EVERGLADES THREATS
Acrostic Activity Sheet

H.I.P.P.O.(C)

Name: _____ Date: _____

The Everglades provides ecosystem services, or natural services that support life on Earth and are essential to the quality of human life and to the functioning of the world's economy. The wetlands in the Everglades filter and clean the water, giving us fresh water to drink, and the different habitats provide flood control, water storage, and protection. This is why it is so important to protect the Everglades.

But the Everglades is in trouble. Using the acronym H.I.P.P.O. (C), we can learn about some of the threats to the Everglades.

An **acronym** is a form of abbreviation used for many purposes, like remembering something.
An **acrostic** is a poem in which certain letters in each line form words or sentences.

Directions: After reviewing the H.I.P.P.O. (C) threats, students will use the word map below to create acrostics using the words provided for each threat.

Standards: SC.8. N.4.2, LAFS.8.W.2.4

H- Habitat Loss: When plants and animals' habitats are converted from usable to unusable habitat.

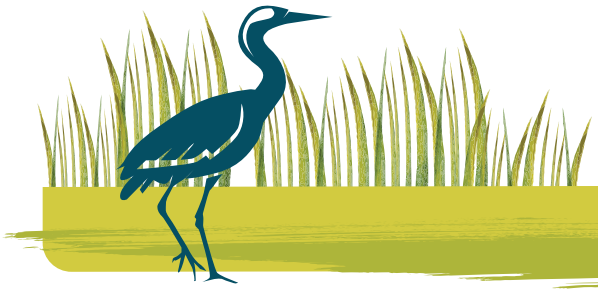
I- Invasive Species: Organisms that are harmful when introduction or spread threatens the natural environment.

P- Pollution: The introduction of contaminants into the natural environment that cause negative change.

P- Human Population: Total number of humans living on earth. More people require more land space and other resources.

O- Overconsumption: A situation where resource use has outpaced the sustainable capacity of the ecosystem.

C- Climate Change: The change in global patterns, attributed largely to the increased levels of atmospheric carbon dioxide produced using fossil fuels.



EVERGLADES THREATS
Acrostic Activity Sheet

THE EVERGLADES FOUNDATION

Word Map

Each threat to the Everglades is listed below, along with a word for you to use when creating your acrostic. An acrostic is a poem in which certain letters in each line form words or sentences.

Example, THREAT: HABITAT LOSS using the word **PROTECT**

P: Panthers are an important species to the Everglades
R: Rangers are doing their best to protect the Florida panther's habitat.
O: Our goal is to not build new homes on their habitat.
T: The Florida panther needs a large space to survive.
E: Everyone can do their part by slowing down their...
C: Cars when driving near a Florida panther habitat.
T: Thank you from the Florida panther!

THREAT: HABITAT LOSS

P:
R:
E:
S:
E:
R:
V:
E:

THREAT: INVASIVE SPECIES

N:
A:
T:
I:
V:
E:

THREAT: POLLUTION

R:
E:
D:
U:
C:
E:

THREATS TO THE EVERGLADES

THREAT: HUMAN POPULATION

C:
O:
N:
S:
E:
R:
V:
E:

THREAT: OVERCONSUMPTION

S:
A:
V:
E:

THREAT: CLIMATE CHANGE

F:
I:
G:
H:
T:

H.I.P.P.O.(C) Information Packet

Habitat Loss

Development pressures from agriculture, industry, and urban areas have destroyed more than half of the original Everglades. Ever-increasing population growth along with industry in southern Florida has resulted in large metropolitan areas and rising pressures on the surrounding natural environments. Agriculture, such as sugar cane, rice, and dairy farms, mostly exist on drained land within the Everglades.

Case Study: United States of America
G. Thomas Bancroft Archbold Biological Station

The Everglades and Everglades National Park are part of a vast wetland system that historically extended over 200 miles from the Kissimmee chain of lakes south through Lake Okeechobee into the freshwater marshes of the Everglades and to the mangrove estuaries. The southern end includes the United States' only subtropical estuary, Florida Bay, and its associated mangrove estuaries, and the third largest coral reef in the world. On the west the system molds into the swamps of the Big Cypress (Robertson and Frederick, 1994). The uplands of the system include pinelands, hardwood forests, and herbaceous rocklands. The uplands contain a mixture of temperate and tropical species. The islands of the Florida Keys are dominated by plants of Caribbean and Central American origin (Tomlinson, 1984; Ross et al., 1992). These tropical plants are generally not found in the lower 48 states.

In the past, the ecosystem supported a huge array of animal species. Large flocks of ducks and coots wintered within the system. In some years, upwards of 200,000 to 250,000 wading birds nested along the interface between the freshwater Everglades and the estuaries (Robertson and Kushlan, 1974; Frohring et al., 1988; Bancroft, 1989; Ogden, 1978, 1994). The estuaries were important nursery grounds for pink shrimp, sea turtles, gray snappers, and many other species now considered economically important. The coral reef bordering the Florida Keys continues to support an array of species found nowhere else in continental United States.

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The climate of southern Florida in combination with good arable land has resulted in an excellent place for humans to live. The population there has increased from only a few tens of thousands in 1900 to over five million people in 1990. An increase of almost two million new residents over the next 20 years (SFWMD, 1994) is projected. Growth rates from 1950 through 1990 averaged about 3% per year. Much of this growth is the result of immigration from other places in the United States and from Cuba, Haiti, and Latin America.

This increase in human populations resulted in major changes to the natural landscape. Initially, extensive drainage of wetlands and clearing of uplands were done to create agricultural lands (Light et al., 1989; Light and Dineen, 1994). Water tables in the Kissimmee Valley and Lake Okeechobee were lowered by more than 5 feet. Extensive wetlands around Lake Okeechobee were drained and converted to agricultural lands for growing winter vegetables, sugar cane, rice, and sod (Light and Dineen, 1994; Aumen, 1994). The hydrologic connection between Lake Okeechobee and the Everglades was severed. Water that had flowed from Lake Okeechobee to the Everglades was shunted east and west to the St. Lucie and Caloosahatchee Canals. Uplands along the eastern side of the Everglades were cleared for human habitation and the cultivation of winter vegetables. Much of the tropical forests in the Florida Keys was cleared for growing pineapples, key limes, and tomatoes.

Hurricanes in 1947 caused extensive flooding, especially south of Lake Okeechobee (Light and Dineen, 1994). The federal government responded by creating the Central and southern Florida Flood Control Project. Its primary function was to provide flood protection to southern Florida while maintaining water supply for agriculture and human consumption (Light and Dineen, 1994). This project completed the draining of the northern quarter of the Everglades, thus forming the 550,000-acre Everglades Agricultural Area. The middle third of the Everglades was converted to a series of five pools (Water Conservation Areas) surrounded by levees and connected by pumps and gates. The flow of water through the system became highlycontrolled. The eastern boundary of the Water Conservation Areas was set 10-20 km west of the eastern boundary of the Everglades; a quarter of the original Everglades was drained. Approximately 13% of the original Everglades was protected in the recently established Everglades National Park.

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Of the original 10,000 km2 in the freshwater marshes of the Everglades, approximately half have been drained and converted to agriculture or urban development (Figure 2; Davis et al., 1994; Light and Dineen 1994). Of the six physiographic landscapes found within the Everglades, two are completely gone from southern Florida and two have been reduced to small remnants. The subtropical pinelands that once covered the higher ground along the eastern border of the Everglades have been reduced to less than 10% of their original numbers. Over half the tropical deciduous forests that covered the uplands of the Florida Keys has been cleared (Strong and Bancroft, 1994). Florida Bay has experienced extensive sea grass dieoffs, and the corals along the Keys' reef tract have decreased in abundance and health.

These changes have been devastating to the wildlife dependent upon these systems. The population of wading birds nesting within the Everglades has decreased by over 90% (Bancroft, 1989; Ogden, 1994). Fifty-four plant and 51 animal species are listed or candidates for listing under the federal Endangered Species Act (Brown et al., 1994). Additional species are listed by the Florida Game and Freshwater Fish Commission, Florida Natural Areas Inventory, and Florida Committee on Rare and Endangered Biota as rare, threatened, or endangered.

Snail Kites and Wood Storks are on federal endangered species lists because of their decreased breeding populations within the Everglades system. Shrimp production and populations of many commercially important fish dependent on healthy estuarine ecosystems have decreased dramatically (Browder, 1985; Browder et al., 1989). Populations of species found within the uplands have become greatly reduced, and many are now isolated in small populations (Robertson and Frederick, 1994). The National Audubon Society estimates that the number of long-legged wading birds, like wood storks and egrets, which nest in the waters of the Everglades has declined 90 percent since the 1920's.

With one of the fastest growing human populations in the country, southern Florida is threatened by habitat destruction, mismanagement of water resources, and conflicting local and regional land use decisions. While several public lands in southern Florida are protected (e.g., Everglades National Park, Loxahatchee National Wildlife Refugee, Florida Panther National Wildlife Refuges, Fakahatchee Strand State Preserve, Collier-Seminole State Park, Picayune Strand State Forest), they depend on key areas that are in private ownership and remain vulnerable: the fate of southern Florida's natural ecosystems is dependent on these critical areas.

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Invasive Species

It wasn't until 1947, when Marjory Stoneham Douglas published "The Everglades: River of Grass," that people began to recognize that the Everglades ecosystem was in trouble. The book chronicled the decline of the large population of wading birds that once inhabited the region, and the arrival of invasive plants like the ferns that cover the tree islands and animals that threaten native species. The National Audubon Society estimates that the number of long-legged wading birds, like wood storks and egrets, which nest in the waters of the Everglades has declined 90 percent since the 1920's.

Small changes brought about by humans can have large negative impacts on the biology of the Everglades in other ways. The subtropical climate and abundant water (which helped make the original biodiversity so rich), combined with increased humaninduced nutrient pollution, makes The Everglades attractive to many animals and plants, which can live very well there and since they have no natural enemies they can breed until they take over habitat used by native species. These invasive species are a major threat to Everglades biodiversity. Most arrive initially due to human influence. Southern Florida has major ports of entry and large pet, aquarium, and ornamental plant industries.

Southern Florida ecosystems have been extensively invaded by exotic (nonnative) plants and animals that pose a significant challenge and add costs and uncertainty to Everglades restoration. New species continue to be inadvertently or deliberately introduced, often as byproducts of the horticultural and pet trade industries. The Florida Exotic Pest Plant Council lists 61 invasive plants (from a total of 1,389 nonnative species) that are known to cause significant ecological impacts in southernFlorida. Some of these species have increased in extent to conditions that threaten native species and communities.

Control of exotic invasive animals has lagged behind the control of invasive plants and still receives less effort than plant control. Of the known and thriving invasive animal species introduced into southern Florida, four are amphibians, 32 are fish, 12 are birds, 46 are reptiles, 17 are mammals, and approximately 79 are invertebrates, according to the South Florida Water Management District. One high-profile example in the Everglades is the Burmese python.

Cuban Tree Frog

The Everglades National Park was established to protect the diverse natural habitats of the region which include freshwater marshes, hardwood hammocks, pinelands, cypress swamps, mangrove swamps, and estuaries. However, despite its status as a national park, the Everglades is threatened by introduced plants and animals.

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Introduced species are those organisms that are native to somewhere else that have been introduced to new areas through human activities. Many introduced species have detrimental effects on native flora and fauna due to lack of population controls such as predators and disease. As population numbers grow out of control, these introduced species are often referred to as invasive species. The introduction of species began in the late 1800s and has escalated since that time. These species continue to spread due to a lack of predators and disease, outcompeting native species for food and space.

(Left) This dense stand of nonnative melaleuca trees was cleared to create suitable conditions for reestablishment of indigenous plants. (Right) A bucketful of baby Burmese pythons collected from a nest in 2009.

Plants: There are over 200 introduced species of plants that have been documented in the Everglades. These plants, including melaleuca (Melaleuca quinquenervia), Brazilian pepper (Schinus terebinthifolius), Australian pine (Casuarina equisetifolia), and Old World Climbing Fern (Lygodium microphyllum) displace native species and alter the natural habitat.

Wildlife: Also detrimental to the habitats and communities of the Everglades are introduced species of wildlife. People have released unwanted pets into the Everglades including aquarium fishes, pythons, boa constrictors, parakeets, and parrots. Feral hogs also pose a major disturbance within the Everglades by digging native vegetation and disturbing archeological sites.

Many species of fish originating from tropical and subtropical regions have been introduced into the freshwaters of the Everglades. Most can tolerate low to moderate salinities, allowing them to become established in brackish water estuaries. These fish have been introduced primarily through aquarium and aquaculture facilities, while some species have been released on purpose in hopes of establishing breeding populations. These fish include the Mayan cichlid (Cichlasoma urophthalmus), walking catfish (Clarias batrachus), Asian swamp eel (Monopterus albus), black acara (Cichlasoma bimaculatum), pike killifish (Belonesox belizanus), blue tilapia (Oreochromis aureus), spotted tilapia (Tilapia mariae), and oscar (Astronotus ocellatus).

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Pollution

For most of its history, that massive rain-fed series of wetlands, lakes and rivers we call the Everglades flowed from just below Orlando and through Lake Okeechobee south to the tip of the Florida peninsula, as well as east and west towards the coasts. The Everglades covered almost 3 million acres.

"In the past hundred years, people have been digging canals and building dams in the Everglades so they could take water out of it, develop agriculture and build homes," says Dr. Tom Van Lent, senior scientist at the Everglades Foundation. "We've built so many canals and drained so much water that the natural flow is interrupted."

In fact, as the twentieth century dawned, early conservationists saw the dredging of the Everglades as the smart, progressive thing to do. As a result, the Everglades is now less than half its original size. 1,800 miles of canals and dams break it up, with water control points and pump stations diverting the natural flow of water to coastal towns and cities. Water must be released to estuaries to prevent flooding and Florida finds itself in a situation where there is often too much water in the wet years, and not enough in the dry.

Sixty years ago, demographers predicted southern Florida's population would reach two million people by the 21st century. It's already at almost 6 million, and expected to double in the next 50 years. All that growth has squeezed the Everglades as development reached inland from both coasts to accommodate the burgeoning population. And with the people came pollution, especially phosphorus from the fertilizers used in agricultural areas north and south of Lake Okeechobee.

Extremely low levels of nutrients, such as phosphorus, are part of the reason that the Everglades is a unique mosaic of sawgrass, tree islands, and open water. However, the nutrient pollution, such as that coming from agricultural runoff and other fertilizers, allows for the growth of species that upset the balance of the ecosystem such as cattails, harmful algal blooms, and duckweed. The sulfur in this agricultural fertilizer, through a complex series of biological and chemical processes, leads to accumulations of toxic mercury in fish, birds, reptiles, and mammals, even in the endangered Florida panther.

Ecosystems in southern Florida developed in an environment low in levels of phosphorus and nitrogen (Aumen and Gray 1994; Davis, 1994). The increased levels of both phosphorus and nitrogen now in surface waters of southern Florida have resulted in shifts in the algae and plant communities found within lakes, marshes, and nearshore marine environments. Algae communities have shifted from ones dominated by various green algae to ones dominated by blue-green algaes. Lake Okeechobee has become more eutrophic; the frequency of large algae blooms dominated by blue-green algae has increased. Setting and meeting water quality standards in southern Florida will require a much broader scientific understanding of nutrient cycling within the system and how those nutrients are used by various organisms than currently exists.

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Eutrophication — the overgrowth of plant and algal species due to excess nutrients — in the normally low-nutrient ecosystem was another element harming the Everglades' vegetation. The extra nutrients were allowing nutrient-loving plants like cattails to invade the wetlands and displace the sawgrass and other native plant species. Scientists linked phosphorus to the eutrophication problem, and phosphorus quickly became the scapegoat for all of the Everglades' troubles with water quality.

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The phosphorus was entering the Everglades from canal-water discharge originating within Lake Okeechobee and the Everglades Agricultural Area, where farmers enriched their fields with phosphorus-heavy fertilizers. In 1988, the federal government sued the state of Florida over the phosphorus contamination. In 1988 and 1992, Florida settled with the federal government and agreed to take steps to reduce phosphorus contamination in the Everglades.

Agricultural interests agreed to limit the use of phosphorus fertilizer, and the state established artificial wetlands — called Stormwater Treatment Areas — on former agricultural land within the Everglades Agricultural Area to help clean the phosphorus-laden canal water before it emptied into the Everglades. Those could be re-engineered to mitigate sulfate. And farmers need to be encouraged to use fewer sulfates. There's certainly enough in the soil already that they don't need extra. Recent work has shown that elemental sulfur isn't even effective any more for agriculture because the soil is changing over time.

Though scientists agree that the agricultural industry is largely responsible for the widespread use of sulfate, no one seems able to answer the question of how much is being used in the area. According to Dr. Melodie Naja, Water Quality Scientist at the Everglades Foundation, farmers use sulfur for three purposes: to lower the pH of the soil (which makes phosphorus more available to plants), as a fungicide in the form of copper sulfate and as a fertilizer counter-ion in the form of potassium sulfate.

"We do not know the exact amount of sulfur that the farmers are using," says Dr. Melodie Naja, a water quality scientist with the Everglades Foundation. "It is an investigation that someone should conduct."

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Heavy metals, particularly mercury, and pesticides have increased dramatically in southern Florida as a result of increased human populations (Brown et al., 1994). The effects of these contaminants on protected areas remained poorly understood. Developing a better understanding of their effects on animals and how to reduce their concentration in the environment will be critical for the protection of biodiversity in southern Florida.

The presence of methylmercury in the Florida Everglades has been documented by scientists and researchers in the area. The chemical can cause significant damage to developing fetuses and children, and leads to major hormonal imbalances in animals native to the Everglades. The state's environmental regulators have been slow to tackle the problem. State agencies have almost no regulations for the use of sulfate, one of the chemicals that may be largely to blame.

Mercury can be extremely harmful to wildlife. "Methylmercury bioaccumulates in an organism," says Dr. Melodie Naja, Water Quality Scientist with the Everglades Foundation. "It sticks to the cells of those that ingest it." The environmental concern, according to scientists, is that mercury can throw off an entire ecosystem, as mercury poisoning can lead to unusual mating behavior that generally doesn't yield offspring.

Today, the future of the Everglades is uncertain. The development of agriculture, the resulting soil subsidence and the use of agricultural chemicals have had profound impacts on the water quality of the Everglades. Now scientists are working with local, state and federal officials to better understand how society's pollution has affected the Everglades' water in an effort to learn how to restore and protect this unique ecosystem.

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Human Population

Human populations within southern Florida have increased dramatically during the last one hundred years. With the construction of canals, newly reclaimed Everglades land was promoted throughout the United States. Land developers sold 20,000 lots in a few months in 1912. Adver tisements promised within eight weeks of arrival, a farmer could be making a living.

The increasing population in towns near the Everglades hunted in the area. Water birds were a particular target of plume hunting. Bird feathers were used in women's hats in the late 19th and early 20th centuries. In 1886, 5 million birds were estimated to be killed for their feathers. Sugarcane became the primary crop grown in southern Florida. Miami experienced a second real estate boom that earned a developer in Coral Gables $150 million. Undeveloped land north of Miami sold for $30,600 an acre. Waterfront property was the most highly valued. Mangrove trees were cut down and replaced with palm trees to improve the view. Acres of southern Florida slash pine were cleared. Some of the pine was for lumber, but most of the pine forests in Dade County were cleared for development.

During the 1950s, '60s, and '70s, an average of a thousand retirees moved to Florida each week. Many of them came to Palm Beach County, where the population doubled during the 1950s.

The quality of the ecosystem has decreased because of direct loss of habitat and the alteration of ecological processes of the remaining system (Davis and Ogden, 1994; Weaver and Brown, 1993). The pattern and quality of water flowing through the wetlands have been altered substantially, and water tables have been lowered under remaining upland habitats.

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Approximately 80% of the uplands south of Lake Okeechobee have been lost since the turn of the century, and 40-50% of the wetlands have been drained (Robertson and Frederick, 1994). However, three relatively large pieces of uplands remain intact (Robertson and Frederick, 1994). One is Long Pine Key in Everglades National Park, the second is in the northern Florida Keys in Biscayne National Park and North Key Largo, and the third is in the lower Florida Keys. Outside these areas, the remaining uplands are small, highly fragmented, and widely dispersed.

Significant drainage in the agricultural area has lowered the water table within that region. However, beyond just affecting that specific region, drainage has forced connecting canals to draw water from the Everglades Park. This amount has been estimated to be as high as 200,000 acre-feet per year. The significant water loss has led to the lowering of the water table within the park, in some places by as much as 2 to 4 feet (Cohn). Not only does this threaten the overall availability of groundwater, especially as the primary source of drinking water for the east coast population, but it increases the threat of salt water intrusion into the aquifer. Both the quality and quantity of the groundwater supply over the entire watershed area has been effected by past water management controls.

In the past, land east of the Water Conservation Areas and Everglades National Park had surface water flow that went west through the Everglades and into the Gulf of Mexico (Fennema et al, 1994). At present, rain that falls on the east coast's developed area is drained east to the Atlantic Ocean rather than west. Furthermore, because water tables must be well below ground surface in the developed area to allow human habitation and agriculture, a major hydrologic gradient is created between the remaining natural areas and the east coast. This gradient causes substantial quantities of water to seep from the natural areas to the east. This seepage is a major factor preventing restoration of more natural flows through the Everglades.

The South Florida Water Management District (SFWMD) is currently working on a water supply plan for southern Florida (SFWMD, 1994). The district is attempting to project the water demands of the three principal users of water in the year 2010. Determining the water needs of the remaining natural areas is critical.

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Overconsumption

Overconsumption is a situation where resource use has outpaced the sustainable capacity of the ecosystem. A prolonged pattern of overconsumption leads to inevitable environmental degradation and the eventual loss of resource bases. Water used in southern Florida stems from the Everglades system. Overuse of water can lead to many problems. For example, decades of pumping groundwater out of the aquifer to meet the demands of Florida's population boom, its sprinklers and its agricultural industry have been very detrimental to Florida's water supply. For the first time, a state with so much rain — the vast majority of it uncaptured — is beginning to seriously fret about water.

In the last 10 years, many of the famous freshwater springs and rivers in the central and northern parts of the state have seen a sharp drop-off in flows and a steady rise in algae. Nearby Rainbow Springs and River are also suffering, although not as much. The declines have accelerated rapidly in the past five years, so much so that they have galvanized Florida environmentalists to launch a broad campaign to bring attention to the problem.

"Florida is a state that has historically had an abundance of water," said Bob Graham, a former Democratic governor and United States senator who assembled the Florida Conservation Coalition last year to help safeguard the state's water. "We have learned that we can degrade our water supplies to the point that water becomes a limitation on the quality of life in Florida. We don't think that is necessary. But we think it is possible, if not probable, unless there are strong policies and enforcement at the state and local level for sound water practices."

Just a few years ago, a request for 13 million gallons would not have turned many heads. But water experts and environmentalists say the effects are cumulative. Although water use has recently decreased, the amounts over all have been set too high for too long and the consequences are only now becoming obvious, they say.

Florida's population boom led to an increase in the number of people and businesses demanding sprinklers (more water is used outside the home than inside). All of it is groundwater from the Florida Aquifer. The decrease in rainfall in central and northern Florida has worsened the situation.

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"We are either in or headed for a water crisis," said Estus Whitfield, a former principal environmental adviser to five Florida governors. About 260 artesian springs along the Suwannee River, for example, naturally pump an estimated 2.8 billion gallons a day from the aquifer. Withdrawals for human consumption and industry amount to 245 million gallons a day. The original draining of the Everglades was largely to facilitate farming in the region. It was thought the land would be good for cotton, tobacco and sugar (Dugger, 1996). The Everglades Agricultural Area was created in 1948 and is comprised of the upper quarter of the natural wetland, containing some 750,000 acres. This area makes up forty six percent of the state's sugar lands and thirty eight percent of the citrus land (Weisskoff, 2000). The EAA consumes a majority of the surface waters in the Everglades. During certain times of the year the EAA is the only source of winter vegetables for the country, but the most produced crop is sugar cane. It occupies over half of the EAA (440,000 acres) and although not suited for the extremely wet environment and high water table of the EAA, sugarcane is largely subsidized by the government so the industry is still turning a large profit (Dugger, 1996).

Significant drainage in the agricultural area has lowered the water table within that region. However, beyond just affecting that specific region, drainage has forced connecting canals to draw water from the Everglades Park. This amount has been estimated to be as high as 200,000 acrefeet per year. The significant water loss has led to the lowering of the water table within the park, in some places by as much as 2 to 4 feet (Cohn). Not only does this threaten the overall availability of groundwater, especially as the primary source of drinking water for the east coast population, but it increases the threat of salt water intrusion into the aquifer. Both the quality and quantity of the groundwater supply over the entire watershed area has been effected by past water management controls. Overconsumption does not affect water alone. The lowered water table also has led to soil erosion. In 1900 there was twelve feet of peat soils above the surface of the bedrock, today more than half of that has eroded and continues to do so at the rate of about one inch per year. As these delicate peat soils begin to dry, they shrink up and blow away (Kalpulli, 2005). Some estimate that some portions of the EAA will reach bedrock in the next twenty five years. Just a few years ago, a request for 13 million gallons would not have turned many heads. But water experts and environmentalists say the effects are cumulative. Although water use has recently decreased, the amounts over all have been set too high for too long and the consequences are only now becoming obvious, they say.

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Climate Change

Over the last 150 years, scientists have observed an increase in global temperature (IPCC 2007). There is a very high degree of confidence and agreement among scientists that the higher global temperature is caused by human activities that increase greenhouse gases in the atmosphere (IPCC 2007).

Greenhouse gases are expected to cause further warming of the global climate with rates that could be greater than what was experienced in the 20th century (IPCC 2007). Warmer temperatures in turn influence other aspects of the climate system, such as precipitation, that many living things depend upon (IPCC 2007 and Gonzalez 2011). Changes in some species' normal life-history patterns due to climate change have already been observed at National Parks throughout the United States (Gonzalez 2011).

Sea Level Rise in Everglades National Park:
The environment of southern Florida and the Everglades is unique because of its low elevation and subtropical climate. Along the coast, seasonal pulses of freshwater from the north meet the constant fluctuation of the tides that nurture severaldistinct ecosystems, including buttonwood forests. These coastal communities are home to many rare and endangered plants such as tropical orchids and herbs, some of which are found only in southern Florida (Stabenau 2011). Unfortunately, these species' special home is in danger because the habitat is changing, in part, due to sea level rise—causing the salinization of groundwater and the soils above (Stabenau 2011). It is unclear whether or not these species can tolerate the increased salinity that will come as sea level continues to rise due to climate change.

Water level in these areas varies with changes in rainfall and freshwater flow as well as influences from ocean tides. Over the last 50 years, the scientists have observed an increase in the water level at some inland, freshwater sites in the park that is consistent in pace with the observed increase in regional sea level (Stabenau 2011). Though it is presently unclear why this correlation exists, and what implications it might have for the freshwater environments of the Everglades, it does suggest the influence of sea level rise may reach far inland.

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Everglades National Park is very vulnerable to sea level rise. The entire park lies at or close to the level of the sea. Sixty percent of the park is at less than 3 feet above mean sea level. The highest ground in the park is 11 feet above mean sea level. The February 2007 report of the Intergovernmental Panel on Climate Change (IPCC) allowed the park to model the potential impact of sea level rise on its lands and waters. Using six different climate change scenarios, the IPCC report projects that sea level could rise between 7 inches to 23 inches by the end of this century. If this projection proves true, 10% to 50% of the park's freshwater marsh would be transformed by salt water pushed landward by rising seas.

The key to predicting the impacts of sea level rise is knowing the rate at which the water will rise. Sea level has been rising in southern Florida since the end of the last ice age, more than 10,000 years ago. Geologic evidence shows that much of the marine area of the park, including Florida Bay and the Gulf Coast, was freshwater marsh 10,000 years ago. Beginning 5,500 years ago, rapidly rising seas (a rate of 9 inches every 100 years) flooded the bay and Gulf Coast and pushed saltwater inland far beyond today's coastline. Approximately 3,200 years ago, the rate of sea level rise dropped to about an inch and a half every hundred years. In this time of slow sea rise, southern Florida gained land, including Cape Sable and the Ten Thousand Islands.

The rate at which sea level would rise in the future is an important factor. Past evidence tells us that if sea levels were to rise slowly, mangroves and shallow mud banks might be able to keep pace with the change. If sea levels were to rise rapidly, it is likely that mangrove areas and coastal wetlands would likely not be able to adapt and would be submerged.

A rise in sea level of between 7 and 23 inches, as projected by the IPCC report, would submerge tidal flats and inland freshwater marshes and impact the species that inhabit these areas, such as wading birds and the Federally endangered Cape Sable Seaside Sparrow. If sea level rises 23 inches, it could submerge the park's pinelands, one of the rarest ecosystems in southern Florida. Rising sea levels could also erode beaches, leaving fewer habitats for nesting sea turtles.

On the other hand, this level of sea level rise would increase the area of shallow basins, mangroves, and brackish marshes resulting in the increase of salt water dependent species.

In the Florida Bay area of the park, rising sea levels could submerge shallow seagrass flats under more water and raise salinity concentrations, adversely affecting fish habitat and associated estuarine fisheries. A June 2006 report by the National Wildlife Federation and the Florida Wildlife Federation highlighted these potential impacts and also suggested that sea level rise would harm the world-class recreational fishery in Florida Bay for bonefish, yellowtail snapper, permit, redfish, snook, spotted sea trout, and tarpon.

Everglades National Park is undertaking a number of actions in response to climate change. They are working hard with their partners to complete the Comprehensive Everglades Restoration Plan (CERP). By removing the canals and levees that form barriers to natural water movement, we hope to restore natural flows to the park and restore the Everglades' capacity to store water. More water in the Everglades would create a freshwater head that would act as a barrier to the landward push of saltwater. This freshwater head

would make the Everglades ecosystem more resilient to climate change.

In addition to the rising seas, scientists expect global warming to lead to changes in temperature and precipitation that will affect plants and wildlife. Although it is impossible to predict with certainty the future climate of a small region, computer models suggest that the overall climate in Florida may warm and that extremely hot days in summer may become more frequent. A warmer climate could allow heat-loving pest species, such as the invasive Australian Melaleuca tree, to expand their range northward in Florida. However, if warmer winters lead to fewer frosts, tropical plants and trees that are vulnerable to cold temperatures may benefit. Increases in the atmospheric concentration of carbon dioxide, one of the primary greenhouse gases responsible for global warming, may affect competition and dominance among plant species. Carbon dioxide generally promotes plant growth, but not all species respond alike to higher concentrations of the gas. Many people wonder if global warming will affect rainfall, hurricanes, or the severe weather events associated with El Niño and La Niña.

Some researchers are concerned that climate change and sea level rise could help push endangered species like the Florida panther and key deer even closer to extinction.

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Sources:

http://www.flmnh.ufl.edu/fish/southflorida/everglades/threats.html

http://www.evergladesfoundation.org/the-everglades/threats-to-the-ecosystem/

http://www.pbchistoryonline.org/page/draining-the-everglades

http://stateofwater.org/ecosystems/springs/

http://www.protectingourwater.org/watersheds/get_wet/protectwater/conserve/

http://www.evergladesfoundation.org/breaking-news/florida-struggles-to-overcome-threats-to-freshwater-springs/

http://kanat.jsc.vsc.edu/student/pollockj/index_main_page_current.htm

http://www.nytimes.com/1989/09/17/us/pollution-poses-growing-threat-to-everglades.html?pagewanted=all&src=pm

http://www.earthmagazine.org/article/pollutants-threaten-everglades-future

http://www.nps.gov/ever/historyculture/developeverglades.htm

http://www.nps.gov/ever/naturescience/cceffectsslrinpark.htm

http://en.wikipedia.org/wiki/Everglades

http://fl.audubon.org/everglades-science

http://www.nps.gov/ever/parknews/everclimatechangetestimony.htm