia* in 2006-7 while other zones show increased diversity. Combined index scores (Fig. 1) show fair (yellow) status in Transition, Central and Southern Zones, and good (green) in the Northeast and Western Zones.

KEY FINDINGS:

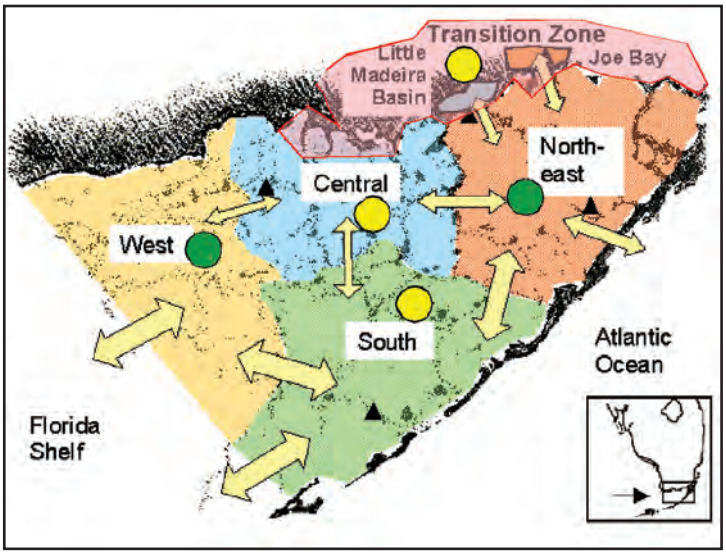


Figure 1. Map of SAV Indicator Zones with current status indicators combining Abundance and Species Indexes.

1. The Abundance Indicator (spatial coverage and average density) is in generally good condition or improving except in the Central and Southern Zones. These zones had previously exhibited loss of SAV through die-off and then became sites of recurring algal blooms. The Northeast Zone metric has declined during a two-year bloom, though slightly above the "good" threshold.
2. The Target Species indices (species diversity and presence of specific target species) are considered more variable and less predictable than the Abundance index. Nonetheless, the Transition Zone has shown clear decline in the *Ruppia* target species over the past two years. Northeast, Southern and Transition Zones have shown some improvement in this indicator due to increased *Halodule* presence.
3. Indicator criteria for both Abundance and Diversity are zone-specific. The Northeastern Zone has generally low SAV density but high coverage and species diversity of *Thalassia*, *Halodule* and *Ruppia*. The Transition Zone has mixed populations of *Thalassia* - *Halodule* and *Ruppia* -macroalgae. The Southern Zone has high occurrence of monospecific *Thalassia* stands while *Thalassia* and *Halodule* co-occur in the Central Zone. The Western Zone is productive with dense, diverse stands of *Thalassia*, *Syringodium*, and *Halodule* in some basins.
4. As freshwater is introduced, *Ruppia* will continue expansion and other species may decline in the Transition Zone, Northeast Bay and the Central Bay in response to lower salinity. Transition bays Long Sound, Joe Bay, Little Madeira Bay, McCormick Creek are expected decline in *Thalassia* as low-salinity species increase, resulting in a more diverse, stable SAV habitat. Reducing hypersalinity and abrupt changes in salinity in Florida Bay, especially in the Transition Zone, Central Bay and Northeast Bay, will assist in preventing development of monospecific stands of *Thalassia*. Conditions that exclude multiple SAV species and reduce species diversity lead to poorer habitat quality and greater potential for seagrass loss. Determination of sources of algal blooms will aid in developing plans to reduce blooms and their impact on SAV.

STOPLIGHTS

ZONE/PERFORMANCE MEASURE	LAST STATUS[a]	CURRENT STATUS[b]	2-YEAR PROSPECTS	CURRENT STATUS[b]	2-YEAR PROSPECTS
NORTHEAST					
Abundance	G	G	Y	Abundance is good in all basins monitored in the NE with a composite scores of 0.81 (max=1) for extent and density of SAV.	Projections are fair in the NE as some reduction in abundance may continue as effects of a persistent algal bloom impact SAV.
Target Species	Y	G	Y	A score of 0.81 (good) is measured for current (2007) species evenness and presence of subdominants *Halodule* and *Ruppia*, up from 0.63 in 2006.	Projection is for increased species complexity and increasing niche creation with additional freshwater inflows, further enhancing diversity are offset near-term by possibility of continued drought.
TRANSITION ZONE					
Abundance	G	G	G	Highest scores for abundance are found in basins in the Transition Zone, increasing from 0.83 to 0.91 in 2006-7.	Continued high abundance is expected with current conditions or increased freshwater flow.
Target Species	R	R	R	Generally good species evenness in 2006 was reduced in 2007 due to dominance by either *Thalassia* or *Halodule* in areas and reduced co-occurrence of the two. Evenness scores are offset by lack of target *Ruppia* in this zone.	Scores are expected to be more variable in this region due to salinity extremes and variable nature of freshwater input. Restoration of freshwater flow and *Ruppia* will not occur within two years.
CENTRAL					
Abundance	Y	R	Y	Abundance in Central basins were marked by low scores throughout, based mostly on low density, trending lower in several basins in this zone in recent years. Spatial coverage was generally very good.	Caution is indicated for this area as it is prone to hypersalinity and algal blooms that can reduce SAV cover. Restoration is designed to improve conditions but two years is likely too short a time to manifest positive impacts.
Target Species	Y	G	G	Increasing presence of secondary target species (*Halodule*) has improved in this region though a slight reduction in species evenness was noted.	Prospects for continuing improvements in diverse species composition are good even under current conditions.
SOUTH					
Abundance	G	Y	Y	The Southern region shows high spatial extent (0.88) but a low score for the SAV density index (avg. 0.34) with slight decline into the yellow criterion in one basin.	Recent phytoplankton blooms may be reflected in lower abundance scores; even with increased flows improvements in SAV abundance not likely.
Target Species	R	Y	Y	In the Southern region basins measured, *Thalassia* dominance is reflected in a poor though improving diversity score (0.25).	Conditions have improved but are not expected to change appreciably in this region in the near term.
WEST					
Abundance	G	G	G	Western Zone basins are marked by high abundance scores (1.0) for both extent and density.	Trends have been of continuing improvement over the long-term average and are expected to continue.
Target Species	G	G	Y	Although on average, the zone has very high scores for diversity (0.75), one area has shown losses in diversity and presence of target species in 2006.	Caution reflects some decline of diversity and target species in a component (Johnson Basin) of overall Western Zone score over two years.

[a]2006 data; [b]2007 data; all zones for which calculations are made are based on 10 year datasets. The 2-Year Prospect forecast assumes that no large-scale hydrological restoration projects are implemented during this time period, which would result in significant ecological response of this indicator. The occurrence of significant climatological events during this period may affect the forecast.

KEY FINDINGS

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, if water flows to the southern estuaries are improved, should return to predominantly green for all regions, with the possible exception of Barnes Sound and Manatee Bay. If water flows do not improve, the areas will probably remain yellow.

KEY FINDINGS:

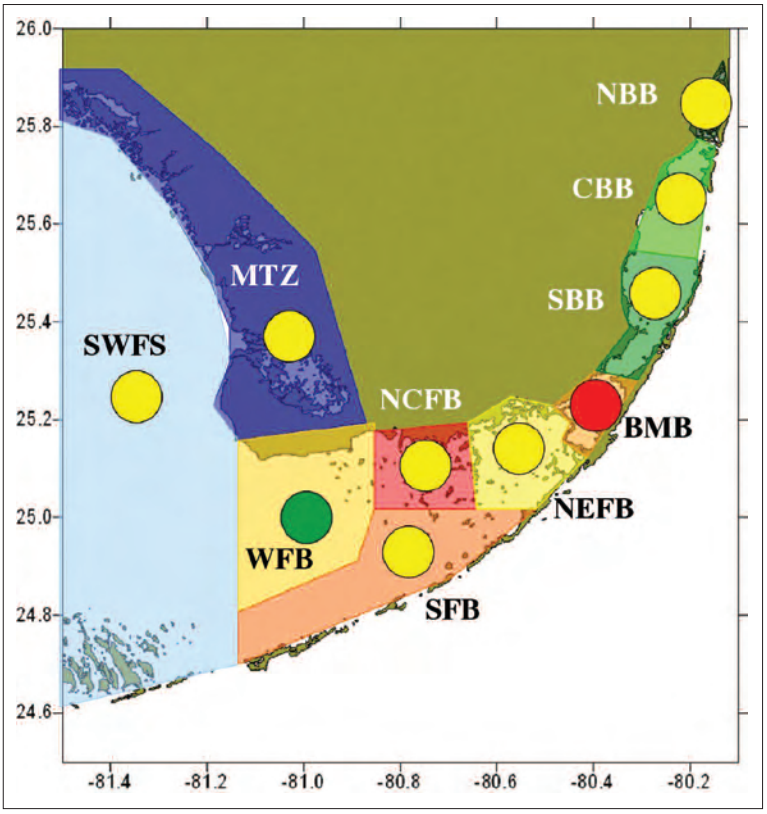
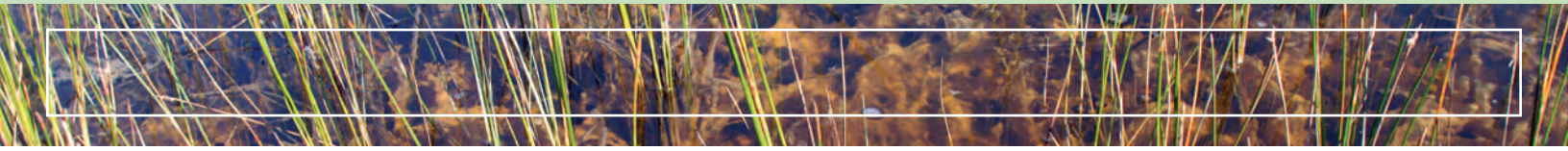


Figure 1. Map of Florida Bay regions with stoplight ratings by region.

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 excess nutrient (eutrophic) symptom expressions were geographically variable and appear to be explainable from existing observations of hurricane activity overall exacerbated by road construction along US 1 in the eastern areas of the bay.
6. If water flows are improved to the southern estuaries water quality is expected to improve and the number and scale of algal blooms to diminish. However, under current water flow conditions there will probably be little or no improvement in the conditions in the southern estuaries.
7. Monitoring of Barnes, Manatee and Blackwater Sounds was critical to being able to detect the impacts of road construction along US 1.
8. Monitoring long-term consequences of nutrient releases into the southern estuaries 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 the southern estuaries, particularly Florida Bay) is critical to continuing the evaluation and assessment restoration for the southern estuaries.

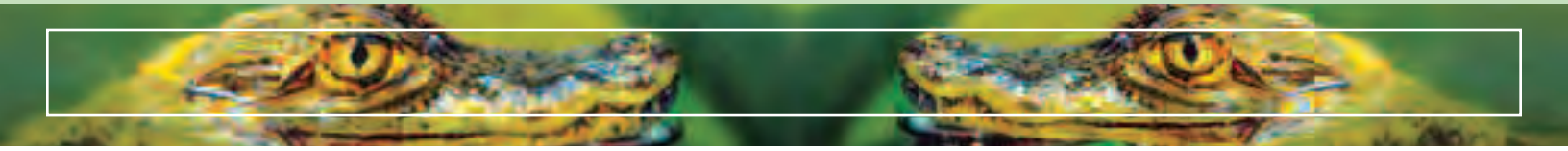
STOPLIGHTS



PERFORMANCE MEASURE	LAST STATUS	CURRENT STATUS[a]	2-YEAR PROSPECTS[b]	CURRENT STATUS[a]	2-YEAR PROSPECTS[b]
Chlorophyll *a* BARNES, MANATEE & BLACKWATER SOUNDS (BMB)	R	R	Y	This region of the bay experienced an unusual cyanobacterial (algae and bacteria with chlorophyll) bloom in 2006. The bloom was initiated by a large spike in phosphorus from a combination of canal releases and highway construction 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.
Chlorophyll *a* NORTHEAST FLORIDA BAY (NEFB)	Y	Y	Y	The current status is due to influence of the cyanobacterial bloom from Barnes, Manatee and Blackwater Sounds periodic expansion into this region.	The return to a green condition for this region of the bay depends on water management activities improving flows into the C-111 basin and Taylor Slough.
Chlorophyll *a* NORTH-CENTRAL FLORIDA BAY (NCFB)	G	Y	Y	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.	Without improvements in freshwater flows to Florida Bay, the area will probably remain yellow.
Chlorophyll *a* SOUTH FLORIDA BAY (SFB)	Y	Y	Y	The current status is due to the extension of the cyanobacterical 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.
Chlorophyll *a* WEST FLORIDA BAY (WFB)	G	G	G	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.
Chlorophyll *a* MANGROVE TRANSITION ZONE (MTZ)	Y	Y	Y	The chlorophyll concentrations were slightly higher in this region for 2006. This may have been due to the active 2005 hurricane season and is unlikely to indicate a negative long-term trend.	The return to a green condition for this region of the bay depends on water management activities improving flows into the C-111 basin and Taylor Slough.
Chlorophyll a SOUTHWEST FLORIDA SHELF (SWFS)	Y	Y	Y	The chlorophyll concentrations were slightly higher in this region for both 2006 and 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.
Chlorophyll *a* NORTH BISCAYNE BAY (NBB)	Y	Y	Y	The chlorophyll concentrations were higher than the baseline for the past four years.	Without any major hurricanes or changes in water flows to this region, it is expected that this region will remain yellow. Significant inputs from canals will continue to affect this area until sheet-flow is restored.
Chlorophyll *a* CENTRAL BISCAYNE BAY (CBB)	Y	Y	Y	The chlorophyll concentrations were higher than the baseline for the past four years.	Without any major hurricanes or changes in water flows to this region, it is expected that this region will remain yellow.
Chlorophyll *a* SOUTH BISCAYNE BAY (SBB)	Y	Y	Y	The chlorophyll concentrations were higher in this region for 2006. 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 or changes in water flows to this region, it is expected that this region will remain yellow.

[a]Data in the Current Status column for the algal bloom indicator reflect data inclusive of calendar year 2006. [b]The 2-Year Prospect forecast assumes that no large-scale hydrological restoration projects are implemented during this time period, which would result in significant ecological response of this indicator. The occurrence of significant climatological events during this period may affect the forecast.

KEY FINDINGS



SUMMARY FINDING:

On the whole, alligator and crocodile status remained constant during 2006, with only one area (Water Conservation Area 3A) showing a decline in status compared to previous years. However, the majority of locations show substantial deviations from restoration targets. The status of alligators and crocodiles is expected to improve if hydrologic conditions are restored to more natural patterns.

KEY FINDINGS:

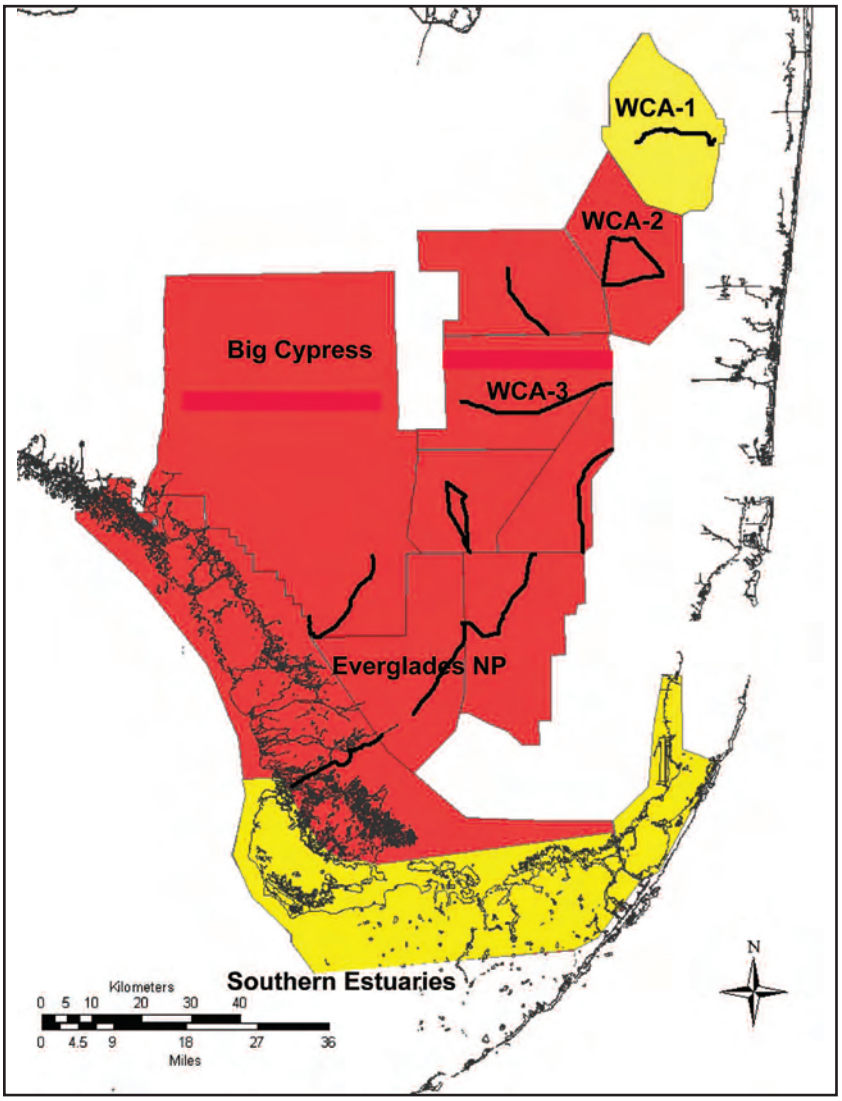
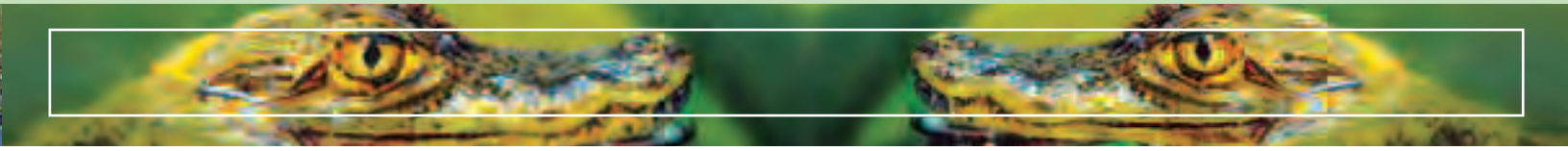


Figure 1. Map of Greater Everglades regions with stoplight ratings by region.

1. Alligator overall status at the A.R.M. Loxahatchee National Wildlife Refuge (WCA-1) is the highest in south Florida and remains stable.
2. Overall status of alligators throughout the Water Conservation Areas is substantially below restoration targets and requires action in order to meet restoration goals.
3. While body condition of alligators is higher in the southern portion of Everglades National Park (ENP) than in other areas, overall status of alligators throughout ENP is below restoration targets and requires action in order to meet restoration goals.
4. Growth and survival components for crocodiles, while below restoration targets, appear stable at this time and are expected to increase given proper hydrologic conditions through restoration.
5. Restoration of patterns of depth and period of inundation and water flow are essential to improving performance of alligators in interior freshwater wetlands.
6. Restoration of patterns of freshwater flow to estuaries will improve conditions for alligators and crocodiles.
7. Continued monitoring of alligators and crocodiles will provide an indication of ecological responses to ecosystem restoration.

STOPLIGHTS

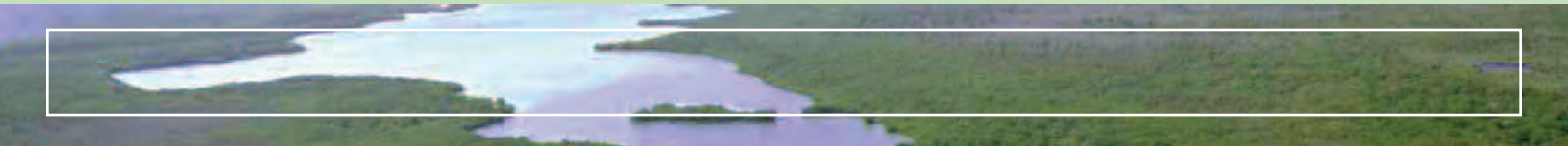


LOCATION	LAST STATUS[a]	CURRENT STATUS[b]	2-YEAR PROSPECTS[c]	CURRENT STATUS[b]	2-YEAR PROSPECTS[c]
AMERICAN ALLIGATOR					
A.R.M. Loxahatchee National Wildlife Refuge	Y	Y	Y	Relative density (component score = 0.83) and body condition (component score = 0.17) combined for a location score of 0.5 and so current conditions do not meet restoration criteria, signifying that this area needs further attention.	A.R.M. Loxahatchee National Wildlife Refuge (WCA-1) and management objectives play an important part in determining success here. If conditions remain constant, prognosis for the future will be stable.
Water Conservation Area 2A	R	R	R	Relative density (component score = 0.17) and body condition (component score = 0.5) combined for a location score of 0.34 and so current conditions are below restoration criteria.	With the stable body condition and low relative density of alligators observed here, status will remain substantially below restoration objectives.
Water Conservation Area 3A	Y	R	R	Relative density in two of the three locations within WCA 3A is low (northern and southern areas) and higher (yellow) in the central area; body condition scores yellow in the north and central areas, and red in the south. The combined score of both components for the overall area is 0.31, which is well below restoration goals.	This is the only area in which status declined between 2005 and 2006. With the central area of WCA 3A having the highest status (yellow), it can be used a guide for raising the northern and southern areas (both currently red).
Water Conservation Area 3B	R	R	R	Relative density (component score = 0.17) and body condition (component score = 0.5) combined for a location score of 0.34 and so current conditions are below restoration criteria.	With the stable body condition and low relative density of alligators observed here, status will remain substantially below restoration objectives.
Everglades National Park	R	R	R	Relative density in all three locations within Everglades National Park is low. Body condition is higher (yellow) in Shark Slough and estuarine areas, but low (red) in northeast Shark Slough. The combined score of these two components for the overall area, and alligator hole occupancy in the inaccessible areas, is 0.35, which is well below restoration goals.	Everglades National Park management objectives will play a direct role in determining success here. If conditions remain as they currently are, restoration goals will not be met.
Big Cypress National Preserve		R	R	Relative density (component score = 0.17) and body condition (component score = 0.5) combined for a location score of 0.34 and so current conditions are below restoration criteria.	Only one year of relative density data has been collected, and body condition has been stable since surveys began in 2004. It is expected that if conditions remain constant, status will remain below restoration objectives.
AMERICAN CROCODILE					
Everglades National Park	Y	Y	Y	Juvenile growth (component score = 0.67) and survival (component score = 0.5) combined for a location score of 0.59 and so current conditions do not meet restoration criteria.	Everglades National Park management objectives will play a direct role in determining success here. If conditions remain constant, prognosis for the future will be stable.
Biscayne Bay Complex	Y	Y	Y	Juvenile growth (component score=0.67) does not meet restoration criteria. There currently is not enough data to calculate a survival component for this area.	Management objectives play an important part in determining success here. If conditions remain constant for growth, prognosis for the future will be stable for this component. Data on survival needs to be collected and figured into the equation.

Blank – No data are available.

[a]Data in the Last Status column reflect data prior to calendar year 2006. [b]Data in the Current Status column reflect data inclusive of calendar year 2006.
[c]The 2-Year Prospect forecast assumes that no large-scale hydrological restoration projects are implemented during this time period, which would result in significant ecological response of this indicator. The occurrence of significant climatological events during this period may affect the forecast.

KEY FINDINGS



SUMMARY FINDING:

On the whole, Eastern oyster status remained constant up to 2007. Given the duration of monitoring of this species, only the Caloosahatchee Estuary had sufficient data to infer trends and status of this indicator. Monitoring in other estuaries (St. Lucie Estuary, Loxahatchee Estuary, and Lake Worth Lagoon) is ongoing, and we expect will yield data to make trend and status assessments for the 2010 report. Current conditions in the Caloosahatchee Estuary show negative deviations from restoration targets, therefore restoration actions are merited. Status of oysters is expected to improve if hydrologic conditions are restored to more natural patterns.

KEY FINDINGS:

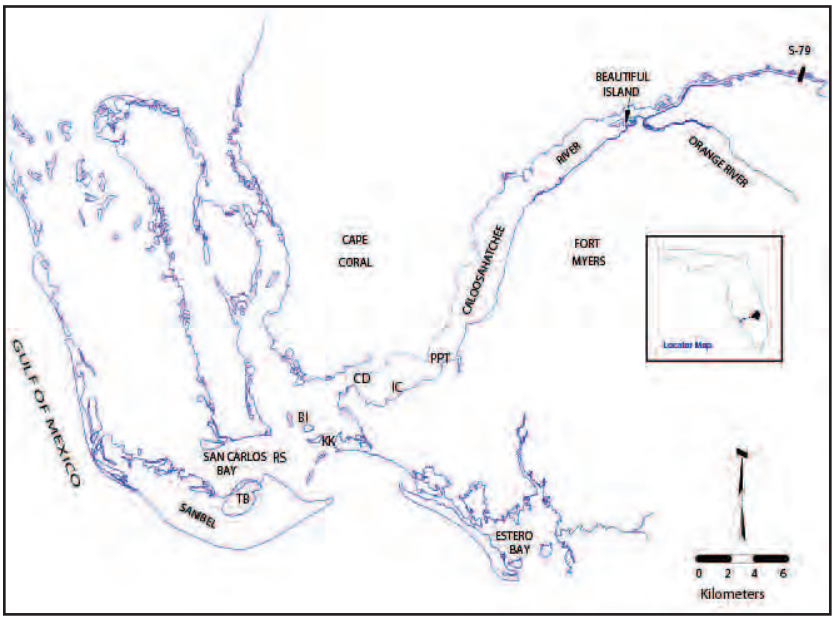


Figure 2. Oyster sampling locations within the Caloosahatchee Estuary. Locations (PPT = Pepper Tree Point, IC = Iona Cove, CD = Cattle Dock, BI = Bird Island and TB = Tarpon Bay) are from upstream to downstream along a salinity gradient.

1. Preliminary results suggest that oyster status in the Caloosahatchee Estuary is the highest in the Northern Estuaries and remains stable. It should be cautioned that insufficient data exist for other estuaries to infer trends and make statistical comparisons.
2. There is too much freshwater inflow into the Caloosahatchee Estuary in the summer months (usually due to flood water releases from Lake Okeechobee) and too little freshwater inflow into the estuary in the winter months (usually a result of water needs for human consumption), disrupting natural patterns and estuarine conditions. The oysters in the Caloosahatchee Estuary are still being impacted by this unnatural water delivery pattern. Too much fresh water impacts reproduction, larval recruitment, survival and growth while too little fresh water impacts the survival of oysters due to higher disease prevalence and intensity of *Perkinsus marinus* and predation.
3. Overall status of oysters in the Caloosahatchee Estuary is below restoration targets and requires action in order to meet restoration goals.
4. Oyster responses and population in the Caloosahatchee Estuary, while below target, appear to be stable at this time and are expected to increase given proper hydrologic conditions through restoration.
5. Restoration of natural patterns (less freshwater flows in the summer and more freshwater flows in the winter) along with substrate enhancement (addition of cultch) is essential to improving performance of oysters in the estuaries.
6. Continued monitoring of oysters in the Caloosahatchee and other estuaries will provide an indication of ecological responses to ecosystem restoration and will enable us to distinguish between responses to restoration and natural variation.

STOPLIGHTS

LOCATION	LAST STATUS[a]	CURRENT STATUS[b]	2-YEAR PROSPECTS[c]	CURRENT STATUS[b]	2-YEAR PROSPECTS[c]
EASTERN OYSTER					
Caloosahatchee Estuary	NA	Y	Y	The oysters in the Caloosahatchee Estuary are still being impacted by too much fresh water in summer and too little fresh water in the winter. Too much fresh water impacts reproduction, larval recruitment, survival and growth, while too little fresh water impacts the survival of oysters due to higher disease prevalence and intensity of *Perkinsus marinus* and predation. Current conditions do not meet restoration criteria, signifying that this area needs further attention.	Management objectives for regulating freshwater inflows play an important part in determining oyster success in the Caloosahatchee Estuary. If conditions remain constant, prognosis for the future will be stable. If the hydrological conditions remain the same, we do not expect to see an improvement in oyster responses in this estuary.
St. Lucie Estuary	NA			Insufficient data	Insufficient data
Loxahatchee Estuary	NA			Insufficient data	Insufficient data
Lake Worth Lagoon	NA			Insufficient data	Insufficient data
Lostman's River (Southern Estuaries)	NA			Insufficient data	Insufficient data

Blank – No data are available.

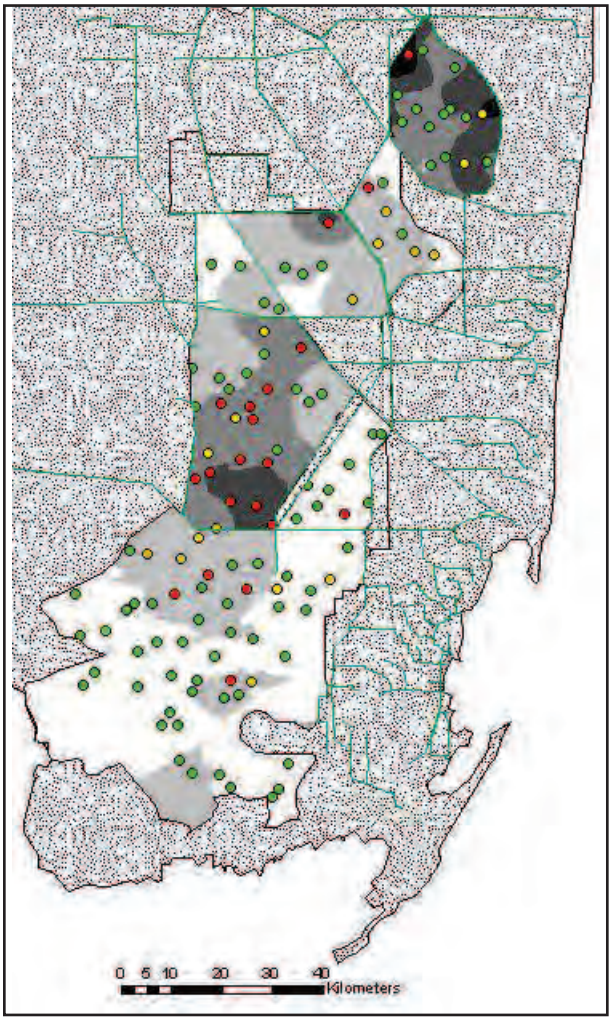
[a]Data in the last status column reflect data collected prior to calendar year 2000. [b]Data in the current status column reflect data collected between calendar years 2000 – 2007. [c]The 2-Year Prospect forecast assumes that no large-scale hydrological restoration projects are implemented during this time period, which would result in significant ecological response of this indicator. The occurrence of significant climatological events during this period may affect the forecast.

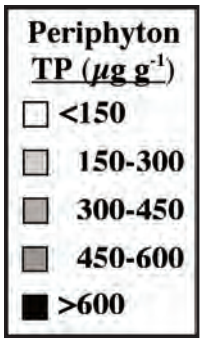
KEY FINDINGS

SUMMARY FINDING:

Many of the sites coded as "altered" (red) are near the peripheral canals surrounding the wetlands, or in drainages downstream of canal inputs (see map). In WCA-1, canals deliver above-ambient concentrations of both nutrients and calcium carbonate, both causing changes in periphyton quality, including increased Total Phosphorus (TP) from nutrient enrichment and reduced organic content from calcium carbonate inputs. In WCA-2A, long-term delivery of above-ambient Phosphorus (P) in canal inputs have caused enrichment cascades throughout most of the system. This is most severe in the northeast portion of this wetland, where monospecific cattail stands predominate, precluding periphyton sampling. The central slough of WCA-3A appears to be enriched, a trend that continues downstream of water control structures in Shark River Slough. Taylor Slough has remained relatively free of enrichment or hydrologic modifications that would influence periphyton composition.

KEY FINDINGS:





1. The percent (26%) of "altered" (red) sites was similar to that estimated for 2005 (25%) and are in areas close to canal sources of P. Areas in central WCA-3A need to be observed to determine if this is an area of unusual concern.
2. A total of 17% of sites were coded yellow for periphyton TP, and are centered near areas downstream of canal inputs of P.
3. A total of 60% of sites were coded yellow or higher for biomass (not shown), primarily reflecting a negative response to increasing P input.
4. Continued input of above-ambient P concentrations will both increase severity of enrichment effects near canals and cause these effects to continue to cascade downstream of inputs.
5. Increased input of water through restorative projects may increase periphyton development in areas formerly dry, but if accompanied by above-ambient P concentrations, cascading P effects are expected.

STOPLIGHTS

PERFORMANCE MEASURE	LAST STATUS	CURRENT STATUS[a]	2-YEAR PROSPECTS[b]	CURRENT STATUS[a]	2-YEAR PROSPECTS[b]
WCA 1A					
Biomass[1]	Y	Y	Y	Periphyton shows evidence of enrichment near canals and calcareous mat biomass has increased due to calcite input from canals.	If canal inputs remain low, status should remain same; increased inputs may cause further enrichment and mat change.
Quality[2]	Y	Y	Y		
Composition[3]	Y				
WCA 2A					
Biomass	Y	Y	Y	Periphyton TP has increased near canal inputs; composition and boimass reflect this long-term input of above ambient P.	If canal P inputs remain above ambient, more sites will be enriched, further changing periphyton biomass and structure.
Quality	R	Y	R		
Composition	Y				
WCA 3A					
Biomass	Y	Y	Y	This area has received some low level P enrichment, reflected in periphyton biomass and quality.	If canal P inputs remain above the protective criterion, status will remain similar or perhaps worsen over time.
Quality	Y	Y	Y		
Composition	Y				
SRS					
Biomass	Y	Y	Y	SRS has received low-level P enrichment for decades, reflected in periphyton biomass and quality.	Increased flow through S-12 structures may encourage periphyton in dry areas, but above ambient P inputs will cause negative change.
Quality	Y	Y	Y		
Composition	G				
TS					
Biomass	G	G	G	TS has remained relatively unimpacted due to low levels of disturbance and low P inputs.	Periphyton should remain the same if conditions continue as they have.
Quality	G	G	G		
Composition	G				

Blank – No data are available.

[a]Data in the Current Status column for the periphyton indicator reflect data inclusive of calendar year 2006. [b]The 2-Year Prospect forecast assumes that no large-scale hydrological restoration projects are implemented during this time period, which would result in significant ecological response of this indicator. The occurrence of significant climatological events during this period may affect the forecast. [1]Biomass metric refers to the ash-free dry biomass of periphyton measured in m2 quadrats. [2]Quality metric refers to the total phosphorus content of periphyton. [3]Composition metric refers to the algal species composition of the periphyton

KEY FINDINGS

SUMMARY FINDING:

Juvenile Pink Shrimp density (number of shrimp per square meter) varies regionally and seasonally. It is consistently greatest in Johnson Key Basin and lowest in eastern Florida Bay and is generally most abundant in the fall. The status of juvenile pink shrimp in the assessment year, 2007, was poor; shrimp density was low compared to the historic record everywhere except Johnson Key Basin in spring of 2007 and South Biscayne Bay in fall of 2007. In Johnson Key Basin, the fall shrimp density of 5.2 shrimp per square meter was the 4th lowest in a 20-year period-of-record. Baselines, or periods-of-record (POR) for historical data sets against which "status" is compared, are only 2 years long for all areas other than Johnson Key Basin and South Biscayne Bay, where the POR is 20 years. These 2-year baseline data sets add considerable uncertainty to the outcomes.

KEY FINDINGS:

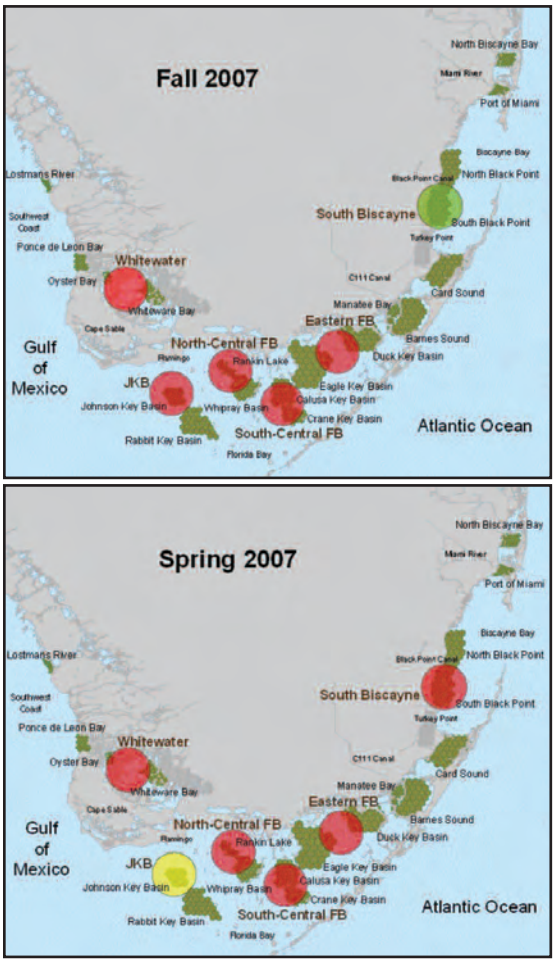


Figure 1. Map of South Florida estuaries with 2007 pink shrimp stoplight scores indicated for each response area, spring and fall.

1. Shrimp are substantially more abundant in the fall than in the spring in Whitewater Bay and most of Florida Bay, but similarly abundant seasonally in Biscayne Bay and eastern Florida Bay.
2. Shrimp density deteriorated over the last 3 years in Whitewater Bay relative to the 2-year POR. Spring density was in the green zone in 2005, the yellow zone in 2006, and the red zone in 2007. Fall density was in the yellow zone in both 2005 and 2006 and in the red zone in 2007.
3. Shrimp density in Johnson Key Basin declined in fall 2007 to low levels compared to the 20-year record and the previous two Monitoring Assessment Plan (MAP) years, 2005 and 2006.
4. The lack of synchrony of year-to-year patterns among response areas in 2005 and 2006 suggests that nearshore conditions are influencing shrimp densities. In contrast, low abundances, relative to previous years, throughout Florida Bay in 2007 may reflect poor spawning success offshore, or may be due to hypersalinity in central Florida Bay in the late summer and fall of 2007, which did not occur in 2005 or 2006.
5. The POR in areas other than Johnson Key Basin and, to a lesser extent, south Biscayne Bay, may be too short at this time to provide a reliable baseline (25th and 75th quartiles) against which to compare current MAP monitoring results.
6. The pink shrimp assessment will be improved with additional baseline data.

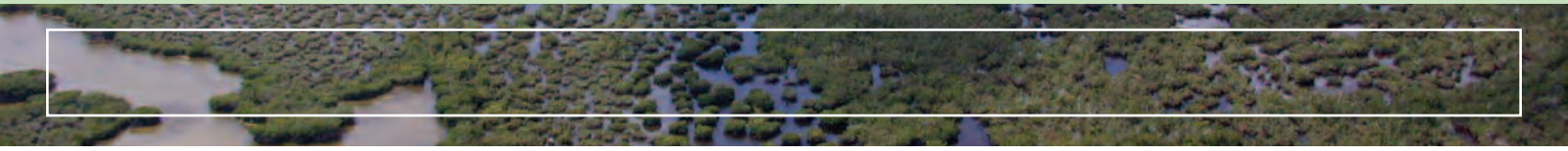
Juvenile Pink Shrimp

STOPLIGHTS

LOCATION	LAST STATUS	CURRENT STATUS	2-YEAR PROSPECTS	CURRENT STATUS	2-YEAR PROSPECTS
SPRING					
South Biscayne Bay	G	R	Y	Pink shrimp density was low compared to the historic record of 6 years (HM=0.45/m^2)[1].	Pink shrimp density is expected to be within neutral range of historic record.
Eastern Florida Bay	Y	R	Y	Density was low compared to short historic record (HM=0.05/m^2).	Pink shrimp density is expected to be within neutral range of historic record.
North-Central Florida Bay	G	R	Y	Density was low compared to short historic record (HM=0.32/m^2).	Pink shrimp density is expected to be within neutral range of historic record.
South-Central Florida Bay	R	R	Y	Density was low compared to short historic record (HM=0.77/m^2).	Pink shrimp density is expected to be within neutral range of historic record.
Johnson Key Basin	Y	Y	Y	Density was neutral compared to historic record of 20 years (HM=2.55/m^2).	Pink shrimp density is expected to be within neutral range of historic record.
Whitewater Bay	Y	R	Y	Density was low compared to short historic record (HM=0.56/m^2).	Pink shrimp density is expected to be within neutral range of historic record.
FALL					
South Biscayne Bay	G	G	G	Density was high compared to historic record (HM=0.72/m^2) but low compared to the nearly 3.0/m^2 of 2005.	Pink shrimp density is expected to be within high range of 6-year historic record.
Eastern Florida Bay	R	R	Y	Density was low compared to short historic record (HM=0.13/m^2).	Pink shrimp density is expected to be within neutral range of historic record.
North-Central Florida Bay	R	R	Y	Density was low compared to short historic record (HM=1.50/m^2).	Pink shrimp density is expected to be within neutral range of historic record.
South-Central Florida Bay	R	R	R	Density was significantly lower than historic mean (HM=3.46/m^2).	Pink shrimp density is expected to be low again if there are no environmental changes.
Johnson Key Basin	G	R	Y	Density was significantly lower than 20-year historic mean (HM=12.98/m^2).	Pink shrimp density is expected to be within neutral range of historic record.
Whitewater Bay	Y	R	Y	Density was significantly lower than short historic record (HM=4.62/m^2).	Pink shrimp density is expected to be within neutral range of historic record.

[1]HM=historic mean density. The 2-Year Prospect forecast assumes that no large-scale hydrological restoration projects are implemented during this time period, which would result in significant ecological response of this indicator. The occurrence of significant climatological events during this period may affect the forecast.

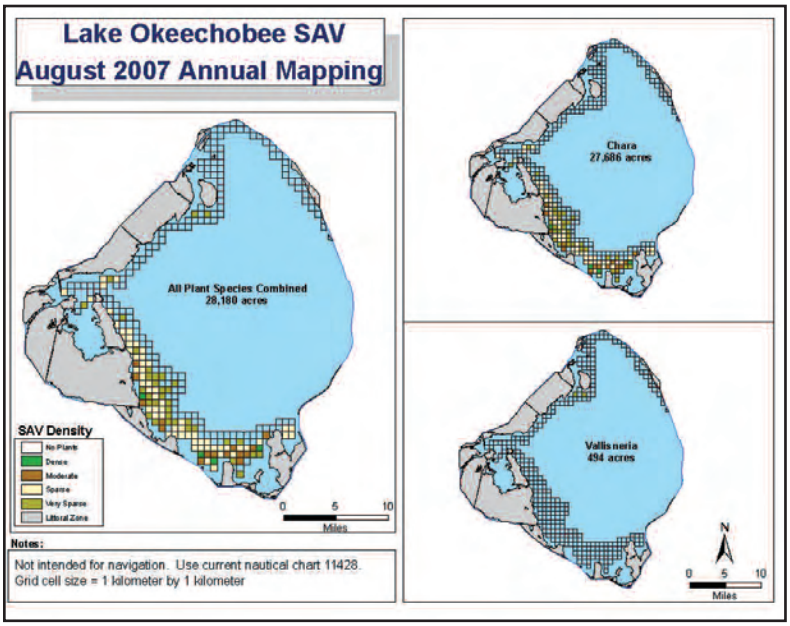
KEY FINDINGS



SUMMARY FINDING:

Submerged aquatic vegetation (SAV) declined from approximately 55,000 acres in 2004 to approximately 3,000 acres in 2006. Dramatic declines in SAV areal coverage were caused by the passage of three hurricanes: Frances and Jeanne in 2004 and Wilma in 2005. Physical disturbance (e.g., uprooting of plants) and prolonged turbidity resulted in the decline in SAV coverage, especially that of vascular plants such as eelgrass (*Vallisneria americana*), Hydrilla (*Hydrilla verticillata*), and peppergrass (*Potamogeton illinoensis*). Chara areal coverage rebounded between 2006 and 2007 and by August 2007 was similar to pre-hurricane coverage during the summer of 2004. A prolonged drought beginning in early 2007 has resulted in lake stages far below the long-term mean and dry conditions across most of the nearshore region which once contained vascular SAV. If a viable seed bank remains in these areas, a return to more typical stages (>12 ft m.s.l) may result in sufficient vascular SAV recovery to classify these areas as yellow rather than red. If these areas remain dry or do not contain a viable seed-bank, the red stoplight status may persist.

KEY FINDINGS:



1. Total SAV coverage decreased by approximately 95% between 2004 and 2006. Much of the SAV was likely lost due to physical disturbance by three hurricanes, and prolonged excessive water column turbidity (>50 mg/L) prevented recovery.
2. *Chara* spp. areal coverage decreased tenfold between 2004 and 2006 but then rebounded to approximately pre-hurricane coverage between 2006 and 2007. *Chara* also has shifted offshore in response to historically low lake stages resulting from a prolonged drought during 2007-08. Prolonged low lake stage may result in large increases in *Chara* areal coverage during the upcoming summer.
3. Vascular SAV, primarily eelgrass (*Vallisneria americana*), Hydrilla (*Hydrilla verticillata*), and peppergrass (*Potamogeton illinoensis*) declined following the 2004 hurricanes and have not yet recovered. Hydrilla declined from approximately 24,500 acres in 2004 to 0 acres by 2006-07. Eelgrass declined from approximately 8,200 acres in 2004 to approximately 500 acres in 2007. Peppergrass declined from approximately 6,700 acres in 2004 to 0 acres in 2006-07. During the winter of 2008, eelgrass was observed in the western nearshore area, and prolonged low lake stage may result in a favorable light regime for vascular SAV plant growth during the upcoming summer.
4. Seed-bank studies are currently being conducted to assess whether viable vascular SAV seeds exist in the nearshore region where the water column is shallow (<1 m). This region is further offshore than those areas where vascular plants typically have been found over the past decade.
5. An anticipated return to more typical lake stages (e.g. > 12 ft m.s.l) following the current drought may result in the reestablishment of the vascular SAV community.

STOPLIGHTS

PERFORMANCE MEASURE	LAST STATUS[a]	CURRENT STATUS[b]	2-YEAR PROSPECTS[c]	CURRENT STATUS[b]	2-YEAR PROSPECTS[c]
Submerged Aquatic Vegetation Areal Coverage NEARSHORE REGION		R		Submerged aquatic vegetation (SAV) coverage, especially vascular plant coverage, decreased dramatically since the fall of 2004. This decline in areal coverage was caused by physical disturbance (uprooting) from three hurricanes (Frances, Jeanne and Wilma) followed by prolonged water column turbidity. *Chara* spp. coverage dramatically increased during 2007, covering approximately 27,700 acres. However, vascular plants accounted for only approximately 500 total acres.	Unknown. Most of the nearshore region known to contain SAV over the past decade has been dry for approximately the past 9-12 months. Seed-bank viability in these areas is unknown. The SAV response to reflooding upon the return to average lake stages is, therefore, uncertain at this time.

Blank – No data are available.

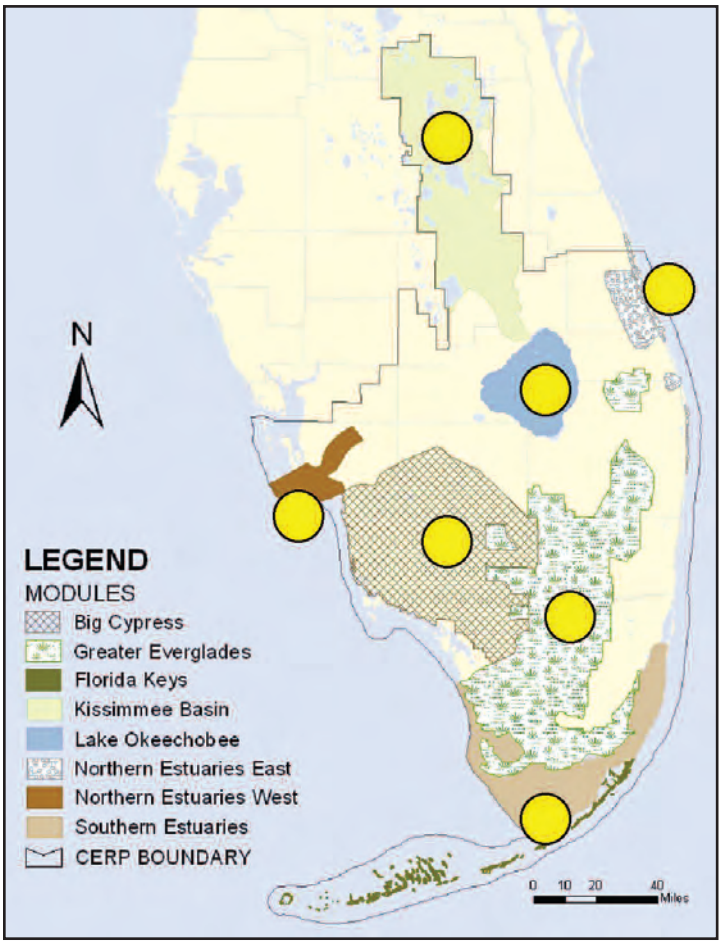
[a]There was no previous SAV areal coverage condition report for Lake Okeechobee. [b]The current status column is based on peak 2007 (August) SAV areal coverage and targets of 40,000 acres of total SAV coverage, with at least 50% being comprised of vascular plants. [c]The 2-Year Prospect forecast assumes that no large-scale hydrological restoration projects are implemented during this time period, which would result in significant ecological response of this indicator. The occurrence of significant climatological events during this period may affect the forecast.

KEY FINDINGS

SUMMARY FINDING:

Most modules have some level of control program for high-priority species and are showing progress with commonly known and wide spread species such as melaleuca, particularly on public lands. However, even Brazilian pepper and Old World climbing fern continue to be serious invaders in many modules, and several new and recently introduced species are being identified in many modules and little information exists on distribution or control methods. Monitoring programs are insufficient for tracking invasive species (especially new species) and predominantly cover only the Greater Everglades Module.

KEY FINDINGS:



1. Control of exotics has been successful but is limited to public lands and only to a few species.
2. Biological control on melaleuca is proving to be very effective as previously released insects are spreading and restoration of natural habitat is being documented.
3. For several other serious invasive plants a number of new insects have been released others are in development for release within 1-2 years.
4. All of the modules have significant invasive exotic plant problems that are documented to be affecting natural areas and altering natural habitats and processes and are not being controlled or monitored.
5. Monitoring programs to assess the trends in invasive exotic plants only cover the entire restoration area for six high-priority species.
6. Monitoring that would identify new species or new distributions for existing species only covers portions of the Greater Everglades module, the other modules are not being monitored.
7. Due to the scale of the problem, new species are becoming established about which little is known, leaving the overall control picture mixed. Control and monitoring efforts are not keeping up with the establishment and expansion of exotic plant species.
8. Existing monitoring programs do not cover the other six modules. Therefore, we are unable to determine where and when new species arrive and establish and assess success of control programs in these areas.
9. While we have made good progress with a number of species, we are still unable to control exotic plant species faster than they are invading and spreading. It is important to get ahead of the exotic plant invasion rate. Control and prevention programs would have to be expanded in order to do that.

STOPLIGHTS

LOCATION	LAST STATUS	CURRENT STATUS	2-YEAR PROSPECTS	CURRENT STATUS	2-YEAR PROSPECTS
KISSIMMEE RIVER	Y	Y	R	**The Good:** Restoration efforts under way with good progress made with some species; Successful control programs for water hyacinth, waterlettuce and melaleuca. New control programs started for other recent invaders. **The Bad:** Many non-indigenous species occur in this region for which little is known about their control, distribution and potential invasiveness.	Little is known about many of the species that occur in this region, yet some are very serious weeds in other parts of world; rehydrated wetlands providing new habitat for aquatic species including hydrilla; New control programs show promise but many species lack effective programs.
LAKE OKEECHOBEE	Y	Y	Y	**The Good:** Large control programs under way provide sustained maintenance control for many species including melaleuca, floating aquatic weeds which is key in restoration efforts. **The Bad:** Some serious species remain in module; continued disturbance of littoral zone may increase chances of new invasions.	Continuation of successful control programs are needed to keep species in check. Lapses in control efforts will result in serious reinvasions of many species threatening region. Difficulties controlling torpedograss and West Indian marsh grass are a concern.
NORTHERN ESTUARIES – EAST COAST	Y	Y	R	**The Good:** Progress with melaleuca, Brazilian pepper and Australian pine; first biocontrol releases for Old World climbing fern. **The Bad:** Other species increasing, most not included in indicator monitoring programs; little known about majority of invaders; unable to assess status in repetitive way to determine trends.	Successes on public lands with several species are largely offset by increases in numerous new species; Potentially serious invaders exist for which little is known about biology or spread; Progress in biocontrol expected.
NORTHERN ESTUARIES – WEST COAST	Y	Y	R	**The Good:** Much progress made with melaleuca, Brazilian pepper, Australian pine; first biocontrol releases for Old World climbing fern; new biocontrol for Brazilian pepper under study. **The Bad:** Other species gaining foothold and most not included in any indicator monitoring program; little known about large majority of invaders and not able to assess their status in an objective or repetitive way.	Successes on public lands with several serious species are largely offset by increases in new species; other species still localized but numerous; potentially serious invaders exist for which little is known about biology or spread; effective monitoring programs are needed to improve control.
BIG CYPRESS	R	Y	Y	**The Good:** Good control of melaleuca and Australian pine; first biocontrol releases for Old World climbing fern; occasional reductions on private lands. **The Bad:** Two potentially serious invaders, crested floating heart and cogongrass are present in module, control efforts ineffective.	Exotic populations decreasing significantly on publicly owned areas; Many species still localized, but one new and potentially serious invader documented by NPS.
GREATER EVERGLADES	Y	Y	Y	**The Good:** Good control of melaleuca and Australian pine; biocontrol for melaleuca effective; first biocontrol releases for Old World climbing fern. **The Bad:** Old World climbing fern and Brazilian pepper still widespread, serious threats; continued rapid spread of these two species with little results from control efforts; still several other species present with little or no control effort or efficacy.	Continued implementation of integrated management of melaleuca and other species should favor improving trend for a few species. New biological controls for Old World climbing fern and Brazilian pepper soon; other species still localized, no new serious invaders detected.
SOUTHERN ESTUARIES	Y	Y	Y	**The Good:** Control programs under way for many years; significant control achieved for Australian pine. **The Bad:** Many new species invasions and possible effects unclear; most of Florida Bay not included in any monitoring program. Latherleaf, a serious invader of rare habitats along the southern coast of Park.	Numerous new invasive species that are not included in a systematic control or monitoring program and are serious unknowns.
FLORIDA KEYS	Y	Y	G	**The Good:** Restoration efforts under way for several years; much progress made on Austrlalian pine, sickle bush, laurel fig. **The Bad:** Still some use of invasive species in private landscapes.	Significant control program in place; progress on many species evident, continued monitoring and control needed to prevent reinvasions and new introductions.

The 2-Year Prospect forecast assumes that no large-scale hydrological restoration projects are implemented during this time period, which would result in significant ecological response of this indicator. The occurrence of significant climatological events during this period may affect the forecast.

Principal Scientist Contact Information

Principal Indicator Scientist	Indicator	Email address	Phone number
Joe Boyer	Florida Bay Algal Blooms	joseph.boyer@fiu.edu	305-348-4076
Joan Browder	Pink Shrimp	joan.browder@noaa.gov	305-361-4270
Robert Doren	Exotic Plants	dorenr@fiu.edu	305-348-6721
Peter Frederick	White Ibis and Wood Stork	pcf@mail.ifas.ufl.edu	352-846-0565
Evelyn Gaiser	Periphyton	gaisere@fiu.edu	305-348-6145
Jerry Lorenz	Roseate Spoonbill	jlorenz@audubon.org	305-852-5318
Chris Madden	Florida Bay SAV	cmadden@sfwmd.gov	561-686-8800 ext. 4647
Frank Mazzotti	Crocodilians	fjma@ufl.edu	954-577-6304
Andy Rodusky	Lake Okeechobee Littoral Zone	arodusk@sfwmd.gov	561-681-2500 ext. 4566
Joel Trexler	Fish and Macroinvertebrates	trexlerj@fiu.edu	305-348-1966
Aswani Volety	Oysters	avolety@fgcu.edu	239-590-7216

Literature Cited and Assessment Report

Bennett, James P. 2000. Ecological Indicators for the Nation: Committee to Evaluate Indicators for Monitoring Aquatic and Terrestrial Environments, National Research Council, National Academy Press, Washington, DC. 180 p., ISBN 0-309-06845-2.

Dale, V.H. and Beyeler, S.C., 2001. Challenges in the development and use of ecological indicators. Ecological Indicators 1, 3-10.

Dennison, W.C., Lookingbill, T.R., Carruthers, T.J.B., Hawkey, J.M., and Carter, S.L., 2007. An eye-opening approach to developing and communicating integrated environmental assessments. Frontiers in Ecological Environments 5, 307-314.

Dunwoody, S., 1980. The science writing inner club: A communication link between science and the lay public. Science Tech. Human Val. 5, 14-22.

Ecological Indicators Special Issue – Indicators for Everglades Restoration (In Press) (2008), doi:10.1016/j.ecolind.2008.06.005

Jackson, L.E., Kurtz, J.C., and Fisher, W.S., (Eds.). 2000. Evaluation Guidelines for Ecological Indicators. EPA/620/R-99/005. U.S. Environmental Protection Agency, Office of Research and Development, Research Triangle Park, NC. 107p.

National Research Council (NRC), 2000. Ecological Indicators for the Nation. Washington, D.C., National Academy Press.

Niemi, G.J. and McDonald, M.E., 2004. Ecological Indicators, Ann. Rev. Ecol. Evol. Sys. 35, 89-111.

Parrish, J.D., D.R. Braun, and R.S. Unnasch. 2003. Are We Conserving What We Say We Are? Measuring Ecological Integrity Within Protected Areas. Bioscience, September 2003; Vol. 53, No. 9, pp. 851 – 860.

Rowan, K.E., 1991. When simple language fails: Presenting difficult science to the public. Journal of Technical Writing and Communication 21, 369-382.

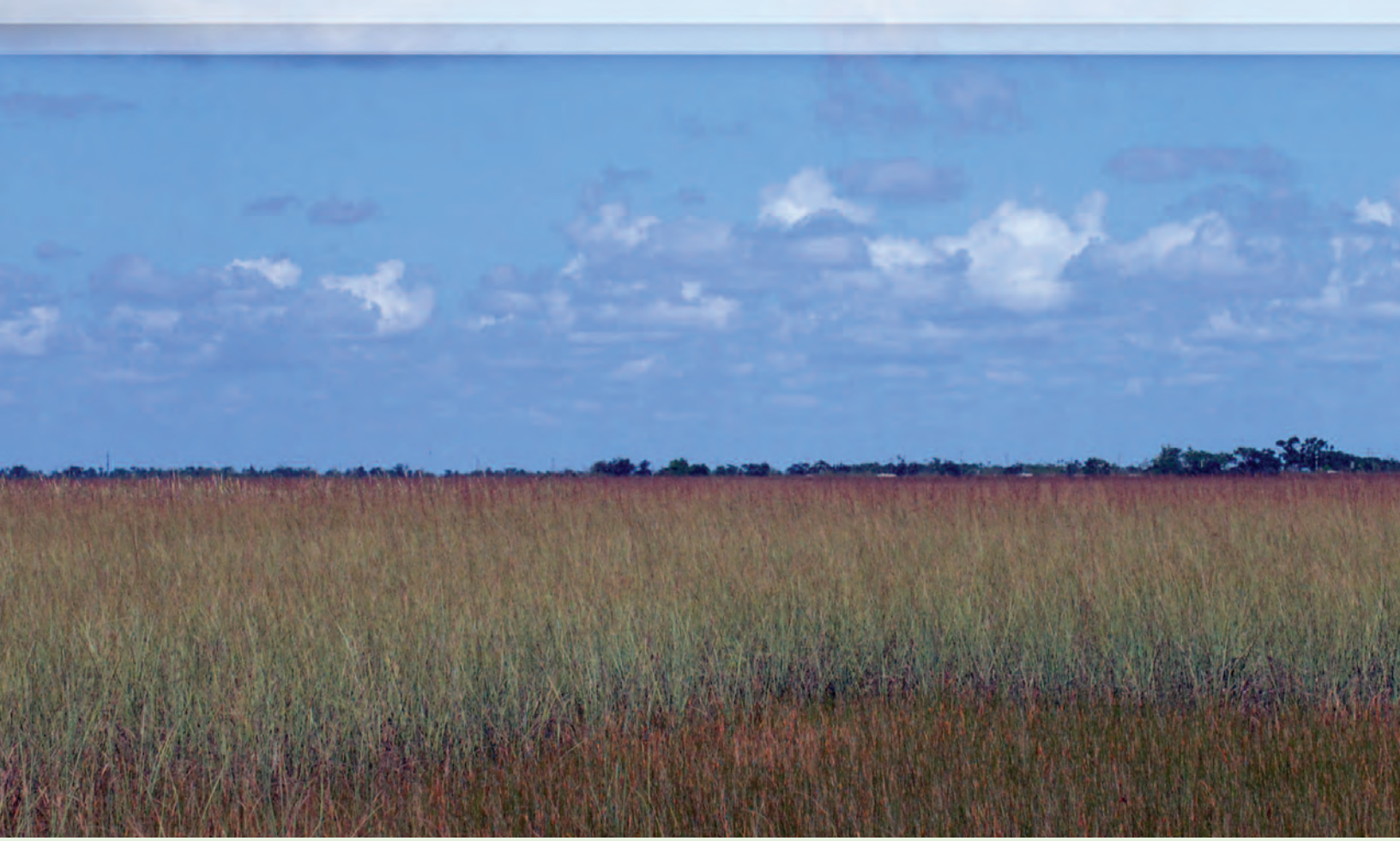
Rowan, K.E., 1992. Strategies for enhancing comprehension of science. In: Lewenstein, B.V. (Ed.) When Science meets the public. American Association for the Advancement of Science, Washington, D.C.

Schiller, A., C. T. Hunsaker, M. A. Kane, A. K. Wolfe, V. H. Dale, G. W. Suter, C. S. Russell, G. Pion, M. H. Jensen, and V. C. Konar. 2001. Communicating ecological indicators to decision makers and the public. Conservation Ecology 5(1):19. http://www.consecol.org/vol5/iss1/art19/

Thomas, L.P., 2006. The use of conceptual ecological models in designing and implementing long-term ecological monitoring. Report to the Prairie Cluster LTEM Program, National Park Service, Washington, D.C. USA.

Weigold, M.F., 2001. Communicating Science: A Review of the Literature. Science Communication 23, 164-193.

Wetlands, Special Issue, 2005. Journal of the Society of Wetland Scientists 25, 795-1002.



Contributing authors in alphabetical order: William Arnold, G. Ronnie Best, Joseph N. Boyer, Laura A. Brandt, Joan Browder, Robert Chamberlain, Michael S. Cherkis, Mark Cook, Kevin M. Cunniff, Peter H. Doering, Robert F. Doren, James Fourqurean, Peter Frederick, Peter E. Fregga, Evelyn Gaiser, Dale Gawlik, Patricia Goodman, Charles W. Goss, Andrew D. Gottlieb, Matthew Harwell, Brian M. Jeffery, Christopher R. Kelble, Brynne Langan-Mulrooney, Jerome J. Lorenz, Michael Lusk, Christopher J. Madden, Frank J. Mazzotti, Amanda A. McDonald, John C. Ogden, Peter B. Ortner, Kenneth G. Rice, Jennifer H. Richards, Michael B. Robblee, Andy Rodusky, David T. Rudnick, Michael Savarese, Bruce Sharfstein, Patricia Sime, Stephen G. Tolley, Joel C. Trexler, Aswani K. Volety and John C. Volin

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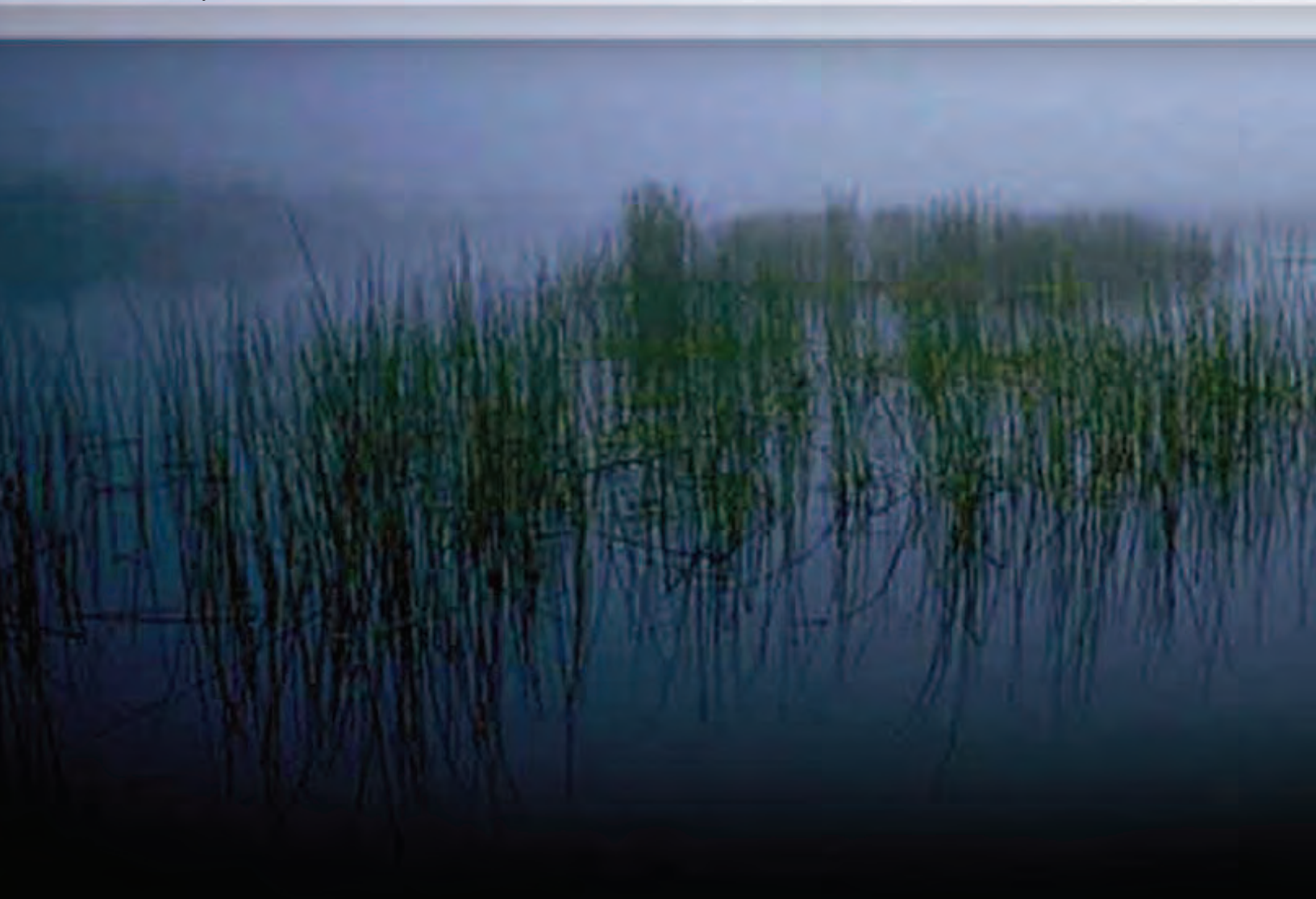

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