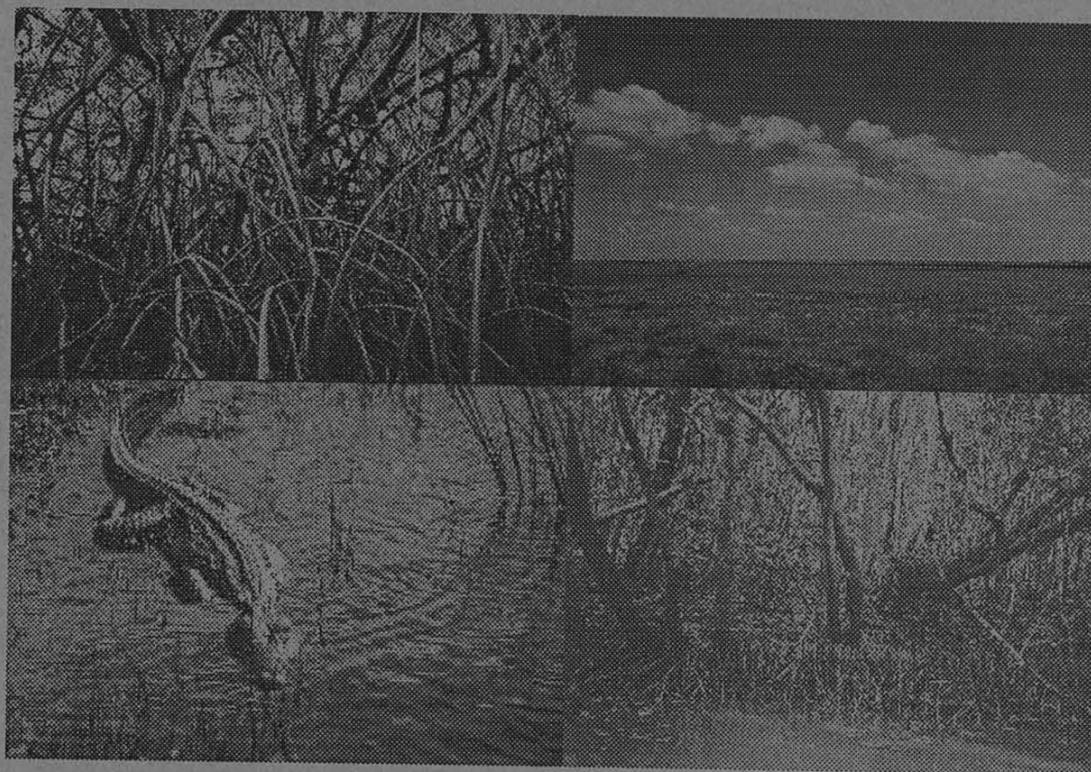

Global Climate Change Project In Everglades National Park



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Global Climate Change Project

Everglades National Park, Florida

Report of an Internship

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"Time is fun when you're having flies."

Gordon Anderson

1. Introduction

To make something interesting out of an obligatory part of my study program, I decided to combine study with challenge. I spent my three-months internship for my study program “Cultuurtechniek” (Land and Water Use) of Wageningen Agricultural University in the Everglades National Park in Florida, USA. I made this decision after talking with some fellow-students who also spent their internship down there.

Going abroad was for me an opportunity to experience something more of the world. After spending more than 5 years in Wageningen it was time for me to leave this city for a while. After writing an e-mail to Gordon Anderson, employee of the South Florida Research Center with my request of fulfilling my internship with him, he invited me to come over. Since his Global Climate Change Project is always in need of personnel and he likes to work with Dutch students.

This report is about my stay in the Everglades from January to April 1999. It contains some general information about the Everglades (section 2), research in the park (section 3) and my contribution to the project (section 4). It won't deal with the technical details of the monitoring stations that are used for the hydrological monitoring. These are gone over in so many other reports of internship of previous students who worked with the project, that I couldn't contribute anything. I spent more time in writing a view for the future.

I want to thank my supervisor, Gordon Anderson, for his great effort in teaching and guiding me.

Adriaan Berkhof
May 1999



2. The Everglades.

2.1 Everglades Ecosystem

National Parks are not islands of land. Outside events shape their fates. Water management is the critical issue for the Everglades, whose watershed begins in central Florida's Kissimmee River basin. Summer storms flooding there once started a shallow, wide river flowing southward to the Gulf of Mexico. Man made water controls disrupted the natural flow, changing the quantity, quality, distribution and timing of the water flowing in the Everglades. South Florida's freshwater supply comes from rain on the Kissimmee River basin and southward, mostly in May through October. Evaporation, transpiration and runoff consume four-fifths of the rain, which may total 40 to 66 inches (100 to 165 cm) per year (McPherson, 1999).

The natural cycle of freshwater circulation historically built up in the shallow Lake Okeechobee. It averages 12 feet (3.7 meter) deep and covers 730 square miles (1890 square meters).

When the water overflowed the low banks at the south part of the lake, the flow of the wide, shallow 'River of Grass' started (see figure 1). Fifty miles (80 km) wide in places, one to three feet (0.3 to 0.9 meters) deep in the slough's center but only 6 inches (15 cm) deep elsewhere, it flowed south 100 feet (30 meters) per day across Everglades sawgrass towards mangrove estuaries of the Gulf of Mexico. The elevation fall between the lake and Florida Bay is only 5 ft (1,7 m). In the winter the six-month dry season starts. So there are only two hydro periods. In The Netherlands, for example, there are four hydro periods.

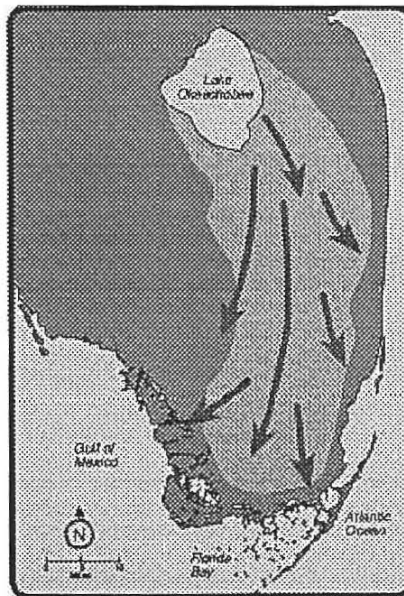


Figure 1: Watershed Everglades (ENP, 1998)

The Everglades flora and fauna are adapted to alternating wet and dry seasons. Water cycle disruptions ruin feeding and nesting conditions (section 2.3).

During the dry season (December to April), water levels gradually drop. Fish migrate to deeper pools. Birds, alligators and other predators concentrate around the pools to feed on a varies menu of fish, amphibians and reptiles. This abundant food source is vital to many wading birds who are nesting during the dry season. Everywhere along the parkroad the concentration of wildlife along the pools can be spotted, which is a fascinating site.

In May, spring thunderstorms are the beginning of the wet season. A winter landscape with small pools of water yields to a summer landscape almost completely covered with water. Wildlife disperses throughout the park again. Fauna repopulate the food chain. By December, the rains cease and the dry cycle begins again.

2.2 History of the Everglades National Park.

To preserve a part of the unique ecosystem the Everglades, Everglades National Park was founded on October 10, 1947, when Daniel B. Beard, first superintendent of Everglades National Park, accepted the 4,000 acre of Royal Park State Park, a gift from the Florida Federation of Womens Club, which became the nucleus of the park.

President Harry S. Truman dedicated Everglades National Park on December 6, 1947, at Everglades City, the small community near northwestern corner of the park. The 21-year effort by conservationists became a reality.

In the more than four decades that followed, many changes occurred. The Daniel Beard Center was formerly the U.S. Army Nike Missile Site built during the Cuban missile crisis. Now a day it is occupied by researchers who study the Everglades Ecosystem and Hydrology.

The present paved road replaced the old gravel and dirt Ingraham Highway in 1956. With improvements in the road, visitation increased dramatically. In 1948 there were 7,500 visitors. The highest record of 1,773,300 was reached in 1972. Numbers dropped significantly during the early 80s, but visitation has been steadily increasing since then, and averaged of about a million in 1990 and 1991. Hurricane Andrew, in 1992, damaged many park facilities. The main entrance of the park was closed for four months. Repairs will continue for years.

The critical issues facing the park management today are focused on the water problems which face all of south Florida. For the park, it is a question of water quantity, quality, timing, and distribution. Two major issues are the 8¹/₂ square miles area and the Tamiami Trail, where two man against nature conflicts take place. Other concerns-fire, drought, mercury contaminations, declining bird and fish populations-are directly related to water. For that reason it is important to develop and implement a long-term basic research program. Studies are designed to understand complex hydro-biological trends and relationships, as well as determine the appropriate management actions, in order to preserve and /or restore natural ecosystems.

The South Florida Research Center conducts research and develops resource management programs. They also monitor hydrological conditions, marine estuarine habitats and its inhabitants, vegetation communities and fire effects, and wildlife populations including endangered species, fresh water marsh fish, and invertebrates.

2.3 Man's impact on the hydrology of the Everglades

By far the most serious effect of man on the environment remains the alterations of water flow patterns for agricultural and metropolitan purposes as flood control, during the wet season, and drinking water, during the dry season. The direct channeling of fresh water from Lake Okeechobee to the coast alters sheet flow, causing soil fires and saltwater backflow in the south of the Everglades. For this reason the flora in Floriday Bay almost died, because the water salinity increased.

Faced by these ever worsening scenarios, the Central and South Florida Project for Flood Control and Other Purposes (C&SF) took over the project in 1948 to save the human environment.

First, the C&SF canalized and embanked the sheet flow to prevent encroachment on developing metropolitan areas as Miami.

Second, agriculture reclaimed the Okeechobee by draining the Lake swamp and rerouting the water to the Water Conservation Areas (WCA) souths of the Lake. Total WCA's, which regulate water flow to prevent flood and drought, now represent 32 percent of the original

Everglades ecosystem. Everglades National Park only contains 25 percent of this system (Van Lent, 1999).

As mention in the previous section, there are two hydro periods in the Everglades. The intrusion of the WCA's places this pattern in serious jeopardy. The levee system interrupts the drydown as conditions on one side not correlate with the conditions of te other. Use of the conservation areas for flood control and unnatural releasing of water also adversely effects these communities. Often this reverses the drydown fronts.

During long dry periods the water consumption of Miami and its suburbs gets priority and the water supply to the park is diminished. The spills along the Tamiami Trail, the Tampa-Miami Highway at the north barrier of the park, will be closed to stop the outflow of water of the Water Conservation Areas (see figure 2).

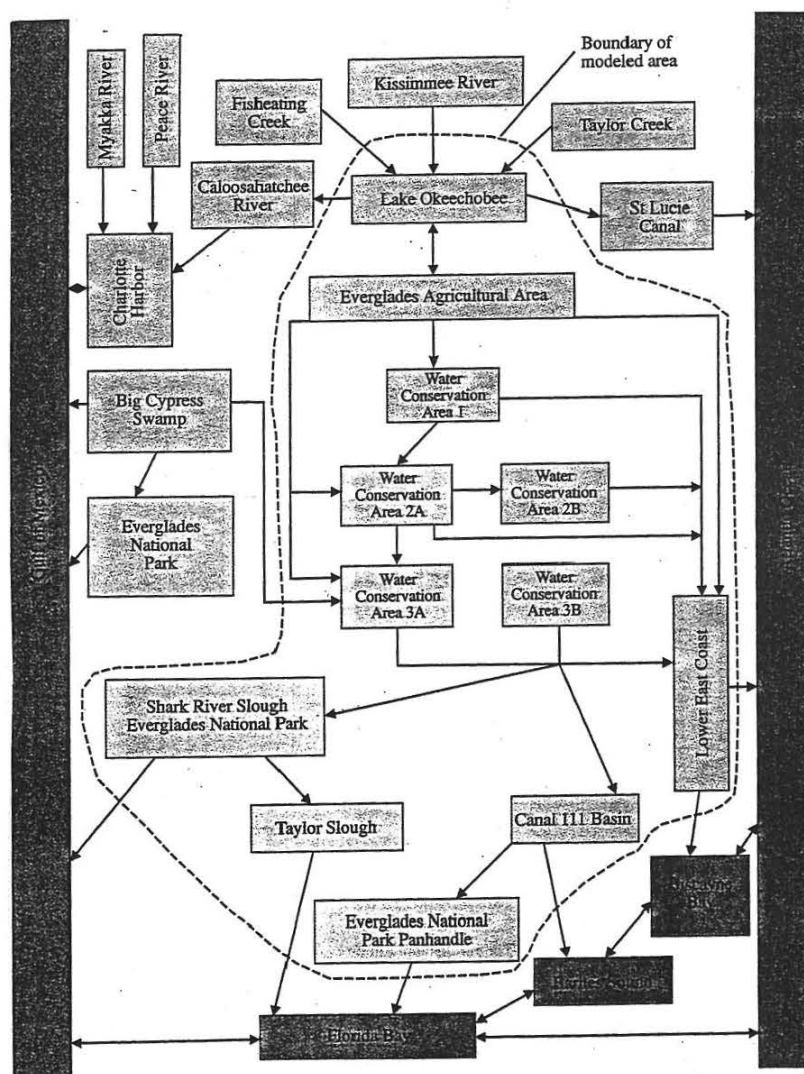


Figure 2: Water Storage and movement in south Florida (arrows indicate dominante flow direction).
(Modified from South Florida Management District, 1993.)

Due to this decline in amount of freshwater in the park, saltwater was able to intrude into freshwater aquifers. As a result the major food supply, such as small fish and shrimp, for the wading birds diminished and the number of nesting wading birds decreased in 60 years from 300,000 to 15,000 (McPherson, 1999).

Also the water quality is changing. Nutrient rich water released from the land reclaimed below lake Okeechobee has increased the proliferation of cattail. Cattail encroached areas do not encourage food supplies for wading birds, essentially removing this wetland area from use.

2.4 Future of the Everglades

Any attempt by man to undo the damage of the past and the present must come from a comprehensive understanding of the function and operation of the original ecosystem in order to prevent further "well intentioned" catastrophes, as happened in the past. One of these was the supply of freshwater during an extreme dry spring to preserve the Everglades flora and fauna from drying out. But instead of helping, nests of many birds such as cape sable seasparrrow were flushed away. This bird population dropped down a great deal and now a lot is done to increase the amount of this "small-bird-with-the-big-name" again. To save the Everglades, people in Florida should realize that mankind's survival remains closely linked with that of their surroundings. Any threat to our biosphere will eventually cycle through and return to affect us. These changes in the wet/dry season cycle have a serious effect on flora and fauna. A lot of research is done to describe these changes.

During my stay in the Everglades I talked and discussed with many people, researchers as well as tourists, about the future of the Everglades. I found out that a lot of the tourists didn't understand or realise the real issues that are threatening the Everglades. Often it is believed that measures taken by the government in advance of the Everglades will disadvantage the people, so these are blocked. So it is almost impossible to make appropriate changes in the water management. I believe that changes in policy to save the Everglades won't affect the people in South Florida as much as they believe. Only if the Everglades is so dry that wildlife is dying or a huge wildfire occurred, something can be done to 'save' the Everglades. I believe this is short sighted.

When more education is given to these people they will understand more what is going on in the Everglades and how important the restoration of this ecosystem is. Results of research can help to convince people. When the majority of the population understands this it will be possible for the government to execute the keys of restoration to save the Everglades. This could take several years. And with the attitude of most people I spoke this can take forever. Time will tell... But will there be time?

3. Research in the park

3.1 The Florida Caribbean Science Center

The Florida Caribbean Science Center is part of the Eastern Region of the U.S. Geological Survey's Biological Resources Division. Center headquarters are in Gainesville, Florida. It has field stations throughout south Florida and the U.S. Virgin Islands.

Scientific activities of this center are coastal and marine ecology, restoration ecology, biological diversity and invasive species. The Global Climate Change Project of Mr. Anderson is also part of the U.S.G.S. research.

3.2 The Global Climate Change Project in South Florida

In order to understand and predict the potential impacts of global change, scientists need to study different geographic areas on the ecosystem, landscape, regional and global levels. National parks are ideal laboratories in which to study global change because of their diversity and their well-preserved ecosystems. Another benefit is, because these parks are government property, problems related to privately owned properties can be avoided. The parks can be used for long-term ecological research necessary to study global change and its effects on various scales.

Covering more than two million acres, Everglades National Park and Big Cypress National Preserve contain the largest remaining subtropical wilderness in the United States. Extensive wetlands range from saline mangrove forests to freshwater swamps and sawgrass marshes. The elevation of these South Florida ecosystems are in the range of a few meters above the sea level. Small changes in global temperature, with the consequence of rising sea level, may have dramatic effects. The sea could inundate freshwater areas and the low lands with consequences for the complete ecosystem. The growing population in South Florida (400 persons immigrate everyday [traffic guide book]) depends on the freshwater of these freshwater wetlands. These conditions make these areas interesting to study the global change. This kind of research may help in determining how to manage the relationship between human and nature in coastal environments.

Everglades National Park focuses on changes to be expected along the inland boundary of the mangrove fringe, where mangroves give way to the freshwater marshes. The working hypothesis is that changes here will be driven by modification in local hydrological conditions, such as hydroperiod and salinity. This is being tested through a two-step approach. First, field studies of hydrology in (the vicinity) of the mangrove/marsh ecotone is conducted to establish the hydrological conditions that control the transition from the mangrove to the freshwater marsh. Second, a model of the coastal hydrology along the South Florida coast will be formulated and calibrated to relate changes in sea level and climate to changes in local hydrological conditions that affect the vegetation. Through this approach it will be possible to project the effects of future sea level and climate scenarios [Nuttall W.K. and Cosby, B.J.]. For example, with a global warming the precipitation could also increase. This will cause a larger input of freshwater in the mangrove area from the 'River of Grass' and 'pushing' the sea water back. With these results people can be convinced that the Everglades ecosystem needs to be restored.

3.3 Monitoring stations in the mangrove/freshwater marsh ecotone.

To achieve the goals as described in the previous section, 16 monitoring stations are built at the west and south coast of the Everglades National Park (see appendix 2). These hydro sites are set up:

- a) To collect essentially continuous records of depth of surface and soil water and the hydraulic head in the underlying limestone aquifer and;
- b) To monitor changes in salinity in the surface, soil, and limestone aquifer.

At some sites also the temperature and the precipitation are measured.

Each transect consists of at least four hydrologic monitoring stations, two in the mangrove and two in the sawgrass marsh. An exception is the Chatham transect, with only three stations.

3.4 Future of this Global Climate Change Project

As for many research projects, only after several years some meaningful facts can be concluded from the research. The GCC project in the Everglades has started in 1993. The first few years were spent on building the hydro sites in the field. Due to many problems the data of the sites contain a lot of "gaps". Over this period of time there is not any or not meaningful data.

Since only 1996 the data is more serious.

To conclude long term changes in the climate a research period of only three years is not sufficient. For that reason the project should go on for a longer period. Especially when the Global Climate Change Project of Gordon Anderson is linked with other water quantity projects in the Everglades National Park a more accurate prediction can be made.

Thanks to the support and effort of many Dutch volunteers, who spent so much time in the Everglades to help with the project, it has now reached the maintain stage. The main constructing activities are finished and only some small improvements need to be done. That does not mean that going out in the field to visit the sites is not necessary any more. The harsh conditions in which the sites operate require a lot of maintenance. But in comparison with the constructing stage more time is left for analysing the data of the hydro sites.

The Global Climate Change Project in South Florida is still operating in the first step (section 3.3). Still field work is done. Only when enough consistent data is collected, the second step can be taken; a model of the coastal hydrology along the South Florida coast will be formulated and calibrated to relate changes in sea level and climate to changes in local hydrological conditions that affect the vegetation. From that point of view, the project needs to go on for more years. Only if the project is properly funded and the employees continue to do their job, this will be possible. Because of the harsh-tropical conditions this job won't be possible for everyone.

When the project is finished, and the predictions can be made, government has a strong instrument to convince people in Florida that doing something to save the Everglades is also involving their future. Till then, the government has to be satisfied when at least small progress is made.

4. Working as an international volunteer in park.

It was quite an experience to live and work in such a large nature area as the Everglades National Park. Driving to the office without seeing any building is an unique experience for some one from The Netherlands.

As a volunteer I performed hydrology field work for the inventory and monitoring (GCC) project. Hydro sites are located in remote areas of Everglades National Park and are only accessible by motorboat, helicopter, airboat and walking. Field working conditions are extremely harsh-tropical weather conditions, biting insects and hard physical labor in mangrove/sawgrass habitat. Although during my stay the weather was most of the days nice and the bugs weren't that bad. Leaving just before May was a wise decision.

The remaining time I spent in related office and lab hydrologic duties: data verification and analyses using various computer software hydrologic modelling. I also built several pump boxes, and installed these on the sites. The more days I spent with my supervisor the more responsibility he gave me. Thanks to that I really felt myself part of the project.

From the field work I learned how hydrological data is collected and what can go wrong in this process. Even if there is data in file, these can be not according to the 'real life'. So always watch out if the data is meaningful. I also learned to manage a field trip from a logistic point of view. Out in the field you can't go back to get a 'baco'. This also made me more inventive.

A few times I was available with my free labor to help various researchers with their work. Joining them was an opportunity to increase my understanding of the hydro-biological relationships in the park. I went out in the field to study the migration of small mammals (mice and rats), to count the population of turtles, to monitor the changes of water quality from the Shark River inlands, and to set up nine tables which can measure the changes in soil elevation.

I also took a "Basic Aviation Safety Course" so that I was able to be a crew member in the helicopter and I took a database program Access class. Those additional trainings can be useful in my further career.

At the end of my stay I gave a presentation about one of the Dutch Wadden Islands, Schiermonnikoog. This talk drew a large audience of at least 40 people, who were enthusiastic about it. In this talk, I related the water management issues of this Island with some of those in the Everglades National Park. I believe it was a good ending of my stay over there.

5. Wageningen in the world.

For an international focussed university, as Wageningen Agricultural University, it is important to know what is expected from its students by their later employers. This section of the report of internship is dealing with what can be expected from a student Land and Water Use when he/she wants a job as a hydrologist at the South Florida Research Center. According to my experience the following can be concluded:

- It is important to know something about geo-hydrology. With that knowledge you are able to understand the spatial relationships between different actors of the system and how these are influencing each other.
- A student should know how hydrological research can be done and which equipment can be used for different kind of monitoring. For example, water level and salinity monitoring require a different kind of approach.
- A student should have knowledge in working with GIS-software, like Arc-Info. This software is used in the research proces. Also it is recommendable that a student can work with spreadsheets and DOS editors, because the hydro data is studied with these kind of programs.
- It is essential that a student is known by the employees of the park. But only in a positive way. This can help you when you want to achieve something that is not possible for your supervisor. Like ordering pizza after 8 p.m. in the Buttonwood Cafe.
- A student needs to be able to work under harsh-tropical conditions. Especially in the wet season, working in the Everglades can be difficult. The winter is the most pleasant time to go over there, although even then the musquitos can be bad.
- Also the remoteness of the park should not bother a student. To reach a hydro site, a long trip has to be made of at least 1 hour of driving with half an hour to 1 hour of boating. For Dutch people this is a long trip.

So, to work in the Everglades you need more then only your theoretical knowledge and background from the classroom.

6. Literature

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Water levels, not flows, are the key indicator of marsh restoration. SFRC, Everglades National Park.

Appendix 1: Addresses

USGS-BRD
Everglades National Park
40001 State Road 9336
Homestead, FL 33034-6733
Telephone: 1-305-242-7800

Gordon Anderson

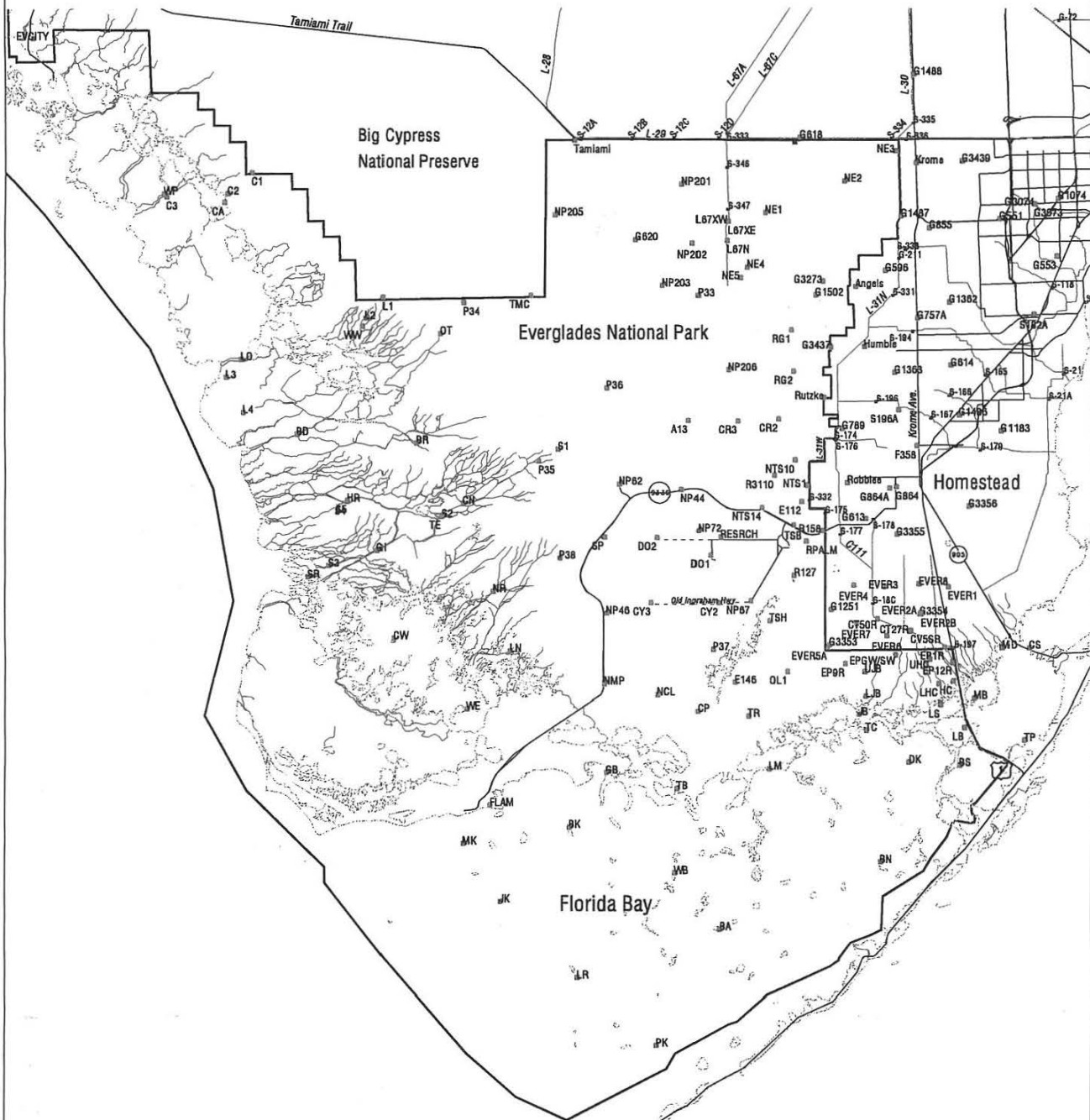
e-mail: gordon_anderson@nps.gov

Dutch Consulate
Miami, Florida

telephone: 1-305-253-7658

Appendix 2: Monitoring sites

MONITORING STATIONS



Appendix 3: Hydrologic pattern of south Florida.

All the water used to flow from Lake Okeechobee south to the Gulf of Mexico and Florida Bay (figure A). Now a days this pattern has been changed dramatically (figure B).

Figure A: Hydrologic features and the natural direction of surface water and coastal water flows under preddevelopment conditions in south Florida.

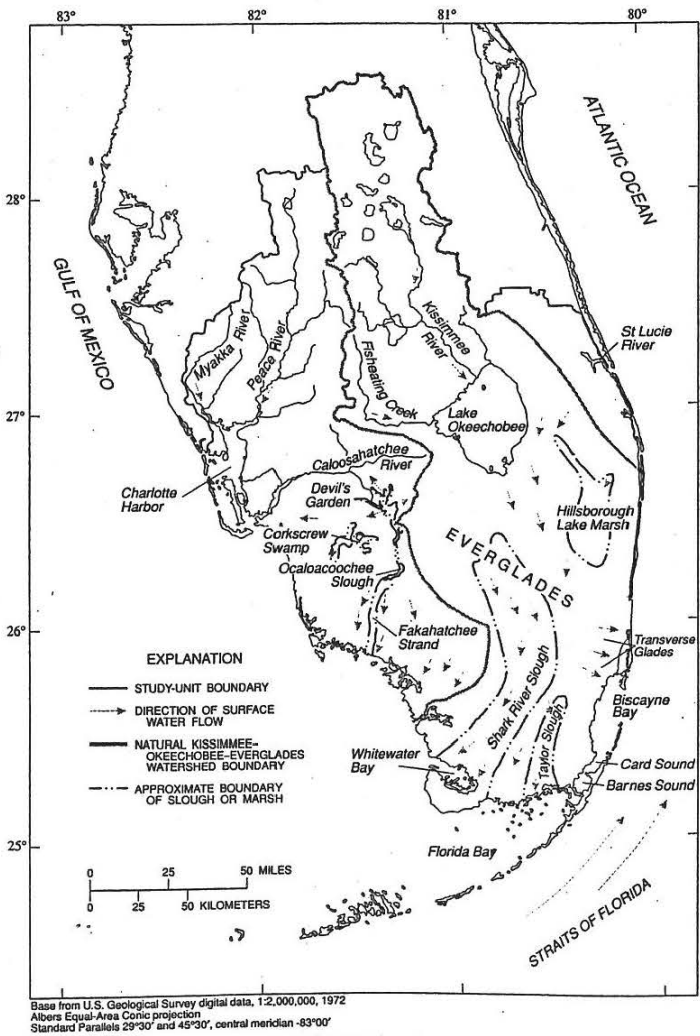
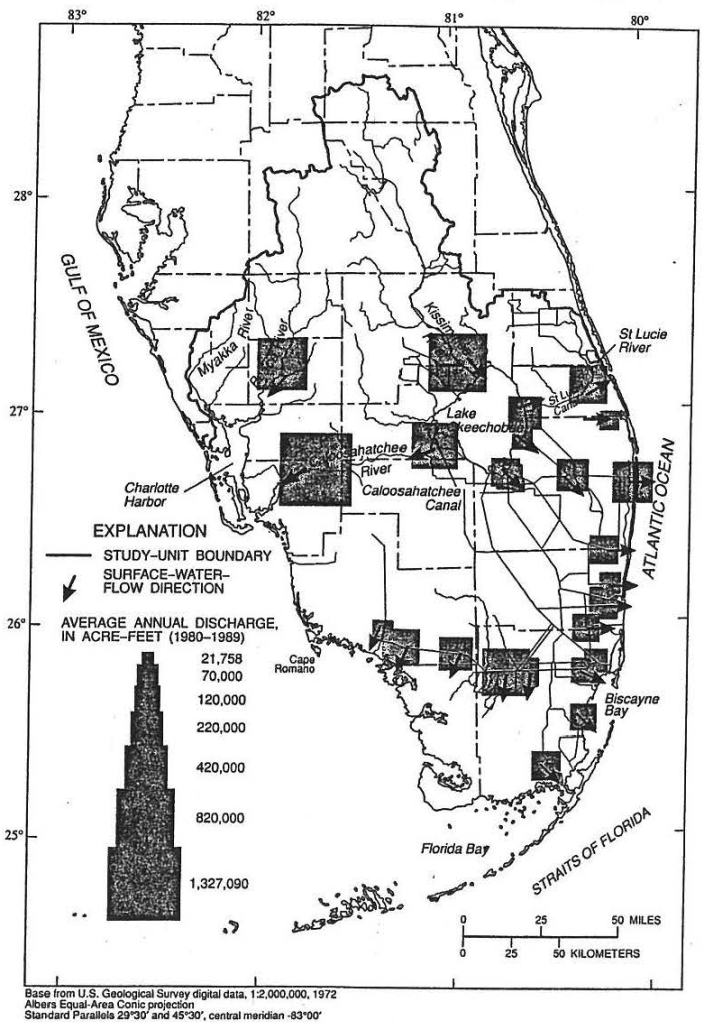


Figure B: Average annual discharge from major canals in south Florida (McPherson, 1999).



Appendix 4: Park Map

