INVENTORY AND ANALYSES OF BIOLOGICAL COMMUNITIES IN SOUTHERN GOLDEN GATE ESTATES, A WATERSHED FOR THE TEN THOUSAND ISLANDS, COLLIER COUNTY, FL: VASCULAR PLANT COMMUNITIES

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ABSTRACT

South Golden Gate Estates, in southwestern Florida, is a large wetland that was permitted for development several years ago. The early stages of development (drainage canals and roads) and land sale were undertaken, so that the hydrology of the area has been changed. The State of Florida has begun acquiring properties here, and the South Florida Water Management District, with the U. S. D. A. Natural Resource Conservation Service, has begun hydrologic restoration of the area. Most of the area is dominated by mixed cypress forest and marl prairie. These communities are often inundated much of the year, but in the South Golden Gate Estates, substrates are seldom under water. Monitoring the progress of restoration will in part be accompanied by measuring changes in water levels and plant communities. This outlines the first information and data collected before restoration commences, and compares current conditions with detailed information gathered over 50 years ago. Substrates in the area are mostly wetlands soils, and are indicated with recent classifications. Since drainage, fire frequencies and areas burned have increased and some communities now support significant populations of exotic Brazilian peppers (*Schinus terebinthifolius*). Cabbage palm (*Sabal palmetto*) appears to have proliferated, colonizing large areas. Vascular plant richness in most communities has remained similar to before drainage, but numbers of species that indicate wetland communities have decreased.

INTRODUCTION

The Southern Golden Gate Estates (SGGE) area, in southwestern Florida, was prepared for development several years ago. As part of this pre-development land preparation, a

system of drainage canals was installed to facilitate water delivery from the inland (wetland) communities to the Gulf of Mexico. Water formerly moved by sheet flow, slowly through this area from the inland wet prairie and cypress wetlands, into the Ten Thousand Islands estuary system. The water delivery system that was installed now carries water through the Faka Union canal, so the fresh water that formerly flowed through the estuary now is discharged in Faka Union Bay. This has likely affected the salinities of waters in this bay and the surrounding waters, so that water qualities may have been compromised throughout the downstream area. In addition to changes in water quality, the seasonal periodicity and volume of freshwater runoff into the estuary communities has been altered by establishing a point-source discharge of fresh water into the Ten Thousand Islands system. The submerged lands and associated mangrove forests of the Ten Thousand Islands estuary are mostly held in public ownership, and managed by state or federal regulatory agencies. Part of the inland tributary area (SGGE) is now being acquired by the State of Florida, so that restoration of hydroperiods and wetland communities will occur. This restoration will also restore fresh water inputs to the estuary system that will be similar to those that occurred before drainage (USGS 1996).

STUDY SITE

South Golden Gate Estates is ca. 94 mi^2 of freshwater wetland with occasional upland communities in southern Collier County. Communities in the southern part of the area, located 3-5 km north of US 41 (Tamiami Trail) are mostly hydric cypress and mixed hardwood sloughs, and marl prairies. Communities in the northern part of the area, south of I-75 (Alligator Alley), are often mesic or hydric pine flatwoods with cypress sloughs. Leighty et al. (1954) similarly indicated the area as largely bald cypress swamp with short grass prairie, and occasional mesic hammocks and flatwoods communities.

The area was altered perhaps most significantly in the late 1960's and early 1970's when the Faka Union drainage canal system was installed. This canal system consists of four north-south oriented canals that effectively drain the area's surface water to deliver it into the main Faka Union canal and directly to the Gulf of Mexico. Gore (1988) estimated that the Golden Gate and Faka Union Drainage canal system drains the Golden Gate Estates area 16 times faster than before canal installation, and has reduced wetland hydroperiods by 2-4 months. In addition, the Golden Gate canal system to the west, and the I-75 borrow canal (also connected to the SGGE drainage canals) drain much of the adjacent and surrounding areas. About 600 km of roads were constructed with borrow material from ca. 77 km of canals that had been installed, also in preparation for development. Most of these roads are oriented east to west and were placed every 0.8 km. These roads do not appear to significantly inhibit water flow, as land slope is gradual and water movement is slow; most substrates are rapidly permeable (Liudahl et al. 1998) and may allow flow beneath the roads. Since preparation for development, much of the area was sold to thousands of owners, but very few currently reside there. Collier County estimated that 26 persons (10-12 households) resided in SGGE in 1990 (Collier County 1999). In the mid-1980's the State of Florida began purchasing properties in the SGGE

(Ramsey and Addison 1996), to eventually place the area within public ownership, so that restoration could occur.

Restoration of wetland communities is expected to be concomitant with hydrologic restoration. This study was conducted to determine conditions of the communities extant in the SGGE area. This information can be compared to descriptions of communities that occurred here before drainage to estimate changes that have occurred after drainage; the data that are collected to describe the current communities will also be valuable to monitor the progress of the future restoration. Biological communities are identified in this study with their vascular plant components.

The primary objective of the wetlands restoration in SGGE will be to produce a system that is similar to the pre-drainage suite of communities in this area. No data describing the natural areas in SGGE are known to have been collected before drainage occurred. However, the area was surveyed in the 1940s as part of a detailed reconnaissance to map the soils of the county (Leighty et al. 1954). This survey included descriptions of the plant communities commonly found on the County's major soil types; part of these descriptions were lists of vascular plants commonly found in these communities. The descriptions and species lists in this survey will be used to compare current and future plant community data. These comparisons can be used to monitor the progress of restoration activities. Land managers should note that a return to ecological conditions that are the same as the pre-drainage situation is unlikely, but that a change to more hydric conditions similar to former communities is anticipated.

METHODS

Six biological communities that may be affected by restoration were selected for monitoring: 1) mesic pine flatwoods; 2) hydric pine flatwoods; 3) cypress or mixed cypress and hardwood slough; 4) hardwood hammock; 5) prairie; *Schinus*-dominated communities. These were located randomly in these communities, at least 20 m from the nearest road to minimize disturbances caused by roads. Five sites at least 3 km distant from the SGGE drainage system were also chosen for comparison. These sites were also established in the same representative communities (above). The *Schinus*-dominated community, however, was not sought for comparison, as this exotic may dominate nearly any terrestrial community in the area (Burch 1992).

Vascular plant species encountered at each site were recorded and a piezometer was installed at each site to determine surface water levels. Global positioning system (GPS) coordinates were recorded at each piezometer so that each site could be located. Descriptions of the sample areas were compared with the outlines of communities commonly found on soil types at each location, as described by Leighty et al (1954). Lists of species found at the sample sites were compared with lists in the ground cover classification legend used by the Soil Survey Party during surveys for the pre-drainage soil survey (Leighty et al. 1954). Numbers of wetland indicator vascular plant species were considered as indicators of hydric influence at each sample area. Wetland indicator

status of vascular plants was determined with the State of Florida Department of Environmental Protection Wetland Species Indicator list (Tobe et al.1998).

RESULTS AND DISCUSSION

Habitat communities were more mesic in the northern part of the study area, and were mostly hydric in the southern part. In the northern area, mesic pine flatwoods, with hydric pine flatwoods and cypress sloughs are common; in the southern area, marl prairies with mixed cypress and hardwood sloughs are common. Many of these areas resemble the descriptions provided by Leighty et al. (1954). However, the species encountered in this study differed from those recorded before drainage.

Many areas appeared to have changed since drainage. Plant species that are associated with more mesic communities have become common in cypress sloughs. This includes invasion by the exotic Brazilian pepper (*Schinus terebinthifolius*). Dominance or partial dominance of tree or shrub layers by *Schinus* is common in communities that were previously described as cypress sloughs, and now appear to be disturbed. These areas usually contain remnant living cypress trees, dead cypress trees, and hardwood trees often found in hydric communities.

Fires appear to have become more frequent throughout the study area. Fires commonly occur in pine flatwoods, and even more often in seasonally inundated prairies (Wade et al. 1980). In hydric mixed hardwood and cypress sloughs, however, fires are much less common. In areas where extreme changes appear to have occurred, few or no live cypress or hardwood trees were found. Dead, charred cypress trees or their stumps, however, were common. Gore (1988) noted that acres burned in Collier County increased significantly after completion of the Faka Union drainage system. The increase continued for several years after its completion.

Sabal palm (*Sabal palmetto*) trees have proliferated in some areas formerly dominated by cypress trees. In these places, occasional tall (apparently old) sabal palms are scattered, with many smaller sabal palms dominating the shrub or low tree canopy. The smaller sabal palms appear to be the same age, suggesting that they became established contemporaneously, and the larger, older individuals appear to be the parent population. The older-appearing sabal palms frequently grew with large root mats surrounding the trunk bases; no adventitious root growth was noted on the younger-appearing sabal palms. Little or no surface water inundation was noted at these locations.
Small (1936) indicated that growth of these roots may be a response to seasonal inundation, suggesting that these areas formerly were subject to seasonal inundation about the depth of the root masses.

Numbers of vascular plant wetland indicator species were lower at sample sites in this study than the indicator species included in lists of species typical of the communities found on soils before drainage (Leighty et al. 1954). Numbers of vascular plant species were greater in the southern (more hydric) part of the study area than in the northern

(more mesic) part, in both pre-drainage and the current studies. In the pre-drainage study (Leighty et al. 1954) the numbers of wetland indicator species was consistently about two-thirds the total number of vascular plants regardless of north-to-south location. In the southern part of the study area the number of wetland indicators was ca. 22, and in the northern part of the area the number of wetland indicators was ca. 12. In the current study, the total number of vascular plant species was about the same regardless of location, and the number of wetland indicator species was greater in the southern part of the study area, similar to the pre-drainage study. The change in numbers of wetland indicators from north to south in the study area occurred in the current study at about the same rate of change (slope) from north to south in the pre-drainage study. However, the total numbers of wetland indicator species in the current study ranged from ca. 12 in the southern part of the study area to ca. four in the northern part of the area.

Numbers of vascular plant wetland indicator species also were consistently lower in hydric communities supported by hydric soils. Twenty-three of the 26 sample sites in SGGE were located on hydric Pineda, Boca, Malabar, Hallandale, Ochopee, or Dania soil types. Wetland vascular plant indicators were considered as those listed as "Obligate" or "Facultative Wet" wetland indicators by the State of Florida Department of Environmental Protection (Tobe 1998). Sample areas on each of these soil types had fewer wetland indicators in 1997 than indicated in 1954 (Figure 1.). Similarly, hydric pine, prairie, and cypress communities had greater percents of indicator species in 1954 than in 1997, and mesic pine communities had a mean higher percent wetland indicators in 1997 (Figure 2.). Lower mean percents of wetland indicators were statistically significant in prairie and cypress swamp communities. Of the hardwood hammocks and *Schinus*-dominated communities analyzed in 1997, all were indicated as cypress swamp communities by Leighty et al. (1954).

CONCLUSIONS

Vascular plant communities in SGGE appear to have changed since the area was drained in the late 1960's and early 1970's. Numbers of vascular plants and types of communities found in 1997 were similar to those described before drainage, but percents of wetland indicators were lower in most communities. Disturbance by fire has also increased since drainage, so that many formerly hydric cypress communities have nearly disappeared or have been invaded by species more typically associated with mesic communities. Brazilian pepper (*Schinus terebinthifolius),* an aggressive exotic, has become common in many areas formerly dominated by mixed cypress associations. Also, numbers of sabal palms appear to be increasing in the areas that were formerly more hydric. Measures of community structure and vascular plant abundance will be used to monitor the progress of restoration. With hydrologic restoration of the area, biological communities are expected to become more hydric, and more similar to those described before the area was drained.

Figure 1 Percent Vascular Plant Wetland Indicators: 1954, 1997, and Percent Remaining in 1997 from 1954.

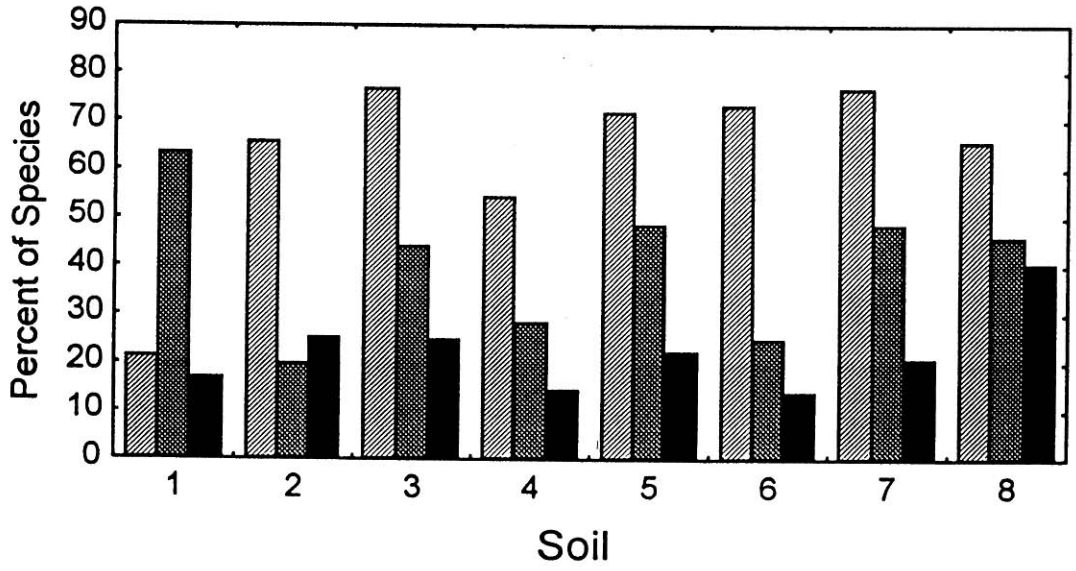

Figure 1. Percent Vascular Plant Wetland Indicator Species: 1954, 1997, and those Remaining in 1997 from 1954. Percents of wetland indicator species are indicated as mean numbers identified in sample quadrat on different soils. Hatched bars are mean numbers of wetland indicators listed in 1954; solid gray bars are mean numbers of wetland indicators identified in 1997; solid black bars are mean numbers of wetland indicators found in 1994 and 1997. Soil types indicated on the abscissa are: 1 - Basinger (n=1), 2 - Jupiter (n=2), 3 - Pineda (n=2), 4 - Boca (n=7), 5 - Malabar (n=4), 6 - Hallandale (n=7), 7 - Ochopee (n=2), 8 - Dania (n=1). Wetland indicators considered were species listed by the State of Florida, Department of Environmental Protection as "Obligate" or "Facultative Wet" wetland species.

Figure 2.Percent Vascular Plant Wetland indicators of Communities in South Golden Gate Estates: 1954, 1997.

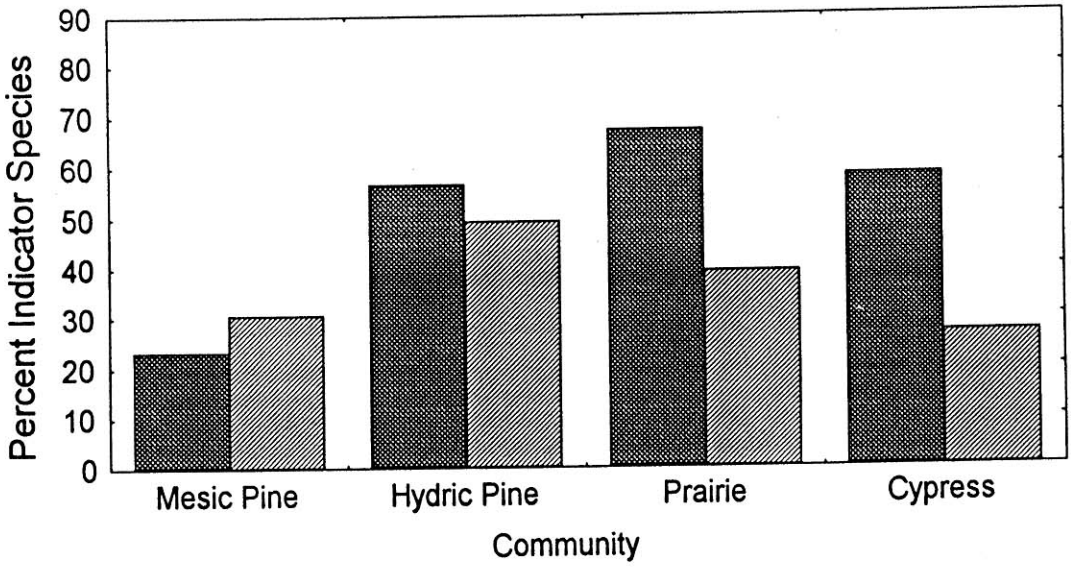

Figure 2. Percent of vascular plant indicators of wetland communities sampled in South Golden Gate Estates: 1954, 1997. Solid bars: wetland indicator species listed by Leighty et al. (1954); hatched bars: wetland indicator species identified in this study (1997). Wetland indicators considered were species listed by the State of Florida, Department of Environmental Protection as "Obligate" or "Facultative Wet" wetland species.

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