

Fire and Resource Management at Big Cypress National Preserve

James N. Burch, Big Cypress National Preserve

Big Cypress National Preserve Location and General Description

Big Cypress National Preserve (BICY) is located in southwestern Florida, north and west of (adjacent to) Everglades National Park. Wetland communities, especially those dominated by bald cypress (*Taxodium distichum*) trees make up much of the preserve's landscape. Topographic relief in the preserve is limited, with a gradual slope (ca. 1ft.mi⁻¹) toward the coast, so that most of the preserve is under at least few inches of water during the summer rainy season. The flat nature of the land also supports large areas of short-grass prairies and saw grass marshes. These graminoid communities naturally burn every few years, so that fire is a common and significant ecological factor.

Fire Management

The BICY Prescribed Fire Management program is the largest in the National Park Service in terms of accomplished burning. This program has about 20 full time employees, and in 2002 completed about half of the National Park Service area burned for fuel reduction. Historically, fire in this area was promoted by humans to enhance hunting and to improve forage for cattle. Frequent fires occurred in much of the mesic to hydric parts of the preserve until grazing leases expired during the past 10-15 years. Also, during the initial decade or more of the preserve's jurisdiction, many former residents, squatters, and resource users produced 'grudge fires', to express feelings contrary to the Park Service's management of the property. This has generally become an issue of the past, and much of this burning has been replaced by an aggressive prescribed fire program. BICY Fire Management burns about 40,000 acres annually.

Resource Management Program at BICY

Resource Management at BICY actively integrates information about the Preserve's natural resources with other divisions in the Preserve. This is an applied extension of the science needed to understand natural systems. Communication with Fire Management is especially valuable, as fire is a common and important abiotic component southern Florida's ecology.

Wildlife Management. Management concerns for fauna in the preserve include fire's implications on species such as Florida panther (*Felis concolor coreyi*), and its prey animals that reside in mesic to hydric communities in the Preserve. Red-cockaded woodpeckers (*Picoides borealis*) require old growth pine forests for nest colony sites; these communities became uncommon after timber cutting in the southeastern United States during the last century. Several colonies occur in BICY, and considerations for this bird are taken when planning for burns in these areas. Cape Sable seaside sparrow

(*Ammodramus maritimus mirabilis*), an endangered bird that resides partly on the southeastern part of BICY, relies on graminoid marshes for nesting. The effects of fire on this community is being studied to determine its possible effects on the marsh and nest site availability. Florida tree snails (*Liguus fasciatus*) reside in hardwood hammocks in BICY. These hammocks are identified so that effects of fires on snails can be minimized.

Cultural Resources and Controlled Fires. Several historic and prehistoric cultural sites have been identified in BICY, and with help from Fire Management have been better identified. In February, 2003, BICY Fire Management burned an area in which the 'Reynolds Sawmill' formerly operated. This site can be recognized by concrete foundation elements and footings for mill equipment that are much more easily located with prairie vegetation burned. This site was surveyed by South East Archaeological Center archaeologists within three weeks after burning. Also in early 2003, Fire Management staff used hand tools to clear a dense stand of exotic Brazilian pepper (*Schinus terebinthifolius*) trees from a Calusa Indian shell mound, so that excavation and artifact recovery could most effectively take place at this archaeological site.

Exotic Plant Removal and Habitat Restoration. Whenever possible Exotic Plant Management coordinates with Fire Management at BICY, to burn areas from which exotic Melaleuca (*Melaleuca quinquenervia*) trees have been removed. Melaleuca trees are serotinous, and will release seeds upon dehydration by fire or by cutting. These trees produce and retain many thousands of small seeds with each season's flowering, so that a stand of large melaleuca trees releases millions of seeds upon cutting. The strategy is to burn these areas after the melaleuca seeds have germinated, but before they are large enough to tolerate fires (usually within a year of germination), as recommended by Myers et al (2001). This strategy has worked well in areas of very heavy melaleuca infestation.

USGS Long-term Fire Ecology Project. The US Geologic Survey, Biological Resources Division has maintained a field station to study fire effects on hydric and mesic pinelands in BICY for about 20 years. Data gathered from this long term study will help managers to understand what fire frequencies may be appropriate for these woodland communities.

Major Communities and Fire Regimes

Cypress and Mixed Hardwood Swamps. Cypress and mixed hardwood swamps cover about 50% of Big Cypress National Preserve. Wade et al. (1980) suggested that these wetland communities are probably more common now than before disturbance by logging. Cypress logging in the mid-1900s opened wetland niches for occupation by hardwood trees. Cypress trees appear to be rapidly re-populating these areas, and anecdotal reports indicate that cypress forests are expanding in many areas that were formerly open (glade) wetlands.

Regarding nearly monocultural cypress forests, Wade et al. (1980) suggested that pre-drainage fire frequencies may have been 100-200 years in dense cypress sloughs. Myers and Ewel (1990) indicated about 20-year fire intervals in cypress forests. These are communities with long hydroperiods and high humidity, so that fires are not well supported except during times of extreme drought. Fire, however, is apparently important to these communities in maintaining dominance by cypress. Without fire, cypress dominated forests would apparently undergo community succession to be replaced by

hydric hardwoods, similar to hardwood succession in pinelands without fires that limit hardwood undergrowth and competition. Dwarf cypress communities, an ecotonal community with elements of cypress slough and marl prairie, burn more frequently (see below: Marl Prairies and Marshes).

Wade et al. (1980) provided no estimate for natural fire frequency in mixed cypress and hardwood sloughs, but suggested that the very wet, dense, interior parts of the sloughs probably seldom experienced fires. The edges of these communities that are ecotonal with marl prairies or with mesic pine flatwoods, however, may experience more frequent burns. Presumably areas more closely associated with adjacent communities will experience fires as often as those communities, and areas closer to the hydric interior of the slough will experience less frequent fires. These differences may be related to seasons and concomitant differences in water levels when burns occur. As slough community areas typically are linear and in areas with little topographic relief, these ecotonal areas can be extensive, and here are considered part of the slough community. Much variation is part of mixed hardwood and cypress communities, so that fire frequency is estimated at 50-100 years.

Marl Prairies and Marshes. Marl prairies and marshes are hydric communities that are dominated by ground cover, and occupy about 20 % of Big Cypress National Preserve. Duever et al (1986) cited works that suggest fires about as often or more often than fires in pinelands, but indicated that prairies are often less productive than pinelands, so that fuel loads may not accumulate fast enough to support more frequent fires. This is perhaps part of the reason for low fire return frequencies in dwarf cypress communities, as ground cover productivities are low and allow little annual fuel accumulation, and much of the marl soil surface may support only sparse vegetation. Wade et al. (1980) also indicated that in dwarf cypress prairies productivities are low and fuels accumulate slowly, so that the fire frequencies here occur at 10-20 year intervals. Areas dominated by saw grass (*Cladium jamaicense*) may burn every 2-5 years, but Wade et al. (1980) cited estimates of pre-disturbance frequency at 3-25 years, suggesting that frequencies near the low end of this estimate may have been most common. Considering this, the estimated natural fire frequency used here is 3-5 years. Saw grass-dominated glades often burn (including prescribed burns) with significant standing water.

Mesic and Hydric Pine Flatwoods. Pine flatwoods communities are mesic to hydric communities that are dominated by open-canopied slash pines (*Pinus elliottii*); these communities cover about 20% of Big Cypress National Preserve. Mesic pine flatwoods are usually co-dominated by saw palmetto (*Serenoa repens*) shrubs, and hydric pine flatwoods are usually co-dominated with graminoid ground cover. Myers and Ewel (1990) indicated much variation of fire frequencies in these communities, depending on environmental variables, and noted the rapidity with which many resident plants burn, recalling a “fire facilitation” hypothesis related to maintenance of pine flatwoods systems through recurring fire. Wade et al. (1980) indicated much variation in pine flatwoods fire frequencies, but pointed out that in closely related pine rockland communities, fire every five or six years was enough to inhibit effective recruitment of pine seedlings, so that natural fire intervals may be greater than seven years. These communities are often adjacent to frequently burning prairies, and may be subject to ignition by those fires, so that more frequent fires can occur. Duever et al (1986) cited studies of fire frequencies in pine forests at three to seven years, and studies that demonstrated succession to hardwood

communities after 15 to 25 years without fire. Regarding these estimates, a natural fire frequency of 7-20 years will be considered here.

Mesic Hammocks. Mesic hammocks are slightly elevated insular areas that are dominated by hardwood trees. Inland these tree islands are usually dominated by temperate trees, and in coastal areas, they are usually dominated by tropical trees. Duever et al (1986) and Wade et al. (1980) mentioned that hammocks are usually insulated from fires by wetlands that surround the islands; also hammock soils are usually moist with water tables within 1 m of the soil surface for most of the year. In coastal areas usually they are surrounded by mangroves; this intertidal swamp seldom supports fire and effectively insulates hammocks from fire (see below: Coastal Systems). Duever et al (1986) conservatively estimated fire frequencies in hardwood hammocks of 50 years or more. Wade et al (1980) provided no estimated fire frequency, but cited evidence of 200+ years interval for fires in hammock interiors.

Coastal Systems. Most of the coastline in southern Florida is dominated by mangrove swamp. This community is an intertidal, tropical tree community that seldom burns. However, the inland ecotone of this community is often adjacent to brackish marsh that may burn with upstream marl prairies. When this occurs, the inland margins of mangrove forests experience these fires. Mangrove swamps usually support little or no ground cover, so that the fires stop at the mangrove interface, but the trees are often killed by the fires' heat. Red mangroves (*Rhizophora mangle*) can be particularly susceptible, as their branches retain few lateral bud meristems to reiterate branch growth. If fires occur after a winter with a severe freeze, then fire can burn into the mangrove forest, consuming frost-killed tree tissues (Wade et al 1980).

Prescribed Fires

The BICY Fire Management Program burns about 40,000 acres annually, to reduce accumulated fuels in plant communities. Considerations for these fires include factors related to fire behavior, such as moisture (drought index, relative humidity), temperature, winds, smoke behavior (transport direction, mixing height, dispersion), and fuels present. Property owners in areas that may be affected by nearby fires are contacted when they are available; prescribed fires are almost always well received by adjacent property owners, as fires were historically used to reduce fuels, or improve forage for domestic or game animals. Fire Management is also in close contact with the State of Florida Division of Forestry, as State restrictions often constrain fire operations. Fire Management also works closely with BICY Resource Management to minimize impacts to Threatened or Endangered species. For example, escape routes or buffer zones are maintained when Florida panthers are known to be in specific areas. In red-cockaded woodpecker nesting areas, resource Management personnel help to determine whether mechanical vegetation removal should be completed before fire is applied to these areas.

Seasons and Naturally Occurring Fires

Rainy and Dry Seasons. Seasons in southern Florida are less defined by temperature than in more northern parts of North America; however, wet and dry seasons produce predictable annual changes. During winter the weather is usually dominated by

jet stream fronts out of the northwest, so that cool clear conditions are common; during spring a persistent high pressure system (Bermuda High) dominates the middle Atlantic region and generates warm dry air throughout most of the southeastern US. The Bermuda High weakens in early summer, so that tropical systems from the Caribbean push northward with high humidity and warm air. This results in increased thunderstorm and rainfall during the summer. Hurricane season is officially from June through November, with these storms most commonly occurring in late August or September; these tropical systems commonly produce several inches of rain in a few days.

Early Thunderstorm Season and Fires. Daily afternoon thunderstorms begin to build from about mid-May through mid-June and occur through early autumn. Lightning that is part of these storms creates limited fire activity during the summer rainy season. Duever et al (1986) indicated May as the month most likely for fires. Wade et al. (1980) indicated that 75% of thunderstorms in southwestern Florida occur from June through September. Records of fires occurring at BICY over the past 20 years indicate that natural fire frequencies are greatest during summer when thunderstorms are most common, and areas burned by naturally occurring fires are greatest early in the summer when conditions are driest and lightning becomes common (BICY Fire Operations 2003). Natural communities are dry in spring because of limited rainfall, lowered surface water levels, occasional winter frosts, and the generally dry weather that dominates the area during the spring.

Plant Community Activities and Fires. A primary ecological consideration for prescribed fires should be season of naturally occurring fires. Fire may be considered a stochastic event, so that its occurrence involves a statistical likelihood in each community, but the actual time of the event is random. This should not be taken to mean that fires should occur with regularity, but that over time, most fires naturally occur during a particular season, and fewer occur during the rest of the year. In southern Florida, we may consider late spring as a likely season for fires, based on ecological observations: 1) late spring is usually the driest season; 2) dry, breezy days occur through much of this season; 3) afternoon lightning becomes common during this season. We can partly test this hypothesis by comparing plant activities in several natural communities that are affected differently by fires.

Growth and reproduction in plant communities often varies with seasons, especially in temperate areas. In southern Florida, seasonal variation occurs, but more as a function of hydrology and fire rather than temperature. Plant communities largely are a function of physical surroundings, so that fires may be considered an important factor in their structure. By looking at flowering plant reproductive activity (flowering), we can compare seasons of reproductive activities with seasons of naturally occurring fires. Reproductive activity is only one factor that should be considered as part of the ecology of communities subject to fire.

Methods

Seasonal flowering of vascular plants that are commonly found in four communities in BICY were compared with estimated fire return intervals for each community. The species selected were from lists of plants found in several locations in southern Florida near to and within BICY. The communities selected are: marl prairies

(118 plants), pine flatwoods (104 plants), mixed hardwood and cypress swamp (119 plants), and tropical hardwood hammocks (130 plants). Seasons of flowering were taken from Wunderlin (1998). Estimates of fire return frequencies were interpreted from several authors (see above: Major Communities and Fire Regimes). Fire is assumed to occur most often during spring, as a result of lightning from dry conditions and thunderstorms (Figure 1.).

Results and Management Implications

Reproductive activities of plants found in major biological communities in BICY varied with estimated naturally occurring fire return frequency. Communities with short fire return intervals had fewer resident plants with reproductive activity during the spring, suggesting that natural fire regimes may influence the species compositions of these communities (Figure 2.).

Marl prairie communities have the highest fire frequencies with the lowest percent of spring (dry season)-flowering plants, and the highest percent of summer (wet season)-flowering plants. Wade et al. (1980) indicated that saw grass marsh fire frequency of two to five years is necessary to minimize fuel buildup. Duever et al (1986) mentioned that low vegetation that is burned back to the substrate surface level will recover well when re-growth occurs before the summer rains occur; however, when rains and concomitant increases in surface water levels occur before re-growth, plants may drown. Wade et al. (1980) recommended spring burning for saw grass, if soils are damp or inundated. This allows fire to remove the dead or old growth, but offers protection of meristem tissues that occur at or below the soil surface, so that re-growth may occur with little delay after fire. Frequent fires (3-5 year intervals) should be considered for these communities.

Pine flatwoods that occur in BICY also have fire returns of only a few years, and often probably similar to their adjacent marl prairie communities. Myers and Ewel (1990) pointed out pine forests' dependence on periodic fire to suppress hardwood succession; Shouse (2003) indicated that naturally occurring fires effectively maintained low fuel levels and arrested seral stage in Mexican pine woodland communities. These communities represent most of the mesic habitat in BICY, and are important for the successes of at least two listed animals (Florida panther, red-cockaded woodpecker) that reside in the preserve. Maintaining these uplands in current successional stages is an important consideration for these animals, so that fire frequencies of 7-20 years should be considered for these plant communities.

Mixed Cypress and hardwood sloughs and tropical hardwood hammocks are natural communities that apparently have fire returns on the order of decades or centuries. Soils, plants, and hydrology in these communities do not promote fires (Wade et al 1980, Duever et al 1986), and the proportions of plant reproductive activities in these communities is higher during times of greater fire probability than in marl prairies of pine flatwoods (Figure 2.). Hammocks have the longest return fire frequencies, the greatest percent of spring (dry season)-flowering plants, and relatively low percent of wet season flowering plants. These communities occupy relatively little area in BICY, but contain at least one State of Florida listed animal (Florida tree snail), and many State of Florida Threatened or Endangered listed plants (mostly epiphytic orchids and bromeliads). Fire

should not be promoted in these communities, as naturally occurring fires apparently were rare.

Conclusions

The ecology of biological communities should be a consideration in planning fires. Wade et al. (1980) indicated that 70% of plants endemic to southern Florida occur in pyroclimactic communities, and plant reproductive activities outlined here appear to be related to fire frequencies and seasons. Duever et al (1986) indicated that out of season fires may perturb life cycles of native plants and animals and may promote growth of some exotics. At Big Cypress National Preserve, conditions of natural systems and prescribed fire are considered based on information collected by USGS and NPS scientists. However, in general, frequencies and timing of prescribed fires largely reflect human requirements. Considerations should be made to prescribe fires during seasons that conform with conditions most similar to naturally occurring fire.

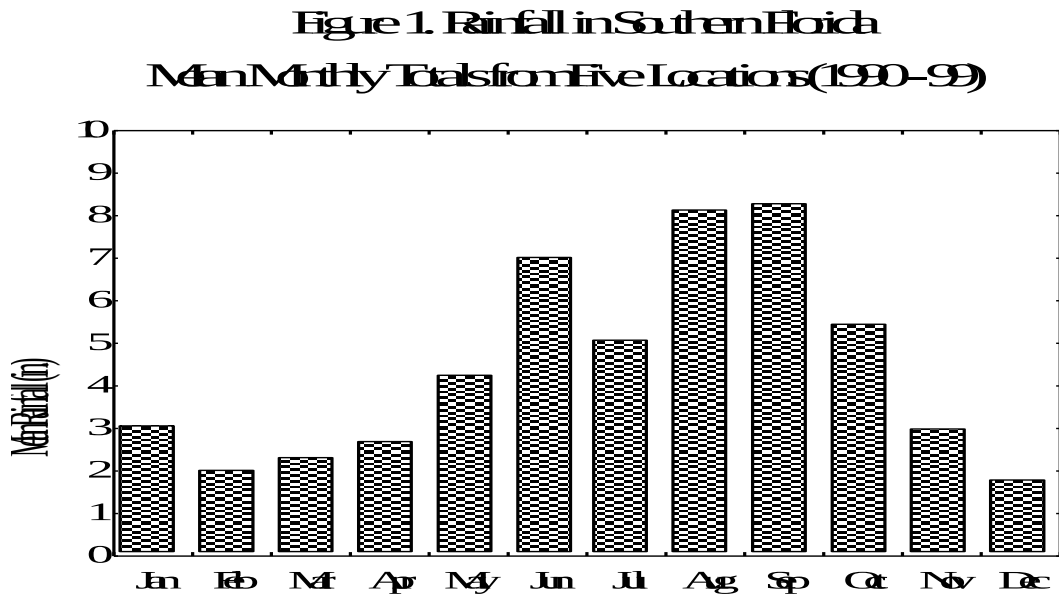


Figure 1. Rainfall in Southern Florida. Mean Monthly Totals from Five Locations (1990 – 99). Total monthly rainfalls are averaged from Gulf Coast Ranger Station (Everglades City, Everglades National Park), Immokalee, Marco Island, Miami International Airport, and Naples, FL, for the years 1990 through 1999 to provide an indication of yearly precipitation in southern Florida. Winter and spring seasons are relatively dry, followed by wet summers. Thunderstorms and lightning strikes become common from early summer through early autumn; tropical storms are most likely to occur in late summer and autumn. Total yearly rainfall is about 55” (1.4 m). (Data from Big Cypress National Preserve Hydrologic Monitoring Program).

Fig 2

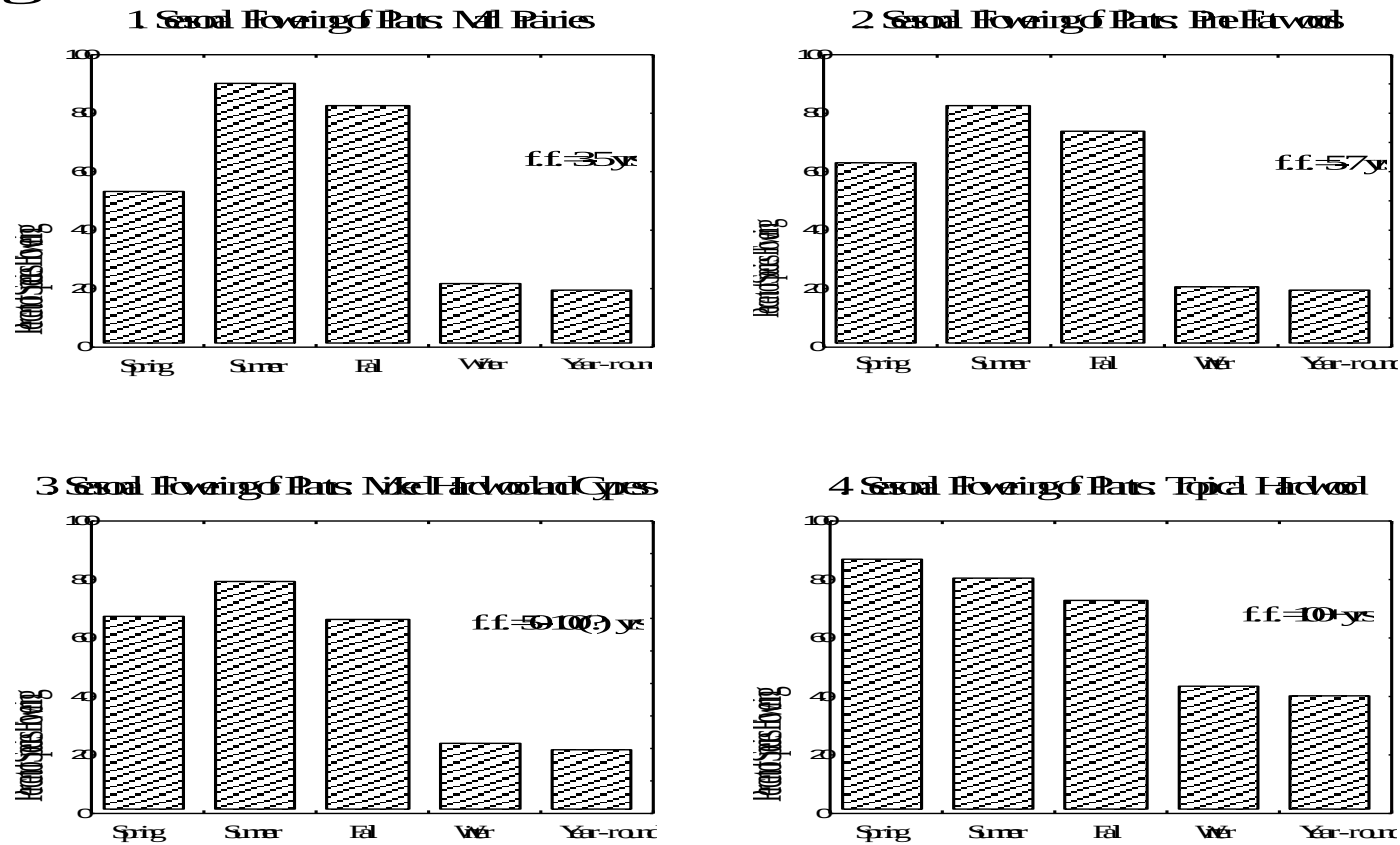


Figure 2. Seasonal Flowering of Plants. Estimated percent of vascular plants flowering during different seasons and year-round in natural communities with different fire frequencies. 1- Marl Prairies; 2- Pine Flatwoods; 3- Mixed Hardwood and Cypress Swamp; 4- Tropical Hardwood Hammock; f.f. = estimated fire frequency in years.

References

BICY Fire Operations. 2003. Unpublished data. Big Cypress National Preserve.

Duever, M. J., J. E. Carlson, J. F. Meeder, L. C. Duever, L. H. Gunderson, L. A. Riopelle, T. R. Alewxander, R. L. Myers, and D. P. Spangler. 1986. The Big Cypress National Preserve. Research Report No. 8 of the National Audubon Society. National Audubon Society, New York. 445 pp; 1 map.

Myers, R. L., H. A. Belles, and J. R. Snyder. 2001. Prescribed fires in the management of *Melaleuca quinquenervia* in subtropical Florida. Pages 132-140 in K. E. M. Galley and T. P. Wilson (eds.). Proceedings of the Invasive Species Workshop: the Role of Fire in the Control and Spread of Invasive Species. Fire Conference 2000: the First National Congress on Fire Ecology, Prevention, and Management. Miscellaneous Publication No. 11. Tall Timbers Research Station, Tallahassee, FL.

Myers, R. L. and J. J. Ewel. 1990. Ecosystems of Florida. University Presses of Florida, Gainesville. 765 pp.

Shouse, B. 2003. Old-growth Forest Spared for Now. Science. 299(5608):802.

Wade, D., J. Ewel, and R. Hofstetter. 1980. Fire in South Florida Ecosystems. USDA Forest Service General Technical Report SE-17. 125 pp.

Wunderlin, R. P. 1998. Guide to Vascular Plants of Florida. University Press of Florida. 806 pp.