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A Vascular Plant Inventory and Description of the Twelve Plant Community Types Found in the University of South Florida Ecological Research Area, Hillsborough County, Florida

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A Vascular Plant Inventory and Description of the Twelve Plant Community Types Found in the

University of South Florida Ecological Research Area,

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by

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ABSTRACT

The University of South Florida Ecological Research Area (USF Eco Area), located in west central Hillsborough County, is an approximately 306 hectare (756 acre) natural area on the Hillsborough River composed of twelve plant communities. While surrounded on three sides by urbanization, the USF Eco Area makes up the western most section of an extended natural corridor that runs approximately 88 kilometers (55 miles) east and north along the Hillsborough River. An inventory of the vascular flora and the associated ecological communities was developed to better assess the USF Eco Area for educational and research purposes as well as enhance informed decisions when evaluating its status for conservation and management purposes. The study, conducted from June 2001 through August 2005, documented 404 vascular plant taxa in 251 genera and 102 families. Three hundred and seventy-eight taxa (94%) are native to Florida of which 13 are endemic; nine are listed as endangered, threatened, or commercially exploited; four are first time recorded occurrences for Hillsborough County; and ten taxa are listed as Florida Exotic Pest Plant Council's Category I or II invasive species. Eleven natural plant communities and one ruderal/developed plant community were documented, mapped and characterized by their unique vegetative, topographic, soil, and hydrological components based on qualitative field observations. The blackwater stream, floodplain swamp, floodplain forest, floodplain marsh, hydric hammock, seepage slope, and wet flatwoods are wetland plant communities that cover 65% of the USF Eco Area. Upland plant communities,

covering the remaining 35%, are mesic flatwoods, scrubby flatwoods, sandhill, xeric hammock, and ruderal/developed.

INTRODUCTION

The University of South Florida (USF) owns a natural area on the Hillsborough River, just north of the Tampa campus, referred to as the University of South Florida Ecological Research Area (USF Eco Area). It is essentially an urban forest surrounded on three sides by intensive development. Throughout the years, the USF Eco Area has been a valuable resource for education and research in the natural and environmental sciences as well as anthropological studies. However, a thorough study has not been done documenting the vegetative, geological, and hydrological structure and characteristics of the area in order to better assess the USF Eco Area for educational and research purposes as well as enhance informed decisions when evaluating its status for conservation and management. Therefore, the objective of this study is to document the flora and associated ecological communities, as they presently occur in the USF Eco Area, incorporating general information about the area's geological and hydrological characteristics.

The floristics and the 12 natural plant communities documented and mapped in the present study revealed that the USF Eco Area is a biologically rich and diverse natural area despite being somewhat compromised by surrounding anthropogenic perturbations and its small size. The diversity of integrated ecosystems in the USF Eco Area provides USF with an excellent resource for both education and research, much needed in this day and age of habitat loss and fragmentation and the accelerated extinction of species threatening the very essence of biodiversity.

SITE OVERVIEW

Physical Location

The USF Eco Area is located near the west coast of central Florida, within the city of Tampa, Hillsborough County, Township 28 S, Range 19 E, Sections 2, 3, and 4 (Figure 1).

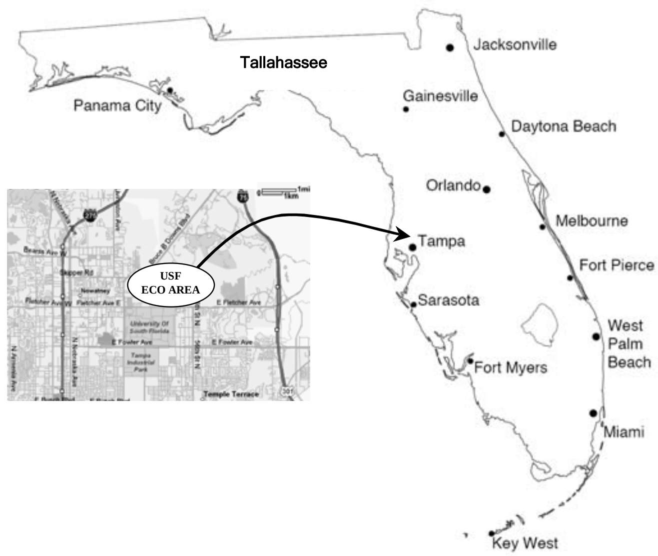


Figure 1. Map of Florida showing the location of the University of South Florida Ecological Research Area (USF Eco Area) in Hillsborough County. (Modified from Florida Center for Instructional Technology 2002 and Mapquest 2005).

The property comprises approximately 306 hectares (ha) or 756 acres (a) bounded by the Tampa Palms development to the north, the Hillsborough River to the east, Fletcher Avenue to the south, and the University of South Florida Golf Course to the west (Figure 2).

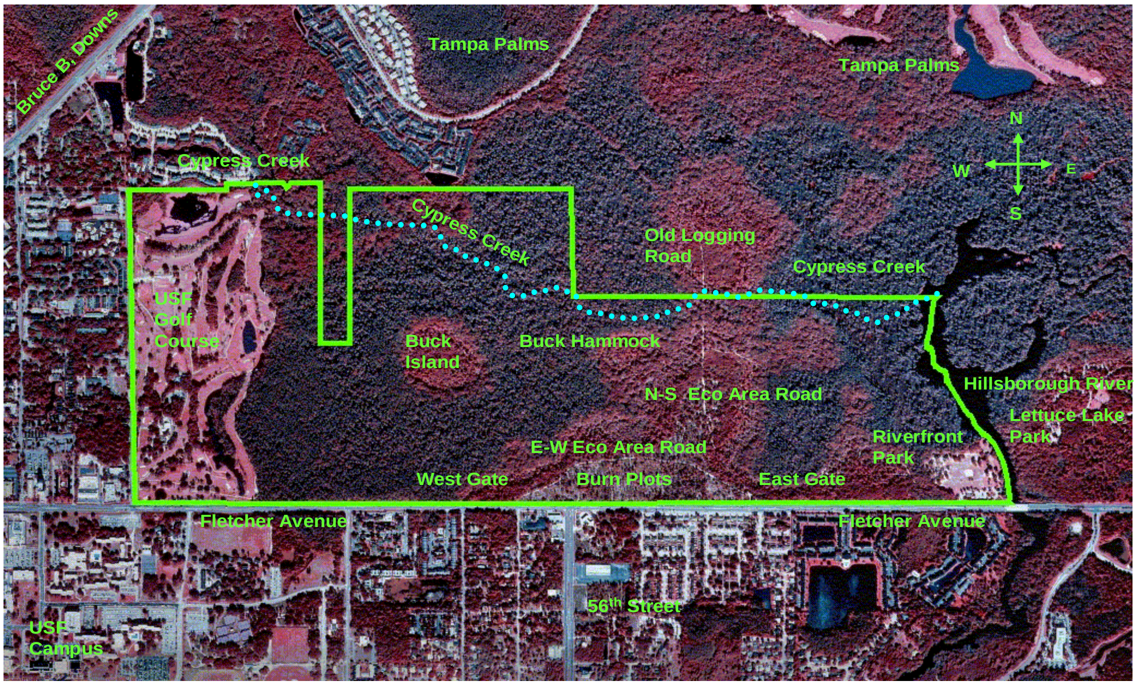


Figure 2. A color infrared aerial of the University of South Florida Ecological Research Area. The property boundary of the USF Eco Area is outlined in green. Approximate course of Cypress Creek flowing through the USF Eco Area is represented by the dotted blue line. (Modified from SWFWMD GIS Division 1999 color infrared aerial photograph).

Over half of the USF Eco Area is composed of floodplain wetlands associated with Cypress Creek and the Hillsborough River. Cypress Creek flows through the area from west to east until it empties into the Hillsborough River within the USF Eco Area boundaries. The rest of the USF Eco Area is composed of natural and developed uplands. The natural uplands are in the south central and southeastern sections of the area and dip north into the floodplain swamp (Figure 2).

The developed uplands are composed of the USF Golf Course, along the entire western edge, and Riverfront Park, on the southeast corner (Figure 2).

Despite the encroaching intensive development to the north, south, and west, the USF Eco Area has remained a natural area and has become the western most section to an extended natural corridor that runs approximately 88 kilometers (55 miles) east and north along the Hillsborough River that includes conservation lands owned by the State of Florida (Southwest Florida Water Management District, Hillsborough River State Park, Green Swamp) and Hillsborough County (Lettuce Lake Park). A recent report by the Florida Natural Areas Inventory (FNAI) categorized the entire USF Eco Area as a Potential Habitat for Rare Species (FNAI/Abbey 2004). FNAI lists several recorded occurrences for the USF Eco Area of rare, endangered, and threatened globally, federally, and state listed plant and animal species and one natural community.

Early Inhabitants

Humans have inhabited the Hillsborough River watershed for at least 10,000 years. Evidence of human occupation in the USF Eco Area was first revealed in 1937 through archaeological investigations conducted by J. Clarence Simpson under the auspices of the Works Progress Administration (Bullen 1952; Collins 2005; Eyles et al. 2001). Simpson and his crew found evidence of Indian occupation on Buck Island, located in the middle of the floodplain swamp, east of the USF Golf Course. Pottery, tools, sherds, two gold discs, and beads as well as skeletal material disclosed signs of village life and a burial area or mound dating from the Weedon Island (ca.700–1,000 A.D.) to Safety Harbor Periods (ca.1,000–1,500 A.D). Some of the excavated materials date as far back as the Archaic Period (ca. 8,000–3,200 B.P.). Evidence of interactions between the Spanish, who had been recorded to have been in the area during the Safety Harbor Period, and the indigenous people of Buck Island were disclosed in some of the beads found in with the Safety Harbor excavations. Some of the beads had been made from European materials that had been reworked into traditional designs of the period. Several pilings still remain from the 880 foot bridge Simpson and his crew had to construct for access to Buck Island through the swamp (Figure 3). The bridge had also included 526 feet of earth fill.

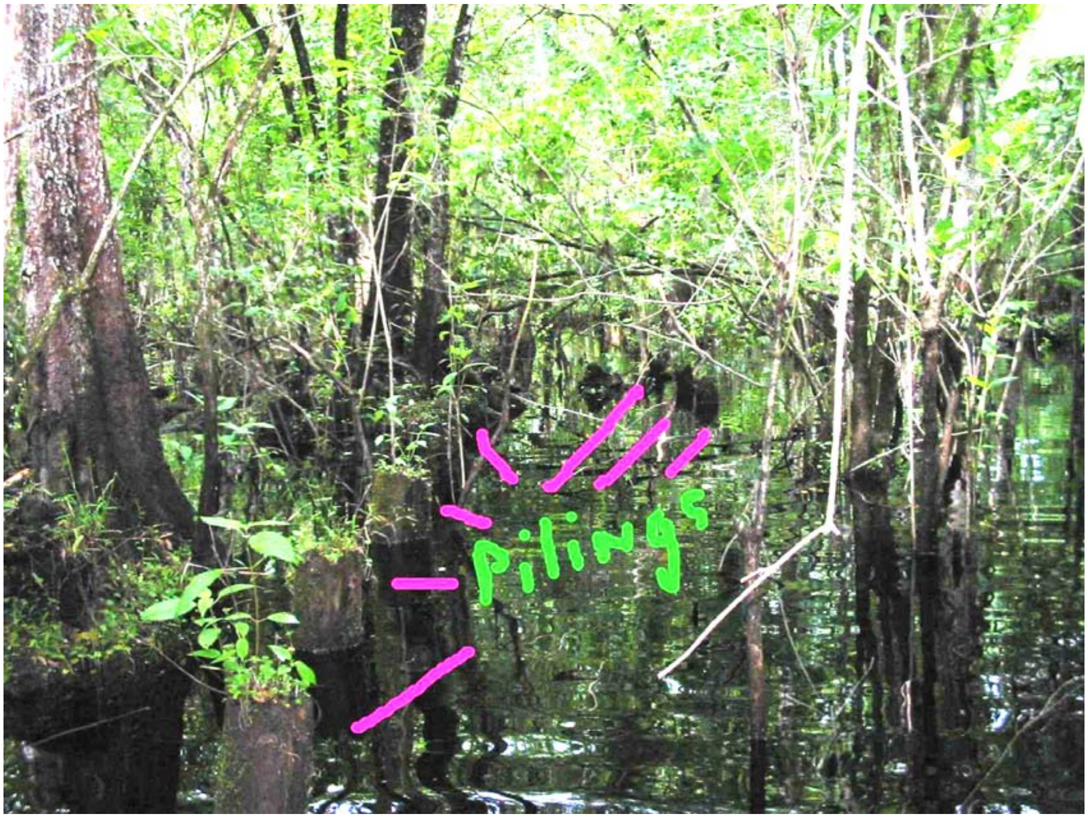


Figure 3. Old pilings are the only signs left from the 880 foot bridge that had provided access to Buck Island across the swamp during the Works Progress Administration 1937 archeological survey and excavations of Buck Island. (Photograph courtesy of Dan Duerr).

Six archaeological sites in the USF Eco Area have been investigated by the Department of Anthropology at USF. Evidence from the sites revealed habitation in the area dating from the Archaic Period to Middle Woodland times (ca. 1,500 B.P) (Collins 2005; Eyles et al. 2001).

Historical Land Uses and History of Acquisition

Information is scarce on the historical land uses of the USF Eco Area hence it has primarily been gleaned from old aerial photographs dating as far back as 1938, local knowledge, and observations in the field during the present study where, in passing, evidence of past habitation and land uses had been noted. As predominantly comprised of swamp and wetlands, the USF Eco Area would have been, for the most part, impenetrable for any uses other than hunting and fishing.

A 1938 USDA/SCS Hillsborough County Soil Survey aerial photograph reveals that the uplands had been used for pasture (Figure 4).

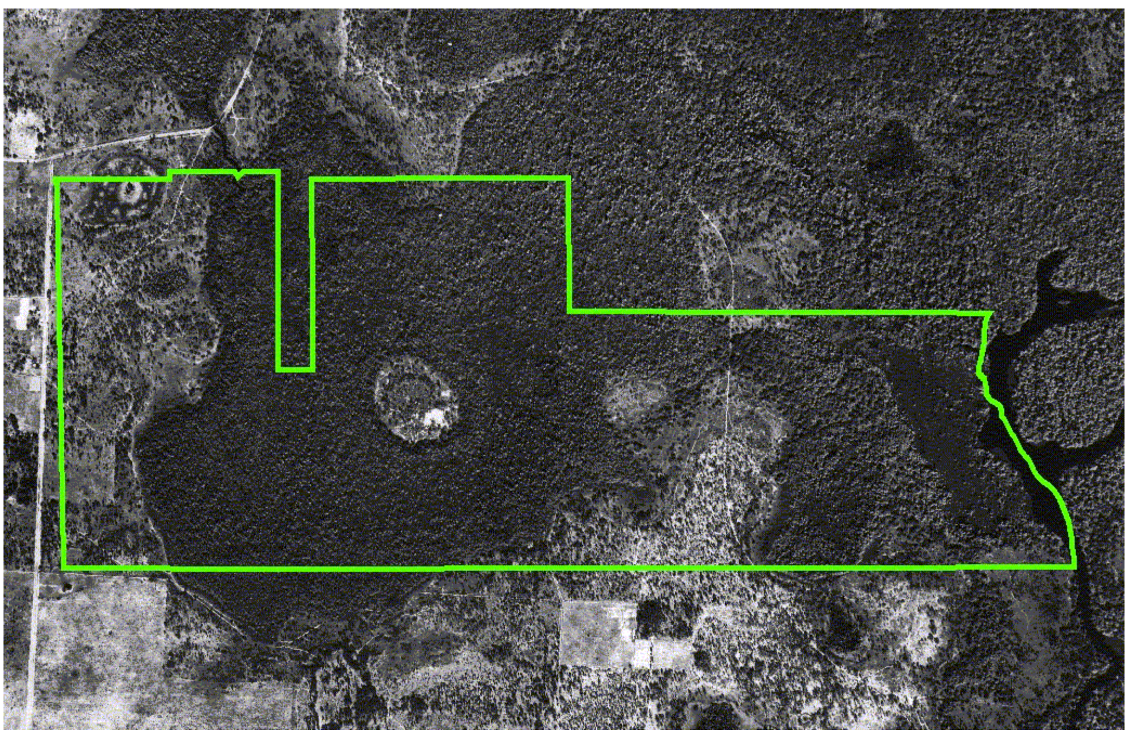


Figure 4. 1938 USDA/SCS Hillsborough County Soil Survey aerial photograph (courtesy of the Environmental Protection Commission of Hillsborough County).

There also appears to have been a home site just northeast of the west gate going into the USF Eco Area. Field observations have somewhat backed up the placement of the home site in having noted an unusual presence, for the area, of several loblolly pines (*Pinus taeda*) and one, fairly large red cedar (*Juniperus virginiana*).

Logging and turpentine operations also appear to have taken place on the site. The north-south dirt road that goes through the USF Eco Area, along the upland ridge that dips north into the floodplain swamp, is on the 1938 aerial photograph. Local knowledge says that this had been an old logging road that had been, prior to 1938, deeply excavated through the upland for access to cypress trees in the floodplain swamp to the north. “Cat faces”, observed on several long leaf pines (*Pinus palustris*) throughout the site, revealed signs of past turpentine operations.

On Dec. 18, 1956 the Board of Education finally agreed on the current site for the then new University of South Florida (Leland Hawes, Tampa Tribune, Oct. 30, 1986). Along with this decision, a Mr. Stanton Sanson generously donated an approximately 700 more acres, north of Fletcher Avenue, to the new university. Mr. Sanson’s donation provided the new USF with open land that had frontage on the Hillsborough River. By 1960, classes were meeting in the first five buildings on the main campus; by 1961, planning for Riverfront Park had been approved; and by 1966, construction of the USF Golf Course was well under way (Leland Hawes, Tampa Tribune, Oct. 30, 1986; Personal Communication: Florida Studies Center; USF Recreation Department).

The USF Eco Area has primarily been used as a resource for education and research in the natural and environmental sciences as well as the above mentioned anthropological studies (Collins unpublished; Eyles et al. 2002). Records of ecological research conducted in the USF Eco Area date back to 1971 (Appendix A). Prior botanical investigation in the USF Eco Area was conducted by Lakela, Hansen, Richardson, Williamson, and Wunderlin.

There are discrepancies as to where the exact placement of the northern boundary is for the USF Eco Area. Between 1956 and today the northern boundary had been changed.

Investigations have yet to produce results as to when and why the boundary had been changed. A title search is currently being conducted to solve the mystery. The northern boundary of the USF Eco Area, used in the present study, is the one currently on record with Hillsborough County.

Climate

In the Holdridge Life Zone System that is based on mean annual temperature and precipitation gradients throughout Florida, Hillsborough County falls in the bioclimatic transition zone between the warm temperate moist forest to the north and the subtropical moist forest to the south (Meyers 2000). The USF Eco Area experiences the typical cyclical subtropical climate of a humid, rainy, and particularly warm period, from June through September, and a dry, mild, but relatively cool period from October through May, with April, May, October, and November being the driest months of the year (Chen and Gerber 1990; Meyers 2000; Winsberg 2003). Summers include a high frequency of thunderstorms and lightning, tropical storms, and periodic tornadoes and hurricanes. The cool and dry winters are often punctuated with cold and warm fronts preceded by winds and precipitation that bring brief periods of below or above average temperatures, respectively. The prevailing winds for the area are predominantly east northeast at an average of eight miles per hour annually, with more of a westerly flow from July through September.

In January, the temperature average ranges from 10.4^{o}C (50.8^{o}F) to 21.4^{o}C (70.5^{o}F) and in August, from 23.7^{o}C (74.6^{o}F) to 32.4^{o}C (90.3^{o}F) (SERCC 2005). During the winter, temperatures can infrequently drop to or just below freezing for short periods of time. The rainy season, extending from June through September, typically has an average precipitation of 72.11 cm (28.39 in) (SERCC 2005). Annually, the average precipitation is 120.9 cm (47.58 in), with August typically receiving the most precipitation at an average of 20.16 cm (7.94 in) and November receiving the least at 4.0 cm (1.6 in) (SERCC 2005).

Geology

The USF Eco Area is associated with the Post Oligocene epoch Ocala Uplift area where it lies on the Tampa Member of the Hawthorn Group Formation, dating from the Upper Oligocene to Miocene epochs of the Tertiary period (5–40 MYBP) (Brown et al. 1990; Meyers 2000; Scott et al. 2001; Scott 2001; Webb 1990). In the Ocala Uplift area, clastic and marine carbonate sediments are typically thin over the lithologies of the Hawthorn formation that include limestone, dolostone, sand, and clay, with some exceptions where sediments can be 10–60 meters thick with a dense layer of impermeable clay between overlying sands and underlying limestone.

Topography, Hydrology, and Soils

The USF Eco Area is essentially in the "ecotone" of two physiographic districts that are included in the Gulf Coastal Lowlands Region of the Gulf Coastal Plain Physiographic Province (Brown et al. 1990; Meyers 2000; Webb 1990). It is located at the southern end of the Ocala Uplift Physiographic District and on the cusp of the northern end of the Southwestern Flatwoods Physiographic District. Both districts reflect the characteristic topography of the Gulf Coastal Lowlands Physiographic Region that includes sweeping expanses of poorly drained, low, flatlands and swampy depressions punctuated by very dry, sandy hills and ridges that were once Plio-Pleistocence shorelines, sand dunes and ridges.

The Ocala Uplift District is characterized by a heterogeneous landscape of hills and low, primarily karst, flats with limestone at or near the surface that, when covered, is thinly overlain with varied sediment types (Brown et al. 1990; Meyers 2000; Webb 1990). Karst plains, pine flatwoods, sandhills, mixed hardwood forests, swamps, and streams typically occur in the district.

The Southwestern Flatwoods District differs from the Ocala Uplift in that it has less heterogeneity in the topography with predominately low flat terrain and fewer hills and ridges (Brown et al. 1990; Meyers 2000; Webb 1990). Sediments over the bedrock are predominantly sand with clay substrata, limestone, and organic materials. Pine flatwoods, cypress dome, and mangrove habitats are typically included in the district.

The heterogeneity of the Ocala Uplift Physiographic District is reflected in the varied elevations found in the USF Eco Area. The highest elevation occurs in the sandhill plant community type at 18 meters (58 feet) above mean sea level (msl) (SWFWMD 1973 aerial photograph with contours). The lowest elevation occurs in the floodplain swamp at 7 meters (24 feet) above (msl). Slopes in the areas with more relief range between 2–5%.

Over half of the USF Eco Area is comprised of wetlands (Figures 2, 5). The hydrology of the area is predominantly associated with Cypress Creek and the Hillsborough River.

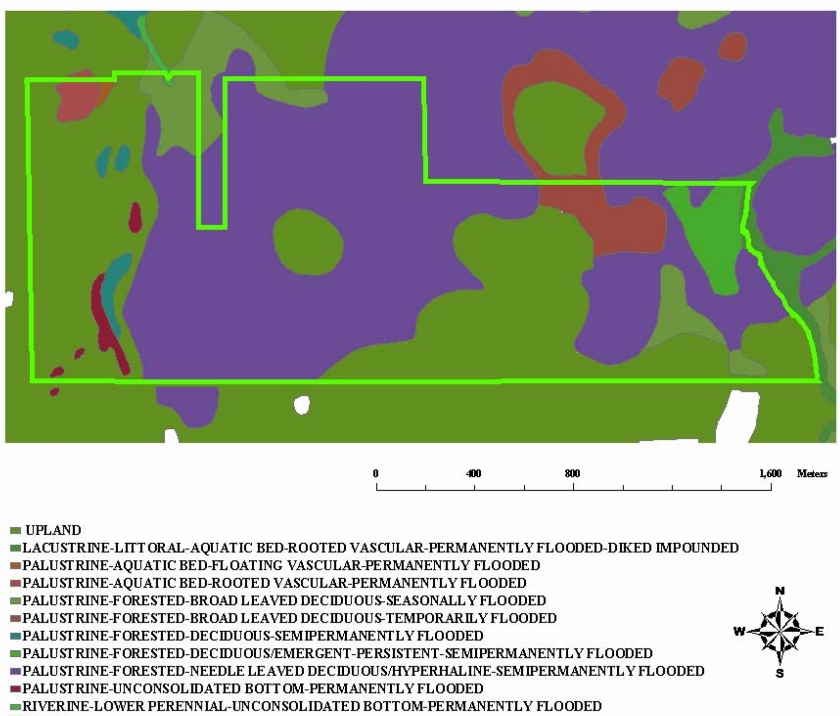


Figure 5. National Wetland Inventory (NWI) map of the University of South Florida Ecological Research Area showing the NWI wetland type classification. (Cowardin et al., 1979).

Soils types in the USF Eco Area range from extremely droughty, excessively drained sands, predominantly of the entisol soil order, to nearly permanently waterlogged muck and peat in the swamp, predominantly from the spodosol soil order (Figure 6) (Brown et al. 1990; Doolittle et al. 1989; Meyers 2000; Webb 1990).

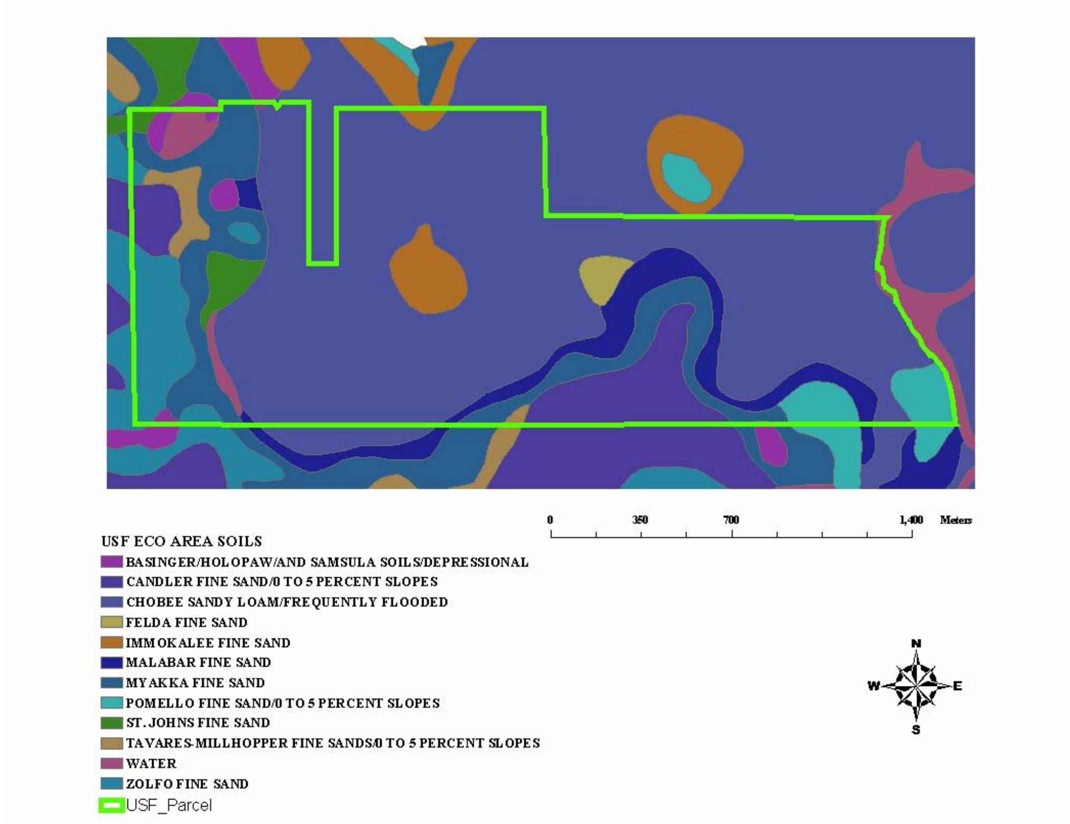


Figure 6. Soil type classification in the University of South Florida Ecological Research Area from the 1989 USDA/SCS Hillsborough County Soil Survey. (Doolittle et al. 1989).

The entisols primarily include the Candler fine sand and Pomello fine sand soil types. The Chobee sandy loam, Felda fine sand, Immokalee fine sand, Malabar fine sand, and Myakka fine sand soil types are primarily spodosols.

Topography, hydrology, and soils for each of the plant community types are dealt with in more depth and specificity in their respective descriptions.

METHODS

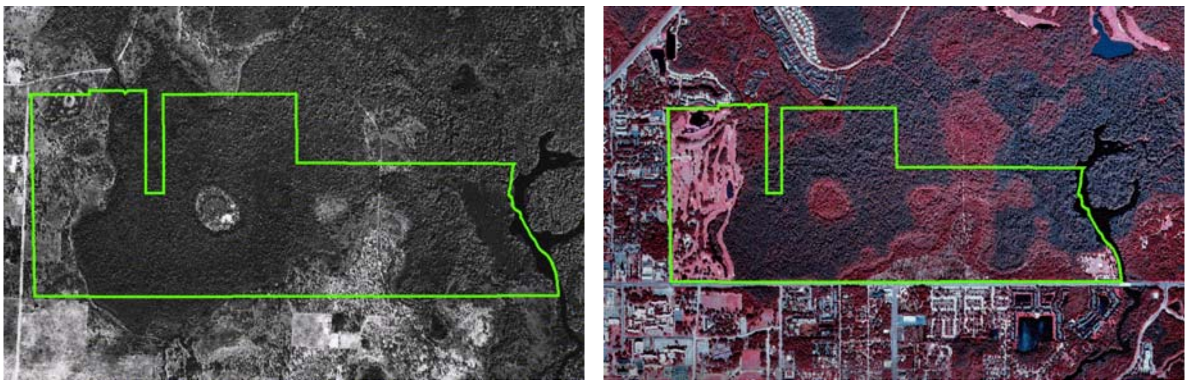
Field Collections

Documentation of the USF Eco flora was done by verification of plant voucher specimens in the USF Herbarium listed by Richardson et al. (1991) and by additional field collections made during the present study. Field collections of vascular plant voucher specimens were conducted from June 2001 through July 2005 in the USF Eco Area with collection trips conducted during each season of the year throughout the five year period. Field characteristics, precise locality, habitat, plant associations, soil type (USDA/SCS 1989 Hillsborough County Soil Survey), elevation (SWFWMD 1973 aerial photograph with contours), and relative abundance (qualitative estimates of relative abundance of the vascular plant species within the habitat collections were made), were recorded for each specimen collected. Collections were made in duplicate with the exception of plants that were on State of Florida rare and endangered species lists (Coile and Garland 2003). Plant voucher specimens were processed in accordance with standard field and herbarium techniques and deposited in the USF Herbarium.

Identification of the plant voucher specimens were primarily made utilizing Wunderlin (1998) and Wunderlin and Hansen (2003, 2005). Nomenclature used is that of Wunderlin and Hansen (2003, 2005). Identified voucher specimens were verified by comparison with specimens in the USF Herbarium and confirmed by Richard P. Wunderlin and Bruce F. Hansen.

Delineation and Characterization of Plant Communities

Plant communities were initially delineated through photointerpretation using color infrared (CIR) (SWFWMD GIS Division 1999) (Figure 4B) and black and white (Hillsborough County 2002) aerial photographs of the USF Eco Area. Ancillary data used for initial delineations included the National Wetland Inventory (USDI/FWS/NWI 1988) (Figure 5), Hillsborough County Soil Survey (USDA/SCS 1989) (Figure 6), and the 1999 FLUCCS LEV 1 Land Use Map (SWFWMD 2004). The 1938 USDA/SCS Hillsborough County Soil Survey aerial photograph was used for historical reference of the plant communities and compared to the more recent 1999 color infrared (Figure 7).



A. B.

Figure 7. Historic and recent aerial photographs of the University of South Florida Ecological Research Area. A. 1938 black and white (USDA/SCS Hillsborough County Soil Survey 1938). B. 1999 color infrared (SWFWMD GIS Division 1999).

Plant community delineations were verified and refined by ground truthing using a handheld Garmin® GPS III® Plus Global Positioning System (GPS) to acquire coordinate points for mapping delineations. Plant association data from specimen collections and general field observations were incorporated into the ground truthing.

The Florida Natural Areas Inventory (FNAI) and Department of Natural Resources (DNR) classification system for the natural communities of Florida (FNAI and DNR 1990) was used for classification and characterization of the plant communities found in the USF Eco Area with additional information from Meyers and Ewel (1990) and Meyers (2000). A map of the USF Eco

Area plant communities was produced using the ESRI™ ArcGIS 8.2 (2001-2002) Geographic Information System (GIS) software.

Data Organization

The color infrared (CIR) (SWFWMD GIS Division 1999), black and white (Hillsborough County 2002), and USDA/SCS 1938 Hillsborough County Soil Survey aerial photographs and the USF Eco Area parcel boundary (SWFWMD GIS Division 2005), National Wetland Inventory (USDI/FWS/NWI 1988), Hillsborough County Soil Survey (USDA/SCS 1989), and the 1999 FLUCCS LEV 1 Land Use Map (SWFWMD 2004) images and data were put into the ESRI™ ArcGIS 8.2 (2001-2002) GIS software layers. Ground truthing and specimen collection locality coordinates were initially downloaded from the handheld Garmin® GPS III® Plus GPS into the Garmin MapSource™ Version 3.02 (1999) GIS software then imported into a Microsoft® Excel 2002 database. All floristic and coordinate data were then imported from the Excel database into the ESRI™ ArcGIS 8.2 (2001-2002) GIS software layers. Plant community delineation for the Eco Area was finalized by digitizing the GPS ground truthing coordinate data into the above mentioned ESRI™ ArcGIS 8.2 (2001- 2002) GIS software layers for mapping.

RESULTS AND DISCUSSION

Floristics

Verification of plant voucher specimens in the USF Herbarium, listed by Richardson et al. (1991), produced 312 vouchered taxa. Additional collections from the present floristic inventory increased the number of vouchered taxa to 404. In the present study, 274 vascular plant taxa were collected and documented, 182 of which were present in the previous vouchered collections, and 92 are new additions to the flora. One hundred and thirty vouchered taxa from the previous collections were not recollected.

The USF Eco Area flora, with the present floristic inventory, consists of 404 vouchered taxa in 251 genera and 102 families (Table 1).

Table 1. University of South Florida Ecological Research Area floristic synopsis

	Taxa[1]	Genera	Families	Native[2]	Exotics[3]	Endemics[4]	County Records[5]
Pteridophytes	12	10	10	7	5	0	0
Gymnosperms	5	2	2	5	0	0	0
Angiosperms (Monocotyledons)	122	56	19	115	7	2	2
Angiosperms (Dicotyledons)	265	183	71	251	14	11	2
Totals	404	251	102	378	26	13	4

[1]Species and infraspecific taxa
[2]Taxa whose natural range included Florida at the time of European contact in the sixteenth century
[3]Taxa introduced into Florida from a natural range outside of Florida after European contact in the sixteenth century (non-native taxa)
[4]Taxa confined within the geographic boundary of Florida
[5]Hillsborough County - first record of taxa presence in Hillsborough County

The vascular plant families with the largest representation are Asteraceae (51 taxa), Poaceae (41 taxa), Cyperaceae (34 taxa), and Fabaceae (27 taxa). The most represented genera include *Rhynchospora* with 9 taxa; *Cyperus*, *Dichanthelium*, and *Quercus* with 8 taxa in each of the three genera; and *Carex*, *Juncus*, and *Polygala* with 6 taxa in each genera. Of the 404 taxa found in the USF Eco Area, 378 (94%) are native to Florida and 26 (6%) are exotic (non-native) (Wunderlin 2003, Wunderlin and Hansen 2005) (Table 1). Of the 378 native taxa, 13 are endemic to Florida (Wunderlin 2003, Wunderlin and Hansen 2005) (Tables 1, 2).

Table 2. Vascular plant taxa endemic* to Florida occurring in the University of South Florida Ecological Research Area (Wunderlin and Hansen 2005)

Arnoglossum floridanum	*Lythrum flagellare*
Asimina reticulata	*Phoebanthus grandiflorus*
Berlandiera subacaulis	*Polygala rugelii*
Carex vexans	*Scutellaria arenicola*
Chrysopsis linearifolia subsp. dressii	*Stipulicida setacea var. lacerata*
Chrysopsis subulata	*Tillandsia simulata*
Coreopsis leavenworthii	

*Endemic taxa - taxa confined within the geographic boundary of Florida.

Ten taxa (9 of the 26 exotic taxa and 1 of the 378 native taxa) are listed as invasive by the Florida Exotic Pest Plant Council (FLEPPC) (FLEPPC 2003). Seven are listed as FLEPPC's Category I invasive species and 3 are listed as Category II invasive species (Tables 1, 3). Fortunately, the relative abundances of invasive taxa in the USF Eco Area are currently rare except for *Alternanthera philoxeroides*, *Eichhornia crassipes*, and *Pistia stratiotes* which are locally common in various areas of the Hillsborough River, Cypress Creek, floodplain swamp, and floodplain marsh.

Table 3. Florida Exotic Pest Plant Council listed invasive vascular plant taxa (FLEPPC 2003) found in the University of South Florida Ecological Research Area

Category I*	Category II**
Eichhornia crassipes	*Alternanthera philoxeroides*
Lantana camara	*Rhynchelytrum repens*
Lygodium japonicum	*Urena lobata*
Nephrolepis cordifolia	
Pistia stratiotes	
Schinus terebinthifolius	
Urochloa mutica	

*Category I - taxa that invade and alter the ecosystems of Florida's natural plant communities
**Category II - taxa that have shown invasive properties and the potential to alter the ecosystems of Florida's natural plant communities

Four taxa are new records for Hillsborough County (Wunderlin and Hansen 2005) (Tables 1, 4). Nine of the 404 taxa found in the USF Eco Area are listed as either endangered, threatened, or commercially exploited by the Florida Department of Agriculture and Consumer Services (Coile and Garland 2003) (Table 5). *Lythrum flagellare* is one of most notable of the collections in that it is an endangered endemic taxon and a new record for Hillsborough County. Previously, *L. flagellare* had only been found in 11 Florida counties and had a disjunct distribution; Hernando and Orange counties in Central Florida and then Manatee, Sarasota, DeSoto, Okeechobee, Charlotte, Glades, Lee, Hendry, and Collier counties in Southwest and South Central Florida.

Table 4. New records of vascular plant taxa for Hillsborough County found in the University of South Florida Ecological Research Area (Wunderlin and Hansen 2005)

Echinochloa muricata
Hypoxis wrightii
Lechea minor
Lythrum flagellare

Table 5. University of South Florida Ecological Research Area vascular plant taxa listed as endangered, threatened, or commercially exploited by the Florida Department of Agriculture and Consumer Services (Regulated Plant Index, Rule 5B-40.0055) (Coile and Garland 2003)

Endangered	Threatened	Commercially Exploited
Lythrum flagellare	*Pinguicula caerulea*	*Encyclia tampensis*
Matelea pubiflora	*Pteroglossaspis ecristata*	*Epidendrum conopseum*
Tillandsia fasciculata var. *densispica*	*Zephyranthes atamasca*	*Osmunda regalis* var. *spectabilis*

Plant Communities

Classification of the USF Eco Area natural plant community types is based primarily on the Florida Natural Areas Inventory and Department of Natural Resources classification system (FNAI and DNR 1990), supplemented by Meyers and Ewel (1990) and Meyers (2000) along with field observations throughout the research period. Twelve plant community types are recognized in the USF Eco Area. Eleven are plant community types found in the natural areas (245 ha, 80%) and one is a community type that is continually disturbed (61 ha, 20%) (Table 6) (Figures 8, 9). The majority of the USF Eco Area is made up of wetlands, which fall under the riverine and palustrine natural community categories. The Hillsborough River and Cypress Creek riverine ecosystems represent the blackwater stream natural plant community type (3 ha, 1%) (Table 6) (Figures 8, 9). The palustrine ecosystems consist of the floodplain swamp (128 ha, 42%), floodplain forest (18 ha, 6%), floodplain marsh (14 ha, 5%), hydric hammock (10 ha 3%), seepage slope (3 ha, 1%), and wet flatwoods (22 ha, 7%) natural plant community types (Table 6) (Figures 8, 9). The mesic flatwoods (23 ha, 8%), scrubby flatwoods (4 ha, 1%), sandhill (13 ha, 4%), and xeric hammock (7 ha, 2%) natural plant community types, found in the uplands of the USF Eco Area, represent the terrestrial natural community category (Table 6) (Figures 8, 9). The ruderal/developed community type (61 ha, 20%) in the USF Eco Area includes the continually disturbed and developed areas composed of the USF Golf Course, Riverfront Park, storage and dumping sites and areas along roads, fences, and firebreaks (Table 6) (Figures 8, 9).

Table 6. Areas of the twelve plant communities found in the University of South Florida Ecological Research Area

Plant Community	Hectares	Acres
Floodplain Swamp (FS)	128	317
Ruderal/Developed[1] (RD)	61	150
Mesic Flatwoods[2] (MF)	23	57
Wet Flatwoods (WF)	22	54
Floodplain Forest (FF)	18	46
Floodplain Marsh (FM)	14	35
Sandhill (SH)	13	31
Hydric Hammock[3] (HH)	10	25
Xeric Hammock[4] (XH)	7	17
Scrubby Flatwoods (SF)	4	10
Blackwater Stream[5] (BS)	3	7
Seepage Slope (SS)	3	7
Total	306[6]	756[6]

[1]USF Golf Course and USF Riverfront Park as well as dump and storage sites and along roads, fences, and firebreaks
[2]Dome Swamps (DS) and Sinkholes (SI) included
[3]Dome Swamp (DS) included
[4]Sandhill (S) and Sand Pine Scrub (SPS) climax community
[5]Hillsborough River and Cypress Creek
[6]Total of just the natural areas is 245 hectares (ha) or 606 acres (a), excluding Ruderal/Developed (RD)

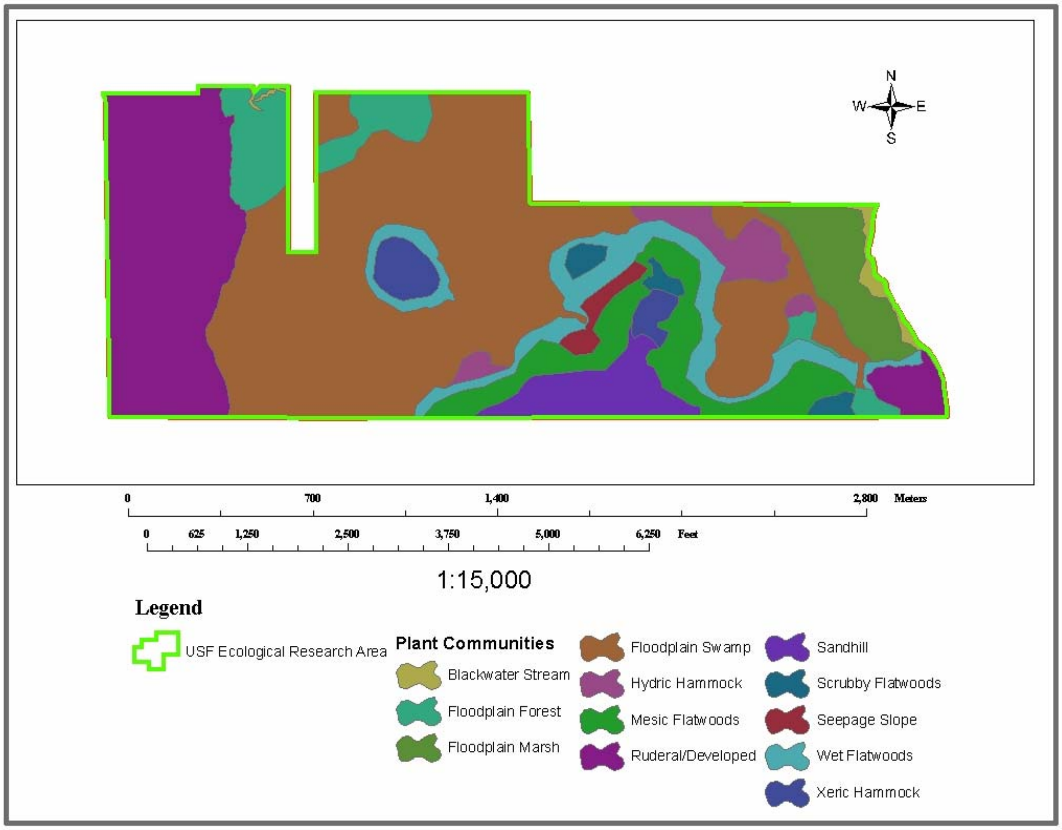


Figure 8. The University of South Florida Ecological Research Area plant community types. The wetlands are comprised of Blackwater Stream, Floodplain Swamp, Floodplain Forest, Floodplain Marsh, Hydric Hammock, Seepage Slope, and Wet Flatwoods. The uplands are comprised of Mesic Flatwoods, Scrubby Flatwoods, Sandhill, Xeric Hammock, and Ruderal/Developed.

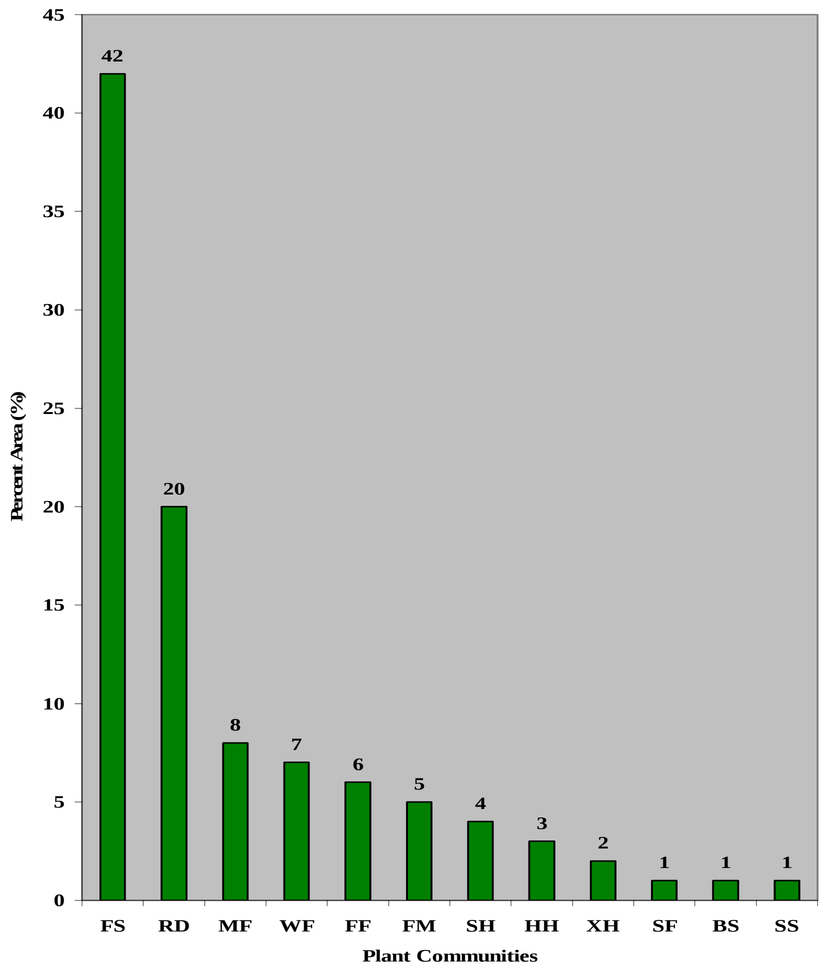


Figure 9. Percent areas of the twelve plant communities found in the University of South Florida Ecological Research Area. Floodplain Swamp (FS), Ruderal/Developed (RD), Mesic Flatwoods (MF), Wet Flatwoods (WF), Floodplain Forest (FF), Floodplain Marsh (FM), Sandhill (SH), Hydric Hammock (HH), Xeric Hammock (XH), Scrubby Flatwoods (SF), Blackwater Stream (BS), Seepage Slope (SS).

Observations during the current survey revealed definite distributional patterns of mixed species assemblages occurring together consistently in specific abiotic and biotic environmental conditions, enough to recognizable in their designated natural plant community types. The USF Eco Area natural plant communities, delineated and classified above, do not have sharply defined and discrete boundaries. Ecotones between community types vary in width with minimal to much species overlap from abutting communities. Ecological communities are dynamic, shifting spatially and compositionally through time, and rarely have discrete and permanent boundaries (Gurevitch et al. 2002; Stiling 1999; TNC 1996). Most likely, the USF Eco Area natural plant communities will shift spatially and compositionally, in time, as a result of changes in abiotic and biotic factors and/or anthropogenic perturbations. For convenience, the observed species assemblages, as they presently occur in the USF Eco Area, are referred to as natural plant communities. A natural plant community, in the current study, is defined per FNAI and DNR (1990). Natural plant community types in the USF Eco Area are delineated and classified to facilitate the inventory, analysis, evaluation, and monitoring of the mixed species assemblages and their associated ecosystems for purposes of research, education, planning, management, conservation, and potential restoration.

Riverine Community

The riverine community in the USF Eco Area consists of the blackwater stream community type. Blackwater streams are the most dominant and widely distributed type of river system found in peninsular Florida (FNAI and DNR 1990; Meyers 2000).

Blackwater Stream—The blackwater stream community in the USF Eco Area covers approximately 3 ha (7 a) or 1% of the total USF Eco Area plant communities and is composed of two riverine systems; Cypress Creek and the Hillsborough River (Table 6) (Figures 8, 9, 10). Despite the small percentage of blackwater stream community in the USF Eco Area, the two riverine systems are highly interdependent and tightly interwoven with the USF Eco Area's palustrine systems of the floodplain swamp, forest, and marsh and hydric hammock community types.

A.

B.

Figure 10. The blackwater stream plant community type in the University of South Florida Ecological Research Area (USF Eco Area). A. Cypress Creek as it enters the northwest corner of the USF Eco Area. B. The Hillsborough River makes up the eastern border of the USF Eco Area. (Photograph courtesy of Ben Mercadante).

Blackwater streams can be both perennial and seasonally intermittent streams (FNAI and DNR 1990; Meyers 2000; Nordlie 1990). Depending on the topography along their watercourses, they can alternately become deep channels confined by steep or low-lying banks; networks of braided streams that create islands of palustrine or upland vegetation; and intermittent streams, periodically disappearing into the low topography of floodplain communities and then occasionally reemerging. The flow in the Hillsborough River and Cypress Creek ranges from moderate to swift which creates shifting sands in the streambed in some areas and incised deep channels with steep banks in others. Typical of blackwater streams, their water levels go through considerable seasonal fluctuations.

The water of blackwater streams is generally acidic, but may become more neutral when stream water is influenced by alkaline ground water at times of low water levels (FNAI and DNR 1990; Meyers 2000; Nordlie 1990). The Hillsborough River and Cypress Creek both have the coffee/tea-colored water, characteristic of blackwater streams, as a result of the high tannin content and rich organic debris accumulated from their headwaters originating in extensive wetlands with organic soils. Particulate and dissolved organic matter overlay a sandy riverbed bottom that is often underlain with limestone. Although limestone is typically exposed periodically along their watercourses, this does not occur in the USF Eco Area.

Emergent, floating, and submerged vegetation is generally minimal in mid-channel in the USF Eco Area blackwater streams due to the dark waters limiting light penetration for photosynthesis. The periodic steep banks, deep channels, and seasonal wide fluctuations in water levels create an unstable habitat for vegetation to take hold. However, emergent, floating, and submerged vegetation occurs in the sloughs as well as in the shallower and slower moving areas along the edges of the streams.

Both Cypress Creek, approximately 70 kilometers (km) or 40 miles (mi) in length, and the Hillsborough River, approximately 88 km (55 mi) in length, run within the boundaries of Florida.

Cypress Creek originates in a vast expanse of marsh in Pasco County, around San Antonio, north of the USF Eco Area. From there it meanders south and eventually becomes one of the major tributaries that feed into the Hillsborough River. Along its watercourse, the natural flow of Cypress Creek has been altered by flood control structures, diking, artificial channeling, channel diversions, and drawdowns in water well field areas.

Cypress Creek enters the USF Eco Area on the northwest corner just east of the golf course (Figure 10A). It runs in a deeply incised natural channel and slowly flows south for roughly 170 meters (m) or 558 feet (ft). Here the creek is approximately 10 m (33 ft) wide, bounded by steep banks of floodplain vegetation, and very little vegetation mid-channel. Cypress Creek then turns to the west southwest, for roughly 160 m (525 ft), where it starts to break up into a braided stream as the elevation drops into the floodplain forest and swamp. There, the main channel narrows even more, the banks are not as steep, and the stream flow quickens. As the main channel begins to twist, turn, and oxbow, it creates small islands composed of floodplain forest and swamp vegetation and becomes hard to distinguish from the other broken off streams. Accumulated organic debris and fallen trees from flood events cause more diversions of the braided streams as well as pockets of ditched areas.

As Cypress Creek meanders through the floodplain forest and west through the broad, low relief of floodplain swamp, just north of Buck Island, the main channel and braided streams become even more undefined, eventually alternating between ephemeral detritus filled and highly acidic swamp streams and more defined channels. Once through the floodplain swamp, the main channel comes together again with low lying banks. The defined channel here is roughly 12 m (39 ft) wide and runs approximately 80 m (262 ft) before it empties into the Hillsborough River on the northeast corner of the USF Eco Area. Due to the extent of undefined and low-lying channels through the floodplain communities and the blackwater stream characteristic fluctuations of extreme to low flows, any floodwater or discharge easily causes Cypress Creek to overflow its banks, flooding the floodplain forest and swamp.

The Hillsborough River headwaters are in the southern portion of the 2,253 square kilometer (870 square mile) expanse of the Green Swamp that extends into Sumter, Pasco, and Hillsborough Counties. On it's approximately 88 km (55 mi.) path from the Green Swamp, the Hillsborough River winds southwest through Crystal Springs in Zephyrhills, the Hillsborough River State Park, Lettuce Lake Park and the USF Eco Area (Bray 2004). Just north and south of the USF Eco Area the natural flow and water level fluctuations of the Hillsborough River become altered by the dam structures of the City of Tampa's Hillsborough River Reservoir, built in the 1920s, and the diversion and impoundment structures of the Tampa Bypass Canal and the Lower Hillsborough River Flood Detention Area, built in the 1960s and 1970s for flood control (Bray 2004). Once through the impoundment and diversion controls, the Hillsborough River winds through downtown Tampa and then finally empties into the mouth of Tampa Bay.

The entire eastern border of the USF Eco Area, approximately .9 km (.6 mi) in length, is on the Hillsborough River (Figure 10B). The flow of the river is a slow run from north to south with a wide channel that cuts through the low topography of floodplain swamp and marsh. Little to no vegetation is found mid-channel but emergent and floating emergent vegetation occurs along the edges of the river. The channel width along the USF Eco Area ranges from approximately 80 m (262 ft) where Cypress Creek empties into the river at the north end, to a width of 200 m (656 ft) in the Lettuce Lake area, and to 30 m (98 ft) wide at Riverfront Park at the southeast corner of the USF Eco Area. The stretch of the Hillsborough River that makes up the eastern border of the USF Eco Area was historically a riverine system, but today is more of a lacustrine system due to the disruption of natural flow from the reservoir and flood control impoundment and diversion structures (Cowardin et al. 1979).

Hydrophyte tree species such as *Acer rubrum*, *Cornus foemina*, *Fraxinus caroliniana*, *Gleditsia aquatica*, *Salix caroliniana*, *Taxodium ascendens*, *Taxodium distichum*, and *Ulmus americana*, found on the margins of the USF Eco Area blackwater streams, reflect the floodplain communities they cut through. *Encylia tampensis*, *Epidendron conopseum*, *Psilotum nudum*, *Tillandsia fasciculata* var. *denispica*, *Tillandsia simulata*, and *Tillandsia usneoides* are among the abundant epiphyte species filling the trees that hang over the streams. Herbaceous hydrophyte species, found along the edges of the streams, include *Carex lupuliformis*, *Osmunda regalis* var. *spectabilis*, *Panicum hemitomon*, *Polygonum densiflorum*, *Rumex verticillatus*, *Scirpus tabernaemontani*, and *Typha domingensis.* Submerged and emergent hydrophytes including *Ceratopteris thalictroides*, *Nuphar advena*, *Pontederia cordata*, and *Proserpinaca palustris*, are present in the shallower and more sheltered areas of Cypress Creek and the Hillsborough River. Other emergent plants, such as *Alternanthera philoxeroides*, *Bidens laevis*, *Eichhornia crassipes*, *Habenaria repens*, *Paspalum repens*, and *Polygonum punctatum* create floating mats, especially where Cypress Creek empties into Hillsborough River. *Azolla caroliniana*, *Lemna aequinoctiali*, *Pistia stratiotes*, *Salvinia minima*, and *Spirodela polyrhiza* are locally common floating aquatic plants that carpet the surface waters in sloughs and slower parts of the streams. *Centella asiatica*, *Cicuta maculata*, *Hydrocotyle verticillata*, and *Micranthemum umbrosum* are a few of the herbaceous plants that colonize dead snags that float in the channels or get caught in the accumulated debris on the edge of the streams. *Mikania scandens* and *Symphiotrichum carolinianum* scramble over debris and fallen trees that have accumulated in the sloughs and the shallower and slower areas of the Creek and River.

Along with the negative impacts of impoundment and diversion structures, artificial channeling, diking, and drawdowns that disrupt the natural flow and water levels of Cypress Creek and the Hillsborough River, both blackwater streams have been altered by agriculture, development, and silviculture along their watercourses. Invasive species such as *Alternanthera* *philoxeroides*, *Eichhornia crassipes*, and *Pistia stratiotes* have also contributed to altering their fragile ecosystems. Riverine systems are closely integrated with their associated wetland systems; alterations to either system will have an effect on the other (FNAI and DNR 1990; Nordlie 1990). Despite the above mentioned anthropogenic perturbations, Cypress Creek and the Hillsborough River watersheds have been protected enough in parts by state, county, and local agencies to provide an oasis for wildlife, including endangered and threatened species and species of special concern, which is vital in these days of compromised wetlands and habitat fragmentation.

Palustrine Communities

The palustrine communities in the USF Eco Area consist of floodplain swamp, floodplain forest, floodplain marsh, hydric hammock, seepage slope, and wet flatwoods community types. The floodplain communities and the hydric hammock are generally intermixed. Differences in their community structure and species composition are due to subtle changes in topography and hydroperiod. The USF Eco Area's seepage slope community is a seepage wetland with impermeable soils. Wet flatwoods primarily make up the ecotone between the floodplain and terrestrial communities.

Floodplain Swamp—Riverine floodplain swamps are the most diverse and productive type of swamp in Florida (Ewel 1990; FNAI and DNR 1990; Meyers 2000). The hydrology of the USF Eco Area floodplain swamp community is dominated by Cypress Creek and the Hillsborough River. Covering approximately 128 ha (317 a) or 42% of the total area, the floodplain swamp is the most prominent plant community in the USF Eco Area (Table 6) (Figures 8, 9, 11). It is a mosaic of saturated black organic soils; pools of organic-stained standing water in depressions of accumulated organic debris; and hummocks created by buttresses of hydrophilic trees, royal ferns, and flood distributed detrital accumulations that occasionally provide footholds for non-hydrophilic plant species.

Figure 11. The floodplain swamp is the dominant plant community in the University of South Florida Ecological Research Area. (Photograph courtesy of Ben Mercadante).

Hydroperiod is the primary control over the ecological structure and seasonal species composition throughout the USF Eco Area floodplain swamp (Ewel 1990; FNAI and DNR 1990; Meyers 2000). Being a riverine floodplain swamp, the flowing waters and rapid seasonal fluctuations in water levels of Cypress Creek and the Hillsborough River create a relatively short hydroperiod, as compared to stillwater swamps, of approximately 6 months, typically from June to February. However, the floodplain swamp in the USF Eco Area remains semipermanently flooded throughout the year, except during extreme droughts, with local differences in hydroperiod occurring within the swamp, that often shift seasonally as detrital accumulations are redistributed by periodic flood events. Although most of the surface water in the swamp is provided by the USF Eco Area blackwater streams, surface water is also contributed by seasonal local precipitation and runoff from impermeable soil layers of abutting communities. The swamp can remain inundated with floodwaters for extended periods of time after prolonged intense rains. Groundwater also contributes to the hydrology of the swamp, since the water table is at or close to the soil surface, especially during dry periods when surface water is at a minimum.

The soils in the USF Eco Area floodplain swamp are made up of a variable mix of highly decomposed organic soils. Chobee sandy loam is the dominant soil type, recognized by its surface layer of black sandy loam underlain with mottled sandy clay loam and hydrological characteristics of very poorly drained, frequently flooded, and high available water capacity (Doolittle et al. 1989) (Figure 6). Pockets of mucky fine sand surface layers and considerable peat accumulations are also found throughout the swamp. The wide fluctuations in water levels of the rich, organic, flowing blackwater streams and the constant rearranging and transporting of accumulated organic debris, sediments, and nutrients by periodic flood events make great contributions to the high productivity typically found within the floodplain swamp system.

Fire frequency in floodplain swamps in general is low, occurring roughly once every century, except during periods of extreme drought, when saturated organic litter and peat have dried out enough to carry fire (Ewel 1990; FNAI and DNR 1990; Meyers 2000). When they do occur, fires in floodplain swamps may burn slowly for an extended period of time, producing a great deal of smoke as a result of the peat accumulations and mucky organic soils. No records of fire occurrences in the USF Eco Area floodplain swamp have been found.

The USF Eco Area floodplain swamp reflects the characteristic vegetative structure of floodplain swamps associated with blackwater streams; a well developed forested canopy, dominated by deciduous needle and broad-leaved trees, thin mid and sub-canopy of mostly deciduous small trees and shrubs, and a sparse groundcover sprinkled with seasonal herbaceous plants and overstory seedlings, that disappear after prolonged periods of inundation (Cowardin et al. 1979; Ewel 1990; FNAI and DNR 1990; Meyers 2000).

Throughout the USF Eco Area floodplain swamp, the most dominant upper canopy tree species is the needle-leaved deciduous *Taxodium distichum*. *Taxodium ascendens,* is more abundant along the margins of the Hillsborough River and scattered sparingly around the swamp. The broad-leaved deciduous trees, found in the upper canopy, are a mix of *Acer rubrum, Gleditsia aquatica, Nyssa sylvatica* var. *biflora*, and *Ulmus americana*. Interestingly, the relative abundance of the *Nyssa sylvatica* var. *biflora* is rare throughout most of the swamp, except in the northwest corner. Many canopy tree species in the floodplain swamp have buttresses, an adaptation to withstand long periods of inundation (Ewel 1990). Hummocks, created by the buttresses of hydrophilic tree species, rhizomes of *Osmunda regalis* var. *spectabilis*, and larger accumulations of debris, support many of the plant species mentioned above and below as well as less hydrophilic tree species, such as *Quercus laurifolia* and *Sabal palmetto*. In the portion of the swamp northwest of Buck Island, one exceptionally large hummock supports an old *Pinus palustris*, a pine tree generally found in upland habitats.

Fraxinus caroliniana is the most dominant mid-canopy tree species throughout the swamp. Closer to the Hillsborough River, it is generally more robust where it is often included in the upper canopy. The diversity of the mid-canopy is low, composed mostly of younger overstory trees, along with the ubiquitous *F. caroliniana*, except for *Cornus foemina*, which occurs occasionally throughout the swamp, and *Salix caroliniana* occurring in areas of tree fall and along the margin of the Hillsborough River. The diversity of small trees is greater along the margins of the swamp where *Ilex decidua*, *Ilex cassine*, and *Myrica cerifera* are included in the mid-canopy along with sub-canopy shrub species such as *Sideroxylon reclinatum* and *Viburnum obovatum*. During the present study, it was observed that certain shrubs in the sub-canopy seemed to trade off dominance in different portions of the swamp. *Cephalanthus occidentalis* was observed to be more dominant in the middle and eastern portions while *Itea virginica* was observed to be more dominant in the western portions.

Campsis radicans and *Toxicodendron radicans* are vines that occur along the margins of the swamp. *T. radicans* occasionally occurs on some of the hummocks as well. *Encylia tampensis*, *Epidendron conopseum*, *Psilotum nudum*, *Tillandsia bartramii*, *Tillandsia fasciculata* var. *denispica*, *Tillandsia recurvata*, *Tillandsia simulata,* and *Tillandsia usneoides* are among the abundant epiphytic plant species in the floodplain swamp.

Ferns such as *Osmunda cinnamomea*, *Osmunda regalis* var. *spectabilis*, *Thelypteris dentata*, *Woodwardia areolata*, and *Woodwardia virginica* occur in shallower areas and on hummocks. Some of the grasses and sedges that occur in the swamp are *Echinochloa muricata*, *Carex gigantea*, *Panicum hemitomon*, *Rhynchospora corniculata*, *Rhynchospora microcarpa*.

Suffrutescent species such as *Hypericum hypericoides*, *Hypericum fasciculatum*, and *Ludwigia spp*. inhabit the margins of the swamp year round. The floodplain swamp has abundant overstory seedlings and herbaceous plants early in the spring before the upper canopy closes. *Boehmeria cylindrica*, ubiquitous throughout the swamp, and *Asclepias perennis* and *Sabtia calycina*, with more of an occasional distribution, are some of the first herbs that begin to show in the spring. *Eichhornia crassipes*, *Polygonum spp.*, *Sagittaria graminea* var. *chapmanii,* and *Utricularia inflata* are emergent and floating herbaceous plants that are found in the standing water of depressions. *Saururus cernuus* occurs mostly in the shallower areas of the swamp, especially north northeast of Buck Island. Small seasonal herbs such as *Centella asiatica*, *Diodia virginiana*, *Galium tinctorium*, *Hydrocotyle verticillata*, *Hypericum mutilum*, *Hypoxis curtisii*, *Micranthium umbrosum*, *Packera glabella*, *Ptillimnium capillaceum*, and *Samolus valerandi* are found on fallen trees and accumulated organic debris periodically throughout the year. After the floodwaters recede, they are also the first to appear in the saturated soils. *Symphyotrichum carolinianum*, is occasionally found scrambling over larger debris and fallen trees throughout.

Anthropogenic alterations of the blackwater streams' natural fluctuations in water levels have compromised the natural cycles of hydroperiod in the USF Eco Area floodplain swamp. The intense logging of cypress in the past and the more recent drainage and filling for surrounding developments have also had a negative impact. Along with the above disturbances, the increasing populations of *Eichhornia crassipes*, a FLEPPC Category I invasive species, are another threat to the swamp's ecosystem. Yet, due to the inaccessibility of the swamp and the protection of the blackwater streams' watersheds, the USF Eco Area floodplain swamp remains a small protected island, in a sea of encroaching development, for many wetland species.

Floodplain Forest—The floodplain forest plant community type is found within the floodplain swamp therefore has similar characteristics in its hydrology, topography, soils, and fire frequency. It is distinguished from the floodplain swamp by occurring at slightly higher elevations, having a shorter hydroperiod, and a vegetative dominance of deciduous hardwood plant species (Ewel 1990; FNAI and DNR 1990; Meyers 2000). Approximately 18 ha (46 a) or 6% of the USF Eco Area is composed of the floodplain forest plant community type (Table 6) (Figures 8, 9, 12). Areas of floodplain forest are found where Cypress Creek enters into the USF Eco Area on the northwest corner, north of the Riverfront Park camping area, and just west of Riverfront Park (Figure 8).

Floodplain forests generally have a hydroperiod of inundation every one to two years for approximately 50% of the growing season (FNAI and DNR 1990). Periodic inundation of the USF Eco Area floodplain forest only occurs during the occasional seasonal flood events after prolonged intense rain. Although the water table depth is near the soil surface, it is lower than that of the floodplain swamp. During the dry season, there is no standing water. The high productivity of the floodplain forest system in the USF Eco Area, as in the floodplain swamp, is a beneficial result of the periodic flood events that move nutrient rich accumulated organic debris around the forest.

A diverse mix of deciduous broadleaf hardwood plant species dominates the vegetative structure of floodplain forests (Cowardin et al.1979; Ewel 1990; FNAI and DNR 1990; Meyers 2000). Characteristically the vegetative structure is a well-developed forested upper canopy, a very open or dense mid and sub-canopy of smaller trees and shrubs, and an understory of seasonal herbs and overstory seedlings.

Figure 12. Floodplain forest in the northwest corner of the University of South Florida Ecological Research Area.

The largest and best example of floodplain forest, covering approximately 16 ha (39 a), is in the northwest corner of the USF Eco Area (Figures 8, 12). The upper canopy is cathedral-like, composed of a mix of very tall *Acer rubrum*, *Fraxinus caroliniana*, *Quercus laurifolia*, *Sabal palmetto*, and *Ulmus americana*. *Gleditsia aquatica* and *Taxodium distichum* occur sporadically around the forest in the wetter areas. The mid-canopy is open and very sparse with few *Carpinus caroliniana*, *Cornus foemina*, *Ilex cassine*, *Ilex decidua,* and *Myrica cerifera*. *Cephalanthus occidentalis*, *Itea virginica*, *Sabal minor*, *Sideroxylon reclinatum*, *Rubus argutus,* and *Viburnum obovatum* occur in the thinly distributed mix of shrubs in the sub-canopy.

Vines that occur in the area are *Campsis radicans*, *Toxicodendron radicans*, and *Vitis aestivalis*. Epiphytes such as *Encyclia tampensis*, *Tillandsia bartramii*, and *Tillandsia simulata* are found closer to the wetter areas of the floodplain forest, overhanging Cypress Creek and the edges of the forest where it drops into the swamp. *Asplenium platyneuron*, a small fern, is also found in the trees. *Nephrolepsis cordifolia*, a FLEPPC Category I invasive fern, is found on a few of the fallen trunks of trees. Fortunately the occurrence of *N. cordifolia* is rare in most of the floodplain forest. Other ferns such as *Osmunda cinnamomea*, *Osmunda regalis* var. *spectabilis*, *Thelypteris interrupta*, and *Woodwardia virginica* occur on the forest floor.

Some of the grasses and sedges that inhabit the USF Eco Area floodplain forest community are *Axonopus furcatus*, *Carax alata*, *Carex lupuliformis*, *Carex vexans*, *Dichanthelium communtatum*, *Oplismenus hirtellus*, *Panicum hemitomon*, *Rhynchospora colorata*, *Rhynchospora fascicularis*, *Rhynchospora microcarpa* and *Rhynchospora mixta*. *Phanopyrum gymnocarpon* is found in dense patches rooted in the mud in the lower elevations and on the edges of the braided streams and oxbows Cypress Creek has made as it cuts through the floodplain forest.

Hypericum hypericoides and *Psychotria sulzneri* are among the suffrutescent plants found in the understory of the floodplain forest along with overstory seedlings. *Asclepias perennis*, *Hypoxis curtissii*, *Iris hexagona*, *Sabatia calycina*, *Sida rhombifolia*, *Solidago leavenworthii*, *Sisyrinchium angustfolium*, *Viola lanceolata*, and *Viola sororia* are some of the seasonal herbaceous plants that have an occasional distribution throughout the forest. Carpeting the floodplain forest floor and periodically colonizing fallen trees and large organic debris are other seasonal herbaceous plants such as *Commelina diffusa*, *Cardamine pensylvanica*, *Centella asiatica*, *Eclipta prostrata*, *Eryngium baldwinii*, *Hypericum mutilum*, *Micranthemum umbrosum*, *Phyla nodiflora*, and *Samolus valerandi*. *Saururus cernuus* occurs in the wetter areas of the forest. Found scrambling over fallen trees and larger organic debris are *Dichondra caroliniensis*, *Melothria pendula*, and *Symphyotrichum carolinianum*.

Despite many of the above mentioned species occurring in all of the USF Eco Area floodplain forest communities, the overall vegetative structure is different. The floodplain forest communities found north of the Riverfront Park camping area, covering approximately 1 ha (3 a), and just west of Riverfront Park, covering approximately 1 ha (4 a), have a lower upper canopy, much denser mid and sub-canopy, and a more sparse herbaceous understory as opposed to the tall cathedral-like and open vegetative structure of the floodplain forest community in the northwest corner of the USF Eco Area (Figure 8). The Riverfront Park areas are much smaller and are mostly surrounded by fill from the park development therefore experience fewer flood events than the floodplain forest in the northwest corner, despite their close proximity to the Hillsborough River. Although the USF Eco Area floodplain forest plant communities have been negatively impacted by the same anthropogenic perturbations as the floodplain swamp, the inaccessibility of the deeper parts of the larger area of floodplain forest in the northwest corner of the USF Eco Area have remained somewhat healthy and undisturbed.

Floodplain Marsh—The vegetative structure of the floodplain marsh plant community type is typically dominated by herbaceous perennial emergent hydrophyte plant species with a sparse sub-canopy of low deciduous shrubs and little to no mid and upper canopy (Cowardin et al. 1979; FNAI and DNR 1990; Kushlan 1990). Vegetation is rooted in organic soils with a peat substrate that remains saturated or inundated with standing water throughout most of the year. Natural cycles of fluctuating water levels and a fire frequency of approximately every 5–10 years are important factors in maintaining the floodplain marsh vegetative structure by limiting peat accumulation and the invasion of woody shrub species.

The floodplain marsh natural plant community type, covering approximately 14 ha (35 a) or 5% of the USF Eco, is a low lying river edge marsh along the west side of the Hillsborough River that extends west into the floodplain swamp for approximately 213 m (700 ft) and runs from the southern edge of the east end of Cypress Creek down to just north of Riverfront Park (Table 6) (Figures 8, 9, 13). The fluctuating water levels of both USF Eco Area blackwater streams influence the hydrology of the floodplain marsh community. It is distinguished from the floodplain swamp by a slightly lower elevation; longer annual hydroperiod of generally 7–12 months, when the marsh is flooded with flowing water; higher peat accumulation; and a vegetative dominance of low deciduous woody shrubs.

The 1938 USDA/SCS Hillsborough County Soil Survey aerial photograph and the 1988 National Wetland Inventory survey show the USF Eco Area floodplain marsh to have historically had the typical riverine marsh vegetative structure dominated primarily by emergent hydrophytes (Figures 4, 5). During the present study, the vegetative structure of the USF Eco Area floodplain marsh was found to be low in diversity, dominated by only two deciduous woody shrub species, averaging less than 9 m (30 ft) in height, with very few emergent hydrophyte plant species. Along with the invasion of woody shrubs, the marsh is also filled with large organic debris and many fallen, dead shrubs.

Salix caroliniana and *Cephalanthus occidentalis* are the two dominant woody shrub species that occur in the USF Eco Area floodplain marsh. *Myrica cerifera*, *Quercus laurifolia*, and

Figure 13. Floodplain marsh in the University of South Florida Ecological Research Area is found west of the Hillsborough River.

Ulmus americana are found on the few hummocks that occur on the edges of the marsh. The fern *Osmunda regalis* var. *spectabilis* occasionally appears on the hummocks as well. *Hydrocotyle ranunculoides*, occurring in large floating mats, is the most dominant herbaceous emergent plant species in the marsh. *Polygonum punctatum* and *Eichhornia crassipes* occur occasionally throughout. *Azolla caroliniana*, *Lemna aequinoctialis*, *Pistia stratiotes*, *Salvinia minima*, and *Spirodela polyrhiza* are floating aquatics that usually carpet the surface water. *Mikania scandens* is abundant, draped over fallen shrubs and larger organic debris. *Boehmeria cylindrica* and small herbaceous non-hydrophyte seasonal plant species, found also in the blackwater streams and floodplain swamp, colonize floating logs, larger organic debris, and the few hummocks in the marsh.

The current low diversity and shrub dominated vegetative structure in the USF Eco Area floodplain marsh plant community reflects the impact of the previously mentioned alterations to the USF Eco Area blackwater streams' hydrological regimes. Disruption of the natural cycles of hydroperiod and water level fluctuations has also produced conditions in the marsh that are not conducive to the fire frequency needed to maintain the historic typical floodplain marsh.

Hydric Hammock—The hydric hammock plant community type occurs in the upper zones of riverine floodplain swamps where the underlying limestone layer is generally closer to the soil surface (Cowardin et al. 1979; Ewel 1990; FNAI and DNR 1990). There are three areas of hydric hammock that, in total, cover approximately 10 ha (25 a) or 3% of the USF Eco Area (Table 6) (Figures 8, 9, 14). A small area of hydric hammock, covering approximately 1 ha (3 a), grades north into the floodplain swamp from the wet flatwoods in the southwestern portion of the USF Eco Area (Figure 8). The largest area of hydric hammock, covering approximately 8 ha (20 a), occurs in the central northeast portion of the USF Eco Area and is surrounded by floodplain swamp to the east, northeast, south, and west northwest and wet flatwoods to the southwest (Figure 8). The area of floodplain forest community north of the camping area, west of Riverfront Park, grades into a small, approximately 1 ha (2 a) area of hydric hammock surrounded by floodplain swamp to the north (Figures 8, 14A).

As in the USF Eco Area floodplain forest communities, the vegetative structure of the hydric hammock community type is dominated by a mix of broad-leaved, mostly deciduous, hardwood plant species in the upper, mid, and sub-canopies. Vegetation is distinguished from the floodplain forest by a greater abundance of *Sabal palmetto* and a vegetative species composition that typically has a wider range of tolerances for survival in upland habitats as well as in habitats with soils that remain saturated for short periods of time after heavy rains.

A.

B.

Figure 14. University of South Florida Ecological Research Area hydric hammock. A. Hydric hammock community west of Riverfront Park. B. Dome swamp.

Hydrology in the hydric hammock also differs from the surrounding floodplain communities in that the main water source primarily comes from deep groundwater seeping from the underlying limestone layer and local rainfall events (Cowardin et al. 1979; Ewel 1990; FNAI and DNR 1990). Hydroperiod in the USF Eco Area hydric hammock communities is typically less than 60 days annually, when soils are only temporarily flooded periodically during the growing season rains. The soils are the same variable organic soils of the surrounding floodplain communities but differ in that they have more sand and less peat in their composition and that the underlying limestone is closer to the soil surface. Fire frequency is rare, as in the floodplain swamp and forest, due to the vegetative structure and plant species composition of the hydric hammock communities not being conducive to fire and the saturated conditions of the surrounding floodplain communities.

Within the western portion of the larger hydric hammock plant community in the USF Eco Area, there is a very small circular dome swamp; a stillwater swamp where dissolution and collapse of the underlying limestone layer has created a small depression (Figure 14B). The dome swamp was not mapped separately because of its relatively small size. The soils in the dome swamp are acidic and very poorly drained. They are mostly composed of peat and muck over the organic sands that had slumped into the depression and are underlain by an impermeable layer of clay hardpan. Groundwater seepage, rainwater, and run-off from the surrounding hydric hammock community are the main water sources for the dome swamp. Water is retained for a longer duration in the deeper central portion than in the shallower periphery of the dome swamp. *Taxodium distichum* is the dominant tree species in the dome swamp and has a taller habit in the center of the dome, where the hydroperiod is longer, than in the outer portions. Within the dome there is very little vegetation except for *Cephalanthus occidentalis* and a few of the same floating aquatics found in the USF Eco Area blackwater streams and floodplain marsh. *Osmunda* *cinnamomea* occurs in the ecotone between the hydric hammock community and the dome swamp, whereas *Osmunda regalis* var. *spectabilis* occurs within the dome swamp.

The vegetative structure of the USF Eco Area hydric hammock plant community type includes an upper canopy with a mix of primarily broad-leaved, mostly deciduous, hardwood tree species, a sparse mid-and sub canopy of mostly young overstory trees and shrubs that can be dense in some areas and open in others within the same hydric hammock. The herbaceous groundcover is mostly a mix of many low seasonal species.

Quercus laurifolia is the dominant tree species in the upper canopy. *Sabal palmetto* occurs frequently throughout and *Quercus virginiana* occasionally occurs on the periphery adjacent to wet flatwoods. *Acer rubrum* and *Ulmus americana* are occasional throughout. *Fraxinus caroliniana*, *Gleditsia aquatica*, and *Taxodium distichum* occur more abundantly on the edges abutting the floodplain swamp whereas they are rarely found in the center.

The mid-canopy frequently contains *Ilex decidua* while *Ilex cassine* only occurs occasionally throughout the community. *Cornus foemina* and *Myrica cerifera* occur occasionally at the edges of the hammocks and are found infrequently throughout. The sub-canopy includes a mix of shrubs that include *Sabal minor*, *Sideroxylon reclinatum*, and *Viburnum obovatum*. The latter periodically forms dense thickets.

Vines include *Ampelopsis arborea*, *Berchemia scandens*, *Campsis radicans*, *Gelsemium sempervirens*, *Parthenocissus quinquefolia*, *Smilax auriculata*, *Toxicodendron radicans*, *Vitis aestivalis*, and *Vitis shuttleworthii*. There is a large patch of *Vitis shuttleworthii* in the center of the largest area of hydric hammock. *Tillandsia recurvata* and *Tillandsia usenoides* are epiphytes that occasionally occur throughout the community.

Few pteridophytes occur in the USF Eco Area hydric hammocks. *Osmunda regalis* var. *spectabilis* occurs occasionally in the ecotones between the hydric hammocks and the floodplain swamp. *Thelypteris interrupta* and *Woodwardia virginica* occur in the ecotone and the outer portions of the hydric hammocks near the floodplain swamp.

The herbaceous groundcover includes many grasses and sedges, and a few rushes. Common grasses that occur in the hydric hammocks are *Axonopus furcatus*, *Panicum hemitomon*, *Panicum rigidulim*, *Dichanthelium commutatum*, *Dichanthelium dichotomum*, and *Dichanthelium portoricense*. *Carex gigantea* is a sedge that occurs on the periphery of the hammocks. *Rhynchospora colorata*, *Rhynchospora corniculata*, and *Rhynchospora microcarpa* are other sedges that are found throughout. *Rhynchospora mixta* carpets the floor of the hydric hammock north of the floodplain forest community, north of the camping area, and is frequently found in the other hydric hammock communities in the USF Eco Area. *Juncus marginatus* is a rush that occurs on the edges and in the lower elevations of the hammocks.

The suffrutescent species *Hypericum hypericoides* commonly appears in the ecotone between the hammocks and swamp. In the hammocks, it is sparsely distributed throughout or occurs occasionally in locally common groups.

Asclepias perennis is a herbaceous perennial that is found along the edges of the hydric hammocks and the floodplain swamp in the spring. *Viola lanceolata* is abundant in the early spring on the floor of the hammocks along with an occasional distribution of *Viola sororia*. In late spring, *Sisyrinchium angustifolium* is evident and has an occasional to frequent abundance as a herbaceous groundcover. *Cardamine pensylvanica*, *Eryngium baldwinii*, *Galium tinctorium*, *Hydrocotyle verticillata*, *Hypoxis curtissii*, *Oxalis corniculata*, *Phyla nodiflora*, *Packera glabella*, and *Ptilimnium capillaceum* are some of the other low seasonal herbs that occur occasionally. *Coreopsis leavenworthii* is abundant throughout while *Cirsium nuttallii*, *Erechtites hieraciifolius*, *Erigeron quercifolius*, *Pluchea rosea*, and *Sabatia calycina* have a more occasional distribution. *Lythrum flagellare*, the Florida endangered, endemic taxon, and new record for Hillsborough

County, is found in an open area on the hammock side of the ecotone between the floodplain swamp and the largest hydric hammock.

The USF Eco Area hydric hammock plant communities are difficult to differentiate from denser floodplain forest plant communities around Riverfront Park. The vegetative structure and species composition are similar. During the present study, *Carpinus caroliniana*, *Cornus foemina*, *Gleditsia aquatica*, and *Taxodium distichum* were observed to occasionally occur throughout the floodplain forest communities whereas *Carpinus caroliniana* was rarely observed to occur in any of the hydric hammock communities in the USF Eco Area and *Cornus foemina*, *Gleditsia aquatica*, and *Taxodium distichum* were rarely observed except on the periphery of the hydric hammocks, just in from the ecotone abutting the floodplain swamp. It was also observed that there was more of a frequent distribution of *Sabal palmetto* throughout the hydric hammock communities than in the floodplain forest communities.

Despite the primarily groundwater hydrological regime of the USF Eco Area hydric hammock communities, they are affected by the anthropogenically altered hydrological regime of the USF Eco Area blackwater streams. Unnatural cycles of hydroperiod and fluctuating water levels could possibly accelerate succession of the hydric hammock plant communities into either a mesic mixed hardwood plant community or a plant community dominated by hydrophytes depending on the drawdown and flooding periodicity.

Seepage slope—The seepage slope plant community type is a wetland formed by water percolating down gentle to steep slopes. A seepage zone is created when the water gets caught in abutting terraced areas or bases of slopes that have an underlying impermeable layer of clay or hardpan (Cowardin et al. 1979; Ewel 1990; FNAI and DNR 1990; Meyers 2000). The constant seepage down slope maintains saturated conditions in the seepage zone's overlying soils of organic sands and peat most of the year except during extreme droughts. Although rarely inundated, water may pool in the deeper zones of the community forming boggy areas of meadows or open water. Seepage slope communities are characterized by a sparse upper and mid-canopy that may be periodically composed of stunted trees, a sub-canopy of mostly hydrophytic shrubs, and a dense and diverse herbaceous layer dominated by a boggy groundcover of sphagnum moss. Carnivorous and mycorrhizal plant species abound in the nutrient-poor acidic soils. Denser canopies of trees and shrubs are often prevented by a fire frequency of 5 years or less.

Covering approximately 3 ha (7 a) or 1% of the USF Eco Area, the seepage slope plant community is a catchment that runs north to south at the base of the western side of the central sandy upland ridge that dips north into the floodplain swamp (Table 6) (Figures 8, 9, 15). The southern end of the community turns west where it becomes a small more concentrated catchment juxtaposed between sloped upland plant communities on three sides. The seepage slope is bounded on the east by the sloped sandy upland communities of scrubby flatwoods, xeric hammock, and sandhill, from the north to south respectively, that grade down into mesic flatwoods with approximate slopes of 2–4% from approximate elevations of 9–12 m (30–40 ft) above msl; on the southeast, south, and south southwest by the sandhill community that grades down into mesic flatwoods with approximate slopes of 4–5% from approximate elevations of 17–18 m (55–58 ft) above msl; on the northwest by a scrubby flatwoods community that grades east into wet flatwoods with an approximate slope of 2% from an approximate elevation of 9 m (31 ft) above msl; and by a wet flatwoods ecotone into the floodplain swamp with approximate elevations of 7–8 m (25–26 ft) above msl on the west southwest, west, north at the northern end, and north where the southern end of the community turns west (Figure 8). The source of the hydrological regime is primarily the down slope seepage from the sandy upland communities being caught by the impermeable clay and hardpan in the underlying soils of the wet flatwoods ecotone. Rainfall events also contribute to the hydrology.

Figure 15. The seepage slope is one of the smallest plant communities found in the University of South Florida Ecological Research Area.

The 1938 USDA/SCS Hillsborough County Soil Survey aerial photograph shows that historically the USF Eco Area seepage slope was primarily open, with sparse upper, mid, and sub-canopies that included several depressions forming areas of boggy meadows and open water;

the largest of which occurring where the southern end of the community turns west (Figure 4). During the present study, the overall vegetative structure of the community was found to be fairly dense in the upper and mid canopies with a mix of somewhat stunted, almost dwarfed, deciduous and evergreen, broad and needle-leaved woody vegetation, the stunted, more dwarfed characteristic of the woody vegetation being most prevalent in the small, concentrated catchment at the southern end of the community; a sparse sub-canopy of mostly hydrophytic shrubs; and a dense herbaceous layer in saturated soils periodically carpeted with *Sphagnum* sp. Throughout the community, lichens and moss cover woody vegetation and low hummocks of varying sizes that have formed by built up soil, roots of trees, or the rhizomes of O*smunda regalis* var. *spectabilis*.

As the community runs north to south along the base of the western side of the central upland ridge, there are many notable, almost circular depressions of varying sizes and composition that form boggy meadows of primarily one to two concentrated herbaceous species that may be remnants of the areas of boggy meadows or open water in the above mentioned 1938 aerial. In the northeast portion of the small, more concentrated catchment at the southern end of the community there is a small, slightly kidney shaped, boggy meadow, approximately 2 m (7 ft) wide by 10 m (33 ft) long, which may be a remnant of the larger area of boggy meadow or open water noted in the 1938 aerial.

Quercus laurifolia dominates the low upper canopy throughout, whereas *Acer rubrum*, *Quercus virginiana* and *Pinus elliottii* are only found occasionally throughout. *Q. laurifolia*, *Q. virginiana*, and *P. elliottii* are often supported by the low hummocks. Stunted *Taxodium distichum* occur occasionally throughout the upper canopy in the small, concentrated catchment at the southern end of the community.

The mid-canopy, dominated by *Myrica cerifera*, includes an occasional occurrence of *Ilex cassine* and a rare occurrence of *Ilex decidua* and *Ilex opaca*. *Vaccinium arboreum* is periodically found in the mid-canopy, either supported by the low hummocks or in areas of the community abutting the mesic flatwoods.

Vaccinium corymbosum is the most dominant shrub throughout the sub-canopy. Also included in the sub-canopy are; an occasional occurrence of *Cephalanthus occidentalis*, in the small, more concentrated catchment, and occasional occurrences of *Sideroxylon reclinatum*, *Vaccinium myrsinites*, and *Viburnum obovatum* where the community runs north to south at the western base of the central upland ridge. Throughout, the low hummocks occasionally support the less hydrophytic *Serenoa repens*, especially where the community abuts the mesic flatwoods.

Occasional vines include *Ampelopsis arborea*, *Campsis radicans*, *Parthenocissus quinquefolia*, *Smilax auriculata*, and *Vitis shuttleworthii*. Epiphytes occasionally include *Tillandsia recurvata* and *Tillandsia usneoides*.

O*smunda regalis* var. *spectabilis*, *Woodwardia areolata*, and *Woodwardia virginica* are pteridophytes that occur more frequently in the small, more concentrated catchment at the southern end and occasionally throughout the rest of the community. *W. virginica* occasionally occurs in locally common groups where the community runs north to south at the western base of the central upland ridge. *Andropogon glomeratus* var. *glaucopis*, *Andropogon glomeratus* var. *pumilus*, *Andropogon virginicus* var. *glaucus*, *Axonopus furcatus*, *Carex verrucosa*, *Eleocharis vivpara*, *Juncus effusus* subsp. *solutus*, *Juncus marginatus*, *Juncus repens*, *Panicum hemitomon*, and *Rhynchospora fascicularis* are some of the grasses, sedges, and rushes that are included in the herbaceous layer.

Suffrutescent species, occasionally included throughout, are *Hypericum crux-andreae*, *Hypericum fasciculatum*, *Hypericum hypericoides*, and *Hypericum tetrapetalum*. Herbaceous species such as *Cirsium nuttalii*, the endemic *Coreopsis leavenworthii*, *Eriocaulon decangulare*, *Lachnanthes caroliana*, *Lachnocaulon anceps*, *Mitchella repens*, *Oldenlandia uniflora*, *Pluchea rosea*, *Rhexia mariana*, *Sabatia grandifolia*. *Syngonanthus flavidulus*, *Viola lanceolata*, *Xyris* *elliottii*, and *Xyris caroliniana* are found throughout the community. The seepage slope community is one of the few areas in which the terrestrial orchid, *Calopogon tuberosus*, occurs; primarily in the small, more concentrated catchment at the southern end. *Drosera capillaris* and *Utricularia subulata* are two carnivorous plants that frequently occur throughout the herbaceous groundcover.

The many open, often circular, boggy depressions of varying sizes, occurring in the portion of the community running north to south along the western base of the central upland ridge, include varying mixtures of one to two concentrated combinations of herbaceous species. Some examples of the varying combinations include a dominance or co-dominance of either *Andropogon glomeratus* var. *glaucopis, Eriocaulon decangulare*, *Lachnanthes caroliana*, *Syngonanthus flavidulus*, or *Xyris elliottii* that may or may not include a scattering of the above mentioned dominant/co-dominant species along with a scattering of *Drosera capillaris, Panicum hemitomon*, *Rhexia mariana*, *Sabatia grandifolia*; patches of *Woodwardia virginica* with a scattering of *Rhynchospora fascicularis*; or just monotypic mats of *Axonopus furcatus*, *Eleocharis vivpara, Juncus repens* or one of the above mentioned dominant/co-dominant species. *Eriocaulon decangulare* and *Lachnanthes caroliana* both dominate the small, kidney shaped, boggy meadow in the northeast portion of the small, more concentrated catchment at the southern end; the former is common in the western portion of the meadow and the latter is more frequent in the central and eastern portion.

The fragile ecosystem of the seepage slope community is extremely susceptible to disturbances and threats that may in turn have the potential to irreversibly alter the community (Ewel 1990; FNAI and DNR 1990; Meyers 2000). The saturated condition of the soils makes the vegetative structure and plant species composition particularly vulnerable to trampling. Unnatural cycles of drawdowns and flood events caused by the anthropogenically altered hydroperiod of the USF Eco Area blackwater streams may pose a threat to the hydrology of the community as a result of its close proximity to the floodplain swamp. The hydrology and the continuum of the USF Eco Area seepage slope, as a whole, has also been potentially altered by an old, raised dirt road that cuts off the small, more concentrated catchment at the southern end from the rest of the community. Lack of fire is also a threat, as mentioned above. A carefully prescribed fire regime may help reduce the growing density of the upper canopy as well as potentially promote more diversity in the shrub and herbaceous species composition that is characteristic of seepage slope communities.

Wet Flatwoods—The wet flatwoods plant community type covers approximately 22 ha (54 a) or 7% of the USF Eco Area and is an integral part of the fire-dependent, open-canopied, pine flatwoods matrix that includes the mesic and scrubby flatwoods community types (Table 6) (Figures 8, 9, 16). The ecotone between the palustrine and terrestrial communities is primarily made up of the wet flatwoods community type (Figures 8, 16A). Scattered patches of the community are also found imbedded within the mesic and scrubby flatwoods communities throughout (Figures 8, 16B). Because of their relatively small sizes, the imbedded patches were not mapped separately.

Differences in the hydrology, vegetative structure, and species composition between the three pine flatwoods community types are strongly influenced by subtle changes in topography and edaphic conditions (Abrahamson and Hartnett 1990; Doolittle et al. 1989; FNAI and DNR 1990; Meyers 2000). The wet flatwoods community occurs in the lower lying elevations and shallow depressions of the pine flatwoods matrix where the soils are very poorly drained. The nutrient poor, acidic sandy soils, primarily Malabar fine sand, are underlain by an impermeable layer of clay or hardpan. Percolation of water is considerably reduced up or down through the hardpan layer. In order to withstand the complex edaphic conditions of the community, vegetation is hydrophytic at the same time xerophytic; adapted to survive the stresses of seasonal inundation for one to a few months per year during the rainy season and dehydration during the dry season when roots are unable to penetrate the hardpan layer to reach the lowered water table. Vegetation is mostly pyrophytic as well; adapted to and dependent on a periodic fire frequency of 3–10 years.

The vegetative structure of wet flatwoods is typically an open upper canopy of pine trees; an insignificant mid-canopy, an open to dense sub-canopy of shrubs, and an open to dense herbaceous layer of grasses, sedges, rushes, and forbs. Variation in the densities of the vegetative structural layers as well as the species composition and diversity generally reflect fire frequency and disturbance history (Abrahamson and Hartnett 1990; Doolittle et al. 1989; FNAI and DNR 1990; Meyers 2000).

In the USF Eco Area, the vegetative structure is variable in the wet flatwoods community that makes up the ecotone between the wetland and upland communities. It ranges from being consistent with the typical vegetative structure of the community type to being more closed in the upper and mid-canopies with a higher percentage of hardwood tree species. Most of the ecotone around Buck Island, east of the patch of scrubby flatwoods northwest of the central upland ridge, and along the western side of the seepage slope community at the base of the central upland ridge are especially dense and, during the present study, were observed to be nearing succession into more of a hardwood community (Figure 8). The sub-canopy and herbaceous layer in the sections of ecotone with more closed upper canopies are generally sparse with few shrubs and herbaceous species amongst patches of moss and sand whereas the sub-canopy and herbaceous layer densities are variable in sections with more open upper canopies. The upper, mid, and sub-canopies of the vegetative structure in the patches of wet flatwoods, found in the lower lying elevations and shallow depressions within the mesic and scrubby flatwoods, are mostly open with a sparse herbaceous layer amongst open patches of sand.

A.

B.

Figure 16. Wet flatwoods in the University of South Florida Ecological Research Area. A. Wet flatwoods ecotone northeast of east gate. B. Imbedded patch of the community within the scrubby flatwoods. (Photographs courtesy of Jack Stites).

Pinus elliottii is the most dominant pine species in the upper canopy of the wet flatwoods community type. *Sabal palmetto* occurs in the upper canopy throughout. *Acer rubrum*, *Quercus laurifolia*, and *Taxodium distichum* appear in the upper canopy in the wetland edges of the ecotone and occasionally throughout. *Pinus palustris*, *Quercus geminata*, and *Quercus virginiana* are included in the upper canopies in the upland edges of the ecotone and the edges of the imbedded patches of wet flatwoods within the mesic and scrubby flatwoods.

Myrica cerifera occurs at the edges of and occasionally throughout the mid-story of the ecotone. *Vaccinium arboreum* occurs in the mid-story on the upland side of the ecotone. It is also found on the periphery of the imbedded patches of the community within the mesic and scrubby flatwoods, along with an occasional occurrence of *M. cerifera*. *Diospyrus virginiana* is occasionally found in the mid-story of the ecotone surrounding Buck Island.

The sub-canopy on the wetland side of the ecotone includes *Sideroxylon reclinatum*, *Viburnum obovatum* and, in a few places, *Vaccinium corymbosum*. *Lyonia ferruginea*, *Lyonia fruticosa*, *Serenoa repens*, and *Vaccinium myrsinites* are frequently found in the upland edges of the ecotone and on the periphery of the community type within the mesic and scrubby flatwoods. *Ilex glabra* is occasionally locally common in some areas of wet flatwoods, notably along the southern road through the camping area.

Campsis radicans, *Gelsemium sempervirens*, *Toxicodendron radicans Vitis rotundifolia*, and *Vitis shuttleworthii* are vines that only occur where the upper canopies of the ecotone are more closed. *Tillandsia setacea* and *Tillandsia simulata* are epiphytes found in the denser upper canopies whereas *Tillandsia recurvata* and *Tillandsia usneoides* occur occasionally throughout.

Grasses, sedges and rushes found throughout the herbaceous layer include *Andropogon glomeratus var. glaucopis*, *Andropogon virginicus* var. *glaucus*, *Bulbostylis ciliatifolia, Fimbristylis caroliniana, Juncus marginatus*, *Juncus scirpoides*, *Panicum hemitomon, Panicum virgatum*, *Rhynchospora fascicularis*, *Rhynchospora globularis*, and *Rhynchospora pusilla*.

Dichanthelium ensifolium var. *unciphylum*, *Dichanthelium leucothrix*, *Dichanthelium strigosum* var. *glabrescens*, and *Eustachys glauca* are generally found in the ecotone, especially in the denser canopied areas. There is an extensive patch of *Stenotaphrum secundatum* that has taken over most of the wet flatwoods ecotone west of the seepage slope community that runs north to south along the western base of the central upland ridge.

Hypericum gentianoides is a suffrutescent plant species that is most often found in the open wet flatwoods depressions and low lying areas within the pine flatwoods matrix. Other suffrutescent species include *Hypericum hypericoides,* found on the wetland edges of the ecotone and occasionally within, and *Hypericum tetrapetalum* which occurs occasionally throughout the community type.

Forbs that occur throughout the wet flatwoods community type include *Lachnocaulon anceps*, *Polygala lutea*, *Polypremum procumbens*, *Pterocaulon pycnostachyum*, *Xyris caroliniana*, *Xyris elliottii*, and *Xyris jupicai*. Carnivorous plants that also occur throughout include *Drosera capillaries*, *Pinguicula pumila*, and *Utricularia subulata*.

Forbs occasionally found in the herbaceous layer of the ecotone include *Agalinis fasciculata*, *Aslcepias longifolia*, *Cirsium nuttallii*, *Coreopsis leavenworthii*, *Eupatorium leptophyllum*, *Helenium flexuosum*, *Hypoxis curtissii*, *Hypoxis wrightii*, *Lacnanthes caroliana*, *Linum medium*, *Lobelia glandulosa*, *Ludwigia suffruticosa*, *Packera glabella*, *Phyla nodiflora*, *Pluchea rosea*, *Polygala cruciata*, *Rhexia mariana*, *Sabatia grandiflora*, *Syngonanthus flavidulus*, *Teucrium canadense*, *Trichostema dichotomum*, and *Viola lanceolata*. *Dichondra caroliniensis*, *Erechtites hieraciifolius*, *Oldenlandia uniflora*, and *Veronica peregrina* occur in denser canopied sections of the ecotone. *Polygala rugelii*, a Florida endemic, is abundant in the southeast section of the ecotone north of the east gate. The section of the ecotone that runs along the eastern edge of the central upland ridge is one of the few places the terrestrial orchid, *Calopogon tuberosus*, is found.

Open patches of wet flatwoods, found within the mesic and scrubby flatwoods communities, include *Polygala nana* and *Sabatia brevifolia*.

The wet flatwoods community is easily compromised by anthropogenic perturbations (Abrahamson and Hartnett 1990; FNAI and DNR 1990). During the present study, an old, raised dirt road was found running through the wet flatwoods ecotone along the floodplain swamp edge, west of the seepage slope community at the base of the central upland ridge (Figure 8). The ecotone in the above area is littered with large pieces of concrete and pavement which may, possibly, have been the source of the extensive patch of *Stenotaphrum secundatum* mentioned above. As with the other palustrine communities that abut the floodplain swamp, the wet flatwoods community in the ecotone is particularly vulnerable to the unnatural cycles of drawdowns and flood events caused by the anthropogenically altered hydroperiod of the blackwater streams.

Despite occurring in the lower elevations of the fire-dependent pine flatwoods matrix, the wet flatwoods community is a pyrogenic plant community that requires periodic fire to maintain the integrity of its fire dependent ecosystem (Abrahamson and Hartnett 1990; FNAI and DNR 1990; Meyers 2000). During the present study, lack of the necessary fire frequency was observed to be evident in the densities of the upper canopies in the vegetative structure of the community in most of the ecotone and in the crowding out of the community type within the mesic and scrubby flatwoods.

Terrestrial Communities

The terrestrial communities, comprised of the mesic flatwoods, scrubby flatwoods, sandhill, and xeric hammock community types, occur in the upland areas of the USF Eco Area. Topography, soil composition, and fire frequency are among the key factors that differentiate the four community types. Mesic flatwoods, occurring on relatively flat terrain, and scrubby flatwoods, on slightly higher elevations, are intermixed within the pine flatwoods matrix that includes the wet flatwoods community type. Terrain with more relief, in the higher elevations of the USF Eco Area, is comprised of the sandhill and xeric hammock communities. The xeric hammock is typically a climax community composed of relict sandhill or sand pine scrub vegetation, depending on the origin of the community.

Mesic Flatwoods—The mesic flatwoods community type, covering approximately 23 ha (57 a) or 8% of the USF Eco Area, occurs on broad, nearly level terrain that gradually slopes down into the wet flatwoods ecotone from the rest of the upland plant communities (Table 6) (Figures 8, 9. 17A). It is the most extensive ecosystem found in Florida and is the primary flatwoods community type within the fire-dependant, open-canopied, pine flatwoods matrix that characteristically includes a mosaic of small imbedded islands of wet flatwoods in lower lying elevations and depressions; dome swamps and sinkholes where dissolution of the underlying limestone has occurred; and scrubby flatwoods on elevated rises within the community (Abrahamson and Hartnett 1990; FNAI and DNR 1990; Meyers 2000). The imbedded islands of wet flatwoods, sinkholes, and dome swamps were not mapped separately because of their relatively small sizes. The wet flatwoods community that primarily makes up the ecotone between the palustrine and terrestrial communities, and the scrubby flatwoods community type were large enough to warrant mapping.

Slight variations in topography and edaphic conditions play an influential role in the complex mosaic of differences in the hydrology, vegetative structure, and species composition between the three flatwoods communities, dome swamps, and sinkholes within the pine flatwoods matrix (Abrahamson and Hartnett 1990; Doolittle et al. 1989; FNAI and DNR 1990; Meyers 2000). The mesic flatwoods community occurs on relatively flat terrain where the soils are moderately drained. The soils are composed of nutrient poor, acidic sands, primarily Myakka fine sand, that

A.

B.

Figure 17. University of South Florida Ecological Research Area mesic flatwoods. A. More open canopied section of the mesic Flatwoods. B. The small sinkhole at the northern end of the community. (Photographs courtesy of Jack Stites).

include a lower percentage of clay in the soil horizons and an insignificant underlying layer of impermeable hardpan and clay as compared to the wet flatwoods community type. Although the community is rarely inundated, it can become periodically saturated during the rainy season. The characteristically open canopies and sandy soils produce generally droughty conditions during the dry season. Most of the species composition within the community is pyrophytic, adapted to and highly dependant on a fire frequency of every 2–3 years.

The vegetative structure of the mesic flatwoods community type is typically open as it stretches across vast tracts of flat terrain. It includes an open upper canopy of widely spaced pine trees; a sparse mid-canopy with a few widely scattered cabbage palms; a variable sub-canopy, composed of saw palmetto and primarily ericaceous shrub species, that can range from being very open, low, and diverse to dense with extensive monotypic stands of saw palmetto; and a variable herbaceous layer composed of grasses and forbs that can range from being sparse and open to densely carpeted. The varying densities of the vegetative structural layers as well as the species composition and diversity are dictated by fire frequency and disturbance history (Abrahamson and Hartnett 1990; Doolittle 1989; FNAI and DNR 1990; Meyers 2000).

Two small notable sinkholes punctuate the mesic flatwoods community in the USF Eco Area. A very small, circular sinkhole with steeply sloped sides occurs in the northern section of the community (Figure 17B) and a slightly larger sinkhole, more oval in shape with moderately sloped sides, occurs on the south side of the southern dirt road through the camping area. Sinkholes are typically cylindrical and conical depressions in the ground that have been formed by the dissolution and collapse of the underlying limestone layer (Abrahamson and Hartnett 1990; Doolittle 1989; FNAI and DNR 1990; Meyers 2000). The soils covering the bottom and sides of the USF Eco Area sinkholes are essentially the same acidic sands found in the surrounding mesic flatwoods. Although inundated with water for only short periods after extended heavy rain events, the sinkholes can remain saturated throughout the rainy season.

Rainwater and run-off from the surrounding community are the main water sources. The water table, when it is higher during the rainy season, may also contribute to the hydrology of the sinkholes where the accumulated sands and debris have not completely occluded the connection to the groundwater. The vegetative structure of the USF Eco Area sinkholes is primarily a herbaceous layer that is mostly composed of wet flatwoods vegetation such as *Bulbostylis ciliatifolia*, *Drosera capillaris*, *Eleocharis vivipera*, *Lachnocaulon anceps*, and *Utricularia subulata*. One *Cephalanthus occidentalis* makes up the sub-canopy in the small, circular sinkhole in the northern section.

There are two dome swamps imbedded within the USF Eco Area mesic flatwoods community (see the hydric hammock community type section for dome swamp characteristics). A very small and shallow dome swamp, that includes a few *Taxodium distichum* and very little else, occurs on the north side of the southern road through the camping area. A larger dome swamp, that includes *Taxodium distichum*, *Osmunda regalis* var. *spectailis*, and *Saururus cernuus* as well as occasionally *Celtis laevigata*, *Sambucus nigra*, and *Habenaria floribunda* on the periphery, occurs east of the east gate on the south side of the main east-west dirt road through the USF Eco Area. The larger dome swamp is the only place in the USF Eco Area where *Lygodium japonicum* and *Melaleuca quinquenervia* are found, two FLEPPC Category 1 invasive exotic plant species.

The mesic flatwoods community in the USF Eco Area has a variable vegetative structure throughout that is generally more closed in the upper and mid-canopies than the typical vegetative structure of the community type, except for the north central and northeast sections and along the west side of the central upland ridge sections where it is more open. In the denser areas, the vegetative structure includes an upper canopy of a few scattered *Pinus spp*. with a dominance of *Quercus spp*.; a mid-canopy primarily composed of *Myrica cerifera*; a fairly dense sub-canopy of primarily tall *Lyonia spp*.; and a sparse herbaceous layer of primarily forbs with few grass species in small, open patches of sand amongst a scattering of *Cladonia spp*. and moss. The north central and northeast sections of the mesic flatwoods are more open and savanna-like with very widely spaced *Pinus palustris*, *Pinus elliiottii*, and *Sabal palmetto* in the upper and mid-canopies; a dense, monotypic sub-canopy of *Serenoa repens*; and a very thin herbaceous layer of forbs in the few small openings within the dense stand of *S. repens*. The more open section of the community along the west side of the central upland ridge is variable and diverse in species composition in the sub-canopy and herbaceous layer.

The upper canopy of the mesic flatwoods includes *Pinus elliottii*, *Pinus palustris*, *Quercus geminata*, *Quercus virginiana*, and *Sabal palmetto*. *Pinus taeda* is only found in the upper canopy in the section of mesic flatwoods just north of the southwestern section of sandhill community and west of where the seepage slope turns west at the southern end of the community (Figure 8). There are several infrequent occurrences of *Ilex opaca* in the mid-canopy of the community. A fairly large *I. opaca* occurs just east of the small sinkhole in the northern section of the community. *Myrica cerifera* and *Vaccinium arboreum* frequently occur throughout the mid-canopy while *Rhus copallinum* is only found occasionally throughout. The mid-canopy in the mid-southeast section of the community, just north and east of the east gate, includes a small population of *Chionanthus virginicus*.

Serenoa repens frequently occurs throughout the sub-canopy while *Callicarpa americana*, *Gaylussacia dumosa*, *Vaccinium darrowii*, and *Vaccinium myrsinites* occur only occasionally throughout. *Lyonia ferruginia*, *Lyonia fruticosa*, and *Vaccinium stamineum* are more frequent in the denser sections of the community. *Ilex glabra* is more often found in the southern section of the campground. Interestingly, *Lyonia lucida*, typically found in the sub-canopy of the mesic flatwoods community type, rarely occurs in the USF Eco Area.

Vines such as *Campsis radicans*, *Gelsemium sempervirens*, *Parthenocissus quincuefolia* *Smilax auriculata*, and *Vitis rotundifolia* occur in the denser canopied mesic flatwoods sections.

Epiphytes include *Tillandsia recurvata*, *Tillandsia simulata*, *Tillandsia usenoides*, and *Tillandsia* x*floridana*.

The pteridophyte, *Pteridium aquilinum*, occurs occasionally throughout the community. Grasses include *Andropogon gyrans, Aristida pupurascens, Dichanthelium leucothrix,* and *Dichanthelium portoricense*.

Suffrutescent species include *Asimina reticulata*, a Florida endemic, and *Lechea minor*, a new record for Hillsborough County. *Balduina angustifolia*, *Chamaecrista fasciculata, Dalea pinnata*, *Euthamia caroliniana*, *Galactia volubilis, Gratiola hispida*, *Helianthemum corymbosum*, *Hypericum tetrapetalum, Piloblephis rigida, Piriqueta cistoides, Pityopsis graminifolia*, *Polygonella polygama*, *Pterocaulon pynchostachyum*, *Sericocarpus tortifolius, Stipulicida setacea* var. *lacerata,* and *Symphyotrichum dumosum* are among the forbs that are scattered throughout the herbaceous layer of the mesic flatwoods.

During the present study, absence of the necessary fire frequency, essential for maintaining the fire-adapted and fire-dependant ecosystem of the mesic flatwoods, was observed in the closed, hardwood dominated upper canopies; the density of the extensive *Serenoa repens* stands in the north central and northeastern sections; and the sparse herbaceous layer throughout that revealed a paucity of grasses and low forb diversity. The difference between the closed canopied sections, where fire has not been through the area for over 20 years, and the more open canopied section of the community, where a fire had gone through the area within the last 10-15 years, illustrates the importance of periodic fire in restricting the invasion of hardwood tree species in the upper canopies of the community.

Close proximity to Fletcher Avenue may be one of the contributing factors that might explain the concentration of FLEPPC Category I invasive exotic plant species in the larger dome swamp in the section of mesic flatwoods east of the east gate, on the south side of the main east-west dirt road through the USF Eco Area. If not checked, there is potential for the invasive species to spread into the rest of the USF Eco Area which, fortunately, has not occurred as of yet.

Scrubby Flatwoods—The scrubby flatwoods community type, covering approximately 4 ha (10 a) or 1% of the USF Eco Area, occurs in three separate areas on the slightly higher elevations within the open canopied, fire-dependent, pine flatwoods matrix that includes the wet and mesic flatwoods community types (Table 6) (Figures 8, 9, 18). The largest area, covering

Figure 18. Scrubby flatwoods in the University of South Florida Ecological Research Area.

approximately 2 ha (4 a), occurs northwest of the central upland ridge that dips north into the floodplain swamp, where it has an approximate slope of 2–3% that grades down into wet and mesic flatwoods from an approximate elevation of 10 m (31 ft) above msl (Figure 8). An area of scrubby flatwoods, covering 1 ha (3 a), occurs at the northern end of the central upland ridge where it grades down into mesic flatwoods with an approximate slope of 2–3% from an approximate elevation of 11 m (37 ft) above msl and abuts xeric hammock to the south (Figure 8). In the southeastern portion, west of Riverfront Park, another area of the community, covering 1 ha (3 a), grades down into mesic flatwoods and a small area of floodplain forest to the east with an approximate slope of 3–4% from an approximate elevation of 11 m (35 ft) above msl (Figure 8).

As mentioned previously, the differences in hydrology, vegetative structure, and species composition between the wet, mesic, and scrubby flatwoods community types are strongly influenced by subtle changes in topography and edaphic conditions (Abrahamson and Hartnett 1990; Doolittle et al. 1989; FNAI and DNR 1990; Meyers 2000). The scrubby flatwoods community is found on the rises and ridges in the higher elevations of the pine flatwoods matrix where the soils are moderately to very well drained. Soils are mostly composed of, nutrient poor, deep acidic sands, primarily Pomello fine sand, that have a minimal percentage of clay in the soil horizons and a very insignificant, if any, underlying impermeable layer of hardpan or clay as compared to the wet and mesic flatwoods communities. Although the water table is not much lower than that of the wet and mesic flatwoods, the pomello sands in the scrubby flatwoods never become inundated, even during extended heavy rains. Felda fine sand, not as well drained as Pomello fine sand, occurs in the slightly less sloped terrain of the scrubby flatwoods northwest of the central upland ridge. It is also composed of nutrient poor, acidic sands but includes a higher percentage of clay in the soil horizons with a fairly significant underlying impermeable layer of hardpan or clay. The area with Felda fine sand may become periodically saturated during the rainy season but is rarely inundated except in lower lying areas where it may become inundated for only short periods after heavy rain events. Scrubby flatwoods, with both soil types, can become extremely droughty during the dry season.

In the map of the USF Eco Area that includes the 1989 USDA/SCS Soil Survey of Hillsborough County, only the scrubby flatwoods in the southeastern portion, west of Riverfront Park, was mapped as Pomello fine sand whereas the scrubby flatwoods northwest of the central upland ridge and the section of scrubby flatwoods at the northern end of the central upland ridge were mapped as Felda fine sand and Myyaka fine sand, respectively (Figures 6, 8). During the present study, the topography, edaphic characteristics, vegetative structure, and species composition in the more sloped terrain of the community northwest of the central upland ridge and the entire section of the community at the northern end of the central upland ridge were observed to be remarkably similar in all respects to the southeastern portion mapped by the USDA/SCS in 1989 as Pomello fine sand (Figures 6, 8). Based on the stated qualitative observations, it was conjectured that the two areas of scrubby flatwoods, noted above, are composed of Pomello fine sand. Site specific confirmation of the soil type, done on a larger scale than used by the USDA/SCS in 1989, is recommended as soil sampling is out of the scope of the present study.

The scrubby flatwoods community type includes much species overlap, as it generally makes up the ecotone that grades from mesic flatwoods into the more upland communities of sandhill and scrub (Abrahamson and Hartnett 1990; FNAI and DNR 1990; Meyers 2000). The vegetative structure of scrubby flatwoods typically includes an upper canopy that can be either open with widely scattered pines and cabbage palms or dense with primarily xerophytic oak tree species; a moderate to dense mid and sub-canopy of low, shrubby, xerophytic trees and shrubs; and a sparse herbaceous layer with open patches of sand. Despite being an integral part of the pyrogenic pine flatwoods matrix, the vegetative structure and species composition is not as conducive to frequent fire as those of the wet and mesic flatwoods communities. Fire may occur every decade or so when the weather has been extremely dry for an extended period and enough leaf litter has accumulated to carry fire through the community.

In the USF Eco Area, the vegetative structure of the scrubby flatwoods community is mostly on the denser side of the typical vegetative structure. The denser upper, mid, and sub-canopies include a sparse herbaceous layer composed of grasses, sedges, and very few forbs amongst scattered lichens (*Cladonia spp*.) and mosses in patches of sand. The higher elevations of the scrubby flatwoods northwest of the central upland ridge, the western portion of the community at the northern end of the central upland ridge, and the entire southeastern section of the community are especially dense with a monotypic upper canopy of *Quercus geminata* and a densely compacted sub-canopy of tall *Lyonia ferruginea* and *Serenoa repens*. The slightly less sloped areas, to the south and southeast, in the section of the community northwest of the central upland ridge as well as the eastern portion of the community at the northern end of the central upland ridge include a more open and diverse vegetative structure with a few widely spaced *Pinus spp.*, *Quercus spp.*, and *Sabal palmetto* in the upper canopy; a sparse mid-canopy of widely scattered *Vaccinium arboreum*; a fairly dense sub-canopy of *S. repens* with a few widely scattered *L. ferruginea*; and a moderately sparse herbaceous layer of primarily forbs, mosses, and *Cladonia spp*. in the few sandy openings within the stand of *S. repens*.

The upper canopy of the USF Eco Area scrubby flatwoods includes *Pinus elliottii*, *Pinus palustris*, *Quercus geminata*, *Quercus virginiana*, *Quercus laurifolia*, and *Sabal palmetto*. *P. elliottii* and *Q. laurifolia* generally occur in the slightly less sloped areas of the community. In the mid-canopy, *Vaccinium arboreum* is frequently found where the upper canopy is not as dense. *Myrica cerifera*, *Rhus copallinum*, and the low, shrubby, xerophytic tree species *Quercus chapmanii* and *Quercus myrtifolia* occur occasionally throughout the mid-canopy. *Serenoa repens* and tall *Lyonia ferruginea* are ubiquitous throughout the sub-canopy of the community, especially in the more closed upper canopies dominated by *Q. geminata*. The sub-canopy also occasionally includes *Asimina reticulata*, *Bejaria racemosa*, *Gaylussacia dumosa*, *Lyonia fruticosa*, *Vaccinium darrowii*, *Vaccinium myrsinites*, and *Vaccinium stamineum*. Interestingly, *B. racemosa*, typically an occasional component in pine flatwoods, only occurs in the USF Eco Area in a small but robust patch in the western portion of the community at the northern end of the central upland ridge

Gelsemium sempervirens and *Smilax auriculata* are vines that occasionally occur in the community. *Pleopeltis polypodioides* var. *michauxiana*, *Tillandsia recurvata*, *Tillandsia simulata*, *Tillandsia usenoides*, and *Tillandsia* x*floridana* are epiphytes that occasionally occur throughout as well.

The pteridophyte, *Pteridium aquilinum*, has a variable distribution throughout. *Andropogon gyrans* and *Aristida pupurascens* are among the few grasses that occur in the USF Eco Area scrubby flatwoods.

Suffrutescent species include *Lechea minor* and *Seymeria pectinata*. *L. minor* is generally found in open patches of sand and is a new record for Hillsborough County. *Euthamia caroliniana*, *Gratiola hispida*, *Piloblephis rigida*, *Polygala nana*, *Pterocaulon pycnostachyum*, *Sericocarpus tortifolius*, and *Stipulicida setacea* var. *lacerata* are the more dominant forbs found in the herbaceous layer throughout the USF Eco Area scrubby flatwoods.

Fire is long overdue in the denser areas of the scrubby flatwoods community in the USF Eco Area, where the diversity of species composition has succumbed to a densely monotypic upper canopy of *Q. geminata* and a dense sub-canopy of *L. ferruginea* and *S. repens*. Otherwise, little disturbance was found in the community during the present study.

Sandhill—The sandhill community type was described by S.W. Greene in 1931 as “The Forest that Fire Made” and “The Forest that Fire Protects” (Greene 1931). It is an open-canopied, xeric, highly pyrogenic pineland, dominated by longleaf pines, that occurs on deep, marine deposited

Figure 19. University of South Florida Ecological Research Area sandhill plant community. (Photograph courtesy of Kai Rains).

sands of very dry, sandy ridges, ridge tops, and rolling hills that were once Plio-Pleistocene beach ridges, sand dunes, and bars (Doolittle et al. 1989; FNAI and DNR 1990; Meyers 1990, 2000). In the past, it had been a prevalent natural community type throughout most of Florida, but has now been reduced to the point where it is globally and Florida State listed as threatened and endangered (FNAI/Abbey 2004). Although relatively small, the sandhill community in the USF Eco Area is one of the few remaining tracts left in Florida.

Covering approximately 13 ha (31 a) or 4% of the USF Eco Area, it is found on the undulating, hillier terrain at the highest elevations in the south central portion where it primarily grades down into mesic flatwoods to the north with approximate slopes of 4–5% from elevations of approximately 12–18 (40–58 ft) above msl, except at the northern tip, where it grades into xeric hammock (Table 6) (Figures 8, 9, 19). The sandhill community in the USF Eco Area is managed by controlled burning, a vital land management tool for the maintenance and preservation of the disappearing community type. For research and educational purposes, several experimental burn plots have been delineated to monitor and study the ecological responses and consequences of differing fire frequencies in the fire prone ecosystem (Figure 20) (Appendix B).

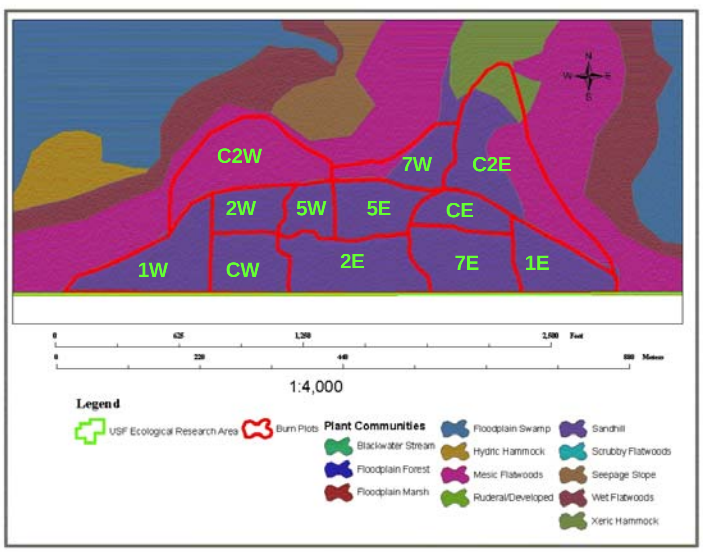


Figure 20. Experimental burn plots in the University of South Florida Ecological Research Area. Numbers refer to scheduled prescribed burn rotation: every 1 year, 2 years, 5 years, and 7 years. C – Control (unburned); E – East; W – West.

The vegetative structure of the sandhill community type is primarily composed of deep-rooted, xerophytic, and pyrogenic vegetation. It typically includes a high, open upper canopy of scattered longleaf pines; a minimal mid and sub-canopy of deciduous oak species, predominately turkey oak; and a herbaceous layer dominated by grasses with wiry morphology interspersed with an abundance of scattered forbs, primarily composed of aster and legume species. Fire frequency and intensity play an influential role in the densities of the vegetative structural layers as well as the species composition and diversity (Doolittle et al. 1989; FNAI and DNR 1990; Meyers 1990, 2000).

Soils in the sandhill are excessively well drained and are composed of very deep, infertile, gray to yellowish, loose sands, primarily Candler fine sand in the USF Eco Area, with little to no horizon development (Doolittle et al. 1989; FNAI and DNR 1990; Meyers 1990, 2000). The rapid permeability and low available water capacity of the porous sands results in minimal run-off and evaporation, making the community a prime aquifer recharge area. The same characteristics also lead to the rapid leaching of plant nutrients. Nutrients are periodically replaced by the frequent fires and burrowing fauna associated with the community. The open canopy, deep sandy soils, along with a seasonal high water table depth of more than approximately 2 m (7 ft), produce droughty conditions throughout the year, particularly in the dry season.

Fire is a natural and extremely important ecological force that has shaped the ecosystem of the sandhill community type. The sandhill is characterized as a fire climax community where low intensity ground fires, with frequencies of every 1–10 years, particularly every 2–5 years, are essential for maintaining the highly fire-adapted and fire-dependent ecosystem (Doolittle et al. 1989; FNAI and DNR 1990; Meyers 1990, 2000). Many of the species associated with the fire prone community require fire for their continual survival and perpetuation. They have evolved adaptations that not only enable them to withstand frequent fires but to also facilitate the movement of fire throughout the community. Without fire, the community eventually becomes a hardwood dominated, xeric hammock from the invasion of non-pyrogenic, hardwood species that close the upper canopies thereby compromise the regeneration of the longleaf pines and sandhill grasses as well as the other open-canopied dependent, pyrogenic species associated with the community.

As mentioned earlier, the sandhill community in the USF Eco Area has been broken up into experimental burn plots that include two plots for each fire frequency regime of every one, two, five, and seven years and four unburned control plots (Figure 20) (Appendix B). The average size of each plot is approximately 1–2 ha (3–4 a). With some exceptions, the two plots with the same fire frequency, as well as the four unburned control plots, do not abut each other.

The different regimes of fire frequency in each of the experimental burn plots and the unburned control plots have produced a variable vegetative structure throughout the community in the USF Eco Area. In the areas with higher fire frequencies, the vegetative structure includes a fairly open upper canopy, primarily composed of widely spaced *Pinus palustris*; sparse mid and sub-canopies composed of a few scattered deciduous *Quercus* tree species and ericaceous shrubs; and a fairly dense herbaceous groundcover. As the fire frequency is reduced per experimental burn plot, the vegetative structure in the upper, mid, and sub-canopies becomes denser with an ever increasing dominance of the non-pyrogenic, persistent leaved *Quercus geminata* and an increasing abundance of *Quercus laevis* and *Quercus incana* as well as other variable tree and shrub species. The increasingly denser canopies, in turn, include an increasingly sparse and less diverse herbaceous groundcover.

Pinus palustris is the dominant upper canopy tree species in the more frequently burned areas. *Quercus geminata* increasingly becomes codominate with the *P. palustris* in the upper canopy as fire frequencies decrease where it occurs as scattered large individuals and/or in clonal clumps of ramets that periodically form dense oak domes. *Pinus elliottii* infrequently occurs in the upper canopy in the lower elevations of the sandhill, abutting the mesic flatwoods. *Sabal palmetto* occurs occasionally throughout.

The predominant and ubiquitous deciduous oak species throughout the mid-canopy of the community is *Quercus laevis* which is sparsely scattered throughout the frequently burned areas and abundant in the areas less frequently burned. *Quercus incana*, a deciduous to semi-deciduous oak species, is sparsely scattered throughout the burned areas but increasingly becomes a codominant with *Q. laevis* in areas with less fire frequency.

The mid-canopy includes an occasional occurrence of *Quercus chapmanii* and *Quercus myrtifolia* in the less frequently burned areas. *Diospyrus virginiana* and *Vaccinium arboretum* occur only occasionally in areas with higher fire frequencies but become increasingly more abundant as fire frequencies decrease. *Crataegus michauxii*, *Prunus umbellata*, *Rhus copallinum*, *Sideroxylon tenax* are other mid-canopy species that occasionally occur throughout the less often burned and unburned areas. *Prunus serotina* occasionally occurs in the unburned areas throughout and *Zanthoxylum clava-herculis* occurs in the unburned areas near the chain link fence on the south side of sandhill that runs along Fletcher Avenue.

Vaccinium darrowii, *Vaccinium myrsinites*, and *Vaccinium stamineum* become more abundant throughout the sub-canopy as the fire frequency drops. *Asimina pygmea*, *Asimina reticulata*, *Licania michauxii*, *Serenoa repens*, *Yucca filamentosa* occur occasionally throughout the sub-canopy of the community.

Very few vines and epiphytes occur in the sandhill. Vines that include *Smilax auriculata* and *Vitis aestivalis* are most often found in the denser canopied, unburned areas. *Tillandsia recurvata* and *Tillandsia usenoides* are among the few epiphytes that occur occasionally throughout, more often in the less frequently burned and unburned areas. The pteridophyte, *Pteridium aquilinum*, is only occasionally found on the edges of unburned areas abutting the mesic flatwoods.

Aristida stricta var. *beyrichiana* and *Sporobolus junceus* are grasses with wiry morphology that dominate the herbaceous groundcover in the sandhill. Strikingly colorful grasses such as *Eragrostis elliottii* and *Sorghastrum secundum* are abundant in the more frequently burned areas. Other grasses, occasionally occurring throughout, include *Anthaenantia villosa*, *Andropogon ternarius, Andropogon tracyi*, *Aristida purpurascens, Cenchrus gracillimus, Dichanthelium ovale*, *Dichanthelium portoricense*, *Eustachys neglecta*, *Eustachys petraea*, *Panicum anceps, Paspalum setaceum*, *Setaria parviflora*, and *Triplasis americana*. Sedges that are also occasionally found throughout the community include *Bulbostylis ciliatifolia*, *Bulbostylis stenophylla, Bulbostylis warei*, *Cyperus croceus*, *Cyperus filiculmis*, *Cyperus retrorsus*, and *Rhynchospora grayi*.

The frequently burned areas include an abundance of suffrutescent and forb species, dominated by the Asteraceae and Fabaceae plant families, that decrease as the canopies become increasingly denser in the less frequently burned and unburned areas. Species from the Asteraceae include a frequent occurrence of *Balduina angustifolia*, *Carphephorus corymbosus*, *Pityopsis graminifolia*, and *Liatris* species such as *Liatris gracilis, Liatris pauciflora*, *Liatris tenuifolia*, and *Liatris tenuifolia* var. *quadriflora*. Asters with an occasional occurrence throughout include *Ageratina jucunda*, *Chrysopsis scabrella*, *Elephantopus elatus*, *Eupatorium compositifolium*, *Euthamia caroliniana*, *Palafoxia integrifolia*, *Sericocarpus tortifolius*, *Solidago stricta*, and *Symphyotrichum concolor*. The asters *Hiercium gronovii*, *Hieracium megacephalo*n, and *Symphyotrichum dumosum* are less often found in the community in the USF Eco Area. *Arnoglossum floridanum*, *Berlandiera subacaulis* and *Phoebanthus grandiflorus* are endemic asters that occur throughout. Fabaceae suffrutescent and forb species include *Baptisia lecontei*, *Chamaecrista fasciculata*, *Clitoria mariana*, *Crotalaria rotundifolia*, *Desmodium floridanum*, *Dalea carnea*, *Dalea pinnata Galactia volubilis*, *Lespedeza hirta*, *Lupinus diffuses*, *Mimosa* *quadrivalvis* var. *angustata*, *Rhynchosia michauxii*, *Rhynchosia reniformis*, and *Tephrosia chrysophylla*.

Other suffrutescent and forb species found throughout the community include *Asclepias humistrata*, *Asclepias tuberosa*, *Asclepias verticillata*, *Cnidoscolus stimulosus*, *Croton argyranththemus*, *Croton michauxii*, *Dyschoristes obllongifolia*, *Eriogonum tomentosum*, *Froelichia floridana*, *Helianthemum corymbosum*, *Houstonia procumbens*, a record occurrence for Hillsborough County of *Lechea minor*, *Lechea sessiliflora*, *Onosmodium virginianum*, *Opuntia humifusa*, *Piriqueta cistoides*, *Polygala violacea*, *Polygonella gracilis*, *Ruellia caroliniensis*, *Ruellia ciliosa*, the endemic *Scutellalria arenicola*, *Stillingia sylvatica*, *Tragia urens*, and *Viola palmata*. *Aureolaria pedicularia* var. *pectinata*, *Seymeria pectinata*, and *Krameria lanceolata* are included among the semi-parasitic species that are periodically found in the sandhill. Trailing, vine-like forbs, included in the herbaceous groundcover, are *Stylisma patens* and the Florida endangered *Matelea pubiflora* (Coile and Garland 2003).

The 1938 USDA/SCS Hillsborough County Soil Survey aerial photograph shows that, historically, the sandhill community type was quite extensive throughout the surrounding area, especially to the south (Figure 4). As a prime, pine dominated upland; it has been usurped and irreversibly altered by development, agriculture, silvaculture, fragmentation, and fire suppression throughout the years (Doolittle et al. 1989; FNAI and DNR 1990; Meyers 1990, 2000). At various times in the past, the community in the USF Eco Area has been used as a home site, pastureland, turpentine extraction site, and dumping ground. Close proximity to Fletcher Avenue makes the community vulnerable to the potential invasion of exotic species, trash, lights, and noise. The sandhill in the USF Eco Area is also compromised by the current, extremely cautious, climate of prescribed burning in urban areas that, in turn, prevents consistency in the burn regimes needed to properly maintain it as well as maintain the proper timeliness of the varying burn regimes within the experimental burn plots. Despite the overwhelming anthropogenic intrusions listed above and the community's relatively small size, the remnant of endangered sandhill community type and its ecosystem, found in the USF Eco Area, has remarkably survived and somewhat maintained an essence of its integrity and viability, so much so, that it still remains an extremely valuable resource to the University of South Florida for research and education in the study of endangered habitats and the species of special concern within them.

Xeric Hammock—The pyrogenic, open canopied, upland communities of scrub, sand pine scrub, and sandhill, that occur on the deep sands of ridges and undulating hills, typically senesce into the xeric hammock community type in their advanced stages of succession (Doolittle et al. 1989; FNAI and DNR 1990; Meyers 1990, 2000). Xeric hammock often occurs in isolated patches where fire has been prevented from running through the above communities for at least 30 years or more by natural fire barriers such as rivers, swamps, or non-pyrogenic communities; anthropogenic fragmentation; or fire suppression. In their senescence, the typically open upper canopies of the above communities become denser with the invasion of non-pyrophytic, hardwood climax vegetation thereby diminishing the herbaceous layer as well as the diversity of the original communities. Remnant vegetative structure and species composition, derived from the original communities, typically creates variation in the overall appearance of the xeric hammock community type.

In the 1938 USDA/SCS Hillsborough County Soil Survey aerial photograph, the two areas of xeric hammock community type, in total covering approximately 7 ha (17 a) or 2% of the USF Eco Area, are shown to have historically been sand pine scrub and sandhill communities with primarily open upper canopies (Table 6) (Figures 4, 8, 9, 21). The larger area of xeric hammock, covering approximately 5 ha (11 a), is a senescent sand pine scrub community that occurs on Buck Island in the middle of the floodplain swamp, in the mid-western portion of the USF Eco Area (Figures 4, 8, 21A). With approximate slopes of 2–3% from elevations of approximately

A.

B.

Figure 21. Areas of xeric hammock plant community in the University of South Florida Ecological Research Area. A. Senescent sand pine scrub on Buck island. B. Senescent sandhill on the central upland ridge.

9–11 m (28–35 ft) above msl, it grades down into the wet flatwoods ecotone encircling the island. The smaller of the two areas, covering approximately 2 ha (6 a), is a senescent sandhill community that occurs on top of the central upland ridge that dips north into the floodplain swamp, (Figures 4, 8, 21B). At elevations of approximately 11–12 m (36–40 ft) above msl, the smaller area of xeric hammock grades into scrubby flatwoods to the north, sandhill to the south, and down into mesic flatwoods to the west and east with approximate slopes of 2–4%.

Primarily composed of xerophytic plant species, typical vegetative structure of the xeric hammock community type is variable in that it can range from a dense, low, and scrubby oak dominated forest in the upper and mid canopies with relatively sparse shrub and herbaceous layers to a multi-storied hardwood dominated forest that may include densely to widely scattered pines in the upper canopy, fairly dense mid and sub-canopies, and a sparse herbaceous layer (Doolittle et al. 1989; FNAI and DNR 1990; Meyers 1990, 2000). Variation in the vegetative structural layers and species composition generally reflect the age of the xeric hammock and the original community types from which it was derived.

Soil types differ between the two areas of xeric hammock in the USF Eco Area, based on the original community types (Doolittle et al. 1989) (Figure 6). Soils in the xeric hammock community on Buck Island exhibit the white-washed sands typically associated with sand pine scrub communities whereas the soils in the smaller area of xeric hammock on top of the central upland ridge are consistent with the characteristic yellowish Candler fine sand of the sandhill community type (Figure 6). There is some question as to the specificity of the mapped soil type on Buck Island that may be a symptom of the small scale used when mapping the 1989 USDA/SCS Soil Survey of Hillsborough County. All of Buck Island, including the ecotone into the swamp, was mapped as Immokalee fine sand which is a poorly to moderately drained soil type that is more consistent with the periodically saturated pine flatwoods community type (Figure 6). During the present study, the topography, edaphic characteristics, vegetative structure, and species composition of the sand pine dominated upper portions of Buck Island were found to be inconsistent with Immokalee fine sand characteristics and its associated community traits. It is conjectured, based on the above qualitative observations, that the higher elevations, dominated by sand pine, may possibly be some other soil type that is more consistent with a sand pine scrub community. Site specific confirmation of the soil type, done on a larger scale than used by the USDA/SCS in 1989, is recommended, as soil sampling is out of the scope of the present study.

Although the soil types of the original sand pine scrub and sandhill communities differ between the two areas, they have similar basic edaphic characteristics. Both soil types are excessively well drained and composed of very deep, nutrient poor, marine deposited siliceous sands, with little to no horizon development, derived from Plio-Pleistocene beach ridges and dune systems (Doolittle et al. 1989; FNAI and DNR 1990; Meyers 1990, 2000). The deep porous sands and the characteristically deep seasonal high water table depths of the original community types produce droughty conditions throughout the year, particularly during the dry season.

Before senescence, both areas of xeric hammock in the USF Eco Area had originally been fire-maintained and fired dependent communities with differing fire frequency and intensity characteristics (sand pine scrub—infrequent, high intensity; sandhill—frequent, low intensity). The floodplain swamp around Buck Island; the close proximity of the less fire-prone communities on three sides of the smaller area of xeric hammock; and the north-south dirt road through the USF Eco Area, cutting part of the smaller area of xeric hammock off from the more fire prone sandhill community to the south, may possibly be the contributing factors that prevented fire from having gone through the original communities. The incombustibility of the climax vegetation in the xeric hammock areas and the density of the upper canopies diminishing the herbaceous groundcover to the point where it is unable to carry a fire, lower the prospects of fire going through the community even more. Chance ignitions, such as lightning hitting Buck

Island or from a fire going through the abutting sandhill community to the south of the smaller area of xeric hammock, may occur only if high winds and low humidity are combined with an extended period of extremely dry conditions and enough leaf litter has accumulated to carry fire through the community. Once a fire is ignited, it is typically a very hot and furious, catastrophic fire that, in turn, could potentially revert the xeric hammock back into its original community or into another community type altogether (Doolittle 1989; FNAI and DNR 1990; Meyers 1990, 2000)

The two areas of xeric hammock in the USF Eco Area reflect the typical vegetative structure of the community type in their similarities and differences. They both have relatively closed upper canopies dominated by *Quercus geminata*, a mix of persistent-leaved and/or deciduous hardwood tree species in the mid-canopies, variable mid and sub-canopies, and relatively sparse herbaceous layers. The distinctive vegetative characteristics between the two separate areas of xeric hammock illustrates the variation that occurs in the basic vegetative structure and species composition that reflects the original community type from which it was derived.

The vegetative structure and species composition found on Buck Island is typical of a xeric hammock community that has developed from sand pine scrub. The upper canopy is dominated by *Pinus clausa* and a fairly dense population of somewhat stunted *Quercus geminata* that also includes a few, very widely scattered *Pinus palustris*. The mid-canopy is composed of a diverse mix of scrubby *Quercus* species, *Vaccinium arboreum*, and a few other hardwood species. Tall *Lyonia ferruginea* dominate the relatively dense sub-canopy. *Herpothallon sp*. and many other lichens cover the trees and shrubs throughout the community. The groundcover in the herbaceous layer, that once included large open patches of white sand that may possibly have included the characteristic scattering of endemic and listed species, typical of isolated scrub and sand pine scrub communities, has primarily been taken over by mosses and several *Cladonia* species amongst a paucity of grasses, sedges, and forbs as the senecense of the sand pine scrub community occurred over time.

The vegetative structure of the small area of xeric hammock on top of the central upland ridge, derived from the sandhill community type, includes a dominance of large *Quercus geminata* with a scattering of a few *Pinus palustris* in the upper canopy. *Quercus laevis* and *Quercus incana* dominate the mid-canopy. The sub-canopy is sparse, primarily composed of scattered *Serenoa repens*. Wiry grasses and very few forbs amongst *Cladonia spp*. and patches of sand make up the sparse and discontinuous herbaceous layer.

The upper canopies in both areas of xeric hammock in the USF Eco Area are dominated by *Quercus geminata*. A wide scattering of *Pinus palustris* and *Sabal palmetto* are also included throughout both upper canopies. *Pinus clausa* is a codominant with *Q. geminata* in the upper canopy of the community on Buck Island, many of which are twisted, leaning, and/or have fallen. There is an occasional occurrence of *Pinus elliottii*, *Quercus laurifolia*, *Quercus virginiana*, and even *Quercus nigra* in the lower to mid elevations of the community on Buck Island.

Quercus chapmanii and *Vaccinium arboreum* occur throughout the mid-canopies of both areas. *V. arboreum* occurs quite frequently on Buck Island, especially as the community slopes down the sides of the island, where it is more open. Other mixed hardwoods, found in the mid-canopy of the community on Buck Island, include occasional occurrences of *Ilex ambigua* and *Persea borbonia* var. *humilis*, and a rare occurrence of *Ximenia americana*. There is also a surprisingly, relatively large population of *Chionanthus virginicus* in the mid-canopy on Buck Island, where it occasionally occurs in locally common groups throughout the higher elevations of the community. *Quercus laevis* and *Quercus incana* are abundant throughout the mid-canopy of the smaller area of xeric hammock on top of the central upland ridge. A wide scattering of *Diospyros virginiana*, *Quercus myrtifolia*, and *Rhus copallinum* are also included in the mid-canopy of the smaller area.

Tall *Lyonia ferruginea* dominates the sub-canopy of the community on Buck Island whereas it only occasionally occurs throughout the sub-canopy of the smaller area of xeric hammock derived from sandhill. *Serenoa repens* and *Vaccinium myrsinites* are occasionally found throughout the sub-canopies of both areas. *Asimina pygmea*, *Asimina reticulata*, *Licania michauxii*, *Lyonia fruticosa*, *Vaccinium darrowii*, *Vaccinium stamineum*, and *Yucca filamentosa* are widely scattered throughout the sub-canopy of the smaller area of the community.

Vines, such as *Gelsemium sempervirens*, *Smilax auriculata*, *Vitis aestivalis*, and *Vitis rotundifolia*, have a variable distribution throughout both areas of xeric hammock. *Tillandsia recurvata* and *Tillandsia usenoides* are epiphytes that occasionally occur throughout both areas as well. Epiphytes such as *Tillandsia setacea* and the endemic *Tillandsia simulata* are found throughout the community on Buck Island. Very few pteridophytes occur in either of the areas of xeric hammock in the USF Eco Area, except for an occasional occurrence of *Pteridium aquilinum*, primarily on the edges of the community.

Dichanthelium ovale, *Dichanthelium portoricense*, *Scleria triglomerata*, and *Rhynchospora megalocarpa* are among the occasional grasses and sedges that occur in the herbaceous layer of the xeric hammock on Buck Island. *Aristida stricta* var. *beyrichiana* and *Sporobolus junceus* are the wiry grasses that dominate the herbaceous layer in the smaller area of the community.

Helianthemum corymbosum is one of the very few forbs that occur in the herbaceous layer of the community on Buck Island. *Balduina angustifolia*, *Baptisia lecontei*, *Carphephorus corymbosus*, *Cnidoscolus stimulosus*, *Dalea pinnata*, *Eriogonum tomentosum*, *Eupatorium compositifolium*, *Galactia volubilis*, *Krameria lanceolata*, *Liatris tenuifolia* var. *quadriflora*, *Lupinus diffuses*, *Polygala nana*, *Stillingia sylvatica*, and *Tephrosia chrysophylla* are the few remnant forbs found in the herbaceous layer of the smaller area of the community derived from sandhill.

Despite several anthropogenic disturbances, both areas of the USF Eco Area xeric hammock community have remained somewhat intact. The xeric hammock on Buck Island is riddled with dug out potholes from many years of archaeological and anthropological investigations into past inhabitation on the island. Prior to 1938, the middle of the smaller area of the community, on top of the upland central ridge, had been deeply excavated in the process of building a logging road for access to the floodplain swamp to the north.

Based on the 1989 USDA/SCS Hillsborough County Soil Survey aerial photograph and the general observations during the present study, both areas of xeric hammock in the USF Eco Area are conjectured to be in the younger stages of the community type. A series of carefully prescribed fire in both areas of the community may potentially revert them back to their original respective communities.

Rural/Developed—The ruderal/developed plant community type is associated with areas in which native vegetation is continually disturbed anthropogenically, so much so that weedy pioneer and exotic plant species become the dominant vegetation. Approximately 61 ha (150 a) or 20% of the USF Eco Area is comprised of the ruderal/developed plant community type (Table 6) (Figures 8, 9, 22). Ruderal areas in the USF Eco Area include dumping and storage sites, and areas along roads, fences, and firebreaks (Figure 22A). Developed areas include the USF Golf Course and Riverfront Park (Figures 22B, 22C). The ruderal areas were not mapped separately as a result of their relatively small sizes whereas the developed areas were large enough to warrant mapping.

Occasional upper, mid, and sub-canopy weedy species found in the USF Eco Area ruderal/developed community include *Prunus serotina*, *Salix caroliniana*, and *Sambucus nigra*. Fortunately, *Schinus terebinthifolius*, a FLEPPC Category 1 invasive exotic plant species, occurs only rarely in the community.


A.


B.


C.

Figure 22. Ruderal/developed plant community in the University of South Florida Ecological Research Area. A. Ruderal. B. USF Golf Course. C. Riverfront Park.

Common weedy grasses and sedges that occur occasionally throughout the community include *Axonopus furcatus*, *Cenchrus gracillimus*, *Cynodon dactylon*, *Cyperus esculentus*, *Dichanthelium ovale*, *Dichantheliunm portoricense*, *Echinochloa muricata*, *Eustachys glauca*, *Eustachys petraea*, *Paspalum notatum*, *Paspalum setaceum*, *Rhynchelytrum repens Setaria parviflora*, *Stenotaphrum secundatum*, and *Urochloa mutica*. Varieties of *Cynodon dactylon* are the dominant grasses planted on the USF Golf Course. *Paspalum notatum* is the dominant grass found around Riverfront Park.

Occassional suffrutescent and herbaceous species included throughout the community are *Acalypha gracilens*, *Ambrosia artimisiifolia*, *Bidens alba*, *Commelina diffusa*, *Conyza canadensis* var. *pusilla*, *Croton glandulosus*, *Dichondra caroliniensis*, *Eryngium baldwinii*, *Erechtites hieraciifolius*, *Erigeron quercifolius*, *Eupatorium compositifolium*, *Froelichia floridana*, *Gomphrena serrata*, *Gaura angustifolia*, *Linaria canadensis*, *Lepidium virginicum*, *Oxalis corniculata*, *Phyla nodiflora*, *Plantago virginica*, *Portulaca oleracea*, *Portulaca pilosa*, *Richardia grandiflora*, *Sida rhombifolia*, *Solanum americanum*, *Urena lobata*, *Veronica peregrina*, and *Youngia japonica*.

ANNOTATED LIST OF THE VASCULAR FLORA

The vascular flora of the University of South Florida Ecological Research Area (USF Eco Area) is documented by voucher specimens in the USF Herbarium. The Annotated List of the Vascular Flora is organized alphabetically by family, genus, and species under the headings of Pteridophytes (Ferns and Fern Allies), Gymnosperms, Angiosperms (Monocotyledons), and Angiosperms (Dicotyledons). Nomenclature of families, genera, and species, as well as common names, follows Wunderlin and Hansen (2003, 2005).

Names marked with an asterisk are exotic (non-native) taxa. Names in bold type are the taxa endemic to Florida. Underlined names are new records for Hillsborough County. Common names follow the scientific name and authority. Common names are followed by the plant community in which the vascular plant taxa were collected. Plant community abbreviations are as follows: blackwater stream (BS), floodplain swamp (FS), floodplain forest (FF), floodplain marsh (FM), hydric hammock (HH), seepage slope (SS), wet flatwoods (WF), mesic flatwoods (MF), scrubby flatwoods (SF), sandhill (SH), xeric hammock (XH), and ruderal/developed (RD). Mesic flatwoods and the hydric hammock have associated dome swamp (DS) and sinkhole (SI) wetlands within them. These are abbreviated MF(DS), MF(SI), and HH(DS). Multiple plant communities listed reflect where collections were made. Plant community abbreviations are followed by the relative abundance within the plant community a collection was made and is abbreviated as: Common (C) (taxa abundant throughout), Frequent (F) (taxa easily found throughout but not as abundant), Occasional (O) (taxa found sporadically throughout), Locally Common (LC) (taxa sporadically found throughout only in groups of individuals), and Rare (R) (taxa with one to very few individuals throughout). Where a taxon is listed as an invasive species by the Florida Exotic Pest Pant Council (FLEPPC) a notation of [CAT I] or [CAT II] is given following the relative abundance (FLEPPC 2003). Collection numbers from the present floristic inventory or the collector's name and collection number of previous collections, not documented and collected during the present study, are in italics at the end of the taxa citation.

PTERIDOPHYTES (FERNS AND FERN ALLIES)

ASPLENIACEAE

Asplenium platyneuron (L.) Britton et al.—ebony spleenwort; FF, FS, SS; F; *Wunderlin et. al. 6416*

AZOLLACEAE

Azolla caroliniana Willd.—mosquito fern; BS; C; *250*

BLECHNACEAE

Woodwardia areolata (L.) T. Moore—netted chain fern; SS; O; *510*

Woodwardia virginca (L.) Sm.—Virginia chain fern; FS, MF(DS), SS; LC, O; *505*

NEPHROLEPIDACEAE

**Nephrolepis cordifolia* (L.) C. Presl—tuberous sword fern; FF, WF; O; [CAT 1]; *334*

OSMUNDACEAE

Osmunda regalis L. var. *spectabilis* (Willd.) A. Gray—royal fern; FS; F; *216*

PSILOTACEAE

Psilotum nudum (L.) P. Beauv.—whisk-fern; FS, HH; *Wunderlin et al. 6400*

PTERIDACEAE

**Ceratopteris thalictroides* (L.) Brongn.—watersprite; BS; O; *294*, *351*

SALVINIACEAE

**Salvinia minima* Baker—water spangles; BS; C; *249*

SCHIZAEACEAE

**Lygodium japonicum* (Thunb.) Sw.—Japanese climbing fern; FS, HH, RD; R; [CAT I]; *Wunderlin et al. 6419*

THELYPTERIDACEAE

**Thelypteris dentata* (Forssk.) E.P. St. John—downy maiden fern; FS, HH; R; *Richardson 1002*

Thelypteris interrupta (Willd.) K. Iwats.—hottentot fern; FF; O; *359*

GYMNOPSERMS

CUPRESSACEAE

Taxodium distichum (L.) Rich.—bald-cypress; BS, FF, FS, HH(DS), MF(DS); C; *Richardson 1004*

PINACEAE

Pinus clausa (Chapm. ex Engelm.) Vasey ex Sarg.—sand pine; XH; F; *188*

Pinus elliottii Engelm.—slash pine; WF; O; *164*

Pinus palustris Mill.—longleaf pine; MF, SH; F; *Richardson 1055*

Pinus taeda L.—loblolly pine; MF; R; *Wunderlin 10197*

ANGIOSPERMS (MONOCOTYLEDONS)

AGAVACEAE

Yucca filamentosa L.—Adam's needle; SH; O; *410*

ALISMATACEAE

Sagittaria graminea Michx. var. *chapmanii* J.G. Sm.—Chapman's arrowhead; FS; F; *165*

AMARYLLIDACEAE

Zephyranthes atamasca (L.) Herb.—atamasco lily; WF; R; *Richardson 967*

ARACEAE

Lemna aequinoctialis Welw.—lesser duckweed; BS; LC, O; *251*

Pistia stratiotes L.—water lettuce; BS; C; [CAT I]; *253*

Spirodela polyrhiza (L.) Schleid.—common duckweed; BS; C; *252*

ARECACEAE

Sabal minor (Jacq.) Pers.—dwarf palmetto; FF; O; *354*

Sabal palmetto (Walter) Lodd. ex Schult. & Schult. f.—cabbage palm; FS, HH, MF, SF, SH, XH; O; *512*

Serenoa repens (Bartr.) Small—saw palmetto; MF, SH, XH; C; *Richardson 913*

BROMELIACEAE

Tillandsia fasciculata Sw. var. *densispica* Mez—cardinal airplant; FS, WF; R; *338*

Tillandsia recurvata (L.) L.—ballmoss; MF, XH; C; *Barthe 108*

Tillandsia setacea Sw.—southern needleleaf; XH; C; *190, 211*

Tillandsia simulata Small—Florida air plant; FS, WF, XH; O; *212, 213, 337*

Tillandsia usneoides (L.) L.—Spanish moss; BS; C; *259*

COMMELINACEAE

**Commelina diffusa* Burm. F.—common dayflower; FF, RD; O–F; *229, 295, 350*

Commelina erecta L.—whitemouth dayflower; RD, XH; R; *Bancroft J-20*

CYPERACEAE

Bulbostylis ciliatifolia (Elliott) Fernald—capillary hairsedge; SH; O–F; *18*

Bulbostylis stenophylla (Elliott) C.B. Clarke—sandyfield hairsedge; SH; F; *86*

Bulbostylis warei (Torr.) C.B. Clarke—Ware's hairsedge; SH; O; *19*

Carex alata Torr.—broadwing sedge; BS, FF; R; *361, 366A*

Carex gigantea Rudge—giant sedge; FS; O; *322*

Carex longii Mack—Long’s sedge; FF, WF; R; *Richardson 1085*

Carex lupuliformis Sartwell ex Dewey—false hop sedge; BS, FS; O; *366*

Carex verrucosa Muhl.—warty sedge; FS, HH(DS), MF(DS), SS, WF; R; *Richardson 986*

Carex vexans F.J. Herm.—Florida hammock sedge; BS, FF, FS; R; *368*

Cyperus croceus Vahl—Baldwin's flatsedge; SH; O; *406*

**Cyperus esculentus* L.—yellow nutgrass; SH; O; *87*

Cyperus filiculmis Vahl—wiry flatsedge; SH; R–O; *411*

Cyperus haspan L.—haspan flatsedge; BS, SS, WF; R; *Richardson 1090*

Cyperus odoratus L.—fragrant flatsedge; RD; F; *371*

Cyperus polystachyos Rottb.—manyspike flatedge; RD; F; *372*

Cyperus retrorsus Chapm.—pinebarren flatsedge; SH; O; *407*

Cyperus surinamensis Rottb.—tropical flatsedge; FS, WF; R; *Richardson 1082*

Eleocharis vivipara Link—viviparous spikerush; SS; O; *291*

Fimbristylis caroliniana (Lam.) Fernald—Carolina fimbry; WF; O; *38*

Fimbristylis puberula (Michx.) Vahl—hairy fimbry; WF; R; *Richardson 987*

Rhynchospora colorata (L.) H. Pfeiff.—starrush whitetop; BS, RD; O; *228*

Rhynchospora corniculata (Lam.) A. Gray—shortbristle horned beaksedge; FS; F; *1*, *316*, *344*

Rhynchospora fascicularis (Michx.) Vahl—fascicled beaksedge; FF, SS, WF; O; *95*

Rhynchospora globularis (Chapm.) Small—globe beaksedge; WF; O; *179*

Rhynchospora grayi Kunth—Gray's beaksedge; SH; R; *111*, *416*

Rhynchospora megalocarpa A. Gray—sandyfield beaksedge; XH; O; *2*, *191*

Rhynchospora microcarpa Baldwin ex A. Gray—southern beaksedge; FF, FS, HH, WF; C; *273*

Rhynchospora mixta Britton ex Small—mingled beaksedge; BS, FS; O; *355*, *363*

Rhynchospora pusilla Chapm. ex M.A. Curtis—fairy beaksedge; WF; O; *39*

Scirpus tabernaemontani C.C. Gmel.—softstem bulrush; FS, WF; R; *Richardson 969*

Scleria ciliata Michx. var. *pauciflora* (Muhl. ex Willd.) Kük.—fewflower nutrush; FS, WF; R; *Ray et al.10216*

Scleria reticularis Michx.—netted nutrush; FS, SS; WF; R; *Bancroft J-23*

Scleria triglomerata Michx.—tall nutgrass; XH; O; *5, 192*

Scleria verticillata Muhl. ex Willd.—low nutrush; WF; R; *Richardson 2011*

ERIOCAULACEAE

Eriocaulon decangulare L.—tenangle pipewort; SS; LC, O; *290*

Lachnocaulon anceps (Walter) Morong—whitehead bogbutton; SS, WF; O–F; *41, 94, 169, 177, 280, 289*

Syngonanthus flavidulus (Michx.) Ruhland—yellow hatpins; SS, WF; O–F; *Richardson 1084*

HAEMODORACEAE

Lachnanthes caroliana (Lam.) Dandy—Carolina redroot; SS, WF; O–F; *Bateson 67*

HYPOXIDACEAE

Hypoxis curtissii Rose—common yellow stargrass; FF, FS, WF; R; *32, 167*

Hypoxis juncea Sm.—fringed yellow stargrass; SS, WF; R; *Lewis 21*

Hypoxis wrightii (Baker) Brackett—bristleseed yellow stargrass; WF; R; *46*

IRIDACEAE

Sisyrinchium angustifolium Mill.—narrowleaf blue-eyed grass; FF, HH, WF; C; *227, 271*

JUNCACEAE

Juncus dichotomus Elliott—forked rush; SS, WF; R; *Richardson 1045*

Juncus effusus L. subsp. *solutus* (Fernald & Wiegand) Hämet-Ahti—soft rush; SS, WF; LC, O; *Richardson 977*

Juncus elliottii Chapm.—bog rush; SS, WF; R; *Richardson 915*

Juncus marginatus Rostk.—shore rush; FF, SS, WF; C; *272, 279*

Juncus repens Michx.—lesser creeping rush; SS; LC, O; *514*

Juncus scirpoides Lam.—needlepod rush; WF; F; *26*

ORCHIDACEAE

Calopogon tuberosus (L.) Britton et al.—tuberous grasspink; SS, WF; LC, R; *245*, *314*

Encyclia tampensis (Lindl.) Small—Florida butterfly orchid; FF, FS; R; *377*

Epidendrum conopseum R. Br.—green-fly orchid; FS, SS, WF; R; *Richardson 893*

Habenaria repens Nutt.—waterspider false reinorchid; BS, MF(DS), WF; R; *Richardson 972*

Pteroglossaspis ecristata (Fernald) Rolfe—giant orchid; MF, SH; R; *Richardson 2019*

Spiranthes odorata (Nutt.) Lindl.—fragrant ladiestresses; FF, FS, WF; R; *Richardson 2007*

Spiranthes vernalis Englem. & A. Gray—spring ladiestresses; FF, FS, SS, WF; R; *Richardson 1022*

POACEAE

Andropogon glomeratus (Walter) Britton et al. var. *glaucopis* (Elliott) C. Mohr—purple bluestem; SS, WF; LC, O; *511*

Andropogon glomeratus (Walter) Britton et al. var. *pumilus* (Vasey) Vasey ex L.H. Dewey—bushy bluestem; SH, WF; O; *Vincent 165*

Andropogon longiberbis Hack.—hairy bluestem; SH; R; *Richardson 1095*

Andropogon ternarius Michx.—splitbeard bluestem; SH; O; *129*

Andropogon tracyi Nash—Tracy's bluestem; SH; O; *84*, *85*, *116*

Anthaenantia villosa (Michx.) P. Beauv.—green silkyscale; SH; O; *124*

Aristida stricta Michx. var. *beyrichiana* (Trin. & Rupr.) D.B. Ward—wiregrass; SH; F; *119*, *127*

Aristida purpurascens Poir.—arrowfeather threeawn; SH; O; *130*

Axonopus fissifolius (Raddi) Kuhlm.—common carpetgrass; WF; R; *Richardson 1050*

Axonopus furcatus (Flüggé) Hitchc.—big carpetgrass; FF, HH, SS; C; *274*, *364*

Cenchrus gracillimus Nash—slender sandbur; SH; O; *118*, *399*

Dichanthelium aciculare (Desv. ex Poir.) Gould & C.A. Clark—needleleaf witchgrass; MF, SF, SH; R; *Richardson 2000*

Dichanthelium commutatum (Schult.) Gould—variable witchgrass; BS, FF, FS; O–C; *296*, *333*, *357*

Dichanthelium dichotomum (L.) Gould—cypress witchgrass; FF, HH, WF; C; *33*, *270*, *318*

Dichanthelium ensifolium (Baldwin ex Elliott) Gould var. *unciphyllum* (Trin.) B.F. Hansen & Wunderlin—cypress witchgrass; HH, MF, SH, WF; O; *Richardson 908*

Dichanthelium leucothrix (Nash) Freckmann—rough witchgrass; FF, HH, MF, WF; O; *282*

Dichanthelium ovale (Elliott) Gould & C.A. Clark—eggleaf witchgrass; SH; O; *55*, *233*, *311*, *380*, *415*

Dichanthelium portoricense (Desv. ex Ham.) B.F. Hansen & Wunderlin—hemlock witchgrass; MF, SH; O; *56*, *157*, *381*, *396*, *398*, *414*

Dichanthelium strigosum (Muhl. ex Elliott) Freckmann var. *glabrescens* (Griseb.) Freckmann—roughhair witchgrass; FF, WF; O; *281*

Digitaria serotina (Walter) Michx.—blanket crabgrass; SH; O; *Richardson 1097*

<u>*Echinochloa muricata*</u> (P. Beauv.) Fernald—rough barnyardgrass; BS, FF, FS, HH; O; *258*

Echinochloa walteri (Pursh) A. Heller—coast cockspur; RD; R; *Richardson 992*

Eragrostis elliottii S. Watson—Elliott's lovegrass; SH; F; *100*, *101*, *104*

Eragrostis virginica (Zuccagni) Steud.—coastal lovegrass; WF; R; *Richardson 1083*

Eustachys glauca Chapm.—saltmarsh fingergrass; WF; O; *178*

Eustachys neglecta (Nash) Nash—fourspike fingergrass; MF, SH; F; *110*, *121*, *137*

Gymnopogon ambiguus (Michx.) Britton et al.—bearded skeletongrass; MF, SH; R; *Hilsenbeck & Stenholm 23*

Panicum anceps Michx.—beaked panicum; SH; LC, O; *61*, *133*

Panicum hemitomon Schult.—maidnecane; FS; O; *Richardson 1096*

Panicum rigidulum Bosc ex Nees—redtop panicum; FF, FS, HH; O; *320*

Panicum virgatum L.—switchgrass; WF; LC, O; *141*

Paspalum repens P.J. Bergius—water paspalum; BS, FS; F; *261*

Paspalum setaceum Michx.—thin paspalum; SH; O; *69*, *88*, *122*, *135*

**Rhynchelytrum repens* (Willd.) C.E. Hubb.—rose natalgrass; SH; LC, R; [CAT II]; *76*

Schizachyrium scoparium (Michx.) Nash—little bluestem; SF; R; *Bancroft 4*

Setaria parviflora (Poir.) Kerguélen—yellow bristlegrass; SH; O; *57, 123, 405*

Sorghastrum secundum (Elliott) Nash—lopsided Indiangrass; SH; F; *99*

**Sporobolus indicus* (L.) R. Br.—smutgrass; SH; R; *Richardson 1038*

Sporobolus junceus (P. Beauv.) Kunth—pineywoods dropseed; SH, XH; O–C; *17, 237*, *384*, *408*

Triplasis americana P. Beauv.—perennial sandgrass; SH; O; *117*

**Urochloa mutica* (Forssk.) T.Q. Nguyen—paragrass; RD; LC, R; [CAT I]; *369*

PONTEDERIACEAE

**Eichhornia crassipes* (Mart.) Solms—common water-hyacinth; BS, FS; LC, O; [CAT I]; *Peaden & Ford 17*

Pontederia cordata L.—pickerelweed; BS, FS; O; *218*

SMILACACEAE

Smilax auriculata Walter—earleaf greenbrier; SH, MF; O; *243*, *403*

Smilax bona-nox L.—saw greenbrier; FS; R; *Richardson 1016*

Smilax pumila Walter—sarsaparilla vine; FS; R; *Richardson 1001*

TYPHACEAE

Typha domingensis Pers.—southern cattail; FS; R; *Richardson 971*

XYRIDACEAE

Xyris brevifolia Michx.—shortleaf yelloweyed grass; SS; R; *Richardson 893*

Xyris caroliniana Walter—Carolina yelloweyed grass; WF; O; *25, 51*

Xyris elliottii Chapm.—Elliott's yelloweyed grass; SS, WF; LC, O–F; *277*,

**Xyris jupicai* Rich.—Richard's yelloweyed grass; WF; O; *199*

ANGIOSPERMS (DICOTYLEDONS)

ACANTHACEAE

Dyschoriste oblongifolia Michx. Kuntze—oblongleaf twinflower; SH; O; *Richardson 957*

Ruellia caroliniensis (J.F. Gmel.) Steud.—Carolina wild petunia; SH; O; *15*

Ruellia ciliosa Pursh—ciliate wild petunia; XH; R; 239; *Long 1198*

ADOXACEAE

Viburnum obovatum Walter—Walter's viburnum; FF, FS, HH; F; *154*

Sambucus nigra L. subsp. *canadensis* (L.) R. Bolli.—elderberry; FS; R; *Richardson 989*

AMARANTHACEAE

**Alternanthera philoxeroides* (Mart.) Griseb.—alligatorweed; BS, FS; LC, O; [CAT II]; *224*, *265*

**Amaranthus spinosus* L.—spiny amaranth; RD; R; *Bateson 193*

**Chenopodium ambrosioides* L.—Mexican tea; RD; R; *Richardson 1070*

Froelichia floridana (Nutt.) Moq.—cottonweed; SH; O; *74*, *79*, *82*

Gomphrena serrata L.—globe amaranth; RD; LC, O; *9*

ANACARDIACEAE

Rhus copallinum L.—winged sumac; MF, SF, SH, XH; O; *92*

**Schinus terebinthifolius* Raddi—Brazilian pepper; RD; R; [CAT I]; *Bateson 62*

Toxicodendron radicans (L.) Kuntze—eastern poison ivy; FF, FS, HH, MF, WF; O; *168*

ANNONACEAE

Asimina pygmea (Bartr.) Dunal.—dwarf pawpaw; SH, XH; R–O; *391*, *397*

Asimina reticulata Shuttlew. ex Chapm.—netted pawpaw; SF, SH, XH; O; *Richardson 909*

APIACEAE

Cicuta maculata L.—spotted water hemlock; BS, FS; O; *223*

Erynigium baldwinii Spreng.—Baldwin's eryngo; BS, FF, FS, HH; O; *158*, *367*

Ptilimnium capillaceum (Michx.) Raf.—mock bishopweed; BS, FS; O; *215*

APOCYNACEAE

Asclepias humistrata Walter—pinewoods milkweed; SH, XH; O; *238*

Asclepias longifolia Michx.—longleaf milkweed; WF; O; *241*

Asclepias perennis Walter—swamp milkweed; FF, FS; R–O; *28*, *340*

Asclepias tuberosa L.—butterflyweed; SH; R–O; *298*, *417*

Asclepias verticillata L.—whorled milkweed; SH; R; *63*, *303*, *312*, *401*

Matelea pubiflora (Decne.) Woodson—trailing milkvine; SH; R; *306*

AQUIFOLIACEAE

Ilex ambigua (Michx.) Torr.—Carolina holly; XH; O; *3*

Ilex cassine L.—dahoon; FF, FS, HH; R; *48*, *276*

Ilex decidua Walter—possumhaw; FF; R–O; *182*, *214*

Ilex glabra (L.) A. Gray—gallberry; MF, SH, WF; LC, O; *Bateson 63*

ARALIACEAE

Centella asiatica (L.) Urb.—spadeleaf; BS, FF, FS; O; *362*

Hydrocotyle verticillata Thunb.—whorled marshpennywort; BS, FM, FS; F; *260*, *276*

ASTERACEAE

Ageratina jucunda (Greene) Clewell & Wooten—hammock snakeroot; MF, SH; O; *115*

Ambrosia artemisiifolia L.—common ragweed; RD; C; *10*

Arnoglossum floridanum (A. Gray) H. Rob.—Florida Indian plantain; SF, SH, XH; R–O; *53*, *310*, *402*

Balduina angustifolia (Pursh) B.L. Rob.—coastalplain honeycombhead; SH; O–F; *59*, *113*

Berlandiera subacaulis (Nutt.) Nutt.—Florida greeneyes; SH; O; *65*, *235*

Bidens alba (L.) DC. var. *radiata* (Sch. Bip.) R.E. Ballard ex Melchert—beggarticks; RD; LC, O; *Bateson 69*

Carphephorus corymbosus (Nutt.) Torr. & A. Gray—Florida paintbrush; SH; F; *98*

Chrysopsis linearifolia Semple subsp. ***dressii*** Semple—Dress' goldenaster; SH; R; *Jones 42*

Chrysopsis mariana (L.) Elliott—Maryland goldenaster; XH; O; *King 91*

Chrysopsis scabrella Torr. & A. Gray—coastalplain goldenaster; SH; O; *128*, *383*

Chrysopsis subulata Small—scrubland goldenaster; MF; R; *Jourdan* & *Crewz s.n.*

Cirsium nuttallii DC.—Nuttall's thistle; FF, FS, HH; LC, R; *315*

Conyza canadensis (L.) Cronquist var. *pusilla* (Nutt.) Cronquist—dwarf Canadian horseweed; RD; F; *78*

Coreopsis leavenworthii Torr. & A. Gray—Leavenworth's tickseed; WF; O; *44*, *181*

Eclipta prostrata (L.) L.—false daisy; BS, FF, FS, HH; O; *225*, *255*, *346*, *348*

Elephantopus elatus Bertol.—tall elephantsfoot; SH; F; *67*

Erechtites hieraciifolius (L.) Raf. ex DC.—fireweed; WF; O; *186*, *283*

Erigeron quercifolius Poir.—oakleaf fleabane; RD; O; *231*

Erigeron vernus (L.) Torr. & A. Gray—slenderleaf fleabane; SH; O; *Richardson 952*

Eupatorium compositifolium Walter—yankeeweed; SH; O; *105*

Eupatorium leptophyllum DC.—falsefennel; WF; F; *147*

Eupatorium mohrii Greene—Mohr's thoroughwort; SH; O; *Richardson 981*

Euthamia caroliniana (L.) Greene ex Porter & Britton—slender goldenrod; MF, SF, SH; O–F; *125*

Gamochaeta pensylvanica (Willd.) Cabrera—Pennsylvania everlasting; SH; R; *Richardson 966*

Helenium flexuosum Raf.—purplehead sneezeweed; WF; O; *376.*

Helianthus angustifolius L.—narrowleaf sunflower; RD; R; *Robbins 86*

Helianthus radula (Pursh) Torr. & A. Gray—stiff sunflower; SH; R; *Brunn 1*

Heterotheca subaxillaris (Lam.) Britton & Rusby—camphorweed; RD, SH; O; *Hilsenbeck Schweinter 10*

Hieracium gronovii L.—queendevil; SH; R; *60*

Hieracium megacephalon Nash —coastalplain hawkweed; SH; R; *313*, *394*, *413*

Lactua graminifolia Michx.—grassleaf lettuce; RD; R; *Richardson 1048*

Liatris gracilis Pursh—slender gayfeather; SH; O; *75*

Liatris pauciflora Pursh—fewflower gayfeather; SH; O; *68*

Liatris tenuifolia Nutt.—shortleaf gayfeather; SH; O; *103*

Liatris tenuifolia Nutt.var. *quadriflora* Chapm.—shortleaf gayfeather; SH; XH; O; *148*, *151*

Mikania scandens (L.) Willd.—climbing hempvine; BS, FM; F; *Bateson 70*

Packera glabella (Poir.) C. Jeffrey—butterweed; FS, WF; O; *240, 319*

Palafoxia integrifolia (Nutt.) Torr. & A. Gray—coastalplain palafox; SH; O; *102*

Phoebanthus grandiflorus (Torr. & A. Gray) S. F. Blake—Florida false sunflower; SH; O; *80*

Pityopsis graminifolia (Michx.) Nutt.—narrowleaf silkgrass; SH; O–F; *77*, *140*

Pluchea rosea R. K. Godfrey—rosy camphorweed; WF; O; *Richardson 996*

Pterocaulon pycnostachyum (Michx.) Elliott—blackroot; MF, SH; O; *373.*

Pyrrhopappus carolinianus (Walter) DC.—Carolina desertchicory; RD, SH; O; *Richardson 1075*

Sericocarpus tortifolius (Michx.) Nees—whitetop aster; SF, SH; O; *131*

Solidago fistulosa Mill.—pinebarren goldenrod; MF, SH, WF; O; *King 156*

Solidago leavenworthii Torr. & A. Gray—Leavenworth's goldenrod; WF; O; *292*

Solidago stricta Aiton—wand goldenrod; SH; O; *132*

Symphyotrichum carolinianum (Walter) Wunderlin & B.F. Hansen—climbing aster; BS, FS; O; *257*

Symphyotrichum concolor (L.) G.L. Nesom—eastern silver aster; SH; O; *120*

Symphyotrichum dumosum (L.) G.L. Nesom—rice button aster; MF, SH; O; *108*, *143*

**Youngia japonica* (L.) DC.—Oriental false hawkweed; RD; O; *263*

BETULACEAE

Carpinus caroliniana Walter—American hornbeam; FF; F; *352*

BIGNONIACEAE

Campsis radicans (L.) Seemann—trumpet creeper; FF, MF, RD, WF; F; *332*

BORAGINACEAE

Onosmodium virginianum (L.) DC.—false Gromwell; SH; R; *307*

BRASSICACEAE

Cardamine pensylvanica Muhl. ex Willd.—Pennsylvania bittercress; FF, HH; O; *160*

Lepidium virginicum L.—Virginia pepperweed; RD; O; *386*

CACTACEAE

Opuntia humifusa (Raf.) Raf.—pricklypear; SH; O; *299*

CAMPANULACEAE

Lobelia glandulosa Walt.—glade lobelia; WF; R; *142*, *146*

Lobelia paludosa Nutt.—white lobelia; WF; R; *Richardson 999*

CARYOPHYLLACEAE

Stipulicida setacea Michx. var. ***lacerata*** C.W. James—pineland scalypink; MF, SF; O; *374*

CHRYSOBALANCEAE

Licania michauxii Prance—gopher apple; SH; O; *304*

CISTACEAE

Helianthemum corymbosum Michx.—pinebarren frostweed; SH, XH; O; *139*, *183*

<u>*Lechea minor*</u> L.—thymeleaf pinweed; MF, SH, XH; F; *20*, *24*

Lechea mucronata Raf.—hairy pinweed; SH; O; *Jourdan* & *Crewz s.n.*

Lechea sessiliflora Raf.—pineland pinweed; SH; F; *134*

CLUSIACEAE

Hypericum fasciculatum Lam.—sandweed; FS, WF; O; *Richardson 1068*

Hypericum gentianoides (L.) Britton et al.—pineweeds; WF; O; *36*

Hypericum hypericoides (L.) Crantz—St. Andrew's-cross; FF, FS, WF; O–F; *30*, *49*

Hypericum mutilum L.—dwarf St. John's-wort; FF, FS, WF; O; *284*

Hypericum tetrapetalum Lam.—fourpetal St. John's-wort; WF; O; *27*, *47*

CONVOLVULACEAE

Dichondra caroliniensis Michx.—Carolina ponysfoot; FF, RD; O; *185*

Ipomoea cordatotriloba Dennst.—tievine; RD; R; *Bateson 60*

Ipomoea pandurata (L.) G. Mey.—man-of-the-earth; SH; R; *Richardson 1018*

Stylisma patens (Desr.) Myint—coastalplain dawnflower; SH; O; *14*

CORNACEAE

Cornus foemina Mill.—swamp dogwood; FF, FS; F; *206*

CUCURBITACEAE

Melothria pendula L.—creeping cucumber; FF; O; *365*

**Momordica charantia* L.—balsampear; RD; R; *Bateson 65*

DROSERACEAE

Drosera capillaris Poir.—pink sundew; WF; C; *324*

EBENACEAE

Diospyros virginiana L.—common persimmon; MF, SF, SH, WF; F; *138*, *210*, *301*

ERICACEAE

Lyonia ferruginea (Walter) Nutt.—rusty staggerbush; XH; F; *6*, *172*

Lyonia fruticosa (Michx.) G.S. Torr.—coastalplain staggerbush; MF, SF, SH; O; *Barthe 89*

Lyonia lucida (Lam.) K. Koch—fetterbush; WF; R; *Barthe 69*

Vaccinium arboreum Marshall—sparkleberry; MF, SF, SH, XH; O–F; *23*, *163*, *196*

Vaccinium corymbosum L.—highbush blueberry; SS, WF; O; *197*, *204*;

Vaccinium darrowii Camp—Darrow's blueberry; MF, SF, SH, WF; O–F; *Richardson 932*

Vaccinium myrsinites Lam.—shiny blueberry; MF, SF, SH, WF; O–F; *195*

Vaccinium stamineum L.—deerberry; MF, SH, XH; C; *232*, *392*, *395*

EUPHORBIACEAE

Acalypha gracilens A. Gray—slender threeseed mercury; RD, SH; O; *83*

Chamaesyce hirta (L.) Millsp.—pillpod sandmat; RD, SH; O; *Richardson 1053*

Chamaesyce maculata (L.) Small—spotted sandmat; RD, SH; O; *Richardson 1054*

Cnidoscolus stimulosus (Michx.) Engelm. & A. Gray—tread softly; SH; O; *236*

Croton argyranthemus Michx.—silver croton; SH; O; *71*, *393*

Croton glandulosus L.—vente conmigo; SH; R; *81*

Croton michauxii G.L. Webster—rushfoil; RD, XH; F; *21*

Stillingia sylvatica L.—queensdelight; SH; O; *62*, *234, 302*

Tragia urens L.—wavy noseburn; SH; O; *382*

FABACEAE

Astragalus obcordatus Elliott—Florida milkvetch; SH; R; *Richardson 1052*

Baptisia lecontei Torr. & A. Gray—pineland wild indigo; SH; O; *309*

Chamaecrista fasciculata (Michx.) Greene—partridge pea; MF, SH; O–F; *11*, *375*

Chamaecrista nictitans (L.) Moench var. *aspera* (Muhl.ex Elliott) H.S. Irwin & Barneby—sensitive pea; MF, SH; O; *Willett 54*

Clitoria mariana L.—Atlantic pigeonwings; SH; R; *300.*

Crotalaria rotundifolia J.F. Gmel.—rabbitbells; SH; R; *58*

Dalea carnea (Michx.) Poir.—whitetassels; SH; O; *16*

Dalea pinnata (J.F. Gmel.) Barneby—summer farewell; SH, XH; O; *114*, *144*

Desmodium floridanum Chapm.—Florida ticktrefoil; SH; O; *13, 136*

**Desmodium incanum* DC.—zarzabacoa comun; RD; R; *Bateson 123*

Desmodium paniculatum (L.) DC.—panicled tricktrefoil; SH; R; *Vincent 23*

Galactia volubilis (L.) Britton—downy milkpea; SH; O; *54*, *244*

Gleditsia aquatica Marshall—water locust; FS; O; *Richardson 946*

Indigofera caroliniana Mill.—Carolina indigo; SH; O; *Jourdan* & *Crewz s.n.*

**Indigofera hirsuta* L.—hairy indigo; RD; O; *Lewis 4*

Lespedeza hirta (L.) Hornem.—hairy lespedeza; SH; O; *126*

Lupinus diffusus Nutt.—skyblue lupine; SH; F; *200*, *209*

Mimosa quadrivalvis L. var. *angustata* (Torr. & A. Gray) Barneby—sensitive brier; SH; O; *308*

Rhynchosia michauxii Vail—Michaux's snoutbean; SH; O; *305*, *404*

Rhynchosia reniformis DC.—dollarleaf; SH; O; *70*

**Senna obtusifolia* (L.) H.S. Irwin & Barneby—coffeeweed; RD; R; *Bancroft K-5*

Sesbania herbacea (Mill.) McVaugh—danglepod; RD; R; *Bateson 156*

Stylosanthes biflora (L.) Britton et al.—sidebeak pencilflower; MF, SH; R; *Wunderlin et al. 5616*

Tephrosia chrysophylla Pursh—scurf hoarypea; SH; O; *72*, *73*, *412*

Tephrosia florida (F. Dietr.) C.E. Wood—Florida hoarypea; SH; R; *Richardson 1049*

Vicia acutifolia Elliott—fourleaf vetch; BS, FS, HH, RD, WF; R; *Richardson 950*

Vigna luteola (Jacq.) Benth.—hairypod cowpea; RD; R; *Bateson 163*

FAGACEAE

Quercus chapmanii Sarg.—Chapman's oak; SF, SH, XH; R–O; *149*, *150*

Quercus geminata Small—sand live oak; SF, SH, XH; O–F; *97*

Quercus incana W. Bartram—bluejack oak; SH, XH; O; *106*

Quercus myrtifolia Willd.—myrtle oak; SF, SH, XH; R; *409*

Quercus laevis Walter—turkey oak; SH, XH; F; *Kaczor s.n.*

Quercus laurifolia Michx.—laurel oak; FF, HH, WF; F; *93*, *170*

Quercus nigra L.—water oak; WF; R; *Richardson 1013*

Quercus virginiana Mill.—Virginia live oak; MF, SF, SS, XH; O; *96*

GELSEMIACEAE

Gelsemium sempervirons (L.) W.T. Aiton—yellow jessamine; WF; LC, O; *180*

GENTIANACEAE

Sabatia brevifolia Raf.—shortleaf rosegentian; WF; O; *35*

Sabatia calycina (Lam.) A. Heller—coastal rosegentian; FF, FS, HH; O; *321*

Sabatia grandiflora (A. Gray) Small—largeflower rosegentian; WF; O; *Weinland 2*`

HALORAGACEAE

Proserpinaca palustris L.—marsh mermaidweed; BS; C; *347*

ITEACEAE

Itea virginica L.—Virginia willow; FS; O; *207*

KRAMERIACEAE

Krameria lanceolata Torr.—sandspur; SH; O; *379*

LAMIACEAE

Callicarpa americana L.—American beautyberry; XH; O; *Wunderlin et al. 6409*

Hyptis alata (Raf.) Shinners—clustered bushmint; WF; O; *Massetti 28*

Piloblephis rigida (W. Bartram ex Benth.) Raf.—wild pennyroyal; MF, SF; O; *194*

Scutellaria arenicola Small—Florida scrub skullcap; SH; O; *66*

Stachys floridana Shuttlew. ex Benth.—Florida betony; RD; O; *Richardson 1037*

Trichostema dichotomum L.—forked bluecurls; MF, SH; O; *Willett 1*

LAURACEAE

Persea borbonia (L.) Spreng.—red bay; XH; O; *4*, *173*

LENTIBULARIACEAE

Pinguicula caerulea Walter—blueflower butterwort; SS, WF; R; *Richardson 897*

Pinguicula pumila Michx.—small butterwort; WF; O;*152, 193*

Utricularia inflata Walter—floating bladderwort; FS; LC, O; *Richardson 973*

Utricularia subulata L.—zigzag bladderwort; MF(SI), WF; O; *203*

LINACEAE

Linum medium (Planch.) Britton var. *texanum* (Planch.) Fernald—stiff yellow flax; WF; O; *42*, 50

LOGANIACEAE

Mitreola petiolata (J.F. Gmel.) Torr. & A. Gray—lax hornpod; FS; O; *Perkey 143*

LYTHRACEAE

Lythrum flagellare Shuttlew. ex Chapm.—Florida loosestrife; HH; LC, R; *267*

MALVACEAE

**Sida cordifolia* L.—Llima; RD; R; *Bancroft K-2*

Sida rhombifolia L.—Cuban jute; BS, FF; R; *297*

**Urena lobata* L.—ceasarweed; RD; O; [CAT II]; *356*

MELASTOMATACEAE

Rhexia mariana L.—pale meadowbeauty; WF; O; *278, 335*

MYRICACEAE

Myrica cerifera L.—wax myrtle; FF, FS, HH, MF, WF; O–F; *45*, *166*, *184*

OLACACEAE

Ximenia americana L.—hog plum; SH; R; *Bateson 54*

OLEACEAE

Chionanthus virginicus L.—white fringetree; MF, XH; LC, O; *189*, *205*, *242*

Fraxinus caroliniana Mill.—pop ash; BS, FF, FS, HH; C; *176*, *217*, *222*, *331*

ONAGRACEAE

Guara angustifolia Michx.—southern beeblossum; RD, SH; LC, O; *385*

Ludwigia maritima R.M. Harper—seaside primrosewillow; SH, WF; R; *Richardson 1039*

Ludwigia microcarpa Michx.—smallfruit primrosewillow; FS; O; *Richardson 1069*

Ludwigia palustris (L.) Elliott—marsh seedbox; FS; O; *Richardson 976*

Oenothera laciniata Hill—cutleaf evening primrose; RD; LC, R; *Richardson 1009*

OROBANCHACEAE

Agalinis fasciculata (Elliott) Raf.—beach false foxglove; WF; O; *325*

Agalinis setacea (J.F. Gmel.) Raf.—threadleaf false foxglove; SH; R; *Richardson 2005*

Aureolaria pedicularia (L.) Raf. var. *pectinata* (Nutt.) Gleason—fernleaf yellow false foxglove; SH, XH; R; *8, 8a*

Seymeria cassioides (J.F. Gmel.) S. F. Blake—yaupon blacksenna; SH; R; *Jones 37*

Seymeria pectinata Pursh—Piedmont blacksenna; SF, SH, XH; O; *22*

OXALIDACEAE

Oxalis corniculata L.—common yellow woodsorrel; FF, HH, MF, RD; F; *159, 230, 269*

PHYTOLACCACEAE

Phytolacca americana L.—American pokeweed; RD; R; *Richardson 911*

PLANTAGINACEAE

Plantago virginica L.—Virginia plantain; RD; O; *246*

POLYGALACEAE

Polygala cruciata L.—drumheads; WF; R; *326*

Polygala lutea L.—orange milkwort; WF; R; *330*

Polygala nana (Michx.) DC.—candyroot; WF; O; *40*

Polygala rugelii Shuttlew. ex Chapm.—yellow milkwort; WF; O; *329*

Polygala setacea Michx.—coastalplain milkwort; WF; R; *Richardson 899*

Polygala violacea Aubl.—showy milkwort; SH; O; *52, 64*

POLYGONACEAE

Eriogonum tomentosum Michx.—wild buckwheat; SF; F; *12*

Polygonella gracilis Meisn.—tall jointweed; SH; O; *112*

Polygonella polygama (Vent.) Engelm. & A. Gray—october flower; MF; O; *89*, *90*, *91*, *107*

Polygonum densiflorum Meisn.—knotweed; BS, FS; R; *Bateson 5*

Polygonum hydropiperoides Michx.—swamp smartweed; FS, MF(DS); R; *Richardson 1071*

Polygonum punctatum Elliott—dotted smartweed; BS; F; *220*, *254*, *264*

Rumex hastatulus Baldwin—hastateleaf dock; RD; R; *Richardson 941*

Rumex verticillatus L.—swamp dock; BS; F; *248*, *343*

PORTULACACEAE

Portulaca oleracea L.—little hogweed; RD, SH; O; *387*

Portulaca pilosa L.,—pink purslane; RD, SH; O; *388*

PRIMULACEAE

Samolus valerandi L. subsp. *parviflorus* (Raf.) Hultén—pineland pimpernel; BS, FF, FS; O; *262*, *349*

RHAMNACEAE

Berchemia scandens (Hill) K. Koch—rattan vine; FF, FS, HH; R; *513*

ROSACEAE

Crataegus michauxii Pers.—Michaux's hawthorn; SH, XH; R; *378*, *389*

Prunus serotina Ehrh.—black cherry; RD; R; *161*

Prunus umbellata Elliott—flatwoods plum; SH, XH; O; *198*, *390*

Rubus argutus Link—sawtooth blackberry; RD; LC, R; *Richardson 927*

RUBIACEAE

Cephalanthus occidentalis L.—common buttonbush; FF, FS; F; *323*

Diodia teres Walter—rough buttonweed; MF, SH; O; *Richardson 1063*

Diodia virginiana L.,—Virginia buttonweed; FF, FS; F; *29*

Galium tinctorium L.—stiff marsh bedstraw; FS; C; *219*, *285*, *339*

Houstonia procumbens (J.F. Gmel.) Standl.—innocence; SF, SH; O; *162*, *175*

Mitchella repens L.—partridgeberry; SS; LC, R; *286*

Oldenlandia uniflora L.—clustered mille graines; FS, HH, SS, WF; O; *171*, *187*, *287*, *328*

Psychotria sulzneri Small—shortleaf wild coffee; BS, FF; LC, R; *358*

**Richardia brasiliensis* Gomes—tropical Mexican clover; FF, FS; R; *268*

**Richardia scabra* L.—rough Mexican clover; RD; LC, R; *Richardson 1061*

Spermacoce assurgens Ruiz & Pav.—woodland false buttonweed; FS; LC, R; *Richardson 983*

RUTACEAE

Zanthoxylum clava-herculis L.— Hercules-club; SH; R; *7, 208*

SALICACEAE

Salix caroliniana Michx.—Carolina willow; FS; F; *201*

SAPINDACEDAE

Acer rubrum L.—red maple; FF, FS, HH, SS, WF; O; *156*

SAPOTACEAE

Sideroxylon reclinatum Michx.—Florida bully; FF; O; *360*

SAURURACEAE

Saururus cernuus L.—lizard's tail; FF, FS; F; *342*

SOLANACEAE

Physalis arenicola Kearney—cypresshead groundcherry; SH; O; *Richardson 1059*

Solanum americanum Mill.—American black nightshade; RD; R; *202*

TETRACHONDRACEAE

Polypremum procumbens L.—rustweed; WF; F; *37*

TURNERACEAE

Piriqueta cistoides (L.) Griseb. subsp. *caroliniana* (Walter) Arbo—pitted stripeseed; SH; O; *400*

ULMACEAE

Ulmus americana L.—American elm; FF, FS, HH; O; *Richardson 937*

URTICACEAE

Boehmeria cylindrica (L.) Sw.—false nettle; BS, FS; O; *31*, *221*, *256*

VERBENACEAE

**Lantana camara* (L.).—lantana; RD; R; [CAT 1]; *Richardson 990*

Phyla nodiflora (L.) Greene—turkey tangle fogfruit; FF, FS, HH, RD, WF; O; *34*, *247*, *317*

VERONICACEAE

Gratiola hispida (Benth. ex Lindl.) Pollard—rough hedgehyssop; MF, WF; O; *43*

Gratiola pilosa Michx.—shaggy hedgehyssop; SS, WF; R; *Richardson 1026*

Linaria canadensis (L.) Chaz.—Canada toadflax; RD; F; *226*

Lindernia grandiflora Nutt.—Savannah false pimpernel; HH, WF; O; *Richardson 975*

Mecardonia acuminata (Walter) Small subsp. *peninsularis* (Pennell) Rossow—axilflower; SS; R; *O. Lakela 23993*

Micranthemum umbrosum (J.F. Gmel.) S. F. Blake—shade mudflower; BS, FS; C; *293*, *345*

Penstemon multiflorus (Benth.) Chapm. ex Small—manyflower beardtongue; SH, XH; O; *Jourdan & Crewz s.n.*

Scoparia dulcis L.—sweetbroom; FM, HH, WF; O; *Richardson 1074*

VIOLACEAE

Viola lanceolata L.—bog white violet; FF, HH, SS, WF; LC, O; *145*, *155*, *288*, *327*

Viola palmate L.—early blue violet; SH; O; *174*

Viola sororia Willd.—common blue violet; FF, HH; O; *153*

VITACEAE

Ampelopsis arborea (L.) Koehne—peppervine; FF; R; *Richardson 974*

Parthenocissus quinquefolia (L.) Planch—Virginia creeper; FF, RD; O; *341*, *370*

Vitis aestivalis Michx.—summer grape; FF; O; *353*

Vitis rotundifolia Michx.—muscadine; WF; F; *336*

Vitis shuttleworthii House—Calloose grape; HH, SS, WF; O; *266*

CONCLUSION

The floristics and the 12 natural plant communities documented and mapped in the present study revealed that the USF Eco Area is a biologically rich and diverse natural area despite being somewhat compromised by surrounding anthropogenic perturbations and its small size. The diversity of integrated ecosystems in the USF Eco Area provides USF with an excellent resource for both education and research, much needed in this day and age of habitat loss and fragmentation and the accelerated extinction of species threatening the very essence of biodiversity.

The extraordinary value of the USF Eco Area, along with its location, is irreplaceable. It provides many opportunities for forming partnerships with organizations and agencies such as Florida Department of Environmental Protection, Florida Division of Forestry, Florida Fish and Wildlife Conservation Commission, Hillsborough County's environmental lands acquisition program, Southwest Florida Water Management District, and The Nature Conservany for management and monitoring that would also incur educational potentials for students working along with personnel from the above groups. The USF Eco Area also provides many potential opportunities for education, research, and management grants from educational, conservation, environmental, and natural science organizations and foundations.

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Appendices

Appendix A: SUMMARY OF RESEARCH ACTIVITIES ON THE ECOLOGICAL RESEARCH AREA
(Updated December 2000)

Ecoarea Research Committee, Gordon A. Fox, Gary Huxel, Earl D. McCoy, and Henry R. Mushinsky

Graduate Degrees granted based upon research at the Ecological Research Area

Adam , S.R. 1978. Populations studies and ecology of a native population of Peromyscus gossypinus and an introduced population of Peromyscus floridanus on Buck Island, Florida. M.S. Thesis, L. Brown, Major Professor.

Carson, G.E. 1982. The reproductive biology of the cotton rat (Sigmodon hispidus) in central Florida. M.S. Thesis, L. Brown, Major Professor.

Colson, J. 2003. M.S. Studies of paternity in the gopher tortoise. M.S. Thesis, H. Mushinsky and E. D. McCoy, Major Professors.

Richardson, D.R. 1985. Allelopathic effects of species in the sand pine scrub of Florida. Ph.D. Dissertation G.B. Williamson and R.P. Wunderlin, Major Professors.

Macdonald, L.A. 1986. The diet of the gopher tortoise, Gopherus polyphemus, in a sandhill habitat in Central Florida. M.S. Thesis, H.R. Mushinsky, Major Professor.

Williams, D. 1987 The effects of fire on the abundance of small mammals. M.S. Thesis, E. D. McCoy and H.R. Mushinsky, Major Professors.

Linley, T.O. 1987 The reproductive effort and output of Gopherus polyphemus in Central Florida. M.S. Thesis, H.R. Mushinsky, Major Professor.

Witz, B. 1987 Insect pygidial gland secretions as a reptile predatory deterrent. M.S. Thesis, H.R. Mushinsky, Major Professor.

Rebertus, A. 1987 The effect of fire on woody vegetation of the sandhills. G.B. Williamson, Major Professor (LSU, Baton Rouge).

Kaczor, S. 1988 The effect of gopher tortoise (Gopherus polyphemus) disturbance on the herbaceous vegetation and microenvironment of the sandhill. M.S. Thesis D. Hartnett and R. Wunderlin, Major Professors,

Weidenhamer, J. 1988 Allelopathic effects of Blygonella myriaphyllan and Cladonia leporina Ph.D. Dissertation, J. T. Romeo, Major Professor.

Wilson, D. S. 1990 Home range, activity, and burrow use of juvenile gopher tortoise (Gopherus polyphemus) in a central Florida population. M.S. Thesis. H.R. Mushinsky and E. D. McCoy, Major Professors.

Witz, Brain W. 1994. The foraging behavior and physiological ecology of Cnemidophorus sexlineatus L. (Squamata:Teiidae) in a Florida sandhill habitat. Ph.D. Dissertation, E. D. McCoy and H.R. Mushinsky. Major Professors.

Chernov, Kimberly R. 1994. Genetic structure of a population of the fungus Basidiobolus as revealed by analysis of anonymous DNA sequences. M. S. Thesis, Dr. Bruce Cochrane, Major Professor.

Connor, Kevin M. 1996. Homing behavior and orientation in the gopher tortoise, Gopherus polyphemus. M. S. Thesis, H.R. Mushinsky and E. D. McCoy, Major Professors.

Hayes, Keeney L. 1996. Visual cliff response and pitfall trap avoidance behavior of the six-lined racerunner, Cnemidophorus sexlineatus. M. S. Thesis, H.R. Mushinsky , Major Professor.

Wilson D. S. 1996 Nest site selection in the striped mud turtle, Kinosternon baurii. Ph.D in Biology Advisors: Drs. Henry R. Mushinsky and Earl D. McCoy.

Nelson, Rex T. 1998 Analysis of phenotypic and genetic variation in the fungal genus Basidiobolus. Advisor: Dr. Bruce Cochrane

Stilson, T. A. 2001 The diet of the juvenile gopher tortoise. M. S. Thesis, E, D. McCoy and H. R. Mushinsky, Major Professors.

Published reports of research conducted on the Ecological Research Area.

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McCoy, E. D. and B. W. Kaiser. 1990. Changes in the foraging activity of the southern harvester ant in response to fire. American Midland Naturalist 123:112-123.

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Appendix B: Dates of controlled burns at the USF ecoarea
Compiled September 1998, Updated July 2005

Prior to 1976, burns were spotty and may have been “natural fires”. Data were obtained by inspection of maps by Bruce Williamson.

1968 2W burned 4/4
1971 2W burned 5/4
1976 5E, 5W, 7W, burned 1/15
1979 1E, 2E, burned 5/3

	1E	1W	2E	2W	5E	5W	7E	7W	burn date
1979	X		X						3 May
1980	X								29 May
1981	X		X		X	X	X		10 June
1982	X								15 May
1983	X	X	X	X				X	27 May
1984	X								29 May
1985	X		X						16 May
1986	X	X		X	X	X			27 May
1987	X	X	X	X					25 June
1988	X	X							15 June
1989	X	X	X	X					16 June
1990	X	X					X	X	12 July
1991	X	X	X	X	X	X			18 July
1992	X	X							30 June
1993	X	X	X	X					20 July
1994	X	X							NO BURN
1995	X	X	X	X					NO BURN
1996	X	X			X	X			2 August
1997	X	X	X	X			X	X	NO BURN
1998	X	X	X	X			X	X	20 August (2 and 7 year plots burned one year later than scheduled)
1999	X	X							28 August
2000	X	X	X	X					NO BURN
2001	X	X	X	X	X	X			NO BURN
2002	X	X							NO BURN
2003	X	X	X	X	X	X			27 October (1year plots - three years later than scheduled) and 24 November (2 and 5 year plots – three and two years later than scheduled respectively)
2004	X	X							NO BURN
2005	X	X	X	X			X	X	