Appendix 7B-2: Draft Baseline CERP Annual Report Card

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INTRODUCTION

The *CERP Annual Report* Cards will provide an overview of the effects of the Comprehensive Everglades Restoration Plan (CERP) on the “health” of the South Florida environment by reporting on 14 “key indicators”. This report card is the first annual report card for the initial elements of the CERP, authorized by the Water Resources Development Act of 2000 (WRDA 2000) and Sections 373.026 and 373.1501 of the Florida Statutes. Now in the earliest stages of implementation, it is not expected that the CERP can yet show positive affects on the indicators of the health of the Everglades basin. Thus, the grades in this report card are indicative of baseline, or pre-CERP, conditions rather than improvements brought about by CERP implementation.

RECOVER is an interagency, interdisciplinary team sponsored by the United States Army Corps of Engineers (USACE) and the South Florida Water Management District (SFWMD). The role of RECOVER is to organize and apply scientific and technical information in ways that are most effective in supporting the objectives of the CERP, and in ensuring that the systemwide goals and purposes of the plan are achieved. RECOVER applies science and the tools of science to three broad mission areas of systemwide evaluation, assessment and planning. These linkages provide RECOVER with the scientific basis for meeting its overall objectives of evaluating and assessing CERP performance, refining and improving the plan during the implementation period, and ensuring that a systemwide perspective is maintained throughout the restoration program.

A major reason for issuing a report card so early in the implementation of the CERP that system responses are not yet possible is to assure the public that RECOVER will be reporting regularly on progress in meeting CERP restoration goals. It is important at this early stage both to familiarize the public with proposed key indicators that will be used for this purpose and to prompt public review and comment on the content and organization of this reporting document. An early objective of the report card is to make improvements in its content and organization in response to public review and comment.

WHAT IS A REPORT CARD?

A report card is a way to briefly and periodically summarize and update progress being made towards a goal or objective. A report card compares the recent or current status of one or more “indicators” with the status of these same indicators during earlier time periods and with interim and final goals that were set for each indicator. A report card also provides a “grade” of each indicator for the purpose of making comparisons among indicators and time periods and for providing either a quantitative (i.e., numerical) or qualitative (e.g., colors or symbols) measure of how well each indicator is reaching its interim and final goal(s). A report card should report on a consistent set of indicators over time, thereby standardizing the measures used to assess the progress being made towards one or more goals. Report cards are usually issued at regular and predictable intervals of time.

Report cards have been used in regional ecosystem restoration and protection programs in many areas of North America. Often, these report cards have been designed in multiple formats to inform a wide range of audiences. Commonly, the intended audiences include the interested public, stakeholders, managers, policymakers, legislators and other funding sources. In most locations, regularly issued report cards have become the primary means of keeping the intended audience informed on the progress of an environmental program.

THE CERP ANNUAL REPORT CARD

The CERP has been designed for the ecological restoration of the greater Everglades basin and to meet water supply and flood protection needs in South Florida’s various urban and agricultural regions. The magnitude of the restoration program and the political and financial commitment that will be needed to see it to completion require that the people of Florida, the nation and the world be regularly informed on the progress being made towards the CERP’s interim and final goals. To provide this measure of progress, a CERP Annual Report Card will be issued throughout the period of CERP implementation.

The objectives of the CERP Annual Report Card are to describe how South Florida’s natural and human systems are responding to CERP influences and to attempt to explain to the informed public why the observed responses are occurring. To meet these objectives, the report card will use a set of key indicators of environmental health for both natural and human systems in South Florida as a way to inform the public about CERP’s success.

The CERP Annual Report Card will grade each of the key indicators. The range of grades for the full set of key indicators is intended to be representative of the success the CERP is having in meeting its goals. Grades will be based on assessments of the status of each of the indicators for each year during CERP implementation. For most key indicators, one or more interim goals will be developed in addition to the final goal(s). Interim goals will indicate levels of improvement that are expected at appropriate intervals during CERP implementation. These interim goals will be added to the report card during the next one to two years.

The creation and production of the CERP Annual Report Card is a programmatic activity of the CERP, meaning that the report card will be used to show progress throughout the full duration of CERP implementation. The RECOVER Leadership Group has primary responsibility for designing and issuing the initial CERP Annual Report Card. The CERP Annual Report Card will be issued annually.

Implementation of the CERP is scheduled to occur over a 35-year time period beginning in 2001. Positive responses to the CERP, determined by key indicators in both the natural and human systems, will only occur as major water storage and delivery features of the CERP are completed and as ecological conditions have had adequate time to adjust to the hydrological and physical changes brought about by the CERP. For this reason, early editions of the CERP Annual Report Card will show little in the way of improvements. Nevertheless, it is important that

RECOVER begin to issue an annual report card from the beginning to help establish familiarity with the key indicators being used to report progress, and to elicit comment that can lead to improvements in the information provided in future report cards.

HOW THE CERP ANNUAL REPORT CARD HAS BEEN CREATED

The basic component of the CERP Annual Report Card is a set of key indicators. Key indicators proposed for the report card have been selected from a much larger number of technical performance measures contained in the *Draft RECOVER Monitoring and Assessment Plan* (RECOVER, 2002). Collectively, the key indicators show how the natural and human systems are responding to the changes brought about by CERP implementation. The specific criteria that were used for selecting the proposed key indicators were that each must (1) measure an element of the natural or human systems that the CERP is expected to improve; (2) be representative of the overall health of all, or a portion of, the regional system and of the goals of the CERP; (3) be an element of the regional system that is both important and relevant to the public and decision makers; (4) have a measure of baseline conditions (pre-CERP) as a means of tracking the responses brought about by CERP implementation; and (5) be understood well enough in the context of South Florida's natural and human systems for monitoring results to be interpretable.

The CERP Annual Report Card has evolved from a *Base Line Report for the Comprehensive Everglades Restoration Plan 1999* (RECOVER, 2000) issued by the RECOVER Leadership Group in 2000. The baseline report was issued to illustrate the proposed purpose and organization for the CERP Annual Report Card. The baseline report described the status and provided a grade for 10 key indicators of the environmental health of South Florida. The grades for the key indicators in the baseline report were for pre-CERP conditions and indicated the starting-point level of health for natural and human systems.

A two-day technical workshop was held on April 2 and 3, 2001 to review the key indicators contained in the baseline report and to propose additional key indicators that would improve balance in reporting the progress towards CERP restoration goals. The review of the original set of key indicators and selection of additional indicators were accomplished by a two-step process during the workshop. These steps were (1) create a list of potential key indicators that would be useful for reporting the success of the CERP in meeting its stated goals, and (2) have all participants in the workshop vote on the list of potential indicators to identify "priority" indicators. The resulting list contained 18 proposed key indicators:

1. Average annual concentration of phosphorus and nitrogen system-wide
2. Everglades tree island/healthy salinity ranges
3. Suite of indicator fishes (spotted trout for Florida Bay; largemouth bass for Lake Okeechobee)
4. Recreational/commercial fishing rates/success
5. Total system wood stork nesting patterns
6. Total system American alligator numbers/patterns
7. Total system wading bird nesting patterns
8. Select "listed" species health
9. Extent of submerged aquatic vegetation in Lake Okeechobee and estuaries

10. Meeting urban and agricultural water needs; 1-in-10 year drought requirements
11. Reestablish Natural System Model (NSM) hydropatterns/remove sheetflow barriers
12. Pink shrimp catch rates in Florida Bay, Biscayne Bay and the Tortugas
13. Increase total extent of healthy wetlands
14. Thousands of acre-feet of fresh water captured/stored
15. Increase the extent of healthy oyster beds in the St. Lucie and Caloosahatchee Estuaries
16. Florida Bay and Gulf Coast roseate spoonbill recovery
17. Impacts of flows to estuaries (crocodile, snail kite, etc.)
18. Reductions in invasive/exotic plant/animal species

The current draft of the CERP Annual Report Card contains a restructuring and synthesis of these 18 proposed indicators into 14 key indicator reports. The 14 indicators are as follows:

1. Total area of healthy oyster beds in the St. Lucie Estuary
2. Flow patterns (volume and timing) as a measure of the health of the Caloosahatchee Estuary
3. Total phosphorus concentrations in Lake Okeechobee
4. Submerged aquatic vegetation in Lake Okeechobee
5. Health of aquatic animal communities in the interior Everglades ridge and slough system
6. Everglades tree island recovery
7. Number of stable subpopulations of the Cape Sable seaside sparrow in Everglades marl prairies
8. Roseate spoonbill nesting patterns in the Southern Mangrove and Florida Bay Estuaries
9. Florida Bay seagrass bed and shrimp health
10. Wading bird nesting patterns for the total system
11. American alligator distribution and abundance in wetland communities throughout the total system
12. Spatial extent of healthy freshwater wetlands throughout the total system
13. Phosphorus effects on natural wetlands throughout the total system
14. Water supply for South Florida

ORGANIZATION OF THE CERP ANNUAL REPORT CARD

The format of the key indicator reports in this annual report card is a modified version of the format originally used in the *1999 CERP Baseline Report* (RECOVER, 2000). Each key indicator in the report card will provide information under five headings:

- **CERP Target -** a brief description of the restoration goal(s) and any interim goals for each indicator
- **Significance and Background -** the rationale for selecting the indicator as representative of the environmental health of a South Florida region or subregion

- **Recent Status and Trends -** the current condition and historical pattern for the indicator in South Florida, and interpretation of the causes of observed changes in the status of the indicators
- **Indicator Grade -** the current (annual) grade for the key indicator (red, yellow or green)
- **Restoration Action -** actions implemented via the CERP during the preceding year (or in the case of this initial report, actions implemented to date) that contribute to achieving restoration goals for each indicator (e.g., lands purchased, construction initiated or completed, operational rules improved, etc.).

Other influences besides those produced by the CERP will be affecting the key indicators. These influences include short-term events, such as hurricanes and other exceptional weather disturbances, and long-term events, which could include the effects of sea level rise along the coast, unpredicted changes in human population demographics, unnatural patterns of fire, and/or stresses caused by exotic plants and animals. The report card will assess the role these outside influences have on CERP's success as they become better recognized and understood.

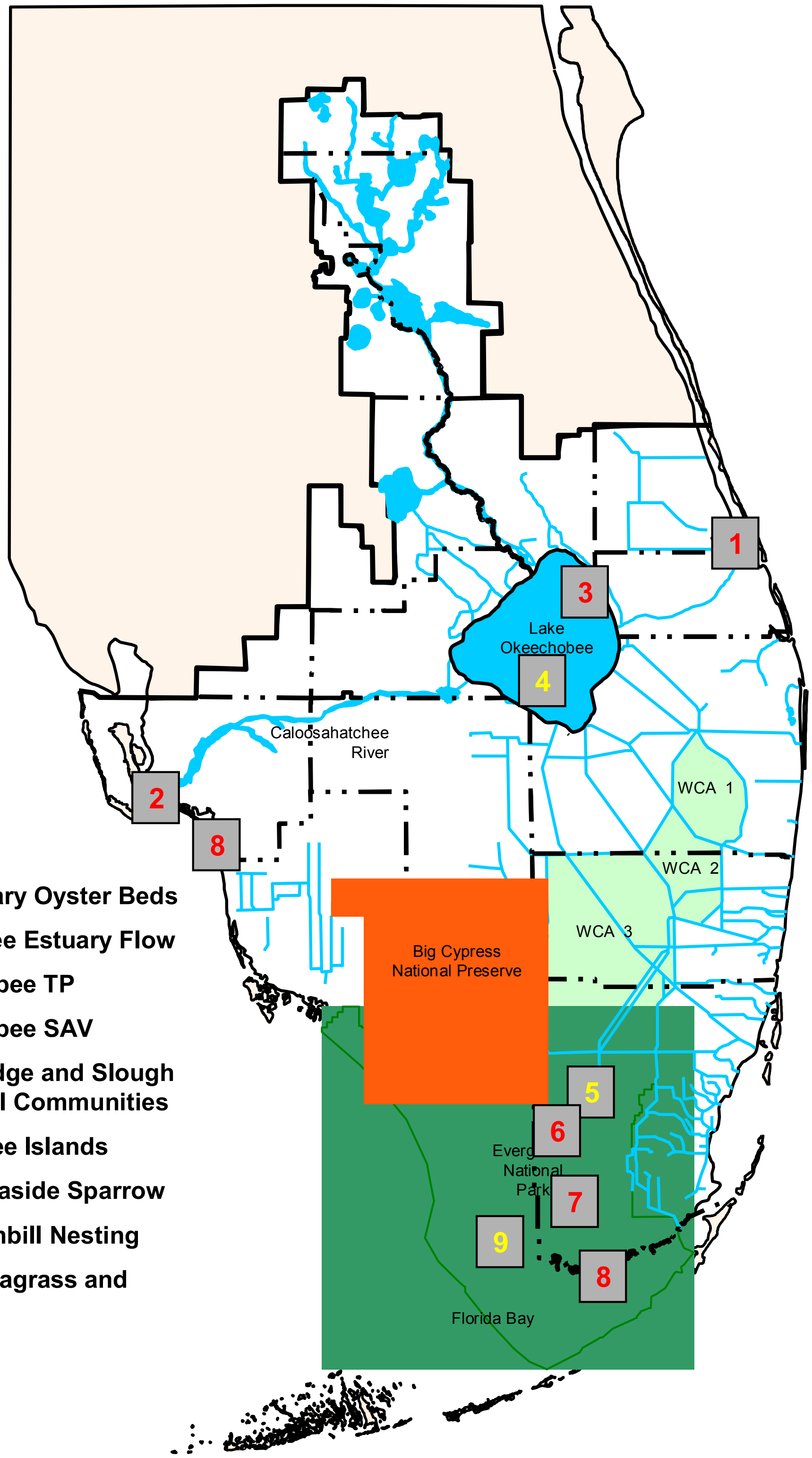
GRADING SYSTEM

The red/yellow/green grading system used in this report card is a modified version of the grading system used in the *CERP 1999 Baseline Report* (SFWMD, 2000). In this report, the grades indicate the following:

- **Red -** the status or condition of the indicator is degraded and unacceptable, or it is changing in a direction that is moving away from the desired restoration target
- **Yellow -** the status or condition of the indicator is improving, but the level of improvement has not yet reached the desired restoration target
- **Green -** the status or condition of the indicator has reached the desired restoration target and this desired status is likely to be sustained

THE BASELINE FOR THE KEY INDICATORS

The remainder of this report consists of the indicator sheets for the 14 key indicators listed above. **Figure 1** presents the general location of nine of the indicators, as well as the grade assigned to each. The remaining five indicators measure the performance of the total system.



1. St. Lucie Estuary Oyster Beds
2. Caloosahatchee Estuary Flow
3. Lake Okeechobee TP
4. Lake Okeechobee SAV
5. Everglades Ridge and Slough Aquatic Animal Communities
6. Everglades Tree Islands
7. Cape Sable Seaside Sparrow
8. Roseate Spoonbill Nesting
9. Florida Bay Seagrass and Shrimp

Figure 1. Location and indicator grade for nine CERP key indicators. Total system indicators are not shown

1. TOTAL AREA OF HEALTHY OYSTER BEDS IN THE ST. LUCIE ESTUARY

CERP TARGET

The target of the CERP is to increase the total area of healthy oyster beds in the St. Lucie Estuary by approximately 4.5 times their current area. A healthy oyster population in the estuary is only possible if more stable salinity levels can be maintained. The target is based on both the implementation of the Indian River Lagoon South Feasibility Study (USACE and SFWMD, 2002) and the components of the CERP. The Indian River Lagoon South Feasibility Study focuses on slowing down and cleaning up flows from the estuary's watershed. The CERP components deal with the undesirable flows from Lake Okeechobee to the estuary through the St. Lucie Canal (C-44). The target is also based on all areas of the estuary that have both a suitable bottom and potentially appropriate salinity ranges to support healthy oyster beds.

SIGNIFICANCE AND BACKGROUND

Development and modification of the St. Lucie Estuary watershed over the last 100 years has led to degradation of the estuary because of alterations in the quantity, quality and timing of fresh water entering the water body. Changes in the timing and volume of freshwater discharges can place severe stress on the entire ecosystem by altering natural salinity patterns. Also, large volumes of nutrient-laden water, along with warm temperatures and long day length during the summer season, contribute to ecologically damaging algal blooms. The inability of the water body to take in this overabundance of algae is made worse by decreased filtering of the water caused by low numbers of healthy oysters and other bivalves.

The American oyster (**Figure 2**) is an almost exclusively estuarine bivalve mollusk. It is ecologically important because it is a filter feeder, it serves as prey for numerous higher animals, and creates habitat for other aquatic organisms. Because oysters are immobile throughout most of their life cycle, they have adapted to a wide range of environmental conditions. The range of salinity needed to sustain a healthy oyster population varies geographically and seasonally within the estuary. The "salinity envelope" is affected by alterations in the quantity, quality and timing of fresh water entering the estuary. Healthy oyster beds have been chosen as a key restoration indicator for the St. Lucie Estuary because a thriving oyster population indicates that the proper quantity and timing of freshwater flows into the estuary have been restored.

RECENT STATUS AND TRENDS

A field survey conducted in 1997 identified approximately 209 acres of remaining oyster beds in the St. Lucie Estuary. Large freshwater discharges from the watershed create stressful conditions for the remaining oysters almost annually. Regulatory releases from Lake Okeechobee that can turn the estuary into a virtual freshwater system and can kill up to 90 percent of the remaining oyster beds in the midestuary occurred in 1998 and can reoccur an average of every six to seven years.

Figure 2. American Oyster Bed

INDICATOR GRADE

While no elements of the CERP have yet been implemented to restore the St. Lucie Estuary, an increase in oyster populations has nonetheless been observed, presumably because large regulatory releases from Lake Okeechobee to the estuary have not occurred since 1998. The dry conditions in the region have helped maintain conditions that are more favorable for an increased oyster population. These increases have not been formally documented, since monitoring has not been conducted since 1997. The grade for oysters is “red.”

RESTORATION ACTION

A comprehensive program on oyster biology began in July 2002. This program will include both laboratory and field work. The program’s primary purpose is to document detailed relationships among salinity, temperature, disease, and oyster viability and reproductive potential. This information will be used to calibrate a model of oyster response to changes in these variables.

The Indian River Lagoon South Feasibility Study was finalized in August 2002. The recommendations of the study include removal of accumulated muck, which smothers oysters and other benthic organisms, and creation of 90 acres of artificial habitat for oysters.

2. FLOW PATTERNS (VOLUME AND TIMING) AS A MEASURE OF THE HEALTH OF THE CALOOSAHATCHEE ESTUARY

CERP TARGET

A more natural flow regime in the Caloosahatchee Estuary will be created by capturing Caloosahatchee River (C-43 basin) runoff and releases from Lake Okeechobee in basin storage and releasing it from storage, as needed, to meet the estuary's needs. Preliminary analysis suggests that a minimum (mean monthly) flow of 300 cubic feet per second (cfs) for *Vallisneria* is suitable to various types of estuarine biota found within the estuary, but mean monthly inflows greater than 2,500 to 3,000 cfs are detrimental to the community any time of the year (**Table 1**). If the vast majority of flows range between 300 and 800 cfs, then the minimum discharge necessary to support *Vallisneria* will be attained. Since normal wet-season mean monthly flows are usually greater than 300 cfs, consideration of meeting this inflow limit should only be necessary during the dry season.

Table 1. Summary of recommended flows through the S-79 structure for maintaining ecological health of key species within the Caloosahatchee River/Estuary system[a]

Species	Low Flow Limit (cfs)	Preferred Inflow Range (cfs)	Upper Inflow Limit (cfs)	Important Months
Vallisneria	300	300 - 800	< 3,000	Dry season (November through May)
Halodule, *Thalassia*	---	---	3,000	
Fish (general)	300	300 - 1,300	3,000	Dry season
Larval fish	---	300 - 800	< 2,500	March through July
Fish eggs	---	150 - 600	< 2,500	All year
Pink shrimp and blue crabs	300	300 - 800	< 3,000	All year
Shrimp and crab larvae	---	< 1,300	< 2,500	All year (espec. spring through July)
Benthic invertebrates (including oysters)	---	300 - 800	< 3,000	All year

a. Source: Chamberlain and Doering, 1998

SIGNIFICANCE AND BACKGROUND

The Caloosahatchee Estuary is highly dependent on and sensitive to freshwater releases. Changes in the timing and volume of freshwater discharges can place severe stress on the entire ecosystem by changing natural salinity patterns. Salinity patterns affect productivity, population distribution, community composition, predator-prey interactions, and food web structure in the inshore marine habitat. Therefore, maintenance of appropriate freshwater inflows is essential for a healthy estuarine system.

RECENT STATUS AND TRENDS

Currently, flows in the Caloosahatchee River and Estuary are controlled by regulation schedules for Lake Okeechobee and the S-79 structure. The regulation schedules' overall ability to meet demands and protect resources is inadequate. Low flows are the primary concern, but during above-normal rainfall years, high flow can also be a concern.

INDICATOR GRADE

No CERP elements designed to improve volume and timing of flows in the Caloosahatchee Estuary have been implemented, and water storage in the basin remains inadequate. The grade for the flow patterns in the Caloosahatchee Estuary remains "red."

RESTORATION ACTION

Minimum Flows and Levels (MFLs) have been developed to address low flows to the estuary. Criteria for MFLs were partially based on selected key indicators of a healthy estuarine system, including Submerged Aquatic Vegetation (SAV) because it provides habitat for much of the estuarine community. The SFWMD's ability to implement MFLs depends on the CERP's water storage components. Implementation of one of these projects, the C-43 Basin Storage Reservoir Project, is expected to produce a more natural delivery of flows to the estuary.

3. TOTAL PHOSPHORUS CONCENTRATIONS IN LAKE OKEECHOBEE

CERP TARGET

One of the targets of the CERP is to achieve a long-term average open-water concentration of Total Phosphorus (TP) of 40 parts per billion (ppb) in Lake Okeechobee. The Florida Department of Environmental Protection (FDEP) has adopted this as the goal for TP for the lake ecosystem.

SIGNIFICANCE AND BACKGROUND

Phosphorus (P) is the nutrient that most often limits the growth of plants and algae in freshwater lakes. When P levels in a freshwater lake become excessive, the resulting changes can be dramatic. For example, increases can occur in plant and animal species that have undesirable impacts on habitat quality. An increase in the occurrence of noxious blue-green algae blooms (**Figure 3, top**) are an example. Based on scientific research done on the lake over the last decade, it is anticipated that reduced P concentrations in Lake Okeechobee will result in clearer water, fewer blooms of noxious algae, increased submerged plants, and better conditions for sport fishing and other ecological and societal uses of the lake (**Figure 3**, **bottom**).

Figure 3. Top: Noxious algal blooms in Lake Okeechobee caused by high total phosphorus concentrations. Bottom: Healthy water

RECENT STATUS AND TRENDS

TP concentrations in Lake Okeechobee were near 40 to 50 ppb when first measured in the early 1970s (**Figure 4**). These concentrations have increased over the last three decades, and concentrations now average near 100 ppb in the lake's open-water area. The increase in TP is linked with increased amounts of external phosphorus coming into the lake over the long term, as well as with high water levels in shorter (year-to-year) time scales.

INDICATOR GRADE

The current grade for Lake Okeechobee is "red," indicating that the performance measure is far from meeting the established restoration goal and that the ecosystem is being impacted as a result.

RESTORATION ACTION

Lands have been acquired for the Lake Okeechobee Critical Project for isolated wetland restoration and pilot Stormwater Treatment Areas (STAs). Project design is proceeding.

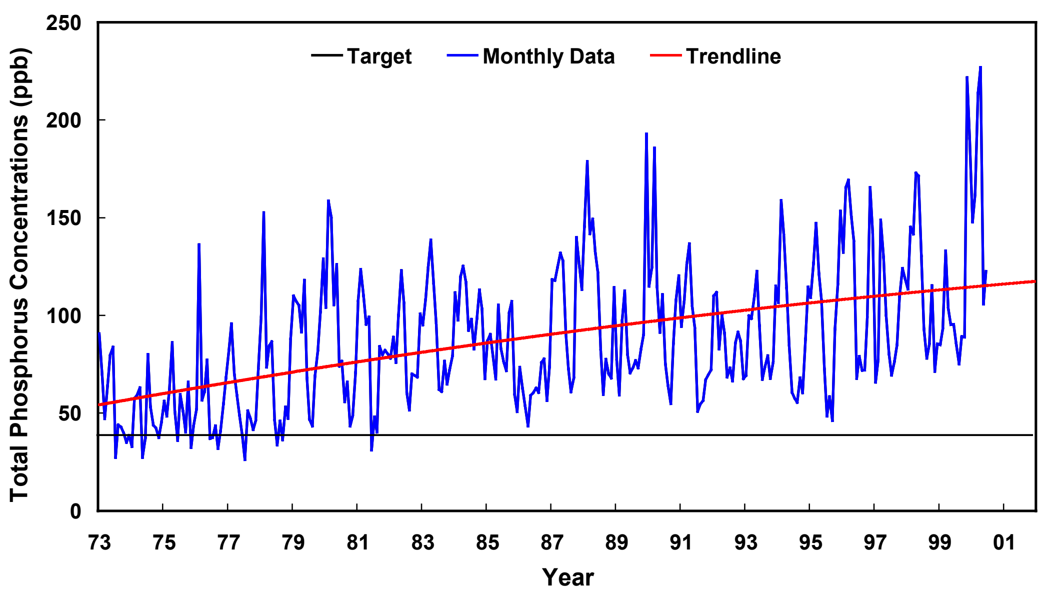


Figure 4. Monthly total phosphorus concentrations in Lake Okeechobee from 1973 to 2001

4. SUBMERGED AQUATIC VEGETATION IN LAKE OKEECHOBEE

CERP TARGET

One of the restoration targets within Lake Okeechobee is to sustain at least 40,000 total acres of SAV around the lake's northern, western and southern shoreline, with at least 20,000 acres contributed by vascular plants (in particular, eelgrass and peppergrass).

SIGNIFICANCE AND BACKGROUND

In shallow eutrophic lakes, SAV plays a critical role in stabilizing sediments, supporting attached algae that removes P from the water, and providing critical habitat for fish, wading birds and other wildlife. Vascular plants provide the most valuable habitat, while *Chara*, a macro alga common in this and other shallow eutrophic lakes, serves to stabilize sediments, but is not as useful for wildlife. Lake Okeechobee's shoreline areas have supported a large acreage of submerged vascular plants in years with moderate-to-low water levels, but the acreage has been reduced to almost zero following multiple years with very high water.

A reduction in the occurrence of high water levels as a result of CERP implementation is expected to cause widespread increases in SAV in Lake Okeechobee. This, in turn, will give rise to clearer water, help to lower P concentrations, and provide conditions conducive to a healthy community of fish, wading birds and other wildlife. The extent to which fish and birds will recover following a sustained recovery of these plants remains to be seen and is a primary focus of ongoing research.

RECENT STATUS AND TRENDS

When researchers from the University of Florida measured the spatial extent of SAV during, and just after, a period of low lake stage and regional drought that occurred from 1989 to 1991, the researchers found between 43,000 and 51,000 total acres of SAV (**Figure 5**). Between 13,000 and 22,000 acres of the lake were covered by vascular plants, with the remainder covered by *Chara*. SAV was not sampled between 1991 and 1997. In 1998, after many years of high lake stage, a rough estimate by the Florida Fish and Wildlife Conservation Commission (FWC) indicated that only 3,000 acres of total SAV remained in the lake. The SFWMD conducted a detailed survey in 2000 immediately after a managed lake recession. The survey indicated that the SAV community had recovered to 44,000 total acres, with over 15,000 acres of vascular plants. Some of the submerged vegetation was lost when an extreme drought in 2001 dropped water levels below 9 feet, a historic low for this lake. However, in late summer 2001, approximately six weeks after stage increased again to over 12 feet, the community began to recover. At the end of the 2001 summer growing season (September), the lake supported approximately 37,000 total acres of submerged plants, with nearly 10,000 acres of vascular plants. In August 2002, after a year of favorable water levels, the lake supported 43,000 acres of submerged plants, with 23,000 acres of vascular plants.

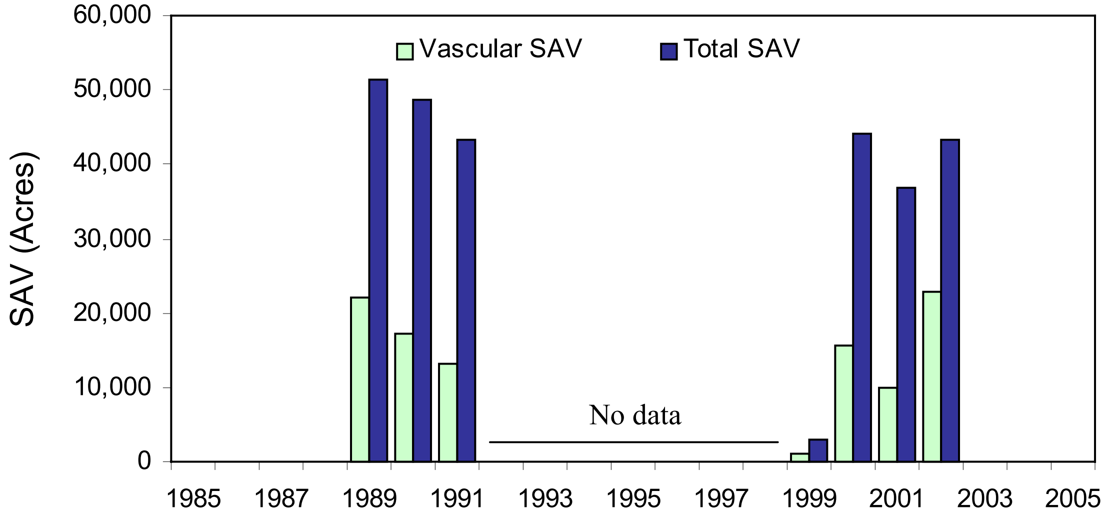


Figure 5. Submerged Aquatic Vegetation over time for Lake Okeechobee

INDICATOR GRADE

The indicator grade for Lake Okeechobee was "red" until 2000, when the SFWMD lowered the lake in a managed drawdown, allowing the vegetation to recover. The current grade is "yellow." Projects are not yet in place to ensure long-term survival of large beds of SAV in the lake.

RESTORATION ACTIONS

One of the CERP's most important features for reducing the occurrence of high lake depths is aquifer storage and recovery (ASR). The Aquifer Storage and Recovery Pilot Project is proceeding on schedule.

5. HEALTH OF AQUATIC ANIMAL COMMUNITIES IN THE INTERIOR EVERGLADES RIDGE AND SLOUGH SYSTEM

CERP TARGETS

Certain species of marsh fishes, frogs, crayfish and aquatic snails are good indicators of the overall health of the freshwater Everglades ridge and slough system. To measure the system's responses to longer, more natural hydroperiods and reduced levels of contaminants, four restoration targets have been established:

- **Animal density** - Increase the numbers and density of native marsh fishes, pig frogs and apple snails
- **Size distribution** - Increase the size range of marsh fishes by increasing the number of larger fishes
- **Relative abundance** - Increase the relative abundance of native sunfishes and chubsuckers; increase the frequency of crayfish species typical of long-hydroperiod marshes (*Procambarus fallax*) relative to those species that are more characteristic of shorter-hydroperiod marshes (*P. alleni*); and maintain or reduce the current low numbers of exotic fish species in the interior marshes
- **Contaminants** - Reduce levels of mercury and other toxins in marsh fishes

SIGNIFICANCE AND BACKGROUND

Fish, aquatic invertebrates and frogs are critical members of the Everglades food web because they are primary sources of food for wading birds and alligators. Wading bird nesting success is strongly influenced by the amount of food available in the marshes. Most wading bird species include fish in their diet, and many species, such as the white ibis, also consume large quantities of crayfish. Apple snails serve as food for a number of birds, most notably the endangered Everglades snail kite. Fish and frogs are also important sources of food for alligators. In addition, pig frogs are economically important in the Water Conservation Areas (WCAs), where they are actively harvested for commercial sale.

The species or groups of species selected as indicators of Everglades health are known to be sensitive to changing patterns of hydrology and water quality, responding to management actions in a short time period (months or a few years). All these species do best in marshes that remain flooded indefinitely, and all have suffered from water management practices that have substantially increased the number and duration of marsh dryouts.

RECENT STATUS AND TRENDS

Everglades National Park personnel have collected records of fish density for more than 20 years at two locations in Shark River Slough: one location in the main slough south of the S-12C structure (SRS), and one location in northeastern Shark River Slough east of the L-67E levee (NESRS). In 1985, the Modified Water Delivery Program altered the management of the NESRS site to recreate historical, wetter conditions. Since management at the SRS site was not modified at that time, it can be considered as a reference area. Comparing these two sites provides an insight into the effect of manipulating hydrology as an ecological restoration tool for the Everglades.

The assessment protocol indicates that the conditions at the SRS site were much more similar to conditions predicted by the Natural Systems Model (NSM) during the period from 1971 to 1995 than the conditions at the NESRS site. From 1981 to 1986, the SRS site had more fish than predicted by the NSM (**Figures 6** and **7**), because managers kept the site from drying out in 1981, when the NSM had predicted that it should have dried out. In contrast, the NESRS site had fewer fish than predicted by the NSM throughout this period. In 1999, the density of fishes in the NESRS and the SRS reference sites were the same (**Figures 6** and **7**), providing some support that this experimental water delivery met restoration goals.

In recent years, mercury levels recorded in mosquitofish have decreased, indicating a possible link to the series of wet years. Continued monitoring is needed to determine if this positive trend is maintained through dry years such as 2001.

No change has been observed in the numbers of exotic fishes in these habitats. Exotic fishes continue to be present in very low numbers. The dry years of 1989 and 1990 corresponded to the range expansion and boom in abundance of at least one nonnative fish, the pike killifish. Monitoring in 2001 and beyond should focus on identifying any similar patterns following the dry period.

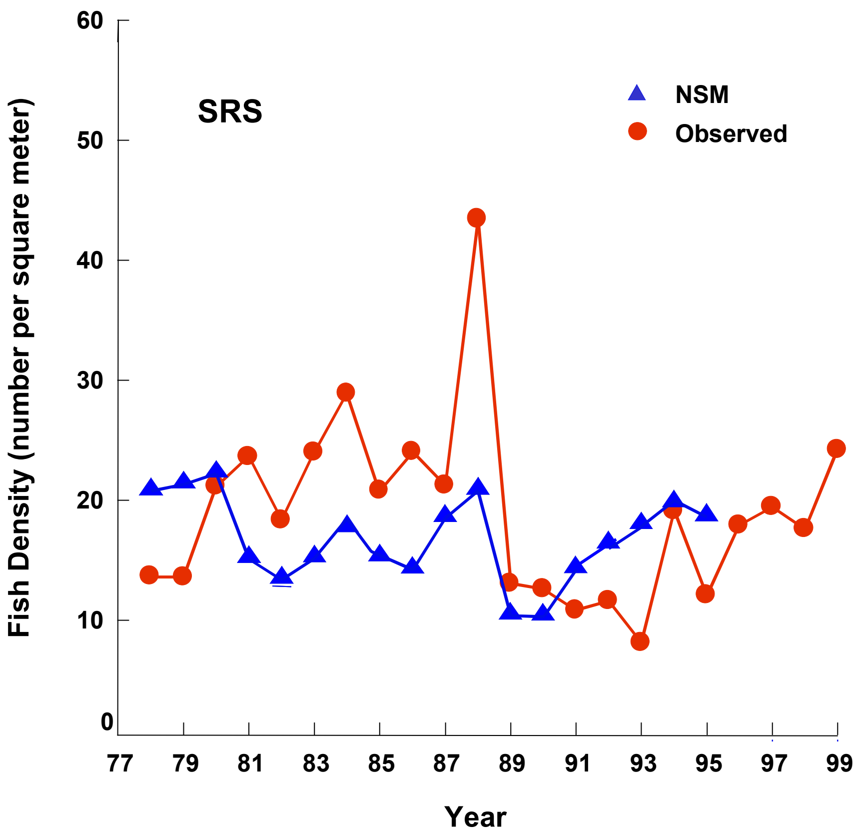


Figure 6. Predicted (NSM) and observed fish densities in Shark River Slough over time

INDICATOR GRADE

The indicator grade for the health of aquatic animal communities in the interior Everglades ridge and slough system is “yellow” reflecting the improvements pre-CERP restoration efforts have had on the system. Density of native marsh fishes has improved, exotics have remained low, and mercury levels have decreased.

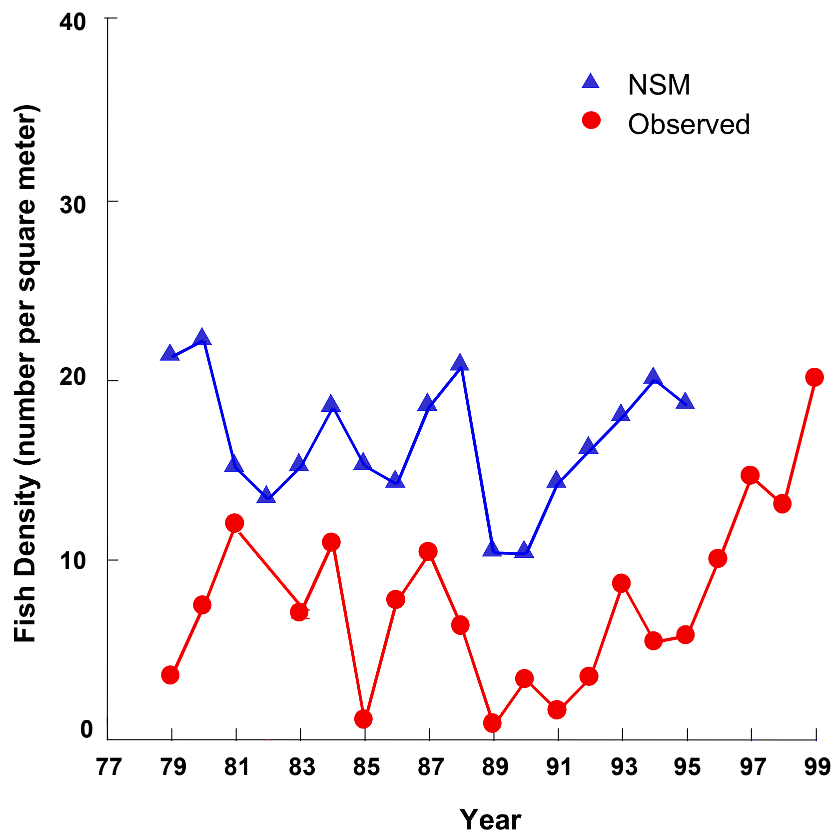


Figure 7. Predicted (NSM) and observed fish densities in northeast Shark River Slough over time

RESTORATION ACTION

Part 1 of the WCA 3 Decomp and Sheetflow Enhancement project will reestablish ecological and hydrological connections between WCA-3A, WCA-3B, and Everglades National Park, resulting in more natural sheetflow and hydroperiod. This project is currently in the planning phase.

6. EVERGLADES TREE ISLANDS RECOVERY

CERP TARGET

A density-weighted tree island "health index" ranging from 0 (death is imminent) to 1 (completely stress free) is based on tree island canopy density and diversity, exotic plant density and tree growth. The CERP target for WCA-2 and WCA-3 is to increase the health index by 25 to 50 percent and prevent any further reduction in tree island area (**Figure 8**).

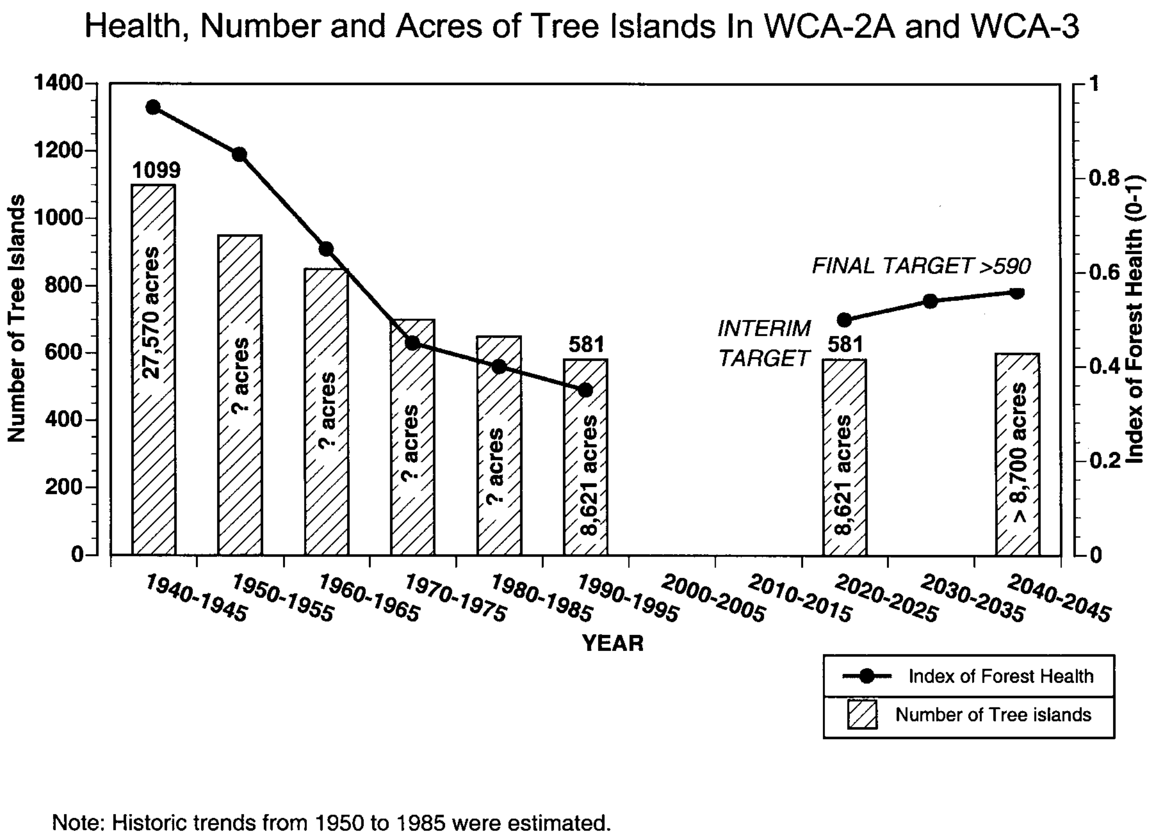


Figure 8. Historic values for the Index of Forest Health assumes that tree islands in 1940 were near optimum health. An interim tree island target is a positive trend for this index and is not a net loss. An interim target for WCA-1, Big Cypress Preserve and Everglades National Park should be to maintain current density and health

SIGNIFICANCE AND BACKGROUND

Tree islands occur throughout the Everglades marshes. Tree islands are small, isolated "high spots" that historically have provided essential habitat for a variety of plants and animals. Tree islands serve as a refuge for animals during periods of high water, are sources of food and cover for wildlife, and provide nesting sites for wading birds and freshwater turtles. The islands are also highly important to the culture of both the Miccosukee and Seminole Tribes. Hunters, fishermen and recreational visitors into the Everglades consider tree islands to be symbolic of the ecosystem's health. **Figure 9** illustrates the trends, importance, attributes and stressors associated with tree islands.

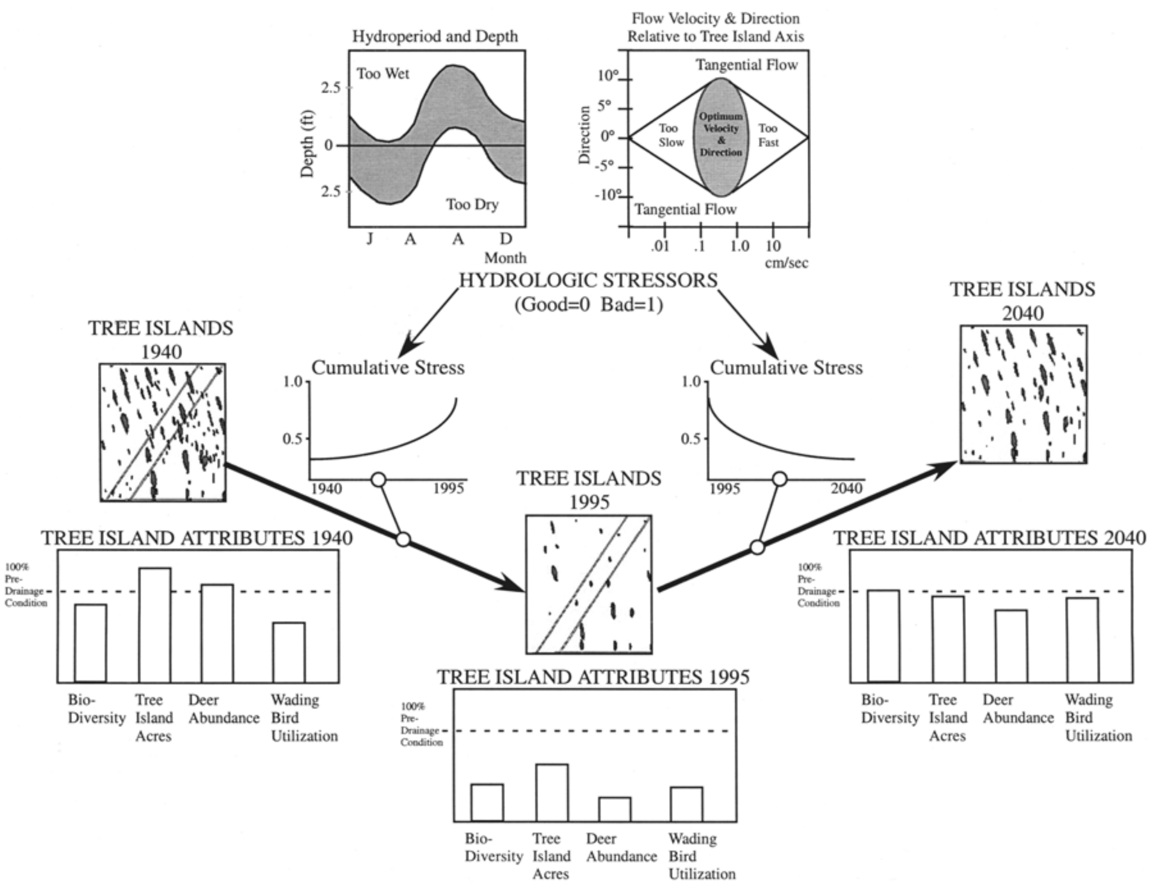


Figure 9. The ecology of tree island historic and predicted change in the Everglades

Because the maximum elevation of the highest tree islands is only slightly above the maximum water levels in the surrounding marshes, tree islands, with their less flood-tolerant vegetation, are very sensitive to unnaturally deep water. Unnaturally deep water can occur in regions where water flow is impeded and dammed. However, relatively deep water can also occur when tree islands lose elevation. Elevation loss occurs when the system is too dry for too long and the peat soils become oxidized or burned. Water management practices have substantially increased the frequency and duration of unnaturally deep water in WCA-2 and WCA-3, resulting in the loss or degradation of many tree islands.

RECENT STATUS AND TRENDS

Comparisons of the number, size and distribution of tree islands between 1940 and 1995 in WCA-2A show that only four of the original 58 tree islands have survived the past 55 years. Three of the four remaining tree islands are stressed and continue to lose trees. Similar comparisons for WCA-3A and WCA-3B show a 45-percent reduction, from 1,041 to 577 tree islands, and a reduction in total tree island acreage from 24,700 to 8,600 acres (a 65-percent reduction).

INDICATOR GRADE

The tree island grade is “red.” The relatively high water conditions from 1995 to 1999 were a stress on tree islands and the relatively dry years of 2000 and 2001 could have been catastrophic. However, tree islands did not burn, and none were destroyed during the drought. Individual islands appear healthy despite the 2001 drought due to the fact that the dry conditions were good for hardwood seed germination and sapling development. Sapling survival will depend on the amount of tree island soil oxidation (and hence elevation loss) relative to the return of high waters during the 2001 to 2002 wet season. Presently, the existing tree islands in WCA-2 or WCA-3 show no evidence of recovery.

RESTORATION ACTION

Large-scale peat burns and tree-island loss were prevented in WCA-3 despite extreme drought conditions. The lack of muck burns was accomplished by rapidly developing an Everglades drought severity index to demonstrate the need for water use restrictions. Other actions in 2001 included (1) the issuing of a remote sensing contract to help develop an inexpensive tool for measuring island tree mass and canopy density for the establishment of a Tree Island Health Index, and (2) the development of a tree island model for the prediction of recovery rates in WCA-2.

7. NUMBER OF STABLE SUBPOPULATIONS OF THE CAPE SABLE SEASIDE SPARROW IN THE EVERGLADES MARL PRAIRIES

CERP TARGET

The CERP's target is to increase from one to three the number of stable subpopulations of the Cape Sable seaside sparrow, with one subpopulation west of Shark River Slough and two east of Shark River Slough. A subpopulation will be considered stable when it supports a minimum of 1,000 individuals, measured as a five-year running average. Because the one currently stable subpopulation typically supports from 1,800 to 2,400 individuals, the goal for the total number of Cape Sable seaside sparrows is a minimum of approximately 4,000 individuals, with a final restoration target of 6,000 individuals, measured as a five-year running average.

SIGNIFICANCE AND BACKGROUND

The Cape Sable seaside sparrow lives only in the marl marshes of the southern Everglades. It is listed as an endangered species by both the U.S. Fish and Wildlife Service and the FWC. The sparrow's dependence on these short-hydroperiod marl prairies makes it an excellent indicator for healthy, marl-forming wetlands that support a diversity of plants.

Three primary stresses have led to steep declines in sparrow numbers and distributions. Shortened hydroperiods (i.e., length of time during the year in which the substrate is either saturated or covered with water) in the eastern marl prairies as a result of water management practices have altered sparrow habitat by leading to an increase in the number of fires and the expansion of woody plants (**Figure 10**). In the western marl prairies, increased hydroperiods and unnatural dry-season flooding, also caused by water management practices, have resulted in an increase in sawgrass-dominated areas and have caused the sparrow breeding season to be interrupted (**Figure 10**). The third major stress is loss of spatial extent of short-hydroperiod marl areas due to agricultural and urban development.

RECENT STATUS AND TRENDS

The number of sparrows in the western subpopulation suffered an approximately 90-percent decline in the early 1990s and has remained below 500 (**Figure 11**). Overall sparrow numbers declined by approximately 50 percent during the same period and have not recovered.

INDICATOR GRADE

No CERP elements have been implemented, and no sustained increase in sparrow numbers has occurred. The Cape Sable seaside sparrow grade is "red."

RESTORATION ACTION

Significant improvement in hydroperiods should result from the implementation over the next few years of restoration projects, such as Modified Water Deliveries to Everglades National Park, that were planned prior to the CERP. The CERP will not increase the spatial extent of possible sparrow habitat areas, but the plan has the potential to further address hydrologic stressors through reduction of dry-season water level reversals and restoration of hydroperiods that support mixed marl prairie habitats.

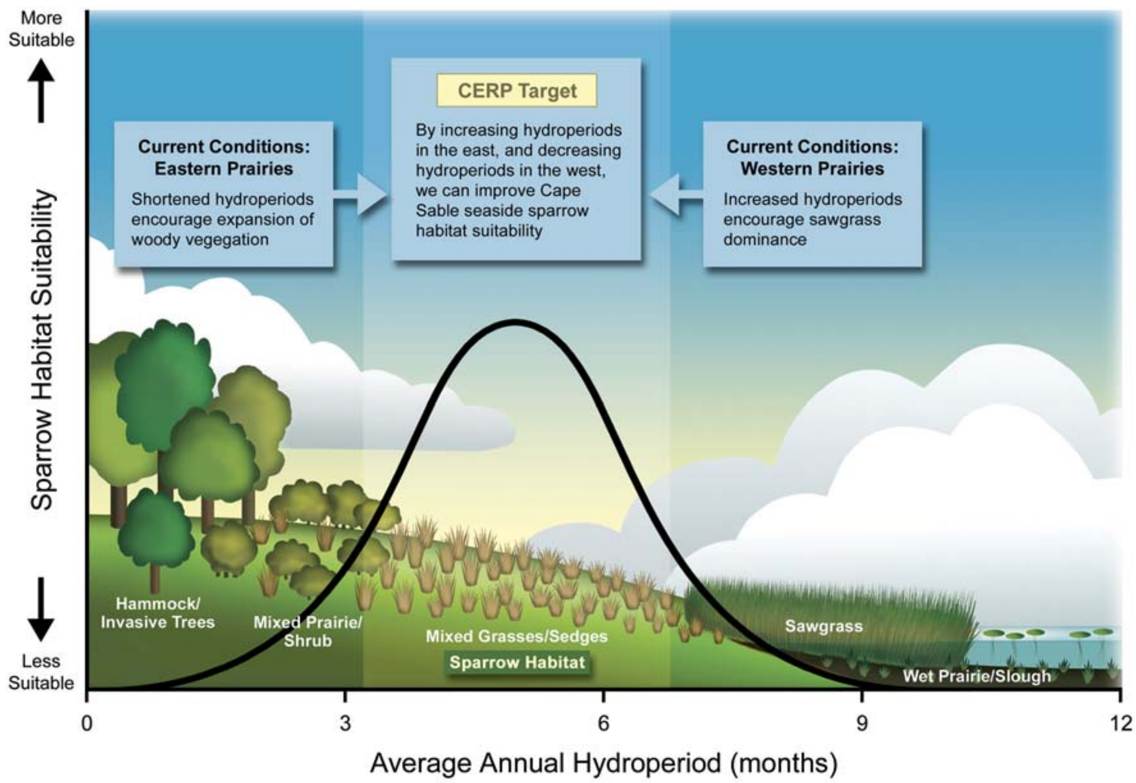


Figure 10. Cape Sable seaside sparrow response to hydroperiod

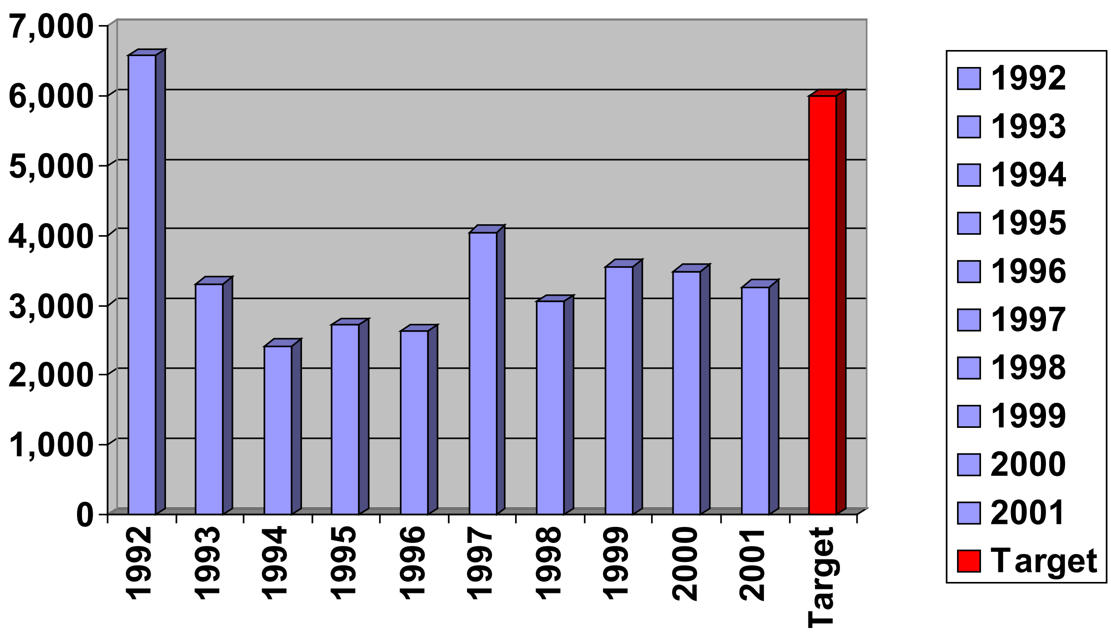


Figure 11. Trends in Cape Sable seaside sparrow numbers

8. ROSEATE SPOONBILL NESTING PATTERNS IN THE SOUTHERN MANGROVE AND FLORIDA BAY ESTUARIES

CERP TARGET

One result of CERP implementation should be the reestablishment of roseate spoonbill (**Figure 12**) nesting patterns in the Southern Mangrove and Florida Bay Estuaries. The targets for reestablishing roseate spoonbill nesting patterns are to achieve roseate spoonbill nesting success in seven out of every 10 years; return breeding spoonbill numbers to 1,000 pairs nesting in Florida Bay annually, half of which would be located in the northeastern region of the bay; and reestablish spoonbill nesting along the southwestern Gulf Coast between Lostman's River and the Caloosahatchee River. To achieve these patterns, the wet-dry seasonal variation in coastal wetland water levels must be restored to those similar to predrainage conditions, and a freshwater or low-salinity prey fish (i.e., fish that birds eat) community must be established within the coastal wetlands.

SIGNIFICANCE AND BACKGROUND

The character of an estuary is determined chiefly by the influence of its freshwater source. During the 1960s and 1970s, water management practices had an increasingly adverse impact on the estuaries, altering the timing, distribution, quantity, and perhaps the quality of fresh water flowing from the Everglades. Recent studies have verified the links between coastal wetland hydrology and prey fish abundance and between wetland hydrology and the nesting patterns of roseate spoonbills that use these fishes as a primary food resource. These studies indicate that roseate spoonbills and their prey are good indicators for evaluating the CERP's effectiveness at restoring estuarine conditions.

Roseate spoonbills are highly dependent on the water being at specific levels at certain times of the year. This dependency is due to the spoonbill's unique feeding strategy, which evolved along with the natural cycles of the wet and dry seasons in tropical and subtropical estuaries. Roseate spoonbills feed primarily on small fishes found in shallow wetlands. Naturally high water levels during the wet season promote conditions that allow these small fish to reproduce. During the dry season, when water levels fall, these fish become highly concentrated in the remaining pools and creeks, which allows the spoonbills to easily catch the fish in quantities large enough to feed themselves and their quickly growing offspring. This food resource is also important for the survival and breeding success of many other species of wading birds, crocodilians and game fishes. Recent water management practices have altered this annual cycle in prey abundance such that the quality of feeding habitat for spoonbills nesting in Florida Bay has deteriorated. Restoration of more historic hydrological conditions should promote greater prey abundance and availability, leading to an increase in the number of years spoonbills can successfully nest.

Figure 12. Roseate spoonbills in Florida Bay (photo by John LeClair)

Prior to a significant European presence, limited evidence indicates that at least 2,000 pairs of spoonbills nested in Florida Bay and along the southwestern Gulf Coast. However, between 1850 and 1930, the spoonbill population in South Florida was annihilated by “plume” and subsistence hunters. Only 15 pairs were present in 1935. Beginning in the 1940s, this population steadily increased in Florida Bay. Initially, the birds were under the protection of Audubon wardens. Subsequently, the spoonbills subsequently came under the protection of the U.S. National Park Service (**Figure 13**). This population increase was possible because the areas in the coastal estuaries where Florida Bay spoonbills did most of their feeding remained healthy. The bay’s spoonbill population peaked in 1979 at about 1,250 nests bay-wide, with more than half the nests located in the northeastern bay. The numbers of spoonbills nesting in Florida Bay have declined since 1979. No spoonbills have returned to nest along the southwestern coast. Spoonbills are now listed as a “Species of Special Concern” by the FWC.

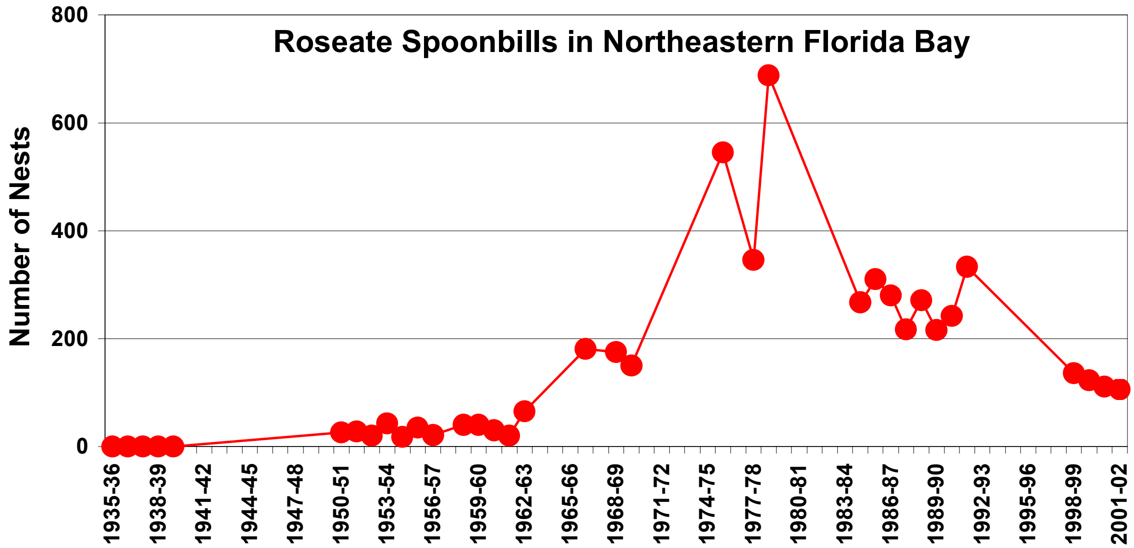


Figure 13. Number of roseate spoonbill nesting pairs in northeastern Florida Bay. These birds are dependant on the wetlands north of the bay (i.e., those impacted by the C-111 canal) for food. The spoonbill's decline in recent decades coincides with completion and operation of the South Dade Conveyance System

RECENT STATUS AND TRENDS

Unfortunately, lack of funding once again limited the ability to perform a total spoonbill count for all of Florida Bay in 2002. However, nest counts of the northeastern colonies indicate that spoonbill numbers continue to decline in the bay and were the lowest recorded since 1963. Estimates of this year's nesting success clearly indicate that spoonbill nest production bay-wide was the highest it has been in 10 years. The complementary forage fish data supports previous findings that spoonbill nesting success is dependent on prey availability and hydrological conditions on proximal foraging grounds. Even though this was a successful year in northeastern Florida Bay, the combined results of an overall regional decline in nesting effort in the northeast, and a linkage between success and foraging quality, indicate that the northeastern foraging grounds are not as reliable as they were 25 years ago. As previously indicated, this decline seems to be related to water management practices associated with the C-111 canal and the South Dade Conveyance System.

INDICATOR GRADE

The indicator grade for Roseate spoonbill nesting patterns in the Southern Mangrove and Florida Bay Estuaries is “red”.

RESTORATION ACTION

During the 1990s, several restoration actions have improved sheetflow to Florida. These actions include the Emergency Interim Plan to increase freshwater flow to the bay, the Experimental Water Deliveries Test 7, the C-111 Project, and Modified Water Deliveries.

Land has been acquired for the C-111 Spreader Canal project. This CERP project will, among other things, provide more natural sheetflow to Florida Bay by eliminating point sources of freshwater discharges through C-111 to estuarine systems of Manatee Bay and Barnes Sound.

Additional restoration actions specifically designed for the bay will be during the Florida Bay and Florida Keys Feasibility Study. This study, which is scheduled for completion in December 2006, will develop modeling tools, assess restoration alternatives, and select a recommended plan for bay restoration.

9. SEAGRASS BEDS AND PINK SHRIMP HEALTH IN FLORIDA BAY

CERP TARGETS

The key biological targets for the restoration of Florida Bay will include seagrass beds, the main aquatic habitat of the bay, and pink shrimp, an important animal species that resides in this habitat. Physical targets include salinity and algal-bloom thresholds. For seagrass beds, the target is that of a diverse community, with a moderate density of plants and widespread coverage of the bay bottom. For pink shrimp, the target is a highly productive, commercial pink shrimp harvest from the Dry Tortugas fishing beds. Shrimp harvest rates should meet or exceed 520 pounds of combined small and large shrimp per vessel-day fished. Salinity targets only reflect the magnitude of salinity levels and not the variability of salinity. Threshold salinity levels of 20 parts per thousand (ppt) for eastern Florida Bay and 30 ppt for western Florida Bay are the targets. Algal bloom threshold targets are 2 ppb of chlorophyll *a* in eastern Florida Bay and 3 ppb of chlorophyll *a* in central and western Florida Bay. More refined targets for Florida Bay restoration are being developed as part of the Florida Bay and Florida Keys Feasibility Study.

SIGNIFICANCE AND BACKGROUND

Florida Bay has sustained ecological damage in association with Everglades drainage and other human activities. The most apparent changes in the bay's ecology have been the occurrence of seagrass die-offs, sustained algal blooms, and declines in lobster, fish and shrimp species.

It is expected that Florida Bay restoration will involve changes in freshwater flow that will not only increase the quantity of this flow, but also alter the timing and distribution of flow. A direct effect of freshwater flow restoration will be a change in the bay's salinity, which will subsequently affect seagrasses and shrimp.

Another potential effect of the bay's restoration will be improved water quality. Decreasing the amount of nutrients coming into the bay should decrease the occurrence of algal blooms. Such blooms often occur with nutrient pollution and can negatively impact seagrass habitat and other ecosystem components.

Seagrass beds are generally considered to be the keystone of the entire bay ecosystem, providing critical food and habitat for shrimp, fish and other organisms. Seagrass beds also help to stabilize the bay's sediments, promoting clear water and helping to minimize algal blooms. Seagrass plants are known to be sensitive to salinity changes.

Pink shrimp are also sensitive to salinity change and are an important link in the bay's food chain. Shrimp provide food for fish and are also an economically important target species. Florida Bay has been identified as a major pink shrimp nursery ground. Previous studies have determined a statistical link between Dry Tortugas shrimp catch rates and the volume of freshwater flowing into the estuaries. Shrimp harvests declined greatly in the 1980s but are expected to benefit from restoration efforts.

RECENT STATUS AND TRENDS

Florida Bay salinity, which has been monitored since 1991, was lowest in the mid-1990s, when rainfall was above average. In 1995 and 1996, more than a third of all observations of salinity were below threshold salinity values (higher indicator values in Figure 15), but salinity increased in 2000 (yielding a decreasing indicator value). With restoration, higher indicator values are expected to be more common during average or below-average rainfall years.

Algal blooms were not measured in Florida Bay prior to the 1990s, but they are thought to have been rare. Algal blooms were highest in 1993, 1994 and 1999. Blooms in 1999 appear to have been stimulated by Hurricane Irene.

The vitality of seagrass habitat improved considerably since 1997 but has declined slightly since 1999. The first quantitative survey of seagrass habitat was done in 1984, and surveys have been done annually since 1994. Improvement in seagrass habitat has been associated not only with fewer turtle grass die-offs, but also with extensive growth of shoal grass in many areas that had experienced a die-off. Improvement occurred following those years that experienced increased freshwater flow and lower salinity.

The indicator for pink shrimp (Dry Tortugas harvests) showed a general decline since the 1960s and 1970s, particularly for relatively large shrimp. The indicator showed improvement in the mid-1990s, but has since declined again. In the past year, small shrimp showed a marked decline, while large shrimp remained as in recent years.

INDICATOR GRADE

The grade for Florida Bay over the past several years has been “yellow” based on decreased salinity, improved seagrass habitat coverage, and indications of improved pink shrimp harvests. Much of this improvement, however, may have been the result of relatively high rainfall in the mid-1990s. During the past year, rainfall and freshwater flow was low, and each of these indicators also declined. The occurrences of algal blooms, which may be related to freshwater flows, remain a concern.

RESTORATION ACTIONS

Restoration actions for Florida Bay during the 1990s included the Emergency Interim Plan to increase freshwater flow to the bay, the Experimental Water Deliveries Test 7, the C-111 Project, and Modified Water Deliveries. The C-111 Project has made substantial progress with the removal of spoil mounds south of the C-111 canal in late 1997 and the completion of a bridge over northern Taylor Slough in late 2000.

Land has been acquired for the C-111 Spreader Canal project. This CERP project will, among other things, provide more natural sheetflow to Florida Bay by eliminating point sources of freshwater discharges through C-111 to estuarine systems of Manatee Bay and Barnes Sound.

Additional restoration actions specifically designed for the bay will be during the Florida Bay and Florida Keys Feasibility Study. This study, which is scheduled for completion in December 2006, will develop modeling tools, assess restoration alternatives, and select a recommended plan for bay restoration.

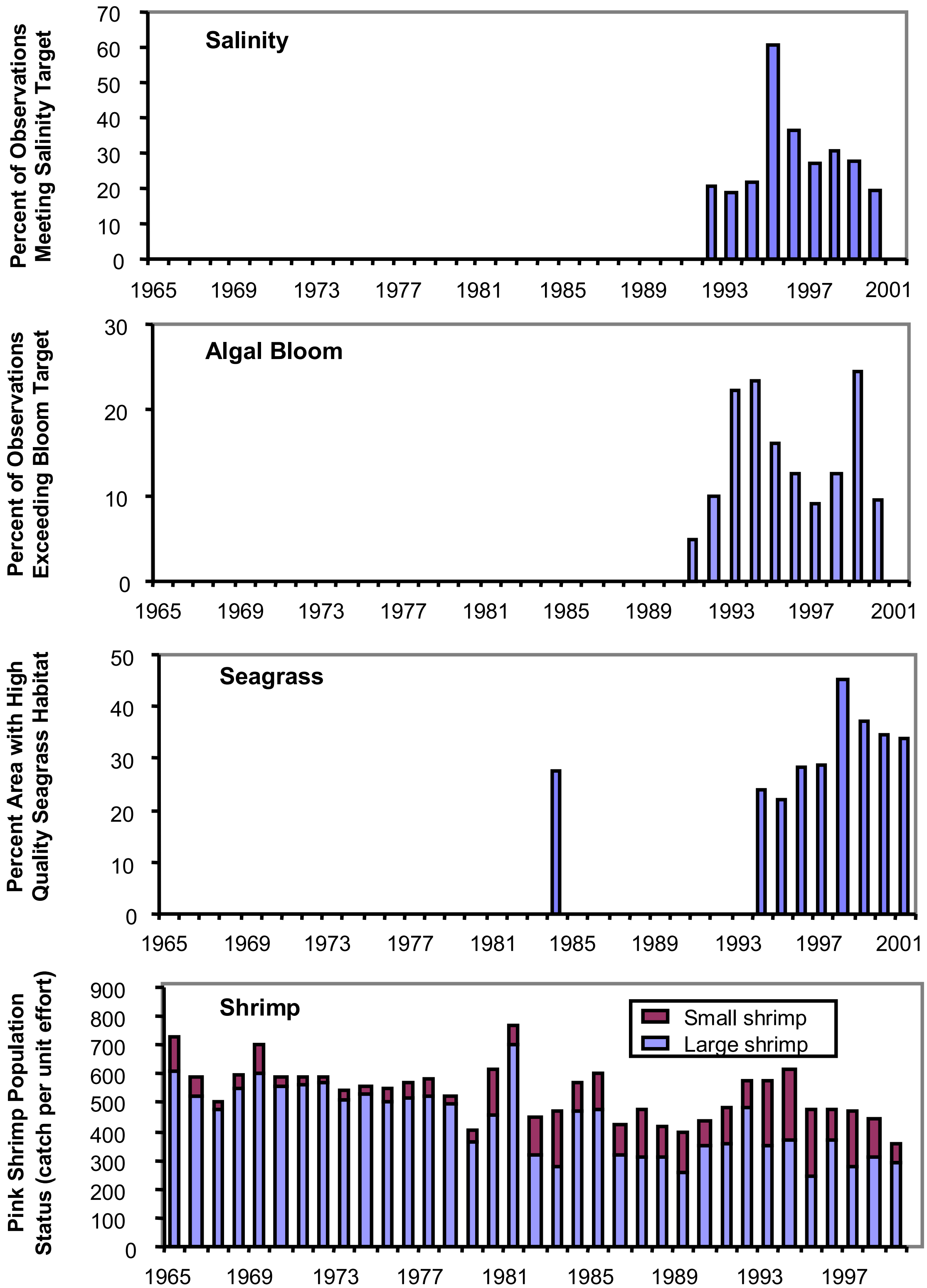


Figure 14. Trends of Florida Bay's ecological indicators, including salinity, algal blooms, seagrass, and pink shrimp. With restoration, these values should increase, except for algal blooms, which should decrease

10. WADING BIRD NESTING PATTERNS FOR THE TOTAL SYSTEM

CERP TARGET

The restoration goal for wading birds in the South Florida wetlands is to restore nesting birds to numbers much more similar to the number of birds that nested here under pre-drainage conditions. The earliest measure of the numbers of wading birds that once nested in the Everglades basin comes from information obtained during the 1930s and 1940s, when the greater Everglades region was much less disturbed than the current system. For the five most common species that nested in the former Everglades colonies, the average annual number for the 1930s and 1940s was 1,125 nesting pairs of great egrets (range: 250 to 4,000 pairs); 5,000 pairs of snowy egrets and tricolored herons combined (range: 250 to 16,000 pairs); 37,000 pairs of white ibis (range: 10,000 to 100,000 pairs); and 2,300 pairs of wood storks (range: 1,000 to 4,000 pairs) (**Figure 15**). No comparable numbers exist for the Big Cypress basin, with the exception of storks. Approximately 5,000 to 10,000 pairs of storks nested in the Corkscrew and Sadie Cypress colonies during some of the years from 1920 to 1960. To be able to meet these numerical goals, wading birds might need to reoccupy the now largely abandoned estuarine colony sites in southern and western Everglades National Park and reestablish a pattern of forming the extremely large "super colonies" that has occurred during some years. In addition, wood storks must be able to return to more natural timing patterns for nesting (between November and January) than current water management practices allow.

SIGNIFICANCE AND BACKGROUND

Large numbers of showy wading birds were a striking feature of South Florida's pre-drainage wetlands. Single nesting colonies once contained as many as 50,000 to 100,000 pairs of birds. Although plume hunters decimated most of these colonies in the late-1800s, protective legislation and good habitat conditions during the early 1900s allowed most of the nesting species to fully recover.

An enormous rookery located along Rookery Branch in the extreme upper reaches of the Shark River was once typical of the size of Everglades' wading bird nesting colonies. In 1934, this super colony was estimated to have been a mile long and several hundred feet wide. These "bird cities" contained 75 to 95 percent of all wading birds nesting in the pre-drainage Everglades. No large colonies have formed at Rookery Branch since the early 1970s.

The total number of wading birds nesting in the greater Everglades region has declined by about 90 percent from the maximum number that nested there in the 1930s. This decline was a direct result of drainage and water management practices that occurred between the 1940s and the 1990s. Substantial reductions in the total area of wetlands, changes in the location, timing and volumes of flows, and the creation of unnatural water impoundments in the Everglades have combined to disrupt traditional nesting patterns, leading to declines in the total number of birds. These changes to the system's hydrology have also caused storks to delay nesting by several months, which has resulted in many pairs failing to raise young birds.

Colonies that have been forced to relocate to the Everglades WCAs have been smaller, and perhaps less successful, than bird colonies in the historic estuarine rookeries, such as the Shark River colony. It is thought that prior to the reduction in flows into the estuaries, these areas produced much more of the food required to support the former bird cities, and that these large rookeries might only reestablish themselves in the Everglades once the natural estuarine flows are restored.

RECENT STATUS AND TRENDS

The total number of nesting wading birds in the Everglades during the period 1999 through 2001 has been higher than for almost any year since the late 1970s. In 2001, the total numbers of nesting pairs for the five Everglades species were 5,450 great egret pairs, 3,600 snowy egret pairs, 2,200 tricolored heron pairs, 17,300 white ibis pairs, and 2,050 wood stork pairs (**Figure 15**). The total for the five species was 30,600 nesting pairs. By species, the number in 2001 substantially exceeds that of the average annual nesting effort for great egrets in the 1930s to 1940s, closely matches the average nesting effort for snowy egrets, tricolored herons, and wood storks, and is about half the average effort for white ibis. For the five species combined, the nesting in 2001 was about one-fourth that of the maximum nesting effort for the five species during the earlier time period.

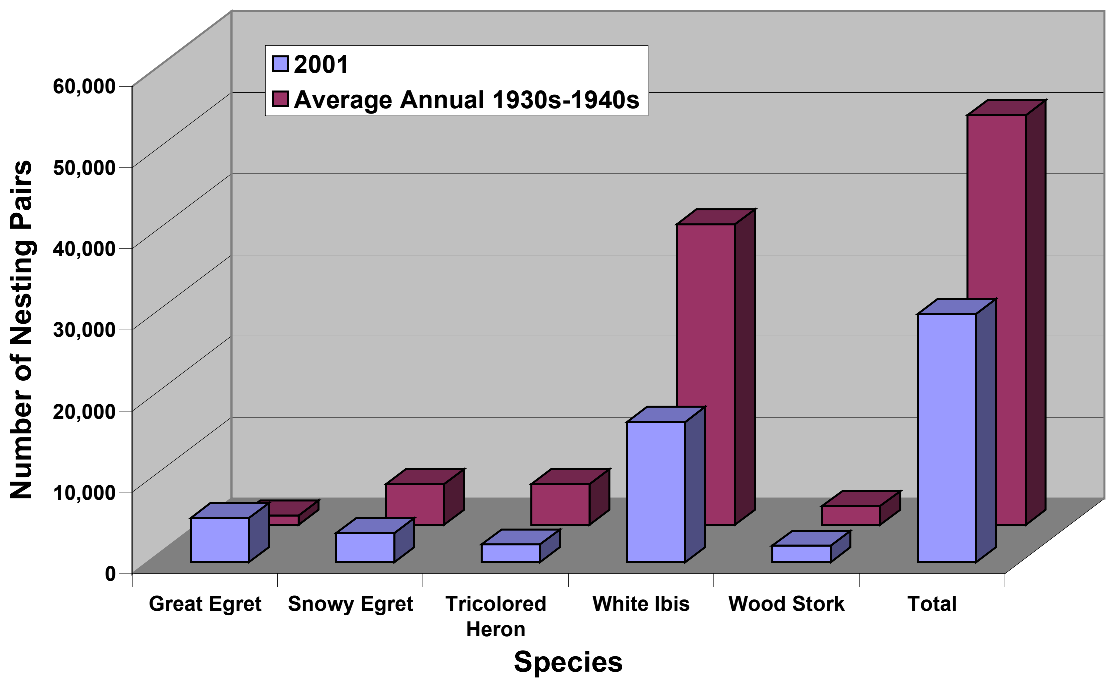


Figure 15. The average annual number of nesting wading bird pairs during the 1930s-1940s and the number of nesting pairs during 2001 in the greater Everglades

No progress was made in 1999 through 2001 in recovering the traditional estuarine nesting colonies. During that period, only 1.6 to 4 percent of the wading birds that nested in the greater Everglades used the estuarine sites. Everglades' storks, presumably stimulated by the rapid drying, began nesting in January and February. In 2001, no storks nested at Corkscrew Swamp Sanctuary, the primary stork nesting site in South Florida.

INDICATOR GRADE

In 2001, the total number of nesting pairs for the five indicator species was substantially higher than the number of nesting pairs observed during a baseline period (1986 to 1995). However, little progress was made in 2001 towards meeting the goals for colony location and timing patterns for nesting birds. Although not yet influenced by the CERP, the increased nesting effort in 2001 calls for a grade of "yellow."

RESTORATION ACTION

Projects developed prior to the CERP, such as Modified Water Delivery to Everglades National Park, will be implemented over the next few years and should result in a significant improvement in hydroperiods. Planning has begun on Part 1 of the CERP WCA 3 Decomp and Sheetflow Enhancement project, which will remove barriers to sheetflow and restore additional flows to Everglades National Park.

11. AMERICAN ALLIGATOR DISTRIBUTION AND ABUNDANCE IN WETLAND COMMUNITIES THROUGHOUT THE TOTAL SYSTEM

CERP TARGET

The restoration targets for the American alligator are to recover more natural numbers and distribution patterns across South Florida's major wetland communities. Current, specific targets are as follows:

- Increase the abundance of alligators in the ridge and slough habitats of Everglades National Park and WCA-2 and WCA-3 to more closely match the natural abundance levels currently found in the Arthur R. Marshall Loxahatchee National Wildlife Refuge
- Recover more natural patterns of sizes of animals indicative of healthy regional populations (not biased to adult males)
- Recover healthy alligator populations in the southern Everglades marl prairies and estuarine creeks and rivers

SIGNIFICANCE AND BACKGROUND

Alligators are a keystone species in the Everglades. They play a major role in influencing the overall health and ecological patterns of the region and create pathways that become important wetland trails for many aquatic animals. Alligator ponds provide places for wetland animals to live and survive during periods of low water. Alligator nest mounds become "high ground" for other animals during periods of flood and also provide places whereupon turtles can lay their eggs and keep them safe from flooding.

Alligators were abundant in the predrainage Everglades basin. The highest numbers of alligators occurred in the less deeply flooded areas of the natural system, such as the expansive cypress swamps of southwestern Florida, the broad marl prairies to the east and west of the southern Everglades, and the freshwater creeks and rivers that drain into the coastal mangrove swamps.

Currently, alligators are much less numerous in the marl prairies and mangrove streams than they were historically. The numbers of alligators in unnatural habitats, such as canals, are high compared to adjacent marshes.

CERP projects are expected to recover more natural regional hydropatterns and change the location and extent of canals throughout the system, resulting in an increase in alligators in the marl prairies as the animals are able to reoccupy these restored wetlands (**Figure 16**). Alligators should also increase in the mangrove fringe areas as the result of increased freshwater flows and reduced salinity, in the marshes adjacent to where canals are removed, and in overdrained areas, such as northern Water Conservation Area 3A, once wetter hydropatterns have been restored (**Figure 17**).

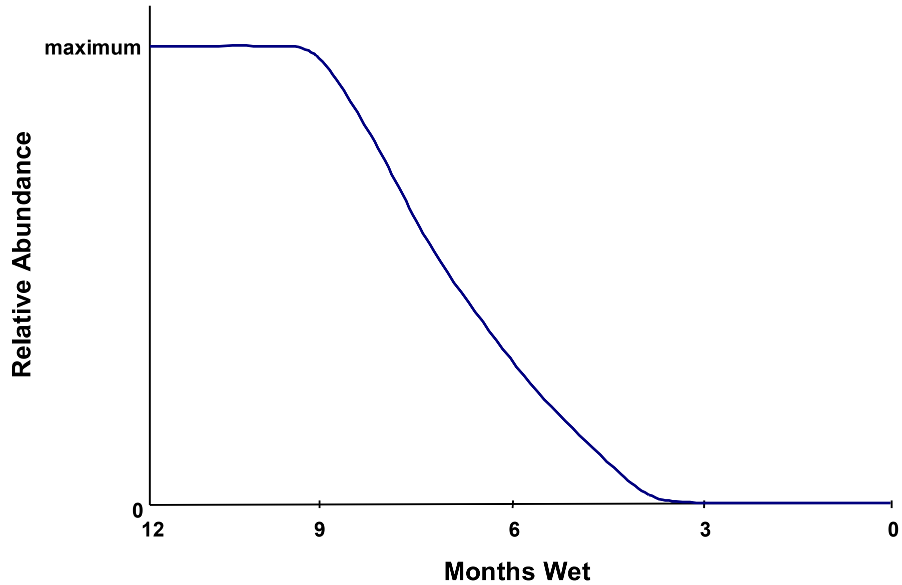


Figure 16. The relative abundance of alligators expected in marl prairies as the number of months the prairies are wet increases, assuming the presence of aquatic refugia

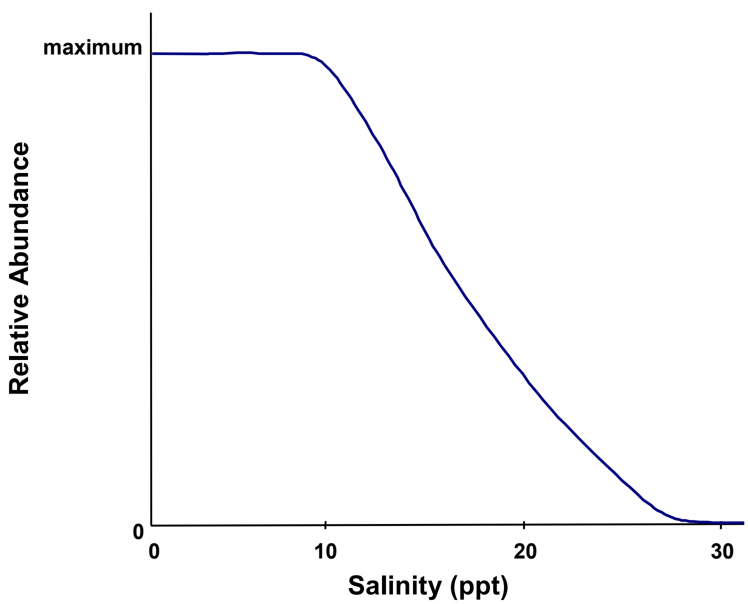


Figure 17. The relative abundance of alligators expected as a result of increased freshwater flow and wetter hydroperiods. Salinity is averaged and integrated over time

RECENT STATUS AND TRENDS

Surveys in the 1950s in the freshwater streams of Whitewater Bay in Everglades National Park indicated a count of 50 to 100 alligators during one five-to-six-hour survey. Similar surveys in 1965 and 1966 found no alligators in these same areas. Surveys in 1998 showed approximately one-fourth of the number observed during the 1950s. Few alligators now inhabit the marl prairie regions, where the animals once occupied numerous ponds. Recently, a relative abundance of alligators, perhaps closer to historical numbers, has been two to five times greater in the Arthur R. Marshall Loxahatchee National Wildlife Refuge than in similar habitats in WCA-2 and WCA-3 or those in the Shark River Slough in Everglades National Park.

INDICATOR GRADE

The indicator grades for American alligator distribution and abundance is “red” for marl prairie communities and “yellow” for marshes and estuaries.

RESTORATION ACTION

A large volume of seepage is lost from WCA-3B to the coast because the existing water management system is unable to raise surface and groundwater levels high enough to prevent seepage. The C-4 Water Control Structure Critical Project will raise surface and ground water levels to prevent drainage of the Everglades and to reestablish natural hydroperiod patterns. Construction began in November 2000 and is expected to be completed in late 2002.

Two other projects that should result in increased American alligator distribution and abundance are in the planning stages. The Western Tamiami Trail Culverts Critical Project, scheduled for completion in 2005, will increase the number of north-south flowways by adding culverts under the Tamiami Trail that will restore natural hydropatterns and improve sheetflow of surface water within Everglades National Park. Part 1 of the WCA-3 Decomp and Sheetflow Enhancement Project will reestablish the ecological and hydrologic connection between WCA-3A, WCA-3B and Everglades National Park.

12. SPATIAL EXTENT OF HEALTHY FRESHWATER WETLANDS THROUGOUT THE TOTAL SYSTEM

CERP TARGET

Healthy wetlands exist in areas where natural patterns of surface water, groundwater, and fire are the dominant processes shaping plant and animal communities. These patterns can be those that existed prior to human alteration of the system, or they can be new regimes that are considered appropriate for the landscape that will exist following restoration. Other human influences that are not necessarily driven by alterations in water and fire patterns, but that have nonetheless significantly impacted wetlands, include excess nutrients and invasive native and exotic plants. Thus, the target for increasing the spatial extent of healthy freshwater wetlands includes establishment of appropriate water and fire patterns throughout the area to be restored. Water patterns include both the depth and duration of flooding, timing and flow. In addition, invasive native and exotic plants should not make up more than 5 percent of the vegetative cover.

SIGNIFICANCE AND BACKGROUND

Healthy wetlands can take many forms depending on the environmental setting and history of each site. Communities in deep wetlands differ from those in shallow wetlands due to the direct effects of hydrology on species with different flood tolerances. Hydrology also affects the occurrence of fire. Areas that experience frequent fires tend to be dominated by herbaceous communities, with wet prairies on shallower sites and marshes on deeper sites. As fire becomes less frequent, woody vegetation becomes more prominent. Shrubs are the first plants to inhabit these communities, such as wax myrtle in wet prairies and willow and buttonbush in marshes. Next, trees begin to dominate a site. Fire tolerance varies considerably among individual tree species. Pines, which are found in shallow wetlands, and cypress, which inhabit deeper wetlands, are much more tolerant of fire than are hardwoods, such as maples, bays and hollies. The latter have gradually expanded their historically very limited distribution in South Florida as a result of the long-term absence of fire in many areas.

Native plant communities are adapted to the low nutrient concentrations characteristic of South Florida surface waters. When concentrations of nutrients, such as phosphorus, increase, a transition to other community types occurs. In this way, cattails, an invasive native species, are able to replace the original sawgrass community under the new higher-nutrient conditions. A number of invasive exotic plant species have occupied large areas of South Florida. In some places, they have come to completely dominate a site, while at other sites they form a dense ground cover or shrub layer under a native forest.

The large spatial extent of healthy wetlands in the pre-drainage Everglades basin was fundamentally important to the processes and diversity that defined the basin's ecological characteristics. The influences of natural disturbances, such as large fires, freezes and hurricanes were also necessary for creating and maintaining a complex mosaic of communities and habitats. These mosaics provided a wide diversity of animal and plant species with habitat conditions that assured long-term survival in a dynamic ecosystem like South Florida. For example, despite the wide variations in rainfall that characterize the South Florida landscape, the Everglades basin once supported such immense numbers of wading birds largely because individual species could easily locate areas suitable to their breeding, nesting and dietary requirements because of the vastness of the region, the diversity of its habitat and the easy availability of good feeding and nesting conditions.

RECENT STATUS AND TRENDS

It would probably be impossible to find a wetland in South Florida that has not been affected by human activity. However, the degree of such human impact is quite variable. Some wetlands, such as those along the southeastern coast, have been completely and unalterably developed and are not included in the restoration plan. At the other extreme, some areas, such as portions of the eastern Big Cypress Swamp, remain relatively unaltered and will require only a limited restoration effort. Between these two extremes, however, are vast areas of wetlands that have been significantly altered, primarily because of the impoundment of overland sheetflows, the diversion of surface waters, increased nutrient loads, and the spread of invasive plants. These latter areas are CERP's main restoration targets. **Figures 18** and **19** present historical land use and present day (2000) land use, respectively. These land use maps include the extent of freshwater wetlands (color).

INDICATOR GRADE

Since healthy wetlands require intact hydrologic and fire regimes, low phosphorus concentrations, and less than 5 percent exotic species coverage, only a very limited portion of the South Florida area to be restored meets these criteria. Therefore, the grade for the extent of healthy freshwater wetlands is "red."

RESTORATION ACTION

During the preceding year, no CERP projects that would be expected to result in an improvement in the extent of healthy freshwater wetlands have been implemented. However, other projects are continuing to improve water quality and reduce the cover of invasive exotic plants in parts of the system to be restored by the CERP.

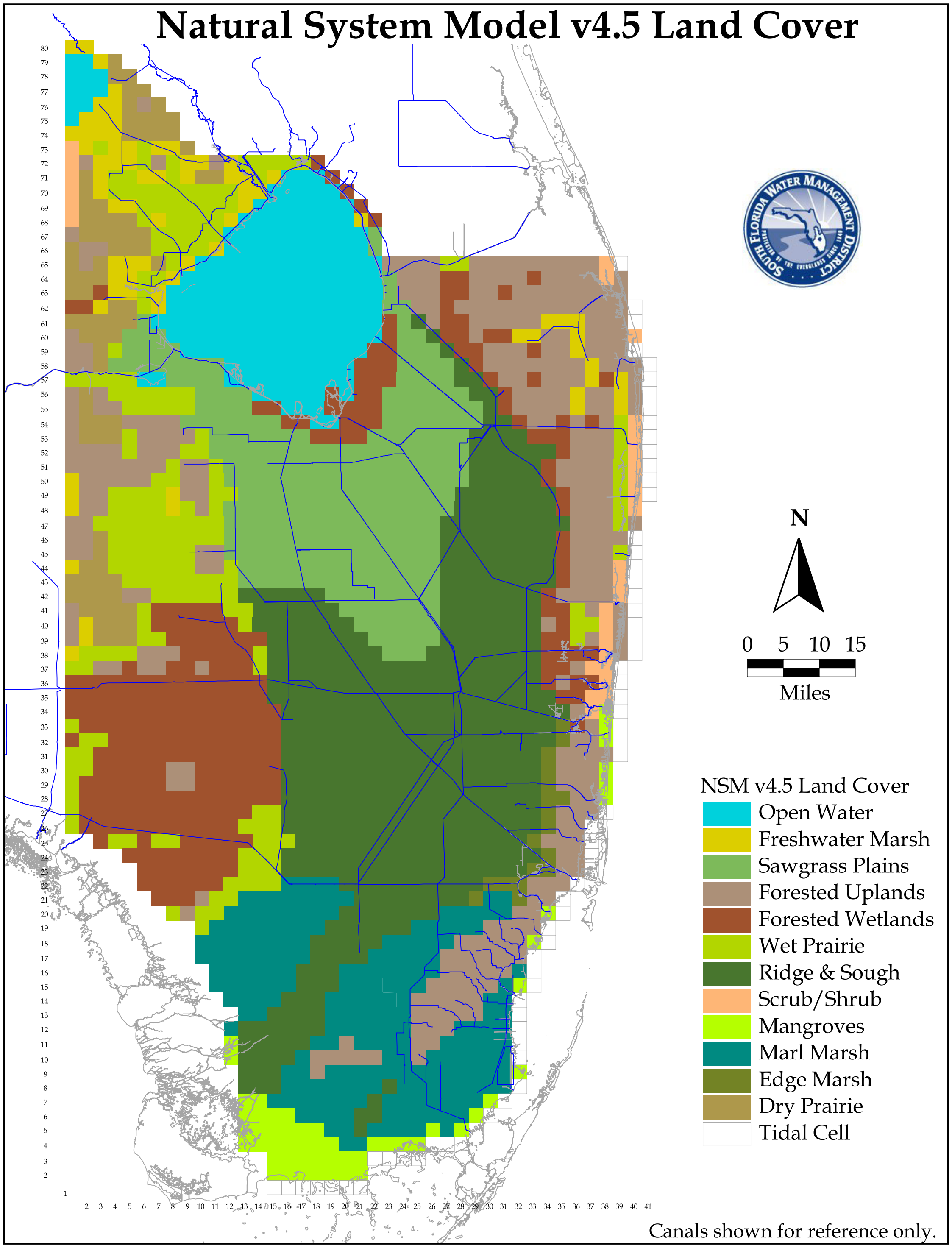


Figure 18. Historic land use map produced using the Natural Systems Model

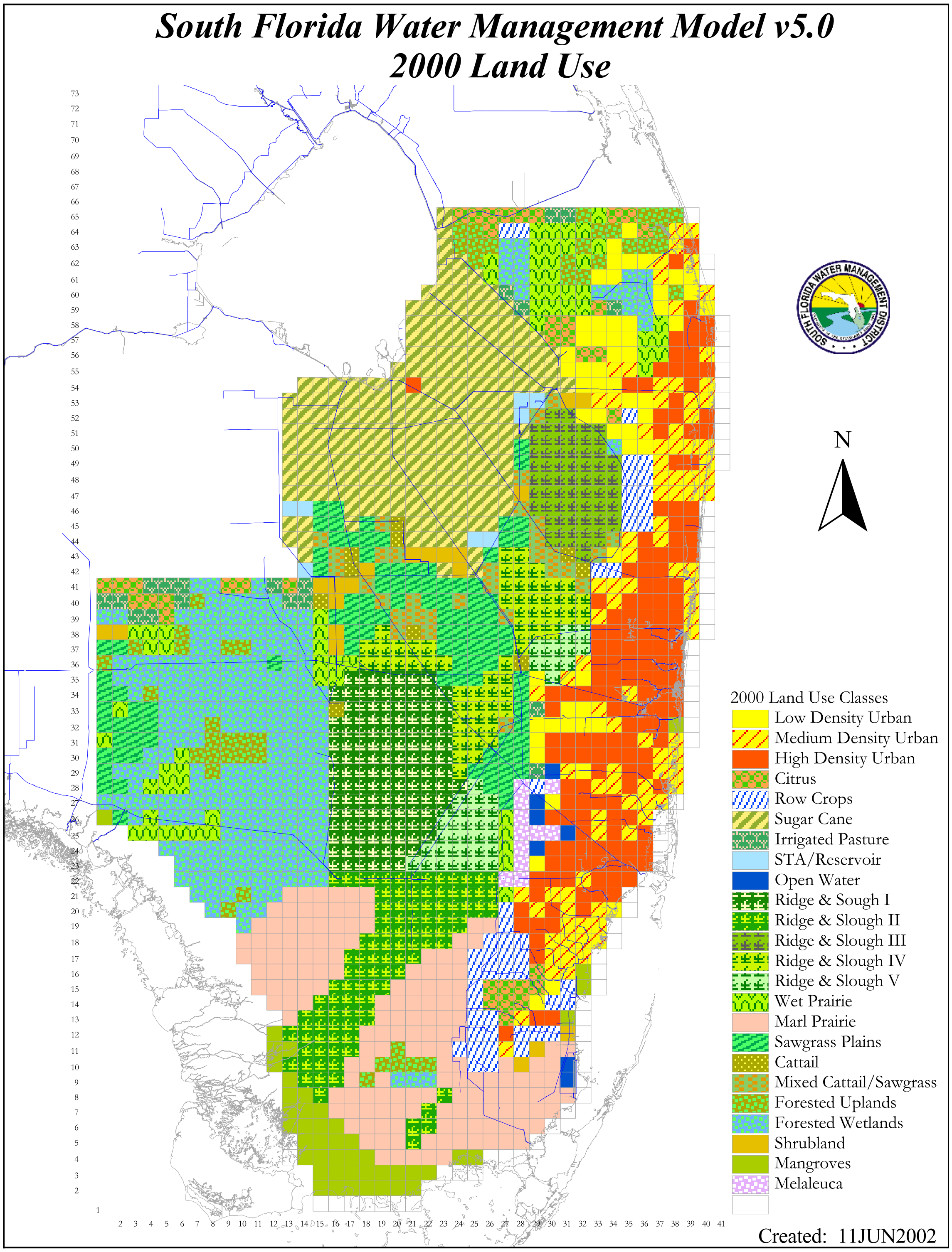


Figure 19. Present day (2000) land use map produced using the South Florida Water Management Model

13. PHOSPHORUS EFFECTS ON NATURAL WETLANDS THROUGHOUT THE TOTAL SYSTEM

CERP PLAN

One target of the CERP is to reduce unnaturally high levels of P in Everglades marshes so native flora and fauna communities will be restored. The effects of unnaturally high P levels in the Everglades have been most noticeable near canals. P levels decrease as the distance increases from structures that allow water to flow into the marshes. Restoration targets for P levels should be developed for the entire system, with specific interim targets established at sites close to present and future discharge points into the marshes (**Figure 20**). For interior sites with low phosphorus levels, the interim and long-term targets are to prevent P levels from increasing. At sites where P levels are high, the interim target is to reduce the rate of expansion of P impacts. A long-term target for these areas is the reversal of nutrient impacts.

A phosphorous index will be developed to measure the recovery or further degradation of the Everglades. This index will be based on concentrations and amounts of total phosphorus (TP) in surface water and soils and in algae (periphyton) and aquatic plants, and on biological measures, such as the species composition of periphyton mats and the expanse of cattails. A comparison of P responses at different levels provides the best approach to assessing both long- and short-term recovery patterns. For example, periphyton communities respond rapidly to changes in phosphorus concentrations and can serve as relatively quick indicators of these changes. In contrast, soils are slow to accumulate and can be used to assess long-term trends in phosphorous patterns.

SIGNIFICANCE AND BACKGROUND

Historically, the Everglades was naturally a low-phosphorous system, with nutrients primarily provided via rainfall. Most natural populations of Everglades' flora and fauna are adapted to low phosphorus levels. Sawgrass strands account for approximately 65 to 70 percent of the total vegetation cover in the natural Everglades. In many areas, these strands are interspersed with more open communities, such as wet prairies, containing rushes and grasses, and deeper-water sloughs, containing water lilies and bladderwort. These open-water habitats should be characterized by an abundant native periphyton community (floating and attached algal mats) that provides both habitat and a food source for invertebrates and fish.

Anthropogenic enrichment has resulted in the conversion of open-water habitat and sawgrass areas into dense cattail stands. Historically, cattail was a minor component of the Everglades flora and is believed to have occurred primarily in naturally enriched or disturbed locations. No evidence has been found from the pre-drainage system for the existence of dense cattail stands such as those that now occur over extensive parts of the northern Everglades.

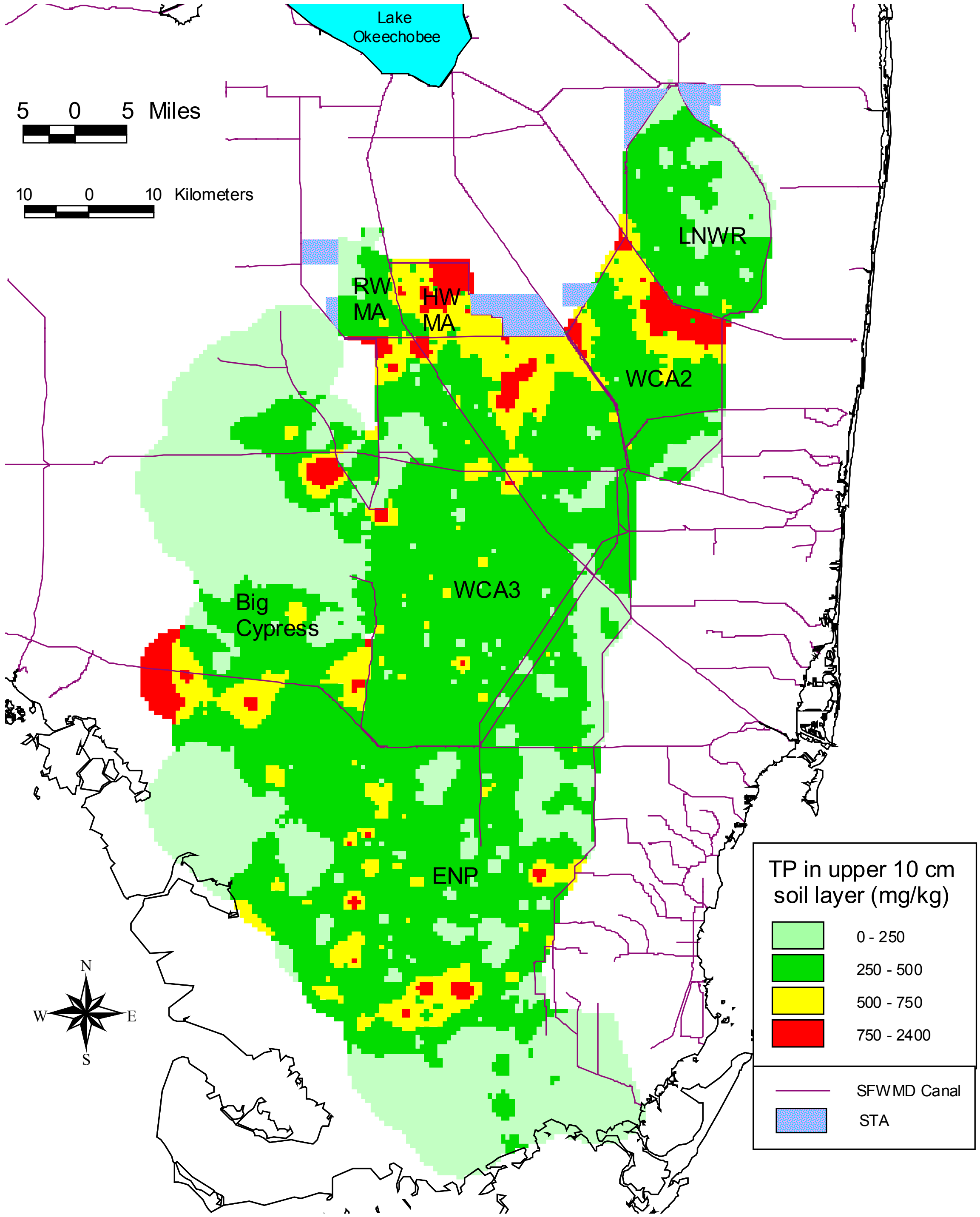


Figure 20. Spatial distribution of surface soil (0 to 10 centimeters) phosphorus concentrations throughout the Everglades (USEPA, 1999; Reddy et al., 1991, 1994; DeBusk et al., 2001; S.M. Smith and S. Newman, unpublished data)

RECENT STATUS AND TRENDS

Vegetation and soil surveys show that P enrichment is generally associated with inflows from canals into the Arthur R. Marshall Loxahatchee National Wildlife Refuge, WCA-2A and WCA-3A. Evidence of elevated P levels is also observed in over-drained northern areas of the Everglades system, such as the Holey Land and Rotenberger Wildlife Management Areas (**Figure 20**). Analysis of soil nutrient and cattail distribution in the most enriched portion of the Everglades (WCA-2A) shows that the expansion of the impacted areas' nutrient front has continued throughout the 1990s (**Figures 21** and **22**).

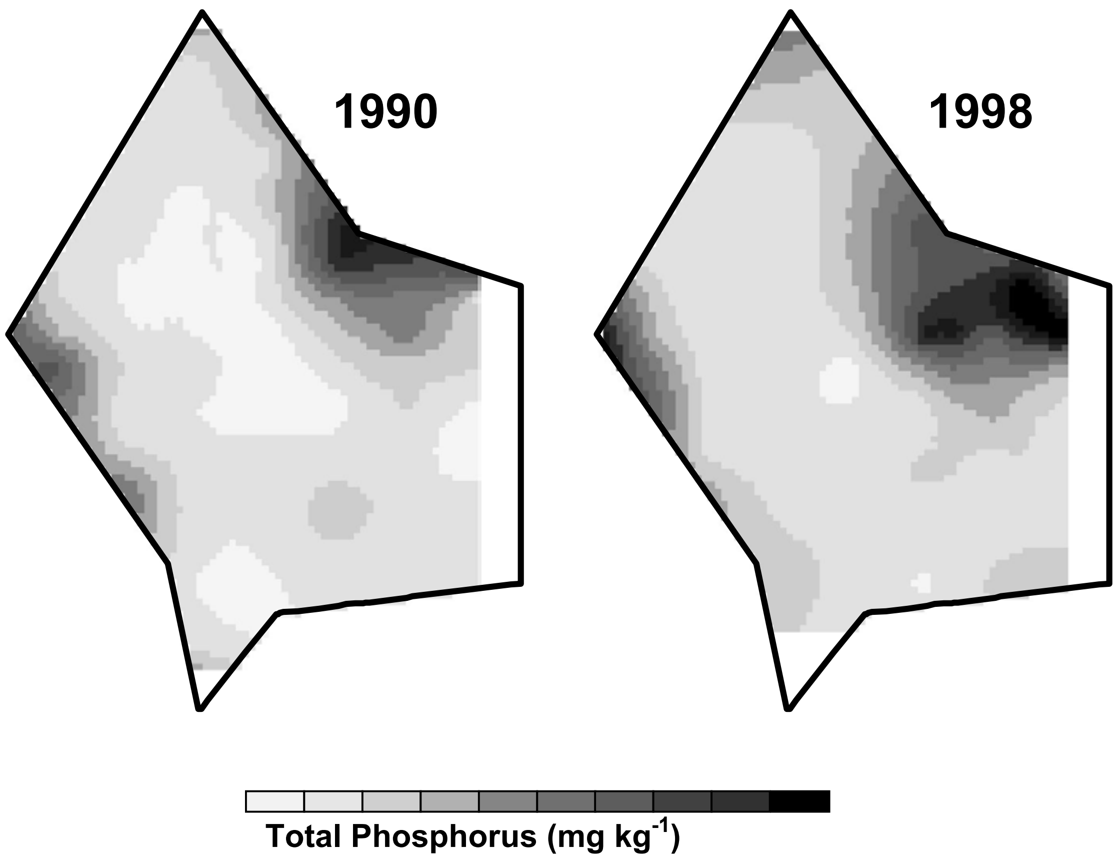


Figure 21. Spatial distribution of soil total phosphorus in WCA-2A, showing an increase in areas of enrichment from 1990 to 1998 (DeBusk et al., 2001). Units are milligrams (mg) of total phosphorus per kilograms (kg) of soil

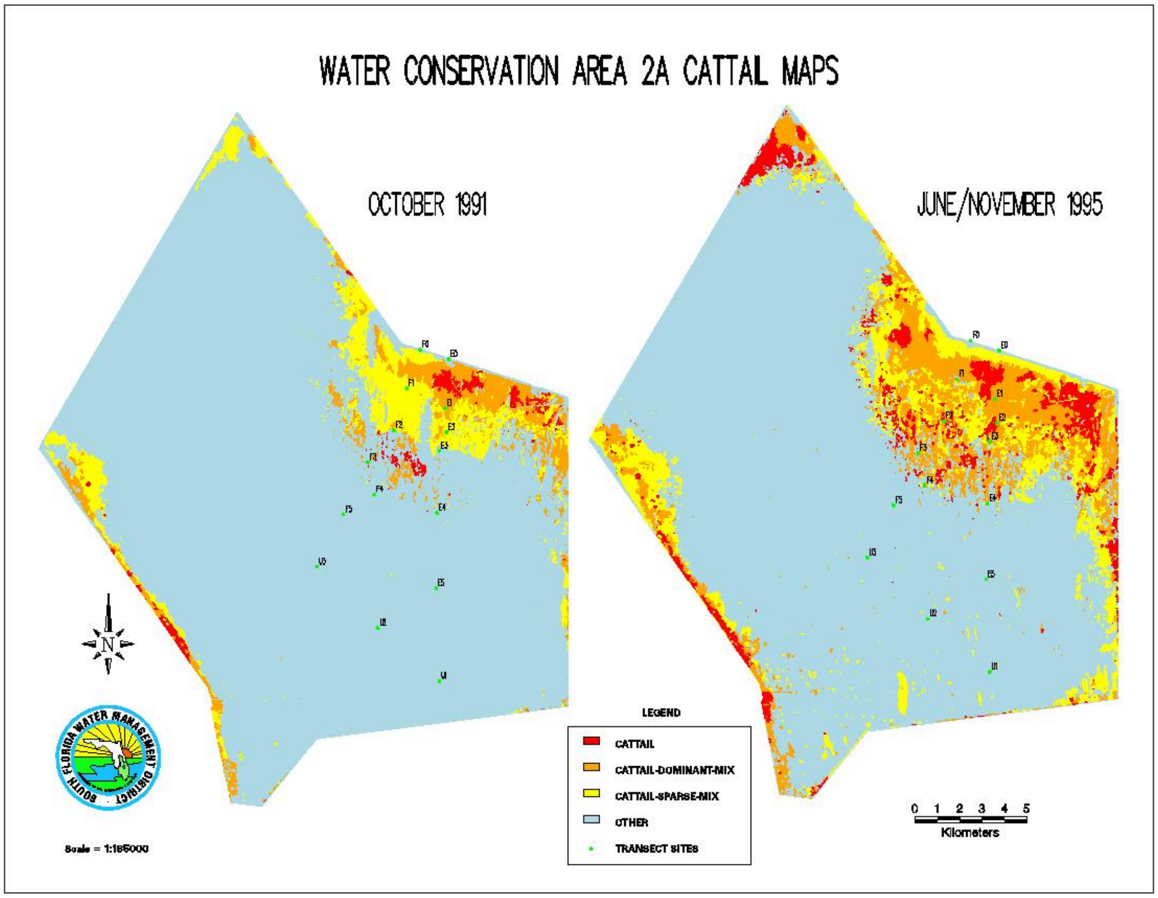


Figure 22. Increase in cattail expanse in WCA-2A from 1991 to 1995 (Rutchey and Vilchek, 1999)

INDICATOR GRADE

The indicator grade for P effects on wetlands is "red".

RESTORATION ACTION

Best management practices (BMPs) for Water Year 2001, May 2000 through April 2001, resulted in an estimated 73 percent P load reduction to the Everglades. During this water year, 53 metric tons of P flowed out of the Everglades Agricultural Area (EAA) basin (including farms, towns and industry) compared to the estimated 195 metric tons that it was predicted would have been in the runoff had BMPs not been implemented. Phosphorus concentrations in the water were also lower, averaging 64 ppb compared to pre-BMP P concentrations of 173 ppb. Four Stormwater Treatment Areas (STAs), STA-1W, STA-2, STA-5 and STA-6, have been built and are operational, producing average discharge concentrations ranging from 20 to 30 ppb. As part of the process of establishing the water quality standard for surface water TP concentrations, the FDEP is developing a series of public workshops. Draft reports suggest that the P standard will be set at 10 ppb.

14. WATER SUPPLY FOR SOUTH FLORIDA

CERP TARGET

The CERP is designed to ensure that South Florida's permitted water users will have at least a 1-in-10-year level of service from the regional water system. A 1-in-10 year level of service means that water needs must be met even during a 1-in-10 year drought event. An average rainfall year is defined as rainfall with a 50 percent probability of being exceeded over a twelve-month period. A 1-in-10 year drought condition is defined as below normal rainfall with a 90 percent probability of being exceeded over a twelve-month period. This means that there is only a ten percent chance that less than this amount of rain will fall in any given year.

During a 1-in-10-year drought event, the regional water available from Lake Okeechobee and the WCAs is expected to supplement local water supplies. For those years when lack of rain is greater than a 1-in-10-year event, it could be necessary to impose restrictions on local water supplies to ensure an adequate supply of water through the end of the drought. However, restrictions could become unnecessary if local water suppliers develop alternative sources.

SIGNIFICANCE AND BACKGROUND

Significantly less water flows through the South Florida ecosystem today compared to historical water flows. In fact, on average, 1.7 billion gallons of water that once flowed through the system are wasted each day through discharges to the Atlantic Ocean and the Gulf of Mexico. Under the CERP, most of this excess water will be captured and stored in surface and underground storage areas until it is needed. The features proposed in the CERP will vastly increase the amount of water storage available in South Florida. As water storage increases and seepage losses decrease, losses to tide will decrease and the amount of regional water available will increase. This stored water will help meet a 1-in-10-year level of service, which is the long-term planning goal for meeting future water supplies that the state's water management districts use for regional water supply plans.

RECENT STATUS AND TRENDS

South Florida had its driest 18-month period ever recorded from November 1999 to April 2001. Most of South Florida was under water shortage restrictions beginning in December 2000. Under the restrictions, public water demands in 2001 decreased from between 7 to 19 percent compared to withdrawals for the corresponding month in 2000. Irrigation water deliveries from Lake Okeechobee to the EAA were reduced by about 40 percent compared to demands.

INDICATOR GRADE

The indicator grade for water supply in South Florida is "yellow".

RESTORATION ACTION

Long-term restoration will be achieved by the implementation of surface water storage reservoirs, seepage management, and ASR projects recommended in the CERP. The water made available by these projects will offset demands of regional water from Lake Okeechobee and the WCAs.

The three regional water supply plans approved in 2000 by the South Florida Water Management District (SFWMD, 2000a, 2000b, and 2000c) recommended projects that would increase water supply in the interim until the CERP is fully implemented. These plans include the developing alternative water supply sources by applying reuse water and reverse osmosis; increasing the efficiency of water storage in local drainage systems; increasing conservation programs; and developing rules for reservations, consumptive use permits and minimum flows and levels. The regional water supply plans have a planning horizon of 20 years, ending in 2020. Updates are prepared every five years.

For more immediate relief, the SFWMD adopted a Water Supply Contingency Plan (SFWMD, 2001) that provides 25 options the agency can implement, in some cases in conjunction with local utilities, to augment water availability. Some of the options were recommended in the regional water supply plan but could be expedited as part of the contingency plan.

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