System-wide Ecological Indicators for Everglades Restoration

2010 Report

This Document

The South Florida Ecosystem Restoration Task Force

Authorized by Congress, the South Florida Ecosystem Restoration Task Force (Task Force) brings together the federal, state, tribal, and local agencies involved in restoring and protecting the Everglades. The role of the intergovernmental Task Force is to facilitate the coordination of the myriad conservation and restoration efforts being planned and implemented. It provides a forum for the participating agencies to share information about their restoration projects, resolve conflicts, and report on progress.

The Task Force has established a suite of system-wide ecological indicators to assess current ecosystem health and provide a means to track ecosystem response to restoration. This suite of system-wide ecological indicators was developed specifically to provide a big picture view of restoration, and the ecosystem's health and response, for the Task Force and Congress.

Report Purpose

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 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 the suite of eleven system-wide ecological indicators.

Cover photograph courtesy of Dr. William Perry, Everglades National Park.

Table of Contents

Executive Summary

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." (Bennett 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 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 (Table 1). 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. 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 be-

Table 1. System-wide Ecological Indicators

Fish & Macroinvertebrates
Wading Birds (Wood Stork & White Ibis)
Wading Birds (Roseate Spoonbill)
Florida Bay Submersed Aquatic Vegetation
Florida Bay Algal Blooms
Crocodilians (American Alligators & Crocodiles)
Oysters
Periphyton & Epiphyton
Juvenile Pink Shrimp
Lake Okeechobee Nearshore Zone
Invasive Exotic Species

cause 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 begin to understand how indicators may respond to ecosystem drivers and stressors such as rainfall, hydrology, salinity, water management, nutrients, and exotic species.

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 see similar ecological responses among indicators. This logical agreement among indicators—a collective response, if you will—could help 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. For example, while Spoonbills, Alligators, and Periphyton may appear to be unrelated, they are directly related through their biological and ecological responses to environmental drivers.

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

Water management and water structures still matter the most. As shown by many of the indicators, the regions of the Everglades that are most insulated or removed from the effects (actions or impacts) of water management and water management structures appear to be relatively more stable ecologically and biologically and generally are the most amenable to the sustenance and restoration of Everglades species. Conversely those regions that are most impacted by water releases (management) and water management structures are the most erratic and unstable hydrologically and ecologically and the most unfavorable for Everglades species.

Where improvements in water management operations have been implemented, improvements for some species have been documented. Water management targets in the central and southern Everglades marshes were closer to hydrological targets this reporting period than in the last six years. Resulting water management improvements in Taylor Slough have shown improvements in the Fish and Macroinvertebrates (e.g., crayfish) indicator for the region. However, scientists are documenting increased nutrient concentrations in upper Taylor Slough as a result of the movement of nutrients into upper Taylor Slough with the added water flow as shown by the Periphyton indicator. As restoration efforts continue, the science learned from updated indicator reports should be used to help managers and scientists determine how to evaluate potential benefits and impacts of different restoration alternatives. Wading Bird populations (specifically White Ibis) have shown substantial improvements in both timing of nesting, production of young, and increase in Ibis “super colony” occurrence. When water management and nature work together to provide for more “natural” abundance and distribution of water, some Everglades species respond positively. While water levels were generally lower than predicted by rainfall, water management provided for a consistent dry-down with virtually no rapid reversals in water levels in the central and southern marshes during this reporting period. This provided for good conditions for Wading Birds (Wood Storks and White Ibis) and aquatic prey availability.

Where no improvements in water management operations have been implemented, species targets continued to remain low or decline. Most of the indicators show no substantial change from the previous report. These indicators are either stable, but well below target levels, or are still showing a decline away from targets. Oysters, Roseate Spoonbills (northeast regions of Florida Bay), Pink Shrimp, Submersed Aquatic Vegetation (Transition Zones), and Alligators and Crocodiles (all regions except Loxahatchee), all clearly show that water management operations and the availability of water during both the wet and dry seasons continue to be the limiting factors for species sustainability and recovery. Excess (too much) water at the wrong times and in the wrong places, or insufficient (too little) water most of the time in most areas, along with rapid reversals in water (either during marsh flooding or draining) are still causing most of the indicators to continue to remain unchanged and below targets overall. This continues to be the situation throughout most of the Everglades.

Phosphorus continues to be a serious concern. Periphyton shows that areas near water management structures are higher in phosphorus than areas farther removed from structures. Movement of phosphorus into some southern areas that have been relatively free of phosphorus pollution is resulting in the documentation of increased impacts, as seen by the increase in nutrient concentrations in upper Taylor Slough. Water flows are key to the restoration of the Everglades, but more water with too much phosphorus continues to be one of the main problems complicating the need for more water.

There is still too little water everywhere in the dry season, most areas have way too little water in the wet season while some impounded areas have way too much water in the wet season; the timing of water releases is still causing large problems. All the indicators, including the additional metrics evaluated in the Restoration Coordination and Verification (RECOVER) System Status Report that are not reported here, clearly show that the Everglades ecosystem is still not getting enough water, and that in many locations that water is subject to management operations that cause serious harm to the ecosystem and the indicators by either piling water in areas that should not be so wet, or drying areas that need water. Oysters and Lake Okeechobee Nearshore Zone clearly show negative impacts from water management actions that cause rapid changes in water volume and in timing of water releases. Current water management practices have not demonstrated "good" hydrological conditions to occur over multiple successive years across the entire landscape, a situation that is essential to the sustenance and recovery of the indicator species, particularly Wading Birds, Crocodilians, Pink Shrimp, Fish, and Oysters.

Many ecosystem components and species across the Everglades have the capacity to be resilient (although resilience is not explicitly measured). For some large regions of the Everglades, both variability in natural environmental conditions and water management operations have worked synergistically together this past reporting cycle with indicators in some regions showing good recovery and generally green stoplights in those regions: Roseate Spoonbill (northwest Florida Bay Colonies), Wading Birds (Wood Storks and White Ibis, headwaters and estuarine areas), Florida Bay Submersed Aquatic Vegetation (Central Bay Regions), and Fish and Macroinvertebrates (Taylor Slough fish populations; macroinvertebrates in Water Conservation Area 3 and Taylor Slough). This shows clearly the potential resilience of these ecosystem components and how rapidly species will take advantage of "good" conditions in the ecosystem, especially if those conditions are "good" consistently and consecutively over a number of years.

Predominant Themes

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

- 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.

- 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.

- 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. Over the past two years, four restoration project groundbreakings have occurred. As such, we would not yet expect to see a preponderance of system-wide trends moving towards more yellow and green stoplights at this time.

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 judgment 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 ecological 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 2001, Thomas et al. 2006, Dennison et al. 2007).

This suite of system-wide ecological indicators has been developed specifically to provide a mountaintop view of restoration for the South Florida Ecosystem Restoration Task Force (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 Task Force (see: www.sfrestore.org), established by section 528(f) of the Water Resources Development Act (WRDA) 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 (a team of scientists and managers) develop a small set of system-wide ecological 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 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, stormwater 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 subset from a larger

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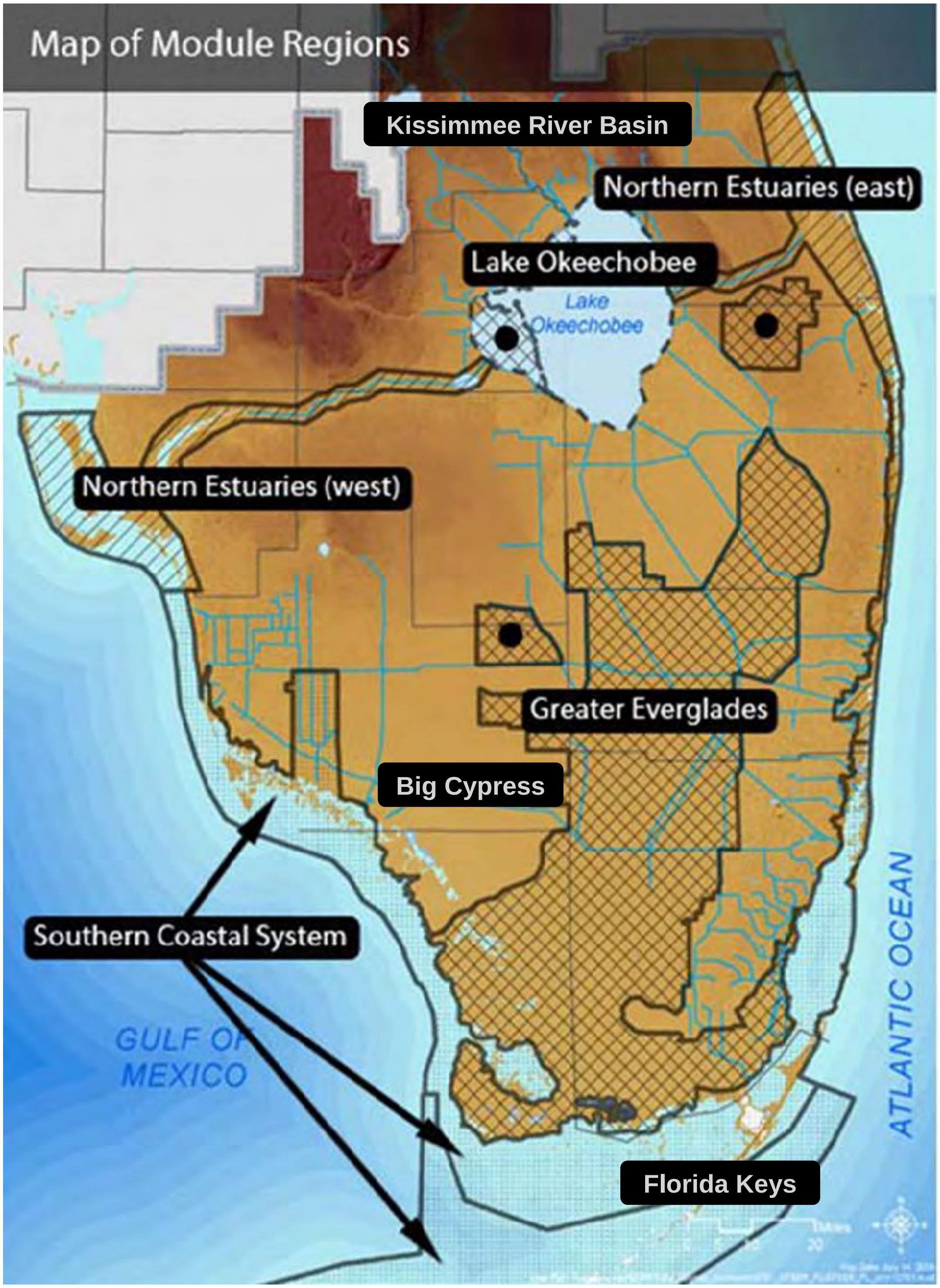


Figure 1. Map of south Florida illustrating the boundary of the South Florida Water Management District (SFWMD) and the regional assessment modules. Figure courtesy of RECOVER's 2009 System Status Report.

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).

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 ecological 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.

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.

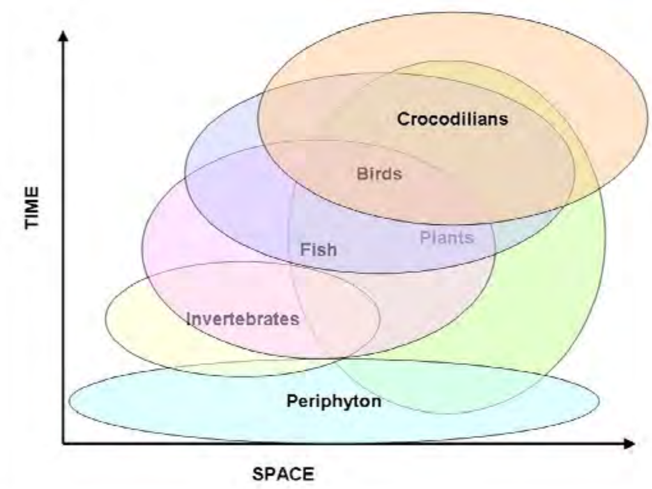


Figure 2. The suite of system-wide ecological indicators was chosen based upon their collective ability to comprehensively reflect ecosystem response in terms of space and time. For example, Periphyton responds to change very rapidly at both small and large spatial scales while Crocodilians respond more slowly to change and at larger spatial scales. As indicators, they "cover" different aspects of the ecosystem. The system-wide ecological indicators collectively "cover" the ecosystem in terms of response to change over space and time.

This figure is an illustration of how individual indicators may interrelate and respond to restoration in terms of space and time. This figure uses six indicators as an example and is not meant to precisely represent the exact spatial and temporal interactions of the system-wide ecological indicators.

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, mercury)
- Soils

Ecological Regions (see Figure 1)
- Greater Everglades
- Southern Coastal System
- 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 Format

Our integrated summary uses 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 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.

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 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. Future activities by stoplight indicator scientists will include updating data to present condition, examining needed adjustments in the stoplights, and an analysis of the stoplight sensitivity to change in environmental condition allowing the scientists to know how quickly the stoplights will respond to improved environmental conditions.

Further Indicator Details

This 2010 Report includes a stoplight/key summary status report for each indicator. For more detailed information on these indicators please refer to the Special Issue of Ecological Indicators: Indicators for Everglades Restoration (2008), the Indicators for Restoration Report (2006) available online at www.sfrestore.org, and the RECOVER System Status Report (SSR) which addresses the overall status of the ecosystem relative to system-level hypotheses, performance measures, and restoration goals. The 2009 SSR provides an integrated assessment of RECOVER's Monitoring and Assessment Plan (MAP) and non-MAP data, spans multiple spatial scales, and in some cases decades worth of information. Because of the broad intergovernmental coordination, the SSR incorporates elements of the stoplight indicator update and provides the detailed underlying, data, theory, and analysis used in this report. The 2009 SSR is available on an interactive web page that allows managers, stakeholders, and scientists with varying interests and degrees of technical expertise to easily find the information they need (http://www.evergladesplan.org/pm/ssr_2009/ssr_main.aspx#). This combination of indicator reports will provide managers with information they need to adjust restoration activities at both large and small scales.

Stoplight Color Legend

Red	Substantial deviations from restoration targets creating severe negative condition that merits action.
Yellow	Current situation does not meet restoration targets and merits attention.
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.

Indicator Overview

Why these organisms are important as ecological indicators for system-wide assessment of restoration.

Fish & 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.

Wading Birds (Wood Stork/White Ibis)

- 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.

Wading Birds (Roseate Spoonbill)

- 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 Submersed Aquatic Vegetation

- Florida Bay has one of the largest seagrass beds in the world, covering 90% of the 180,000 hectares of the bay.
- Submersed 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 (Alligators & Crocodiles)

- 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 Nearshore 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.

Invasive Exotic Species

- 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.

Fish & Macroinvertebrates

Summary Findings

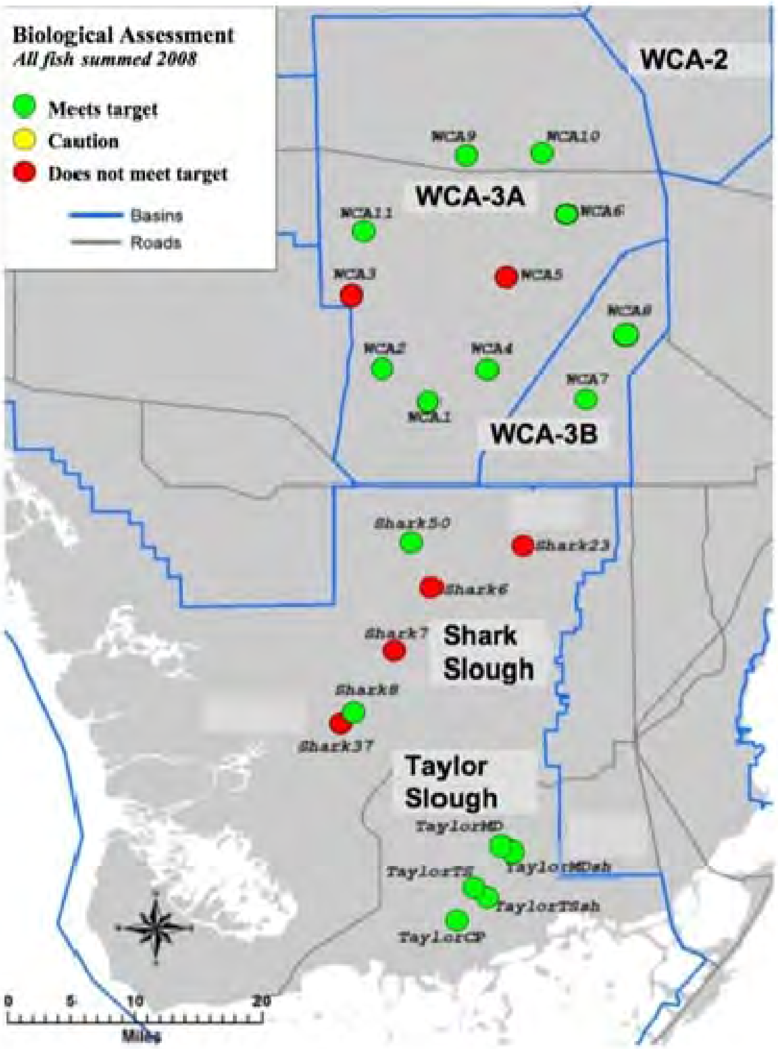
In 2008, four of six monitoring sites in central Shark River Slough did not meet restoration targets (red) because of drier conditions than expected based on rainfall[1]. The net effect was one of concern (yellow) for the region. These conditions resulted from fewer fish that prefer wetter conditions than expected, but levels of drought-tolerant species were consistent with expectations. Water management is causing drier conditions than would be expected based on the amount of rainfall and water depth patterns in the baseline hydrological period of 1993 through 1999.

After several years of concern in Taylor Slough, all indicators except non-native fish were within desirable ranges. Results were mixed in WCA-3A, where two sites yielded fewer fish than expected based on rainfall, but seven others were within desired ranges, as were both monitoring sites in WCA-3B. This long-term monitoring program indicates that water management was closer to targets in 2007 and 2008 than in years 2001 through 2006. Monitoring data indicate that non-native taxa continue to be most common at edge habitats, though widespread in Everglades marshes, and their frequency may be increasing in Taylor Slough. This trend should receive further attention.

Key Findings

1. All of the sites coded red for fish density resulted from fewer fish than expected based on observed rainfall, and most are in Shark River Slough.
2. Taylor Slough showed an improvement in 2007 and 2008 compared to previous years (2001-2006).
3. Results were mixed in WCA-3A, though the overall assessment is acceptable (green). There was evidence of more frequent drying than expected from observed rainfall in the western area. Everglades crayfish were infrequently collected in WCA-3A in the baseline period and afterwards.
4. There were no systematic deviations from rainfall-based expectations in WCA-3B for all fish summed.
5. 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. In 2008 monitoring sites were added downstream from the C-111 canal in the ENP panhandle, and non-native taxa at times exceeded the 2% cutoff at those sites. There appears to be an increasing trend of non-native taxa in Taylor Slough; several species were present including Mayan cichlids, swamp eels, and spiny eels.

[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 the monitoring sites were used to model hydrology. Alternative hydrological model outputs, such as those derived by the Natural System Model, generally yield longer target hydroperiods than used here leading to more frequent impacts.



The map above shows the location of long-term monitoring sites and reflects annual assessments for the Total Fish performance measure. The table on the following pages reflects the average stoplight score within each region for fish and macroinvertebrates.

Fish & Macroinvertebrates

Performance Measure	'00	'01	'02	'03	'04	'05	'06	'07	Current Status	Current Status	2-Year Prospectus
Shark River Slough											
Eastern mosquitofish	G	G	Y	R	R	Y	Y	R	Y	Fewer than expected.	Two-year prospects are for no change, but Tamiami bridge project should improve this PM in future.
Flagfish	G	G	G	Y	G	G	G	G	G	At expected levels based on rainfall and target-period hydrology.	Two-year prospects are for no change, but Tamiami bridge project should improve this PM in future.
Bluefin killifish	G	Y	Y	R	Y	Y	Y	Y	Y	Fewer than expected.	Two-year prospects are for no change, but Tamiami bridge project should improve this PM in future.
Total fish	G	G	R	R	R	R	R	R	Y	Fewer than expected.	Two-year prospects are for no change, but Tamiami bridge project should improve this PM in future.
Everglades crayfish	G	Y	G	Y	R	Y	Y	Y	G	At expected levels based on rainfall and target-period hydrology.	Two-year prospects are for no change, but Tamiami bridge project should improve this PM in future.
Non-native fishes	Y	Y	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.	Two-year prospects are for possible increase or no change, but Tamiami bridge project may negatively affect this PM.
Taylor Slough											
Eastern mosquitofish	G	G	G	Y	Y	Y	Y	G	G	At expected levels based on rainfall and target-period hydrology.	New projects at S-332 and C-111 should lock in good performance of past year.
Flagfish								G	G	At expected levels based on rainfall and target-period hydrology.	New projects at S-332 and C-111 should lock in good performance of past year.
Bluefin killifish	G	Y	R	R	R	R	R	G	Y	Near, but below, expected levels based on rainfall and target-period hydrology.	New projects at S-332 and C-111 should lock in good performance of past year.
Total fish	G	G	Y	Y	R	R	R	G	G	At expected levels based on rainfall and target-period hydrology.	New projects at S-332 and C-111 should lock in good performance of past year.
Everglades crayfish	G	G	G	Y	R	Y	Y	G	Y	Above expected levels based on rainfall and target-period hydrology.	New projects at S-332 and C-111 should lock in good performance of past year.
Non-native fishes	Y	Y	Y	Y	Y	Y	Y	R	Y	Present at all monitoring sites. None more than 2% of all fish collected; numbers highest at mangrove boundary.	New projects increasing connectivity to canals may negatively affect this PM.

The 2-Year Prospect forecast assumes no large-scale climatological events such as hurricanes with excessive rain or drought during this period.

Performance Measure	'00	'01	'02	'03	'04	'05	'06	'07	Current Status	Current Status	2-Year Prospectus
Water Conservation Area 3A											
Eastern mosquitofish	G	G	Y	Y	Y	G	G	G	G	At expected levels based on rainfall and target-period hydrology.	PM should continue at good levels relative to target; DECOMP projects may change area hydrology so much new targets required in future.
Flagfish	G	G	G	G	G	Y	Y	G	G	At expected levels based on rainfall and target-period hydrology.	PM should continue at good levels relative to target; DECOMP projects may change area hydrology so much new targets required in future.
Bluefin killifish	G	G	Y	Y	Y	Y	Y	G	G	At expected levels based on rainfall and target-period hydrology.	PM should continue at good levels relative to target; DECOMP projects may change area hydrology so much new targets required in future.
Total fish	G	G	G	G	G	G	G	G	G	At expected levels based on rainfall and target-period hydrology.	PM should continue at good levels relative to target; DECOMP projects may change area hydrology so much new targets required in future.
Non-native fishes	Y	Y	Y	Y	Y	Y	Y	R	Y	Present at all monitoring sites but no evidence of trends. All less than 2% of total and fewer than in Everglades National Park.	No change is likely, though DECOMP projects will increase access to canals already connected.
Water Conservation Area 3B											
Eastern mosquitofish	G	G	R	R	R	R	Y	G	G	At expected levels based on rainfall and target-period hydrology.	Two-year prospects are for no change in this PM or improvement because of DECOMP projects.
Flagfish	G	Y	Y	Y	Y	Y	Y	Y	Y	Tendency for higher values than expected at northern site.	Two-year prospects are for no change in this PM or improvement because of DECOMP projects.
Bluefin killifish	G	R	R	Y	G	G	G	G	G	At expected levels based on rainfall and target-period hydrology.	Two-year prospects are for no change in this PM or improvement because of DECOMP projects.
Total fish	G	G	G	G	G	G	G	G	G	At expected levels based on rainfall and target-period hydrology.	Two-year prospects are for no change in this PM or improvement because of DECOMP projects.
Non-native fishes	Y	Y	Y	Y	Y	Y	Y	Y	G	Not found at either monitoring site within WCA-3B.	Two-year prospects are for possible increase or no change, but DCEOMP projects may negatively affect this PM.

Wading Birds (Wood Stork & White Ibis)

Summary Findings

Conditions for nesting were exceptional for wading birds in 2009, with relatively long hydroperiods and long inter-drying intervals prior to the nesting season, and weather conditions that led to a long, uninterrupted drying pattern throughout early winter through spring. As a result, crayfish biomass was very high and the proportion of the freshwater marsh that was available for foraging was very high in winter/spring 2008/09. Spring 2009 saw the largest nesting event recorded since the early 1940s, with nearly all species responding positively, and both large colonies and large numbers of colonies throughout the system.

There were encouraging trends in three of the four indicators in 2009. Storks nested earlier than has been typical (late January and February), a considerably larger proportion of nesting took place in the mangrove ecotone (20%), and it was an ibis supercolony year (over 43,000 nests initiated). One indicator (ibis supercolony) now consistently exceeds the target. While trends are encouraging for the other three indicators, thresholds for restoration have not been achieved, and remain numerically distant. However, 2009 also showed exceptionally high reproductive success for ibises, great egrets, and wood storks, suggesting that the Everglades in 2009 became a net production site rather than a reproductive sink for these species. In addition, it seems quite likely that the very large increase in numbers of nesting storks and the novel colonies of storks in the coastal zone were both fueled in part by a large cohort of young storks produced in the Everglades and throughout the southeastern United States in 2006. While productivity is not something that can be compared quantitatively with the historical Everglades, it seems very likely that the Everglades did function as a net exporter of birds, and the evidence from 2009 suggests that the ecosystem may be functioning in this capacity again. Taken together, these indicators suggest marked progress towards desired restoration goals. Finally, the very dramatic increases in most indicators in 2009 indicates that wading bird populations have the ability to respond to restored conditions very rapidly.

Key Findings

Conditions preceding the breeding season in 2009 were excellent both for production of crayfish biomass, particularly in the southern Everglades, and for making food available over very large expanses of the Everglades (83% of the landscape). The latter feature was due to a long, uninterrupted drying from November through May. Over 43,000 nests were initiated throughout the Everglades, which is more than in any year since the early 1940s. Increases in nesting compared to recent years were seen in all species except for snowy egrets. Novel nesting locations were found by many species including wood storks in coastal regions of the Everglades.

Indicators:

1. Wood storks inititated nesting earlier than has been typical of the last 20 years, beginning in January in 2009. The nesting date index is numerical, with a 1 (March) being less desirable than a 5 (November). The 5-year running average index in 2009 was 2.0. The restoration target corresponds to nesting dates earlier than December 30th (4 – 5). While the earlier nesting in 2009 is indeed hopeful, the trend is only slightly increasing, and does not meet the restoration target.

2. The proportion of nesting birds occurring in the headwaters/ecotone in 2009 was 21.1%. This is a considerable increase over the average of 8.1% over the last ten years. There were also a number of novel colonies in the coastal zone, which suggests that conditions there were generally favorable, and independent of effects of colony fidelity. This is a considerable uptick in the nearly flat trend of the last 10 years. However, the goal of 70% or greater of the birds nesting in the coastal zone remains distant.

3. The ratio of ibis and stork nests to great egret nests in 2009 (3.5:1) is still far below the 30:1 characteristic of predrainage conditions. In addition, there has been only a slight increase over the average of the last ten years (2.97), especially compared with the target ratio.

4. 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 in most recent years. The large nesting of ibises in 2009 (43,415 nesting pairs) easily qualified as a supernormal nesting, bringing the five-year running average to 1.20. Recent research strongly supports the hypothesis that the change is due to increased production and availability of prey, particularly crayfish, to ibises. Restored conditions are expected to result in an average interval of 1.45 years. This indicator of restored conditions therefore appears to have been met.

PERFORMANCE MEASURE	LAST STATUS	CURRENT STATUS	2-YEAR PROSPECTS	CURRENT STATUS	2-YEAR PROSPECTS
Wading Bird Indicator Summary	R	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	R	R	Current ratio is well below 30:1 considered representative of healthy nesting conditions.	This ratio appears to have stabilized and did not improve much even in a good nesting year.
Month of Wood Stork nest initiation	R	R	Y	2009 initiation was in January, but 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 because of late initiation.
Proportion of nesting in headwaters	R	R	Y	Proportion nesting in the headwaters was 21.1% in 2009, a considerable uptick.	Recent trends are mildly positive, but distant from the 70% target.
Mean interval between exceptional ibis nesting years	G	G	G	This interval now consistently exceeds the target for restoration, and has shown dramatic improvement in last decade.	The trend is positive and consistent in recent years.

Note: Data in the Current Status columns are inclusive of calendar year 2007. 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.

Wading Birds (Roseate Spoonbill)

Summary Findings

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 northwest part of the bay are relatively low and numbers bay-wide are still not meeting targets. Northeastern bay colonies and bay-wide numbers continue to decline. There have been improvements, however, in water management operations that have allowed for favorable climatic conditions to result in four consecutive successful nesting cycles for both the northwest and northeast parts of the bay. The chicks hatched in these four nesting cycles should start reaching sexual maturity and this may result in an upturn in the number of nests. The spoonbill performance measures are expected to further improve after proposed changes to the South Dade Conveyance System (SDCS) (i.e., Mod Waters and the C-111 Spreader Canal Phase 1) are completed.

Key Findings

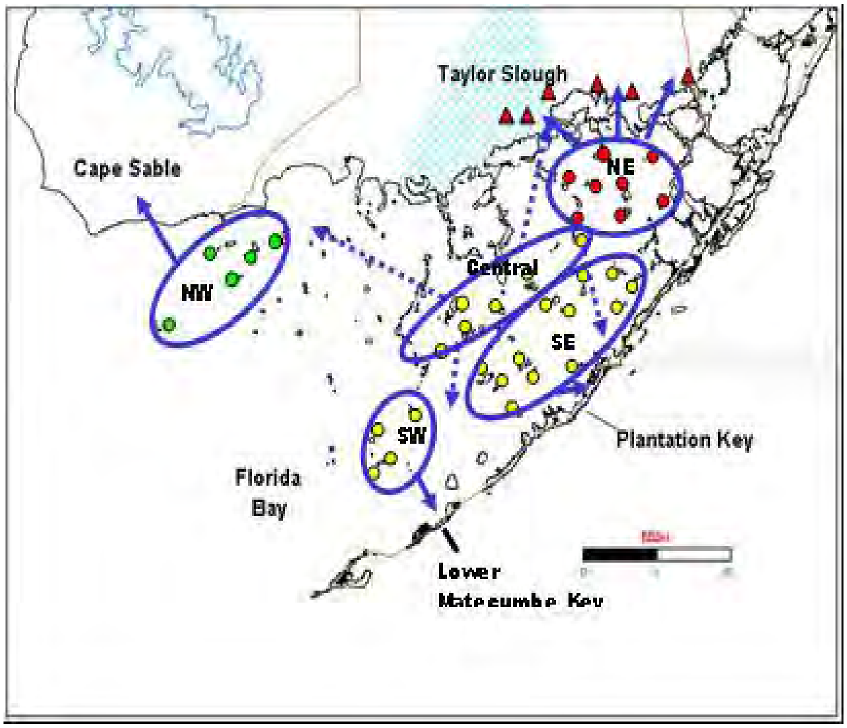
1. Northeastern Florida Bay is in need of immediate action in order keep spoonbill numbers from continuing to decline. Although the northeast colonies have performed well over the last four years, the average productivity in this region is still well below production rates observed in the northwestern colonies. The number of nests in the northeastern bay remained very low in 2007 with only 90 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.

3. There were 433 nests bay-wide in 2009. This was well below the target of 1258 nests. Bay-wide and northeastern nest numbers continue to decline but might begin to increase in the next few years as chicks hatched during the last four successful cycles reach the age of reproduction.

4. 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.

5. The northeastern 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 northeastern Florida Bay are not meeting criteria necessary for proper estuary function in these locations.



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.

Wading Birds (Roseate Spoonbill)

Zone/ Performance Measure	LAST STATUS	CUR-RENT STATUS	2-YEAR PROS-PECTS	CURRENT STATUS	2-YEAR PROSPECTS
Total Number of Nests					
Number of nests in FL Bay (5-year mean)	Y	Y	R	The target number of nests for the whole bay is 1,258. The 5-year mean number of nests was 433 or 34% 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 34% 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, however, four consecutive years of nesting success may prevent this from occurring.
Nesting Location					
Number of nests in NE FL Bay (5-year mean)	R	R	R	The target number of nests is 688. The 5-year mean number of nests was 90 nests or 13% of target, indicating that the NE FL Bay spoonbill population is in jeopardy.	Although 4 consecutive successful years may result in recruitment into the nesting population, thereby reversing the downward trend, it is unlikely to increase numbers sufficiently within the next 2 years to change this metric.
Number of nests in NW FL Bay (5-year 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 222, 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 (5-year mean)				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.

The Last Status column reflects data prior to 2007.

The Current Status column reflects data collected in the 2006-2007 nesting cycle.

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.

Wading Birds (Roseate Spoonbill)

Zone/ Performance Measure	LAST STATUS	CUR-RENT STATUS	2-YEAR PROS-PECTS	CURRENT STATUS	2-YEAR PROSPECTS
Nesting Production and Success					
Chick Production in NE FL Bay	R	Y	Y	The 5-year mean of NE production was 1.22 chicks/nest (c/n). This is above the success threshold of 1c/n but below the overall target of 1.38 c/n based on pre-SDCS conditions.	Greater sensitivity to the spoonbill nesting cycle by water managers has resulted in greater nesting success during years with favorable climatic conditions. This sensitivity is expected to continue increasing the 2 year prospectus from red to yellow.
Chick Production in NW FL Bay	Y	G	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 1.50 chicks per nest indicating that the NW continues to perform well and is currently greater than Pre-SDCS NE colonies.	The trend has been above average production in 4 of the last 5 years indicating that the NW colonies continue to be highly productive.
Percent successful years in NE FL Bay	R	Y	Y	In NE FL Bay, 6 of the last 10 years have been successful at >1 c/n. Current conditions are well below restoration targets.	Greater sensitivity to the spoonbill nesting cycle by water managers has increased the possibility of nesting success during favorable climatic conditions.
Percent successful years in NW FL Bay	G	G	G	In NW FL Bay, spoonbills have been successful 8 of the last 10 years.	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	Y	Y	The overall score for nesting success is the lowest score of the four component metrics. In this case, both the nesting success and nesting production in NE FL Bay are yellow. Therefore the overall score is red.	The greater sensitivity to the spoonbill nesting cycle by water managers has increased the possibility of nesting success during favorable climatic conditions, however, until the C-111 Spreader Canal Project is completed, there will still be limitations on maintaining favorable conditions resulting in a prospectus of yellow.
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 3% 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.

The Last Status column reflects data prior to 2007.

The Current Status column reflects data collected in the 2006-2007 nesting cycle.

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.

Florida Bay Submersed Aquatic Vegetation

Summary Findings

The Composite Index that summarizes overall system status for SAV in Florida Bay shows an improvement to good in the Central Zone for water year 2009 (May 2008-April 2009) compared to the 2007 assessment. All other zones had the same overall scores in 2009 as in 2007 despite both positive and negative changes in the underlying indexes. The Composite Index for 2009 was good in the Northeast and Western Zones, and fair in the Transition and Southern Zones.

Key Findings

1. The Abundance Index (combining both spatial coverage of bottom area and average density indicators) was good in the Northeast and Western Zones, fair in the Central and Transition Zones, and poor in the Southern Zone. Underlying indicators reflect good spatial coverage of SAV in almost all basins throughout the bay but mixed results in the density indicator, reducing the overall Index scores for some basins. Notably the abundance was poor in both Madeira Bay and Twin Key Basin.

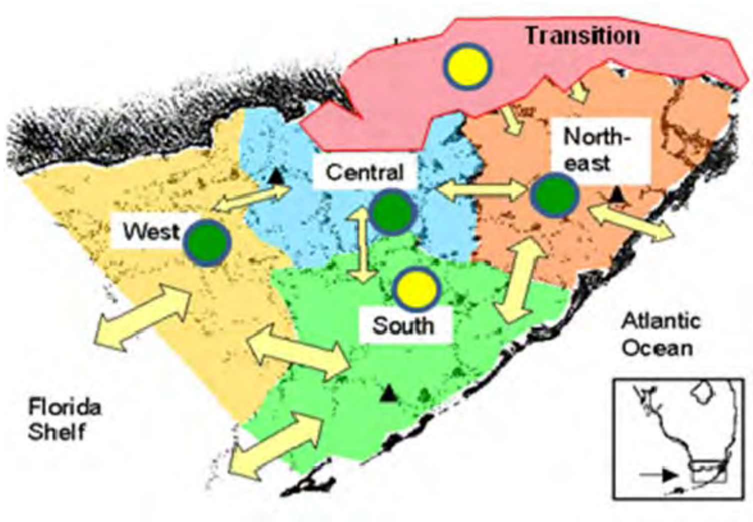
2. In general, the Target Species Index, which combines indicators for species diversity and presence of desired species, showed continued good status in the Northeast, Central, and Western Zones and improvement from poor to fair in the Southern Zone reflecting increased community diversity. Only the Transition Zone showed continued weakness, with Target Species Index scores of fair for 2006-2009. Most zones showed scores of good for presence of target species but the Transition Zone had an aggregate score of poor for the lack of community diversity.

3. Basins in the Northeast Zone have generally good SAV density and good spatial coverage scores. In some basins, SAV density is generally low but due to the oligotrophic nutrient character of the region, low productivity is considered normal and these levels qualify for good scores for the Abundance Index. However, Northeast basins that were affected by an algal bloom from 2005-2008 (chiefly Barnes and Blackwater Sounds) were negatively impacted, with reductions in both density and extent of SAV. The affected basins showed some improvement in both indicators toward pre-bloom status in 2009, although not yet enough to be significant. In the Transition Zone it is notable that Little Madeira Bay, at the mouth of Taylor River and which formerly scored consistently in the good range, fell to a poor score for the Target Species Index in 2009, scoring poor in both the underlying target species and species diversity indicators.

Note:

Due to the addition of stations in some of the zones and input of new data, some of the indicator and index scores were recalculated for 2006 and 2007, reflecting slight changes from previous reporting. For additional information on SAV indicators see Madden et al. 2009.

A two-year prospectus was not developed for SAV at the time this report was prepared.



Map of SAV indicator zones with current status indicators combining abundance and species indexes.

Florida Bay Submersed Aquatic Vegetation

Zone/ Performance Measure	'06	'07	'08	'09	CURRENT STATUS
Northeast Zone					
Abundance	G	G	G	G	The aggregate Abundance Index is in the good range for the Northeast Zone with spatial extent scores increasing to 0.91 and 0.93 for years '08 and '09 (max=1). Effects of the '05-'08 algal bloom continue to impact SAV in basins flanking US 1 resulting in fair scores for the density component in Barnes, L. Blackwater, and Blackwater in '08 and '09.
Target Species	Y	G	G	G	Target species scores improved from fair in '06 to good in'07- '09 in the Northeast Zone, reflecting increased presence of subdominant species *Halodule* and *Ruppia.*
Transition Zone					
Abundance	G	Y	Y	Y	The aggregate Abundance Index for the Transition Zone was fair in 2009, having decreased each year from '07 through '09 due mostly to reduced seagrass density, with notable declines in Joe Bay and L. Madeira Bay, and improvement in Long Sound. Despite declining density, the spatial extent component of the index is good for most basins except Highway Creek and Joe Bay where it is fair.
Target Species	Y	Y	Y	Y	The aggregate Species Index is fair for 2009 in the Transition Zone as in previous years. The target species component is generally good, although in Little Madeira it has declined to poor, while the species dominance component is poor or fair in all Transition Zone basins.
Central Zone					
Abundance	R	R	Y	Y	Abundance Index in the Central Zone was in the fair range in '08-'09, an improvement from '06-'07. Spatial coverage was generally very good but low density reduced the underlying density indicator score for the zone and the overall Index.
Target Species	Y	Y	G	G	Increasing presence of secondary target species (*Halodule* and *Ruppia*) in the Central Zone has improved the aggregate Species Index in this region to good in '08 to '09 after fair scores in '06-'07.
Southern Zone					
Abundance	R	R	R	R	The Southern Zone continues to reflect a poor rating in the Abundance Index in '09 as in previous years. Despite high scores for spatial extent, composite scores were reduced by low scores for density in the poor range.
Target Species	R	R	R	Y	The Species Index improved to fair in the Southern Zone for '09 from poor in the previous three years. The species dominance component remains poor although target species improved in '09, elevating the overall index.
Western Zone					
Abundance	Y	Y	G	G	The Western Zone had high scores for the Abundance Index, with values in the good range for both extent and density in '08-'09, an improving trend from '06-'07.
Target Species	G	G	G	G	The Western Zone continues to reflect high scores for the Species Index, as the target species component was in the good range from '06-'09. The underlying species dominance and target species scores show a good mix of desired species for the zone.

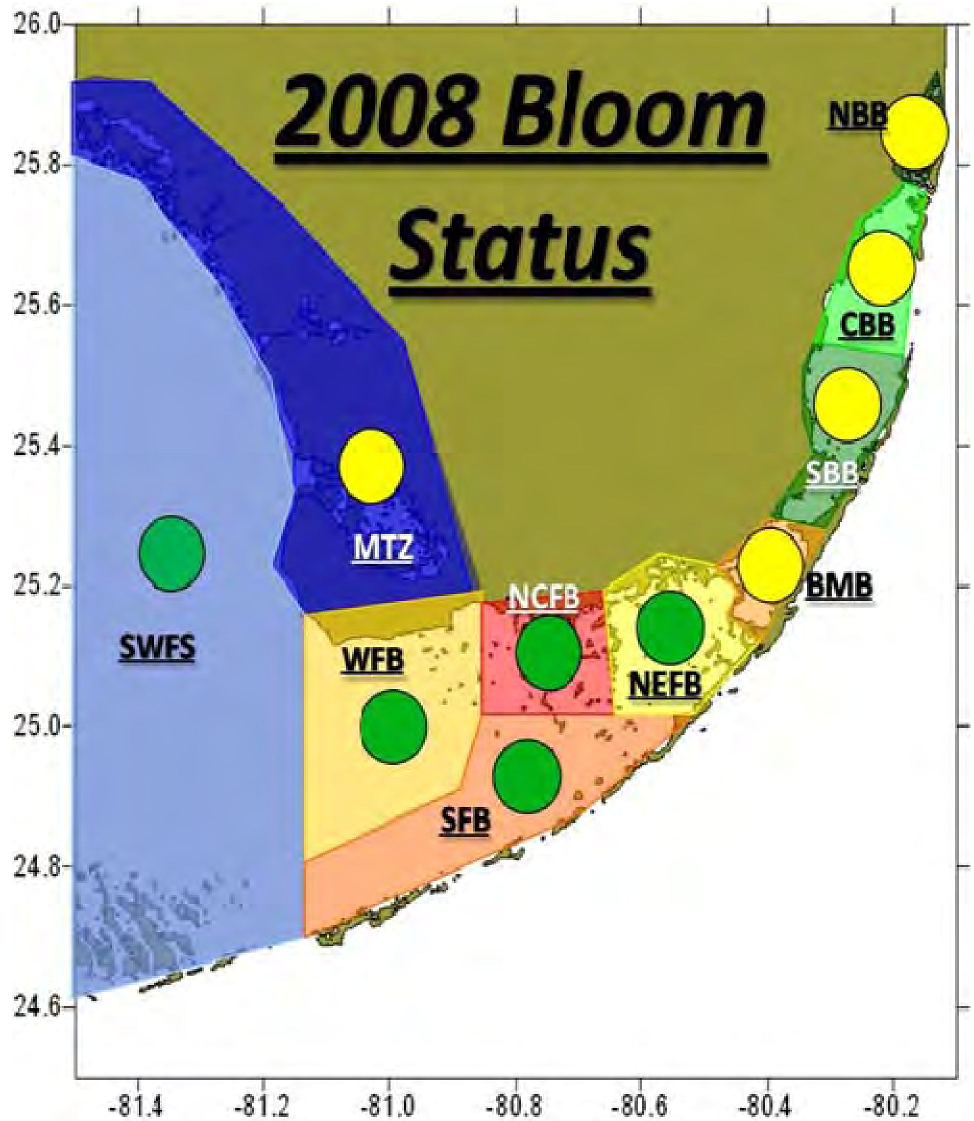
Florida Bay Algal Blooms

Summary Findings

Elevated nutrients from the active 2005 hurricane season resulted in algal blooms in many sub-regions of the southern coastal system (SCS) in 2006 and 2007. These blooms have since subsided and many sub-regions returned to green condition in 2008. This may have been in part due to the drought lowering freshwater flow and thus nutrient loading to the SCS during 2008. As the drought lessens and rainfall increases, it is expected that more sub-regions may receive a yellow condition. If water flows to the SCS are improved and there is not significant hurricane activity, this indicator could return to predominantly green for all sub-regions. If water flows do not improve, many areas will be predominantly yellow.

Key Findings

1. The majority of sub-regions assessed had significant algal bloom activity in 2006 that appears to have been predominantly influenced by the active 2005 hurricane season aggravated for eastern Florida Bay by road construction on US-1.
2. The majority of sub-regions assessed had chlorophyll-*a* and algal blooms rated as good (green).
3. The sub-regions assessed where chlorophyll-*a* was higher than the median do not appear to be indicative of long-term negative trends.
4. Overall excess nutrients (eutrophic expressions) were geographically minimal and appear to be explainable from existing phenomenological conditions of hurricane activity exacerbated by road construction along US-1 in Barnes, Manatee, and Blackwater Sounds (BMB).
5. If water flows are improved, the SCS water quality could improve and the magnitude and frequency of algal blooms could diminish.
6. Monitoring of BMB was critical to detect and quantify the impacts of road construction along US-1. This short duration disturbance resulted in a multi-year algal bloom that as of 2008 had not returned to background conditions.
7. Although the BMB algal bloom lasted several years, there is the possibility that its ecological consequences, including the loss of benthic grazers, could last for decades and leave the area more susceptible to future algal blooms.
8. Monitoring long-term consequences of nutrient releases into the SCS from both natural (e.g., hurricanes) and human causes (e.g., road construction) and their interactions with hydrological restoration (e.g., more freshwater flow into the SCS, particularly Florida Bay) are critical to continuing the evaluation and assessment of restoration.



Map of the SCS with stoplight ratings by sub-region.

Florida Bay Algal Blooms

Zone/ Performance Measure	'06	'07	'08	2-YEAR PROS-PECTS	CURRENT STATUS	2-YEAR PROSPECTS
Chlorophyll *a* **BARNES, MANATEE & BLACKWATER SOUNDS (BMB)**	R	R	Y	G	This sub-region experienced an unusual cyanobacterial bloom in 2006. The bloom was initiated by a large spike in phosphorus from a combination of highway construction and canal releases in response to the active hurricane season. Through 2008, this bloom has decreased, but chlorophyll concentrations have not returned to previous levels.	We expect that this area will return to its green condition that existed from 1995 until 2006 as both chlorophyll *a* and nutrients have been consistently declining from their peak in 2006.
Chlorophyll *a* **NORTHEAST FLORIDA BAY (NEFB)**	Y	G	G	G	The cyanobacterial bloom from Barnes, Manatee, and Blackwater Sounds no longer propagates into this sub-region causing this sub-region to remain highly oligotrophic.	The persistent green condition for this sub-region of the bay depends on water management activities in the C-111 basin and Taylor Slough.
Chlorophyll *a* **NORTH-CENTRAL FLORIDA BAY (NCFB)**	Y	G	G	Y	The current status is due to the lack of a seasonal cyanobacterial bloom in both 2007 and 2008. These blooms do not appear every year, but have occurred intermittently over the past 15 years.	If water management improves flows of water to Florida Bay via McCormick Creek it is expected that this cyanobacterial bloom could become less frequent and pronounced.
Chlorophyll *a* **SOUTH FLORIDA BAY (SFB)**	Y	R	G	G	The current status is green and reflects the absence of the cyanobacterical bloom extension from the north-central sub-region during 2008. This has occurred intermittently over the past 15 years and is expected to continue to do so in future, especially after the passage of hurricanes.	If water management improves bloom conditions in the north-central sub-region, it is likely the north-central bloom will rarely extend into this sub-region.
Chlorophyll *a* **WEST FLORIDA BAY (WFB)**	G	G	G	Y	Since 2006, the seasonal diatom blooms in this sub-region have not been as dense or widespread as in the past.	This sub-region is influenced primarily by Shark Slough outputs and southerly transport of Gulf of Mexico water along the SW Florida Shelf. Conditions are therefore dependent on external forcing, as well as water management along the southwest coast.

The 2-Year Prospects 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.

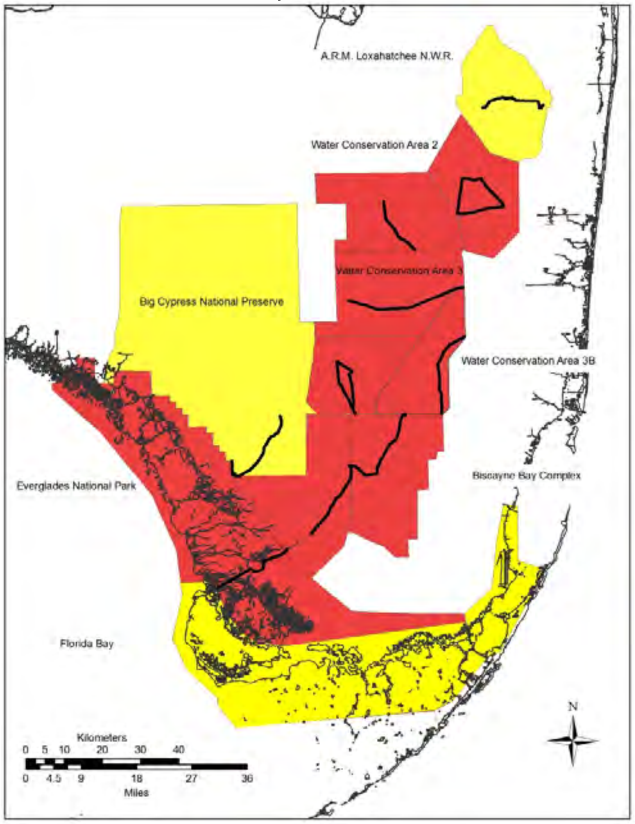
Zone/ Performance Measure	'06	'07	'08	2-YEAR PROS-PECTS	CURRENT STATUS	2-YEAR PROSPECTS
Chlorophyll *a* **MANGROVE TRANSITION ZONE (MTZ)**	Y	G	Y	Y	The chlorophyll concentrations were slightly higher in this sub-region during 2008. This concentration was not significantly above the baseline and is unlikely to indicate a negative long-term trend.	Without any major hurricanes, it is expected that this sub-region will remain yellow due to seasonal diatom blooms.
Chlorophyll *a* **SOUTHWEST FLORIDA SHELF (SWFS)**	Y	G	G	Y	The chlorophyll concentrations were slightly higher in this sub-region during 2006, but have since decreased likely in part due to the droughts decreasing freshwater flow to the southwest Florida shelf and minimizing the seasonal diatom bloom.	This sub-region is influenced primarily by Shark Slough outputs and southerly transport of Gulf of Mexico water. As rainfall increases from the drought of 2008, diatom blooms may increase in this sub-region.
Chlorophyll *a* **NORTH BISCAYNE BAY (NBB)**	Y	Y	Y	Y	The chlorophyll concentrations have been slightly higher in this sub-region since 2006. However, concentrations were not significantly greater than baseline for any of the three years.	Without any major hurricanes, it is expected that this sub-region will remain yellow.
Chlorophyll *a* **CENTRAL BISCAYNE BAY (CBB)**	Y	Y	Y	Y	The chlorophyll concentrations have been slightly higher in this sub-region since 2006. However, concentrations were not significantly greater than baseline for any of the three years.	Without any major hurricanes, it is expected that this sub-region will remain yellow.
Chlorophyll *a* **SOUTH BISCAYNE BAY (CBB)**	Y	Y	Y	Y	The chlorophyll concentrations have been slightly higher in this sub-region since 2006. This area was influenced by periodic expansion of the cyanobacterial bloom from Barnes, Manatee, and Blackwater Sounds into this sub-region in 2006. However, concentrations were not significantly greater than baseline for any of the three years.	Without any major hurricanes, it is expected that this sub-region will remain yellow.

The 2-Year Prospects 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.

Crocodilians (Alligators & Crocodiles)

Summary Findings

On the whole, alligator and crocodile status remained constant during 2009, with only one area (Big Cypress National Preserve) showing an increase in status compared to previous years. However, the majority of locations show substantial deviations from restoration targets; therefore restoration actions are merited. Status of alligators and crocodiles are expected to improve if hydrologic conditions are restored to more natural patterns.



Key Findings

1. Alligator overall status at the A.R.M. Loxahatchee National Wildlife Refuge is the highest in south Florida.
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. Overall status of alligators throughout ENP is below restoration targets and requires action to meet restoration goals.
4. Growth and survival components for crocodiles, while below restoration targets, appear stable at this time and are expected to improve with restoration of timing and amount of freshwater flow to estuaries.
5. Restoration of patterns of depth and period of inundation and water flow is 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.

Map on left depicts the Greater Everglades with stoplight ratings by region.

Zone/ Performance Measure	LAST STATUS	CURRENT STATUS	2-YEAR PROSPECTS	CURRENT STATUS	2-YEAR PROSPECTS
American Crocodile					
Everglades National Park	Y	Y	Y	Juvenile growth (component score = 0.5) and survival (component score = 0.5) combined for a location score of 0.5 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 survival (component score=0.5) does not meet restoration criteria. Data are not currently available to calculate juvenile growth.	Management objectives play an important part in determining success here. If conditions remain constant for survival, prognosis for the future will be stable for this component.

Zone/ Performance Measure	LAST STATUS	CUR-RENT STATUS	2-YEAR PROS-PECTS	CURRENT STATUS	2-YEAR PROSPECTS
American Alligator					
A.R.M. Loxahatchee National Wildlife Refuge	Y	Y	Y	Relative density (component score = 0.67) and body condition (component score = 0.5) combined for a location score of 0.59 and so current conditions do not meet restoration criteria, signifying that this area needs further attention.	A.R.M. Loxahatchee National Wildlife Refuge 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) and body condition (component score = 0.5) combined for a location score of 0.25 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	R	R	R	Relative density in two of the three locations within WCA-3A is low (northern and central areas) and higher (yellow) in the southern area; body condition scores are yellow in all three areas. The combined score of both components for the overall area is 0.39, which is well below restoration criteria.	The southern area of WCA-3A has the highest status (yellow), and can be used as a reference for conditions in the northern and central 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 ENP is low (red). Body condition is higher (yellow) in Shark Slough, northeast Shark Slough and estuarine areas. The combined score of these two components for the overall area, and alligator hole occupancy in the inaccessible areas, is 0.37, which is well below restoration criteria.	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	Y	Y	Relative density (component score = 0.17) and body condition (component score = 0.67) combined for a location score of 0.42 and so current conditions do not meet restoration criteria. The change in status reflects availability of data to detect trends.	Big Cypress National Preserve management objectives will play a direct role in determining success here. If conditions remain constant, prognosis for the future will be stable.

The Last Status column reflects data prior to and inclusive of calendar year 2006.
The Current Status column reflects data inclusive of calendar years 2005-2009.
The 2-Year Prospects column is based on the following assumption: there will be no changes in water management from the date of the current status assessment.

Oysters

Summary Findings

On the whole, Eastern oyster status remained constant up to 2010. It should be cautioned that the duration of monitoring for this species in the estuaries is relatively short (4-9 years) and hence trend data should be treated with caution while inferring status of this indicator. Continuing monitoring will yield data to make trend and status assessments in the coming years and will strengthen the confidence of the status. Current conditions in the Caloosahatchee Estuary show deviations from restoration targets, therefore restoration actions are merited. For example, relatively dry years during the past three years has resulted in higher disease prevalence and increased predation and mortality of juvenile oysters and spat recruitment. Status of oysters is expected to improve if hydrologic conditions are restored to more natural patterns.

Key Findings

1. Preliminary results suggest that oyster status in most of the Northern Estuaries remains stable. It should be cautioned that insufficient data exists for the Southern Coastal System to infer trends and make statistical comparisons.
2. There is too much freshwater inflow into the Caloosahatchee and St. Lucie estuaries in the summer months and too little freshwater inflow into the estuary in the winter months, disrupting natural patterns and estuarine conditions. The oysters in both of these estuaries are still being impacted by this unnatural water delivery pattern. Too much freshwater impacts reproduction, larval recruitment, survival, and growth. Too little freshwater impacts the survival of oysters due to higher disease prevalence and intensity of *Perkinsus marinus* and predation; this appears to be occurring in the Lake Worth Lagoon.
3. Overall status of oysters in all of the Northern Estuaries is below restoration targets and requires action in order to meet restoration goals.
4. Oyster responses and populations in the Northern Estuaries are below targets and may be in danger of declines under current salinity levels. Growth rates and recovery rates for abundances suggest that oyster index scores could be 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.

Continued monitoring of oysters in the Northern Estuaries and Southern Coastal System will provide an indication of ecological responses to ecosystem restoration and the ability to distinguish between responses to restoration and natural variation.

The last status column reflects data collected prior to calendar year 2000.
The current status column reflects data collected between calendar years 2000 – 2009.
The 2-year prospects column uses the following assumption: there will be no changes in the water management from the date of the current status assessment.

Zone/ Performance Measure	LAST STATUS	CUR-RENT STATUS	2-YEAR PROS-PECTS	CURRENT STATUS	2-YEAR PROSPECTS
Eastern Oyster					
Caloosahatchee Estuary		Y	Y	The oysters in the Caloosahatchee Estuary are still being impacted by too much freshwater in summer and too little freshwater in the winter. Too much freshwater impacts reproduction, larval recruitment, survival, and growth, while too little freshwater impacts the survival of oysters due to higher disease prevalence and intensity of *Perkinsus marinus* and predation. For example, the past 3 years have been dry years resulting in higher *P. marinus* prevalence values in oysters. 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. However, if dry conditions were to persist, it will result in higher disease prevalence and predation of oyster spat and will result in decrease in oyster index score (from yellow to red). If the hydrological conditions remain the same, we do not expect to see an improvement in oyster responses in this estuary.
St. Lucie Estuary - North		Y	Y	The oysters in the St. Lucie River Estuary are being impacted annually by too much freshwater, especially in late summer. Oysters in the North and South Fork are consistently rated as failing. In the central portion of the estuary, densities reached caution level in the last three years. Reduced condition and recruitment are typical. Oysters are capable of growth only during brief periods of improved conditions. 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 St. Lucie Estuary. If conditions remain at or below optimal salinities, prognosis for the future will be continued decline of existing oyster populations. The oyster index score will drop from a mix of yellow (cautionary) and red (failing), depending on location, to red (failing).
St. Lucie Estuary - South		R	R		
St. Lucie Estuary - Central		Y	Y		
Loxahatchee Estuary - North		Y	Y	The oysters in the Loxahatchee Estuary are still being impacted by some periods of too much freshwater in summer and too little freshwater in the winter. Current conditions do not meet restoration criteria, signifying that this area needs further attention. Although abundances are rising slightly, extended periods of high salinity result in increased prevalence and intensity of disease and reduced condition and reproduction.	If current conditions persist, increased disease and predation combined with reduced condition, growth, and reproductive output will result in declines in the oyster index score, with the overall score falling to red (failing).
Loxahatchee Estuary - South		R	R		
Lake Worth Lagoon		Y	Y	The oysters in the Lake Worth Lagoon are still being impacted by some periods of insufficient freshwater, especially during winter months. Current conditions do not meet restoration criteria, signifying that this area needs further attention. Although abundances are rising slightly, extended periods of high salinity result in increased prevalence and intensity of disease and reduced condition and reproduction.	If current conditions persist, increased disease and predation combined with reduced condition, growth, and reproductive output will result in declines in the oyster index score, with the overall score falling to red (failing).
Lostman's River (Southern Coastal System)		Y	Y		

Summary Findings

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, 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 has 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.

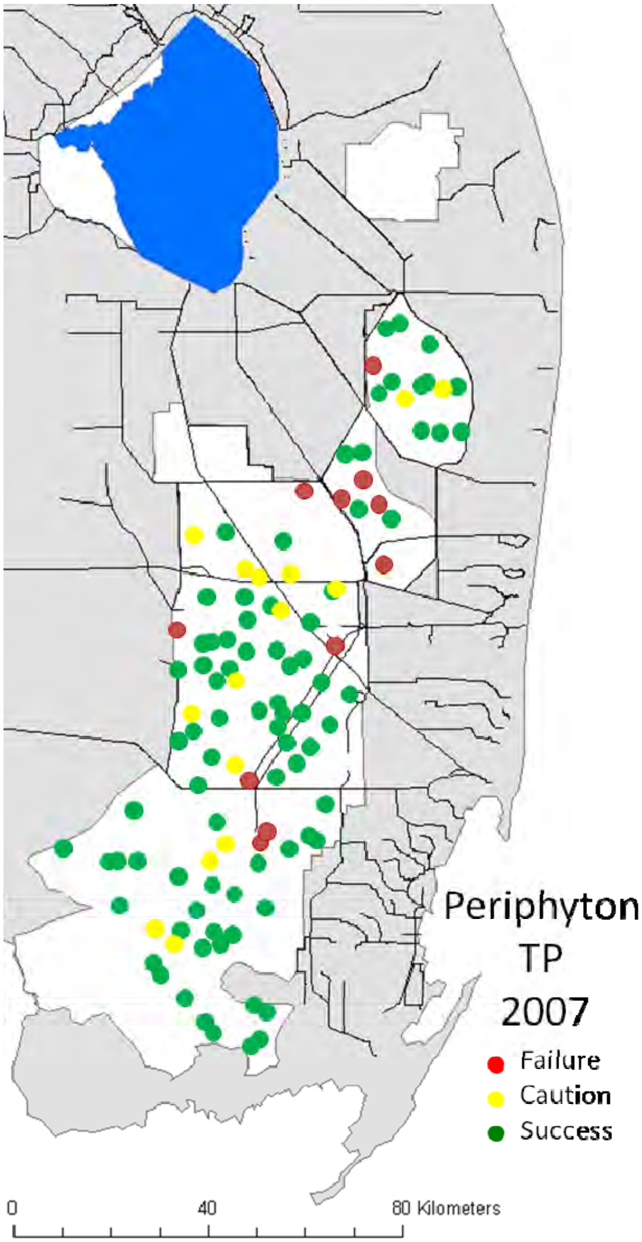
Enrichment in central WCA-3A, noted in 2005 and 2006, was less pronounced in 2007, while signals of enrichment were noted near the peripheral canals.

Shark River and Taylor Sloughs have remained relatively free of enrichment or hydrologic modifications in the sampled areas, although enrichment has been noted downstream of the S-12 structures on the Tamiami Trail (Shark Slough) and near the S-332 structures and C-111 canal (Taylor Slough).

Key Findings

1. A total of 11% of sites had “altered” periphyton TP levels. This was lower than observed in 2006 (26%) and 2005 (25%) due primarily to a reduction in the number of altered sites in WCA-3A. This reduction may be due to depleted canal flows into WCA-3A during this relatively dry year.
2. A total of 14% of sites were coded yellow for periphyton TP, and were located in similar locations to those detected in 2005 and 2006, primarily downstream of canal inputs.
3. A total of 55% and 39% of sites were coded yellow or higher for biomass and species composition (not shown), primarily loss of biomass and native species in response to P enrichment.
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.

The map shows the location of long-term monitoring sites and reflects annual assessments for the Total Phosphorus (quality) performance measure. The table on the right reflects the average stoplight score within each region for biomass, quality, and composition.



Zone/Performance Measure[a]	2005 STATUS	2006 STATUS	2007 STATUS	2-YEAR PROS-PECTS	CURRENT STATUS[b]	2-YEAR PROSPECTS
WCA-1						
Biomass	Y	Y	Y	Y	Periphyton shows enrichment near canals and calcareous mat biomass has increased at some sites due to calcite input from canals.	If canal impacts remain low, status should remain same; increased inputs may cause further enrichment and calcification of mats.
Quality	Y	Y	Y	Y		
Composition	Y	Y	Y	Y		
WCA-2A						
Biomass	Y	Y	Y	Y	Periphyton TP and composition continue to reflect high P input to this wetland, particularly downstream of water flow structures.	If canal P inputs remain above ambient, more sites will be enriched, further damaging periphyton structures and biomass.
Quality	R	Y	R	Y		
Composition	Y	Y	Y	Y		
WCA-3A						
Biomass	Y	Y	Y	Y	This area has received some low-level P enrichment, particularly near canals. Evidence was less pronounced in this drier year.	If canal P inputs remain above the protective criterion, status will remain similar or perhaps worsen over time.
Quality	Y	Y	Y	Y		
Composition	Y	Y	Y	Y		
Shark River Slough (SRS)						
Biomass	Y	Y	Y	Y	Shark River Slough has received low-level P enrichment for decades, reflected in biomass, quality, and composition, particularly downstream of the S-12 structures.	Increased flow through culverts and Tamiami Trail modifications may encourage periphyton in dry areas, but above-ambient P inputs will cause negative change.
Quality	Y	Y	Y	Y		
Composition	G	Y	Y	Y		
Taylor Slough (TS)						
Biomass	G	G	G	G	Taylor Slough has remained relatively unimpacted to the interior due to low levels of disturbance and low P inputs, except near the S-332 control structures.	Periphyton production may incrase with increased water delivery to TS, but quality could be threatened if poor quality water continues to drain through the eastern boundary of ENP.
Quality	G	G	G	G		
Composition	G	G	G	G		

[a]Each wetland basin is scored with a red, yellow, or green symbol for each indicator, based on the proportion of sites falling within these categories in assessment (yellow if > 25% of sites are coded yellow or red; red if > 50% of the sites are red). Biomass = ash-free dry mass (gmS2), quality = total phosphorus content (mg gS1), and community composition = diatom similarity (%).
[b]Data in the Current Status column for the periphyton indicator reflect data inclusive of calendar year 2007.

Juvenile Pink Shrimp

Summary Findings

The six strategically located assessment areas of the MAP Fish and Invertebrate Assessment Network (FIAN) allow documentation of the status of pink shrimp populations during the critical period when they are on their nursery grounds. Abundance metrics vary in magnitude and are consistently highest in Johnson Key Basin and lowest in eastern Florida Bay (historical means of 12.98 vs. 0.13, and 2.55 vs. 0.05, shrimp/m^2 for Fall and Spring, respectively). The historical record used to create assessment thresholds for green, yellow, and red scores consists of only 2 years for all areas except Johnson Key Basin and South Biscayne (18 and 5 years, respectively), suggesting caution in interpreting scores. Five MAP years provide a good start toward a representative view of temporal and spatial variability.

Key Findings

1. Overall, there were no improvements in pink shrimp abundance through the 5-year period of MAP sampling by the FIAN, and only the South Biscayne assessment area was consistently green.
2. Fall 2008 conditions were apparently relatively favorable for pink shrimp (based on the historical record) in Whitewater Bay and South Biscayne assessment areas and nowhere else.
3. Low abundances based on very short historical records apparently did not set thresholds unrealistically low in eastern, north-central, and south-central Florida Bay, since pink shrimp abundance performed even more poorly in subsequent years.
4. Historical data series for areas other than Johnson Key Basin and South Biscayne are too short to provide reliable thresholds for evaluating CERP effects. MAP data currently being collected will be used to update the thresholds before significant CERP implementation.

Key Recommendations

1. Continue monitoring pink shrimp abundance in the six assessment areas to expand baseline datasets using the same sampling design.
2. Compare temporal patterns of change in pink shrimp abundance in the six areas to determine whether or not they change in synchrony suggesting a common forcing function.
3. Examine salinity patterns prior to the faunal collections to look for potential causality.

Note: A two-year prospectus was not developed for SAV at the time this report was prepared.

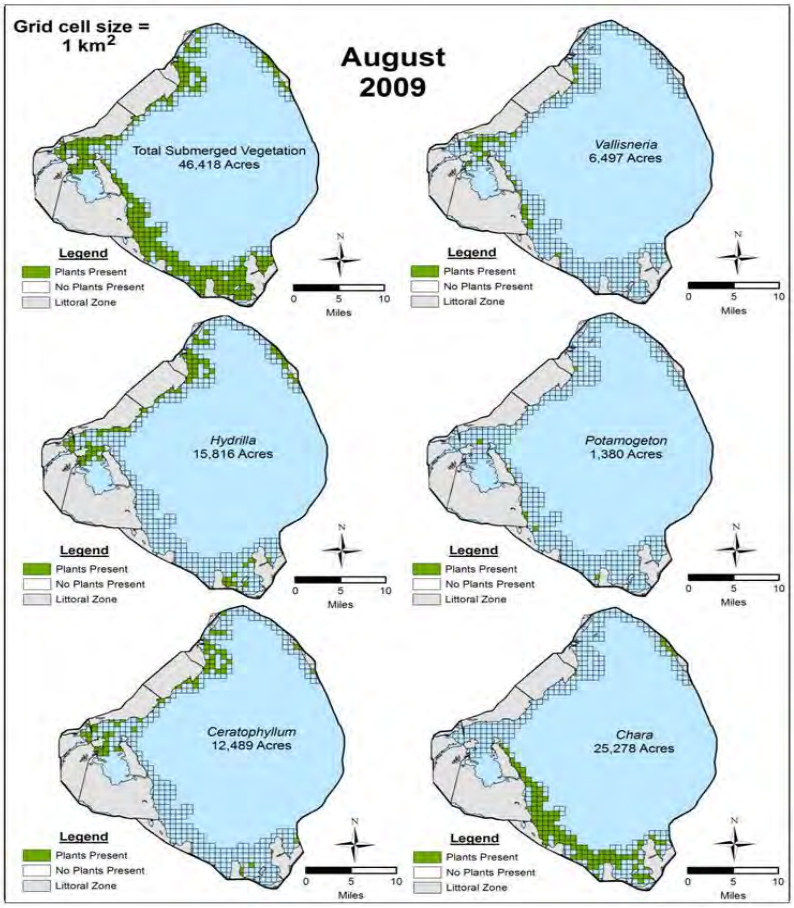
The six pink shrimp assessment areas (open yellow circles) in relation to the 19 FIAN sampling locations (green). Each assessment area is composed of either a single sampling location (Johnson Key Basin, South Biscayne) or aggregates of two (Whitewater, North-Central Florida Bay, South-Central Florida Bay, and Eastern Florida Bay).

Zone/Performance Measure	2005	2006	2007	2008	2009	CURRENT STATUS
Spring						
South Biscayne	G	G	Y	G	R	Overall this is the best performing of six areas in spring.
Eastern Florida Bay	R	Y	R	R	G	This area achieved positive status for the first time in 2009.
North-Central Florida Bay	G	G	Y	Y	R	5-year MAP record suggests declining trend.
South-Central Florida Bay	Y	R	R	Y	R	This area has performed poorly versus its histori-cal record.
Johnson Key Basin	G	Y	Y	Y	R	2009 was the poorest year versus 18-year histori-cal period of record.
Whitewater Bay	G	R	Y	G	G	Spring status continues to be good in 2009.
Fall						
South Biscayne	G	G	G	G	G	5-year historic criteria have proven easy to ex-ceed.
Eastern Florida Bay	Y	R	G	Y	R	Status was poor in 2009 versus the historical record.
North-Central Florida Bay	G	R	R	R	R	Poor performance exhibited in four of five MAP years.
South-Central Florida Bay	R	R	R	R	R	This is the worst performing of six areas in fall.
Johnson Key Basin	Y	G	R	Y	R	Poor performance exhibited in 2009 versus 18-year historical period of record.
Whitewater Bay	Y	Y	R	R	R	This area performed poorly in fall, unlike spring.

Lake Okeechobee Nearshore Zone

Summary Findings

A prolonged drought during 2007–2008 resulted in historically low lake stages and dry conditions across most of the nearshore region that previously contained vascular SAV. During this period when lake stage was significantly lower than the long-term mean stage over the past several decades, previously SAV-dominated areas inshore became dominated by emergent and terrestrial plants. Lake stage then increased during the fall of 2008 and was within the desired stage envelope during 2009. SAV responded by recolonizing these areas, increasing in areal coverage relative to that in 2007, with total acres increasing by approximately 64%, from 28,180 acres in 2007 to roughly 46,418 acres in 2009. The vascular SAV taxa which saw dramatic increases in areal coverage during this reporting period were coontail (*Ceratophyllum demersum*), Hydrilla (*Hydrilla verticillata*), and southern naiad (*Najas guadalupensis*). Each of these SAV taxa increased in areal coverage by >1000% from 2008 to 2009. The increase in peppergrass (*Potamogeton illinoensis*) was more modest (459%) from 2008 to 2009, while eelgrass (*Vallisneria americana*) areal coverage decreased by 31%. The target of at least 40,000 acres of SAV with ≥50% coverage by vascular SAV was achieved during summer 2009, as vascular SAV accounted for approximately 66% of the total SAV coverage. *Chara* areal coverage was similar over the past two years, ranging from 28,515 acres in 2008 to 25,278 acres in 2009 and thus has remained similar to pre-hurricane coverage observed during the summer of 2004. As the terrestrial and emergent plants in the inshore portion of the nearshore region become less dominant under lake stages which currently are higher than those observed during 2007–2008, SAV may continue to recolonize these areas if a viable SAV seed bank is still present and the lake remains in the desired lake stage envelope of 12.5 – 15.5 feet above mean sea level.



Map of Lake Okeechobee with SAV densities in the nearshore region for 2009.

Lake Okeechobee Nearshore Zone

Key Findings

1. Total SAV coverage increased by approximately 64% from 2007 to 2009. If the lake continues to remain in the stage envelope considered favorable for SAV growth, and disturbance events such as hurricanes and droughts are infrequent, SAV coverage may continue to increase.

2. *Chara spp.* areal coverage has remained at approximately pre-hurricane levels although the location of beds is offshore relative to its previous distribution prior to the prolonged drought of 2007–08. *Chara* probably will not recolonize its previous range until emergent and terrestrial plant densities markedly decrease.

3. Dramatic increases in areal coverage were observed for several vascular SAV taxa during this reporting period. Coontail increased from 477 acres in 2008 to 12,489 acres in 2009, while Hydrilla increased from 1,150 acres to 15,816 acres, and southern naiad increased from 1,208 acres to 13,500 acres. Peppergrass increased from 247 acres to 1,380 acres during the past 2 years, while eelgrass coverage changed little (9,405 acres in 2008 to 6,497 acres in 2009) and remained similar to that prior to the 2004 hurricanes (roughly 8,200 acres). Hydrilla and peppergrass areal coverage are still somewhat lower than they were during the summer of 2004 (Hydrilla – 24,500 acres, peppergrass – 6,700 acres), although at their present rate of expansion, they may exceed 2004 coverage during summer, 2010.

4. Seedbank studies were conducted to assess whether viable vascular SAV seeds existed in the nearshore region but farther offshore from where vascular plants typically have been observed over the past decade. The areas where sediment was collected for these seedbank studies were located just offshore from where the inshore emergent and terrestrial plants became dominant in 2007. The study results suggested that very few viable seeds were located further offshore relative to where SAV had been found prior to the hurricanes in 2004.

5. Maintaining the lake within the recommended stage envelope as often as possible, which the current lake operating schedule should assist in doing, is important for the continued reestablishment and maintenance of the vascular SAV community. Maintaining this range of lake stages also should continue to reduce the densities of emergent and terrestrial vegetation in the inshore areas of the lake, thereby enabling SAV to recolonize areas where it previously was found.

Zone/ Performance	LAST STATUS	CURRENT STATUS	2-YEAR PROSPECTS	CURRENT STATUS	2-YEAR PROSPECTS
Submersed Aquatic Vegetation Areal Coverage NEARSHORE REGION	R	G	G	SAV coverage, especially vascular plant coverage, has increased since 2007. *Chara spp.* coverage has remained relatively constant over the past 2 years. Vascular plant coverage dramatically increased for *Ceratophyllum*, *Hydrilla*, *Najas,* and *Potamogeton* over the past 2 years, *Vallisneria* coverage decreased slightly. Vascular SAV accounted for approximately 27,931 total acres or 66% of total SAV.	The SAV response to reflooding upon the return to desired lake stages has been positive to date. As long as the lake remains within the desired lake stage envelope, it is anticipated that SAV areal coverage will continue to increase or at least remain similar to that observed during summer, 2009. Implementation of the LORRS 2008 lake regulation schedule should mitigate in favor of a downward shift in lake stages that might favor SAV expansion.

[a]The previous status was 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.
[b]The current status column is based on peak 2009 (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 assumptions being used for the 2-Year Prospects Column are that here will be no large changes in the lake regulation schedule operations from the date of the current status assessment and SAV will continue to expand into formerly occupied inshore areas.

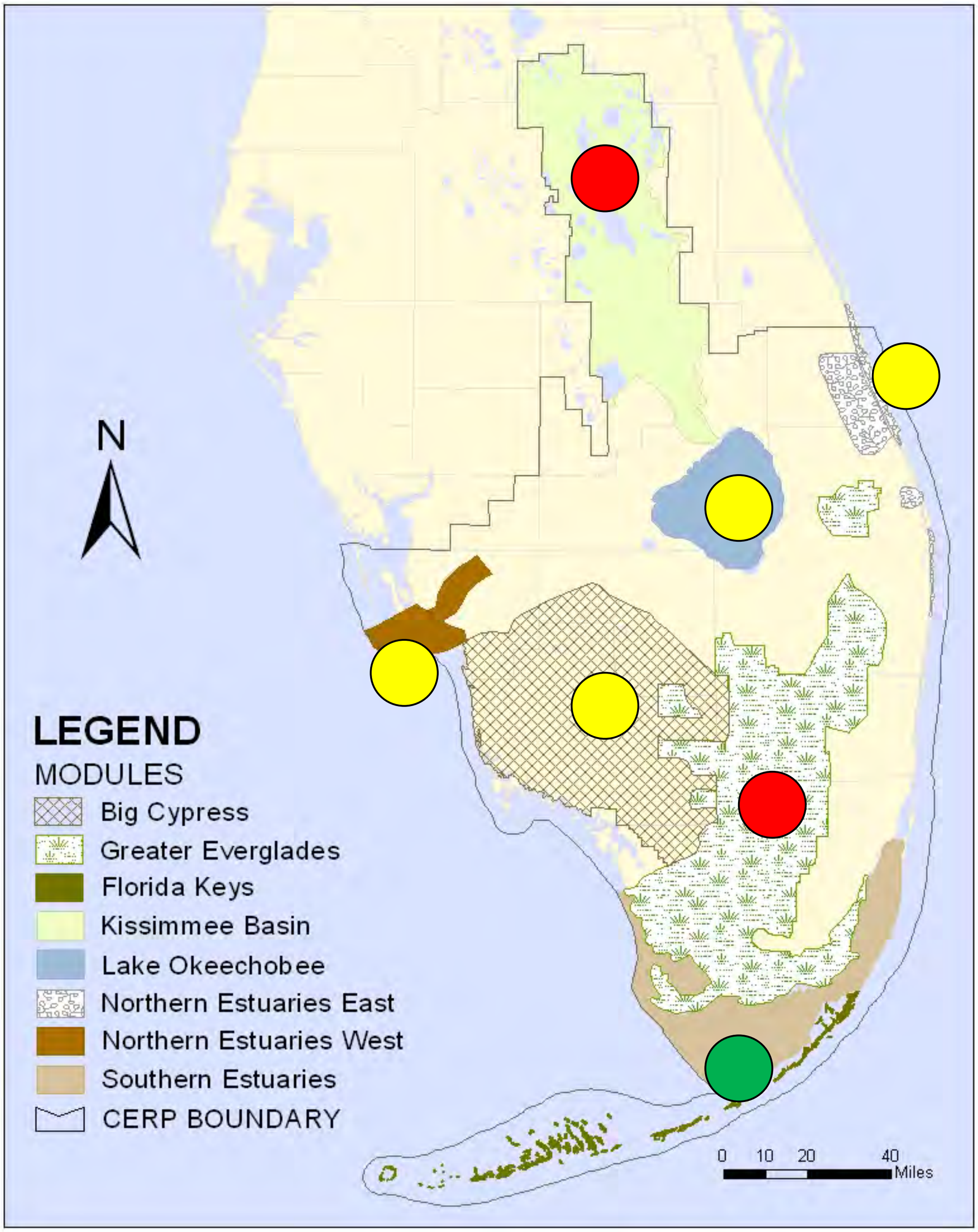
Invasive Exotic Species

Summary Findings

All modules have control programs for high priority invasive plant species on public lands, where progress continues for some species such as melaleuca. Brazilian pepper and Old World climbing fern continue to be serious invaders in most modules, although some localized progress is documented. However, decreasing funding trends threaten to reverse progress as maintained areas become re-infested. Land managers continue to detect new non-indigenous species, and often lack information on distribution and control methods. Invasive plant management on private lands remains deficient in all modules, ensuring continued invasion vulnerability to conservation lands. The Greater Everglades Module remains the only region with a systematic monitoring program for established species and there is some progress toward developing an early detection monitoring network there. Other modules have insufficient monitoring programs for tracking invasive species.

Key Findings

1. Control of invasive plants is successful for a few species, but only on public lands.
2. Biological control of melaleuca continues to be an important component of integrated pest management for this species. Three agents are now well-established and melaleuca reduction is documented.
3. New insects have been released for several other serious invasive plants, and other agents are in development for release within 1-2 years. Significant progress towards implementation of the CERP biological control project is likely to further successes in biological control throughout south Florida.
4. Most of the modules have significant invasive exotic plant problems, which are affecting natural areas and altering natural habitats and processes. In most cases, invasive plant populations are not being systematically monitored.
5. Reduced funding for control is a serious threat to management success to date. Land managers are concerned that previously restored areas may become re-infested if resources limit active maintenance control.
6. Monitoring programs to assess the trends in invasive exotic plants only cover the Greater Everglades Module and for only six high-priority species.
7. 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 sufficiently monitored. Therefore, the ability to determine where and when new species arrive and establish is very limited.
8. Due to the scale of the problem, new species are becoming established, leaving the overall control picture mixed.
9. While good progress has been made with a number of species, we are still unable to control many 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.


N
LEGEND
MODULES
Big Cypress
Greater Everglades
Florida Keys
Kissimmee Basin
Lake Okeechobee
Northern Estuaries East
Northern Estuaries West
Southern Estuaries
CERP BOUNDARY
0 10 20 40
Miles

Invasive Exotic Species

Zone/ Performance Measure	LAST STATUS	CURRENT STATUS	2-YEAR PROS-PECTS	CURRENT STATUS	2-YEAR PROSPECTS
KISSIMMEE RIVER	Y	Y	R	**The Good:** Many priority invasive species are successfully managed, although some difficult-to-control species continue to threaten restoration goals. Successful control programs for water hyacinth, water lettuce, and melaleuca. A new biological control agent for water hyacinth becoming established. **The Bad:** Old World climbing fern distribution is expanding, and it is proving difficult to stay ahead of its spread. 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:** Existing control programs provide sustained maintenance control for many species, including melaleuca, and floating aquatic weeds, which is key in restoration efforts. **The Bad:** New arrivals to Florida, such as tropical water grass and Wright's nutrush, will likely continue to appear and pose new management problems; 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	Y	**The Good:** Progress with melaleuca, Brazilian pepper, and Australian pine, but infestations remain on adjacent private lands; a second biocontrol release for Old World climbing fern is showing promise. **The Bad:** Other species increasing, most not included in indicator monitoring programs; little known about many invaders.	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	Y	**The Good:** Much progress made with melaleuca, Brazilian pepper, and Australian pine, but significant infestations remain on private lands. **The Bad:** Other species gaining foothold and most not included in any indicator monitoring program; little known about many invaders and not able to assess their status in an objective or repetitive way.	Successes on public lands with several species are offset by increases in new species; other species localized but numerous; potentially serious invaders exist for which little is known about biology or spread; monitoring programs needed to improve control.

Zone/ Performance Measure	LAST STATUS	CURRENT STATUS	2-YEAR PROS-PECTS	CURRENT STATUS	2-YEAR PROSPECTS
BIG CY-PRESS	R	Y	Y	**The Good:** Good control of melaleuca and Australian pine; aggressive control program for Brazilian pepper and Old World climbing fern underway. Systematic monitoring program in place. **The Bad:** Two potentially serious invaders, crested floating heart and cogongrass, are present in module; control efforts for cogongrass ineffective.	Exotic populations decreasing significantly on publicly-owned areas; many species still localized.
GREATER EVER-GLADES	Y	R	R	**The Good:** Integrated control of melaleuca, Brazilian pepper, Old World climbing fern, and other species continue in Water Conservation Areas. Systematic monitoring program underway. No new serious invaders detected. **The Bad:** Brazilian pepper and Old World climbing fern still widespread in other areas and appear to be expanding; still several other species present with little or no control effort or efficacy.	The ability to maintain current control of priority species is threatened by declining resources. Biological controls for Old World climbing fern and Brazilian pepper are needed for successful control; ongoing monitoring efforts are improving management decision-making and tracking; other species still localized.
SOUTHERN ESTUARIES	Y	Y	Y	**The Good:** Control programs under way for many years; significant control achieved for Australian pine. Successful early detection and rapid response of a newly detected mangrove invader. **The Bad:** Several 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 the park, continues to expand.	Numerous new invasive species that are not included in a systematic control or monitoring program and are serious unknowns.
FLORIDA KEYS	Y	G	G	**The Good:** Much progress made on Australian pine, sickle bush, laurel fig, and other priority species. Well-developed management programs in place. Progress in developing region-wide early detection/rapid response network. **The Bad:** Populations of some priority species on private lands remain uncontrolled; continued use of some invasive species in private landscapes; potential expansion of Guinea grass a concern.	Significant control programs in place; progress on many species evident, continued monitoring and control needed to prevent reinvasions and new introductions.

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Additional Information

RECOVER Monitoring and Assessment Plan: http://www.evergladesplan.org/pm/recover/recover_map_2009.aspx

RECOVER System Status Report: http://www.evergladesplan.org/pm/ssr_2009/ssr_main.aspx#

System-wide Ecological Indicators for Everglades Restoration, 2008 Report: http://www.sfrestore.org/scg/documents/2008_System-wideIndicatorsReport.pdf

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