Pond Swamps

FNAI Global Rank:	**G3/G4**
FNAI State Rank:	**S2/S4**
Federally Listed Species in S. FL:	**7**
State Listed Species in S. FL:	**33**

Pond Swamp. *Original photograph by Betty Wargo.*

Pond swamps are seasonally inundated forested wetlands located around or within landscape depressions. They include the lake border swamps and major wetlands within large landscape basins, as well as smaller cypress domes and gum ponds. The dwarf cypress savannas that cover vast shallow basins in the Big Cypress subregion are also categorized as pond swamps. Although many small and/or shallow pond swamps have been cleared and converted to agricultural or residential uses, most of the larger systems are still extant. (A notable exception is the great pond apple swamp that once bordered the southern edge of Lake Okeechobee. It was diked off, drained, cleared, and planted to sugarcane. Subsequent oxidation has caused soil subsidence that has completely altered the character of this landscape.) Most of the remaining systems have been degraded to some extent by logging, drainage, impoundment, melaleuca invasion, and/or pollution.

Increased hydroperiods, nutrient enrichment, and contamination from agricultural runoff are major problems, since pond swamps are often surrounded by farmlands and water is typically diverted from these lands into the wetlands. Appropriate timber management and exotic species control are also significant management concerns. In comparison to most South Florida ecosystems, a substantial percentage of pond swamp has already been placed under conservation management. Most of these swamps are located within disturbed landscapes that do not adequately buffer the wetlands or permit normal between-habitat interactions. Preservation and restoration of natural landscape matrices of flatwoods and prairies are the most critical long-term need for pond swamp preservation.

Synonymy

Pond swamps include FNAI's basin swamps and dome swamp, NRCS's cypress swamp, Society of American Foresters' (SAF) slash pine-hardwood, and pond cypress, water-tupelo, and swamp tupelo. Synonymies for each of these communities are provided in the synonymy tables at the end of the account. Note that some of these definitions include northern types that do not occur in South Florida.

Distribution

Pond swamps are abundantly scattered throughout South Florida (Figure 1). Larger basin swamps and lake border swamps are more common towards the northern end of the region, whereas cypress domes dot the landscape almost everywhere. Dwarf cypress savannas, which can be categorized as a very shallow and diffuse type of basin swamp, characterize the Big Cypress Swamp.

Description

Topography and Geology

Dome swamps typically develop in flat karst landscapes where sand has slumped around or over a sinkhole, creating a conical depression.

Larger basin swamps can occupy almost any kind of landscape depression. Many are thought to have developed in oxbows of former rivers or in ancient coastal swales and lagoons from periods with higher sea levels.

Soils

Dome soils are composed of peat, which is thickest toward the center of the dome. This peat is generally underlain by acidic sands and then limestone. Some domes have a clay lens that helps retain water.

Basin swamp soils are generally acidic, nutrient-poor peats, often overlying a clay lens or other impervious layer.

Vegetative Structure

Dome swamps have small young "pond cypress" trees towards their outer edges, grading into larger and older "bald cypress" towards the interior, giving a dome a distinctly rounded cross-sectional profile. (Because pond cypress *Taxodium ascendens* and bald cypress *Taxodium distichum* can be recognized as clearly different in these field situations, the two names are used here. Although some authorities persist in considering these different species, most ecologists now regard them as morphological variations reflective of different growing conditions.) The typical central pond creates the doughnut shape that characterizes these systems on aerial photographs.

Basin swamp structures vary. In theory, a mature system would have the wide variety of tree sizes characteristic of an old-growth forest, but logging has altered the structure of almost all such swamps.

The shallow and diffuse type of basin swamp that covers most of the Big Cypress Swamp is characterized by scattered stunted bonsai-like "hatrack" or "toy" cypress, which are seldom over 3 to 4.6 m (10 to 15 ft) tall, though they are old trees and may have large buttresses.

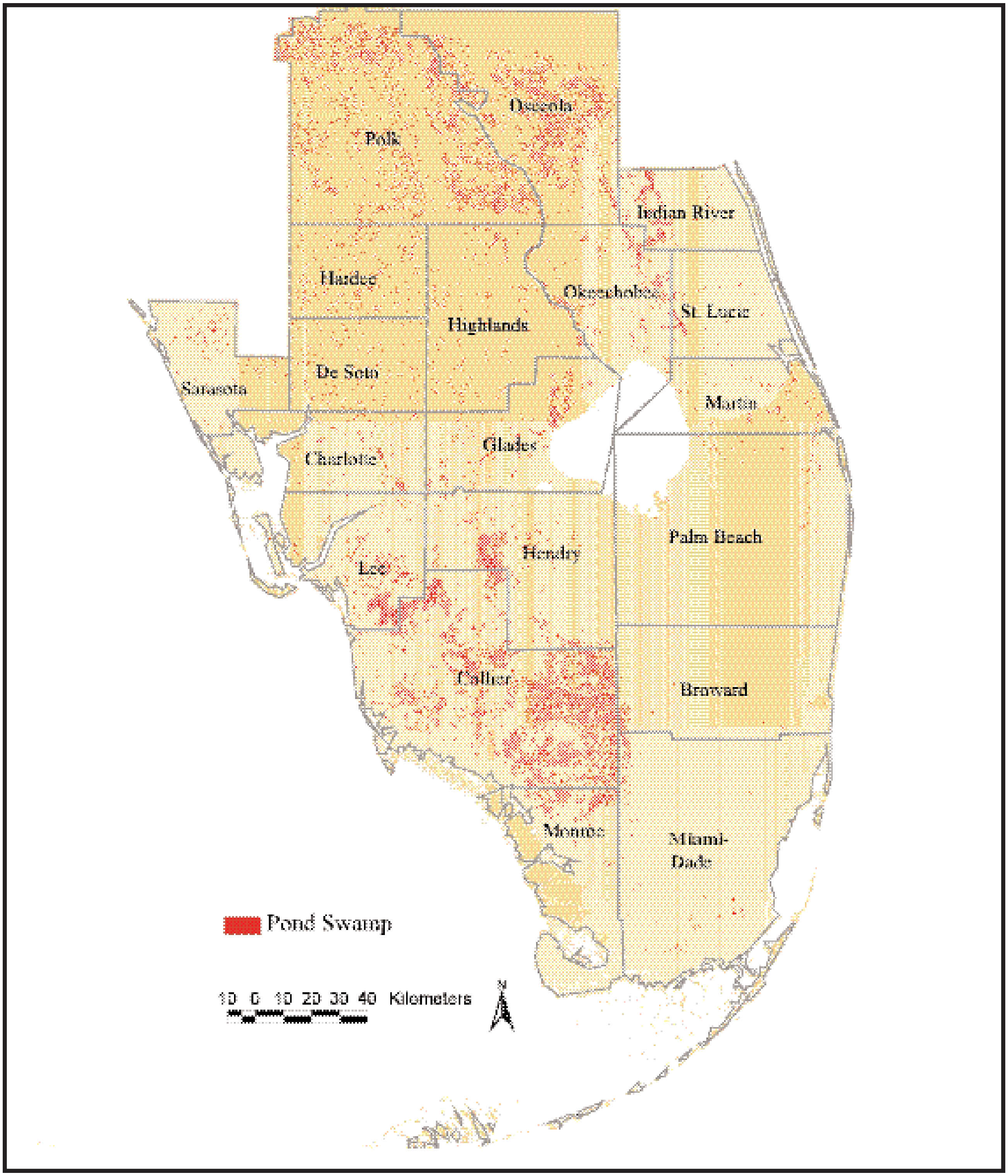

Figure 1. The occurrence of forested pond swamps in South Florida (adapted from USGS-BRD Landsat TM imagery).

Vegetative Composition

Typical dome swamp plants include pond cypress, red maple (*Acer rubrum*), dahoon (*Ilex cassine*), swamp bay (*Persea palustris*), sweetbay (*Magnolia virginiana*), coastal plain willow (*Salix caroliniana*), wax myrtle (*Myrica cerifera*), buttonbush (*Cephalanthus occidentalis*), St. john's wort (*Hypericum* spp.), chain fern (*Woodwardia* spp.), poison ivy (*Toxicodendron radicans*), laurel greenbrier (*Smilax laurifolia*), Spanish moss (*Tillandsia usneoides*), and fireflag (*Thalia geniculata*).

Dominant basin swamp plants include blackgum (*Nyssa sylvatica* var. *sylvatica*), cypress, and slash pine (*Pinus elliottii*). Other typical plants include red maple, swamp bay, sweetbay, loblolly bay (*Gordonia lasianthus*), Virginia willow (*Itea virginica*), wax myrtle, buttonbush, laurel greenbrier, and Spanish moss.

Wildlife Diversity

Typical dome swamp animals include raccoon (*Procyon lotor),* bobcat (*Felis lynx*)*,* gray squirrel (*Sciurus carolinensis*)*,* white-tailed deer (*Odocoileus virginianus*)*,* wood stork (*Mycteria americana*)*,* wood duck (*Aix sponsa*)*,* swallow-tailed kite (*Elanoides forficatus*)*,* barred owl (*Strix varia*)*,* pileated woodpecker (*Drycopus pileatus*)*,* great crested flycatcher (*Myiarchus crinitis*)*,* rusty blackbird (*Euphagus carolinus*), striped mud turtle (*Kinosternon bauri*)*,* eastern mud turtle (*Kinosternon subrubrum*)*,* eastern mud snake (*Farancia a. abacura*)*,* cottonmouth (*Agkistrodon piscivorus*)*,* oak toad (*Bufo quercicus*)*,* southern cricket frog (*Acris gryllus dorsalis*)*,* pinewoods treefrog (*Hyla femoralis*)*,* little grass frog (*Pseudacris ocularis*)*,* and narrowmouth toad (*Gastrophryne carolinensis*).

Typical basin swamp animals include Florida black bear (*Ursus americanus floridanus*)*,* raccoon, river otter (*Lutra canadensis*)*,* gray squirrel, wood duck, hawks, great horned owl (*Bubo virginianus*), barred owl, pileated woodpecker, songbirds, chicken turtle (*Deirochelys reticularia*)*,* striped mud turtle, crayfish snake (*Regina alleni*)*,* cottonmouth, cricket frog, and little grass frog.

The Carolina parakeet (*Conuropsis carolinensis carolinensis*), now extinct, was documented as feeding heavily on cypress seed (Sprunt 1954). Since the parakeets customarily flew many miles between feeding and roosting sites, it is logical that this species may have played a significant role in cypress seed dispersal. Absence of this dispersal agent might explain the problems with cypress regeneration now observed isolated pond swamps.

Wildlife Species of Concern

Federally listed species that depend upon or utilize the flowing water swamp community in South Florida include: Florida panther *(Puma (=Felis) concolor coryi),* bald eagle (*Haliaeetus leucocephalus*), wood stork (*Mycteria americana*), Everglade snail kite (*Rostrhamus sociabilis plumbeus*), Kirtland's warbler (*Dendroica kirtlandii*), and eastern indigo snake (*Drymarchon corais couperi*). Tanner (1942) reported that the ivory-billed woodpecker

Swallow-tailed kite. *Original photograph by Barry Mansell.*

(*Campephilus principalis*) occurred adjacent to swamps dominated by bald cypress and hardwoods. Biological accounts and recovery tasks for these species are included in "The Species" section of this recovery plan.

The **Big Cypress fox squirrel** (*Sciurus niger avicenna*) requires a landscape mosaic, including pine and cypress, in close proximity. The State of Florida has designated the Big Cypress fox squirrel as a threatened species.

The **American swallow-tail kite** *(Elanoides forficatus)* prefers tall pines and cypress for nesting and requires a diverse mosaic of swamp and floodplain forest, rivers and lake margins, hardwood hammocks, bayheads, prairies, sloughs, and mangroves for foraging (Meyer and Collopy 1996).

Plant Species of Concern

Federally listed species that depend upon or utilize the pond swamp community in South Florida include the Okeechobee gourd *(Cucurbita okeechobeensis okeechobeensis).* A biological account and recovery tasks for this species is included in "The Species" section of this recovery plan.

The **Okeechobee gourd** requires a sunny slough habitat with branching shrubs to climb on. It was originally most common in the pond apple swamp along the southern edge of Lake Okeechobee. Restoration of similar pond apple swamps, therefore, creates opportunities for reintroduction of this endangered species.

Ecology

Current knowledge of the ecology and conservation status of seasonally ponded isolated wetlands in the southeastern United States is summarized in Kirkman *et al.* (1998).

Hydrology

Dome swamps often derive much of their water through runoff from surrounding uplands, but they may also be connected with underground channels in which, case subterranean flows would dominate the hydrological regime. These wetlands generally function as reservoirs that recharge the aquifer when adjacent water tables drop during drought periods.

The normal hydroperiod for dome swamps is 200 to 300 days per year with water being deepest and remaining longest near the center of the dome.

A basin swamp may have a perched water table that can act as a reservoir, releasing groundwater as adjacent upland water tables drop during drought periods. The typical hydroperiod is approximately 200 to 300 days.

Fire

Fire is essential for the maintenance of a cypress dome community. Without periodic fires, hardwood invasion and peat accumulation would convert the dome to a hydric hammock or bayhead. Dome swamps dominated by bays are close to this transition.

Fire frequency is greatest at the periphery of the dome and least in the interior, where long hydroperiods and deep peat maintain high moisture levels for most of the year. The normal fire cycle might be as short as 3 to 5 years along the outer edge and as long as 100 to 150 years towards the center. The profile of a dome swamp (*i.e*., smaller trees at the periphery and largest trees near the center) is largely attributable to this fire regime. The shorter hydroperiods along the periphery permit fires to burn into the edge more often, occasionally killing the outer trees.

Cypress is very tolerant of light surface fires, but muck fires burning into the peat can kill them, lower the ground surface, and transform a dome into a pond.

Occasional fires are essential for the maintenance of cypress-dominated basin swamps. Blackgum- and hardwood-dominated basin swamps burn less often, while pine-dominated basin swamps burn more frequently.

Typical fire intervals in basin swamps may be anywhere from 5 to 150 years. Cypress and pines are very tolerant of light surface fires, but muck fires burning into the peat can kill the trees, lower the ground surface, and transform a basin swamp into a lake.

Status and Trends

Although a number of researchers have estimated wetland loss rates in Florida, little of this data is refined enough to permit meaningful estimation of the extent to which flowing water swamps have been lost. Between 1940 and 1980, Florida's total forested area declined by 27 percent (Knight and McClure 1982 cited in Noss *et al.* 1995). Since 1970, forested wetland communities throughout Florida have been reduced by 17 percent (Noss *et al.* 1995).

Land cover changes in Florida since European colonization have been estimated based upon mapping of historic vegetation types (Davis 1967, Cox *et al.* 1997). Of the forested wetland communities, open scrub cypress has been least impacted with 87 percent of its historic acreage intact (Cox *et al.* 1997). Whereas 67 percent of Florida's original cypress swamp forests and 63 percent of the swamp hardwood forests still exist today, only 38 percent of the original wetland hardwood forests remain. The percentage of these remaining forested wetlands in Florida that have been protected through public ownership to be managed as natural areas are as follows: 87 percent of open scrub cypress, 33 percent of cypress swamp forests, 25 percent of swamp hardwood forests, and 15 percent of wetland hardwood forests (Cox *et al.* 1997).

Using 1985 to 1989 Landsat satellite imagery for Florida, another mapping analysis estimated that managed areas protect 58 percent of remaining shrub swamps, 34 percent of cypress swamps, and 25 percent of hardwood swamps (Kautz *et al.* 1993 cited in Cox *et al.* 1997).

Comparative analysis of 1986 and 1991 Landsat imagery showed that St. Lucie County lost 41.5 percent of its dome swamps during that 5-year period (Duever *et al.* 1992).

Changes in the landscape matrix have had and continue to have major impacts on pond swamps. Conversion of adjacent pinelands and prairies to pastures, farm fields, citrus groves, and residential developments has restricted the normal movement of fires, sheetflow, and wildlife essential to ecological processes within these communities.

Development of much of the surrounding landscape has increased the amount of runoff that must be absorbed by the remaining wetlands. Intentional drainage of irrigated agricultural lands into wetland systems is compounding the problem in many areas. Pond swamps are especially vulnerable to such impacts because they often occur as small wetlands surrounded by agricultural lands.

In the United States, agricultural practices account for greater than 87 percent of recent wetland losses (Nelson 1989 cited in Noss *et al.* 1995).

Agricultural runoff also poses a contamination threat. Not only does it commonly contain pesticides, but it is typically enriched with fertilizer residues. These fertilizers contain nutrients that promote eutrophication. Since fertilizer composition is unregulated and many fertilizer components originate as industrial byproducts, such runoff can also be a source of toxic waste contamination.

Borrow pits, surface mines, and wellfield drawdowns can lower water tables and impact pond swamp hydrology.

Cypress domes have been used to purify secondarily treated wastewater (Brandt and Ewel 1989). This introduces excess organic matter, nutrients, and minerals to the wetland system. "Major changes observed in swamps receiving treated effluent are the development and persistence of a continuous cover of duckweed (*Lemna* spp., *Spirodela* spp., and *Azolla carolinensis*), development of anoxia in the water [Dierberg and Brezonik 1984], and an increase in passerine bird populations together with elimination of amphibian reproduction [Harris and Vickers 1984]" (Brandt and Ewel 1989).

Exotic species invasion is an increasing problem in flowing water swamps. Exotic plants reported from this community include: melaleuca (*Melaleuca quinquenervia*), Brazilian pepper (*Schinus terebinthifolius*), Japanese climbing fern (*Lygodium japonicum*), and skunk vine (*Paederia foetida*).

Exotic animals include: hog (*Sus scrofa*), house cat (*Felis silvestris*), Cuban treefrog (*Osteopilus septentrionalis*), and walking catfish (*Clarias batrachus*).

Historically, commercial interest in forested wetlands was limited to timber harvest, with little attention paid to long-term management techniques (Brandt and Ewel 1989). The mature cypress, which were especially valuable for their resistance to decay, were almost all harvested during the logging boom that peaked in the 1920s (Brandt and Ewel 1989). The total volume of standing cypress timber reached its lowest point in 1933, but has steadily increased during the last 60 years (Brandt and Ewel 1989). The second-growth trees currently available do not produce the same quality of decay-resistant lumber as the old-growth trees did; they are primarily used for fenceposts, stakes, mulch, and pulp (Terwilliger and Ewel 1986 cited in Brandt and Ewel 1989). Clearcutting is widely practiced due, in part, to the fact that all sizes of trees can be made into chips for mulch (Brandt and Ewel 1989). The cypress mulch industry is more active in north Florida, but some South Florida cypress is harvested for this purpose.

Cypress knees are harvested and sold for lamp bases, floral arrangements, and various other kinds of curios and decorative items. Since the knees' function is poorly understood, the impact of their removal is unknown.

Numerous other materials are occasionally harvested from pond swamps. Deer, hogs, and other game animals are hunted here, which affects herbivore-vegetation and predator-prey relationships. Poaching of epiphytes may deplete populations of abundant species (like *Tillandsia fasiculata*) and seriously impact less common ones. Collection of medicinal herbs is increasing in all habitats and may impact swamp vegetation in the future.

Although cattle rarely venture into the larger basin swamps, grazing has degraded many cypress domes.

Bee keeping practices may have serious effects on pollinator ecology. Exotic honeybee colonies are often maintained in wetland landscapes, where they can rely on abundant melaleuca nectar when other food is scarce. How this affects native pollinators and the reproduction of native plants is unknown. Bee keeping also poses hazards to black bears, since bee keepers sometimes shoot bears who foil their electric fences and raid their hives.

Management

Land Protection

Preservation of remaining high quality pine flatwoods and prairie buffers and pond swamps in intact landscape matrices is the highest land protection priority.

Conservation Acquisitions and Agreements

Table 1 lists conservation lands that include important Pond Swamps.

Regulatory Mechanisms

The natural resource conservation elements of county comprehensive plans, county and State development permitting policies, pollution control and vegetation management regulations, and DEP and water management district water resource protection and wetlands permitting procedures help protect pond swamps. Underfunded enforcement programs limit the effectiveness of these regulations, however. Better enforcement of existing regulations is more critical than enactment of new ones.

Restoration Projects and Programs

Historically, most wetlands restoration efforts have been directed at marsh ecosystems. Only within the past 15 to 20 years have there been significant attempts to restore forested wetlands (Clewell and Lea 1990). Given the timeframe necessary for forest regrowth, most of these projects are still too new for critical evaluation.

Forested wetland restoration efforts have been focused on two types of situations: reforestation of lands cleared for agriculture and subsequently abandoned (where the main objective is to establish a forest canopy) and restoration of wetlands cleared for surface mining projects (where the objective has been to replace the full spectrum of tree species and undergrowth components, with considerable attention given to establishing the appropriate hydrology and hastening soil development (Clewell and Lea 1990).

Based on a review of forested wetlands restoration projects, Clewell and Lea (1990) have identified six critical factors which interact to determine whether or not a project will be successful. They are hydrology, substrate stabilization, rooting volume, soil fertility, control of noxious plants, and herbivore control.

Specifically, cooperation among engineers, hydrologists, and soil scientists must be encouraged to ensure that water delivery timing, depth, and quality are synchronous with the natural systems being emulated (Clewell and Lea 1990). Flood tolerance varies widely among different species and among different size classes within species and is also dependent upon stage of the growing season (Bedinger 1979). Newly planted vegetation is particularly susceptible to water stress.

Topographic relief should be planned with substrate stabilization in mind as project sites are often open and subject to erosion which hinders the establishment of trees and undergrowth (Clewell and Lea 1990).

Soil volume must be considered as roots need an adequate volume of soil to anchor themselves and exploit moisture and nutrients (Clewell and Lea 1990). Rooting volume may be limited by depth to the wet season water table and mechanical resistance where soil density has been increased by compaction caused by heavy equipment at project sites (Clewell and Lea 1990).

Soil fertility varies considerably with the project site. Fertilization is usually necessary to prevent trees from languishing so long as saplings that they are suppressed by weeds (Clewell and Lea 1990).

Control of noxious plants is necessary where their proliferation threatens to suppress desirable species. Certain tall weed species may be beneficial as shelter for young trees, however (Clewell and Lea 1990).

On a regional scale, restoration of pine flatwoods and prairie buffers is more important to pond swamps than wetland restoration in itself.

Management Strategies and Techniques

SWFWMD has budgeted funds for research into biological control of skunk vine. Japanese climbing fern is promptly treated with herbicide when detected on SJWMD lands.

Timber harvest in cypress swamps ranges in intensity from clearcutting to thinning. The most frequently prescribed silvicultural systems are clearcutting and seed-tree cutting. There is no clear evidence that any method is significantly superior for assuring subsequent cypress regeneration, but it is clear that a seed source must be left on or adjacent to the site, that severe fires following a harvest can prevent regeneration, and that profound changes in hydroperiod, water levels, soil aeration, and/or understory vegetation can hinder seed germination and seedling survival (Brandt and Ewel 1989). When an isolated cypress dome is harvested, seed trees must be left or sufficient light must be available to assure coppice production (sprouting from the stump). Where cypress is selectively removed, cypress seedlings and saplings are likely to be outcompeted by more shade-tolerant hardwoods and coppicing may not be reliable.

Planting cypress will hasten the establishment of a new stand. Seedlings should be tall enough to escape inundation and should be protected from herbivory (Brandt and Ewel 1989).

Informal roads and trails can create wide muddy swaths and gullies through wetlands. Various types of web mats can be used to stabilize such trails. Geoweb has been used successfully for this purpose on SJWMD lands in Osceola County. Tracks from recreational vehicles, logging trucks, and other machinery can create deep ruts in soft wetland soils. As water levels subsequently rise and fall, fish and other organisms may be trapped within these pools, which affects the food chain by influencing mobility of predators and prey. Mosquitoes have been observed to be more numerous under such circumstances (Wharton *et al.* 1976).

Synonymy Tables:

BASIN SWAMP

Kuchler	113/Southern floodplain forest
Davis	7/Cypress swamp forests
	8/Swamp forests, mostly of hardwoods
NRCS	17/Cypress swamp
Myers & Ewel	Freshwater swamp forest-depression or basin wetlands
SAF	85/Slash pine-hardwood
	100/Pond cypress
	103/Water tupelo-swamp tupelo
FLUCCS	614/Gum swamp
	616/Inland ponds and sloughs
	621/Cypress

Other synonyms include gum swamp, bayheads.

DOME SWAMP

Kuchler	113/Southern floodplain forest
	112/Southern mixed forest
Davis	7/Cypress swamp forests
NRCS	17/Cypress swamp
Myers & Ewel	Freshwater swamp forests-depression or basin wetlands
SAF	85/Slash pine-hardwood
	100/Pond cypress
	103/Water tupelo-swamp tupelo
FLUCCS	613/Gum swamps
	616/Inland ponds and sloughs
	621/Cypress

Other synonyms include cypress dome or pond, cypress head, gum pond, cypress gall, pine barrens pond, non-alluvial depressional wetland, limesink pond, and (in Georgia) grady pond and citronelle pond.

Synonymy Tables: *cont.*

Where the Florida Game and Fresh Water Fish Commission's (GFC) Cypress Swamp or Hardwood Swamp communities occur in more-or-less round and isolated basins or depressions, they can be categorized as pond Swamps.

The following GAP categories can be classified as pond swamps when they occur in more-or-less round and isolated basins or depressions.

18	I.B.2.N.(d,e)....	Cold-deciduous temporarily or seasonally flooded/saturated forest (=swamp forest)
19	I.B.2.N.e.180	*Taxodium ascendens* Forest Alliance
20	I.B.2.N.f.060	*Taxodium distichum* Semipermanently flooded Forest Alliance
21	I.C.1.N.c....	Seasonally flooded tropical or subtropical semi-deciduous forest
23	I.C.3.N.c....	Seasonally flooded mixed needle-leaved evergreen-cold-deciduous forest (=mixed swamp forest)
29	II.A.2.N.b....	Seasonally flooded temperate broad-leaved evergreen woodland
32	II.B.1.N.d.010	*Taxodium ascendens* Tropical Woodland Alliance

Where the following GAP category occurs within or adjacent to another Pond Swamps type, it may also be included in this community:

36	III.A.1.N.c.030	*Myrica cerifera-Ilex cassine* Shrubland Alliance

Table 1. Proposed conservation lands important to pond swamps

Proposed Conservation Area	Notes on Forested Wetlands	Notes on Conservation Proposal
Alston Tract	Scattered cypress domes.	SWFWMD Project
Belle Meade	Dwarf cypress savannas.	1997 CARL Priority 3
Bright Hour Watershed	Mostly dry prairie with some basin swamps and a classic 100-acre baygall with gordonia. Six major slough systems within the proposed acquisition make up much of the headwaters of Prairie and Shell Creeks.	SWFWMD Group "C" Project (Land to be Evaluated)
Catfish Creek		1997 CARL Priority 22, SFWMD Project
Charlie Creek System	Drainages along the main channel of Charlie Creek and tributaries (Bee Branch, Buckhorn Creek, Little Charley Bowlegs Creek and Old Town Creek) form a series of swamps and sloughs. This system drains into the Peace River.	SWFWMD Project
Charlotte 1	Scattered cypress domes. Protects the headwaters of Telegraph Swamp.	SWFWMD Group "C" Project (Land to Be Evaluated)
Charlotte Harbor Flatwoods	Site includes strands and domes in a flatwoods matrix, but melaleuca invasion is a major problem.	1997 CARL Priority 14
Cypress Creek/Trail Ridge	Cypress and pine have been logged out of hydric hammocks and basin swamps north of SR 70, and flows from Cypress Creek, which historically passed under SR 70, have been routed west through a ditch along the north side of the highway. Most of the historic slough remains intact south of SR 70, where very little logging or ditching has been done. The Carlton lands include an impressive stand of virgin cypress (FNAI Basin Swamp EOR # 066). There are bayheads and cypress domes and a band of hydric hammock (Van Swearingen Creek) in the Trail Ridge area along the west side of Bluefield Road.	SFWMD Project
Fox Branch	Scattered cypress and mixed hardwood swamps.	SWFWMD Group "C" Project (Land to Be Evaluated)
Green Swamp	There are good strand swamps with hydric hammock islands on the Jahna property owned by sand mining company, but associated uplands have been cleared. The Overstreet tract in the southwest corner of the site has cypress domes, cypress strands, hydric hammocks, and floodplain swamps, which drain into Little Gator Creek, then into the Withlacoochee River.	1997 CARL Priority 20 and 1997 CARL LOF 1, SJWMD SOR and P-2000 Project, SWFWMD Project
Hall Ranch		1997 CARL Bargain 18

Table 1. ***cont.***

Proposed Conservation Area	Notes on Forested Wetlands	Notes on Conservation Proposal
Horse Creek	Mixed hardwood swamps. Includes portions of large headwaters swamps in the upper portion of the Horse Creek watershed. Threatened by proposed phosphate mining on adjacent lands.	SWFWMD Group "C" Project (Land to Be Evaluated)
Loxahatchee Slough	Agriculturally disturbed habitat mosaic including pine flatwoods, cypress domes, and wet prairies. Heavily infested with melaleuca and other exotic vegetation.	SFWMD Project
Osceola Pine Savannas	This is an area of old beach ridges and intervening swales, with high quality longleaf pine flatwoods interrupted by cypress strands, cypress domes, and wet prairies.	1997 CARL Priority 24
Parker-Poinciana	Includes mesic flatwoods, a large cypress/bay head, logged-over flatwoods, and hydric hammock along the Lake Hatchineha shoreline.	SFWMD Project
Ranch Reserve	Headwaters of Blue Cypress Creek. Includes high quality cypress strands, cypress domes, and hydric hammocks in a flatwoods matrix.	1997 CARL LOF 4, SJWMD SOR and P-2000 Project. Conservation easements are key to protection strategy.

Table 2. Managed areas important to pond swamps

Managed Area	Managing Entity
Avon Park Air Force Range	DOD
Collier-Seminole State Park	DEP
Three Lakes Wildlife Management Area	GFC
Triple N Ranch Wildlife Management Area	GFC

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Restoration of Pond Swamps

Restoration Objective: Prevent further reduction in area of pond swamps, protect all remaining high quality habitat, and restore and manage protected lands to maintain ecological processes and biodiversity. Restoring and maintaining swamps within a healthy fire-maintained flatwoods and prairie landscape mosaic is critical.

Restoration Criteria

The recovery objective will be achieved when: (1) a reserve design incorporating all currently protected tracts and remaining high-quality habitat has been developed and implemented; (2) pond swamps are protected through acquisition or cooperative agreements with landowners; (3) appropriate management plans have been prepared and funded for all lands within the reserve network; (4) restoration has been successfully initiated such that ecological processes are operating normally; and (5) natural succession and restoration actions through funded management programs can be expected to re-establish community structure and biodiversity on all significant degraded sites within the reserve network.

Pond swamps within the reserve system must be adequately buffered from urban and agricultural runoff.

Community-level Restoration Actions

1. **Prevent further destruction or degradation of existing pond swamps.**

   1.1. **Acquire threatened pond swamps.**

   Table 2 presents land acquisition proposals that incorporate important pond swamps that should be protected. Other important areas that should be protected include: (1) cypress domes within flatwoods matrix on Sarasota County ranchlands and: (2) basin swamp in Collier County, 8.86 km (5.5 mi) northeast of Belle Meade (FNAI EOR #013).

   There are many other pond swamps worthy of protection within local conservation systems. Natural landscapes, including healthy examples of such swamps, should be regarded as high priorities for local conservation efforts.

   1.2. **Promote conservation easements and landowner agreements to protect pond swamps.** Appropriate agreements should be negotiated with landowners.

   1.3. **Enforce regulatory protection.** Lands are seldom adequately monitored to assure compliance, and penalties and enforcement are often inadequate to motivate adherence to the law. Increased funding for regulatory monitoring and enforcement programs is needed at all levels.

1.4. **Prevent degradation of existing preserves**. Conservation lands should be maintained according to management plans to ensure that pond swamps, along with their associated flatwoods and prairie matrices, are protected from degrading land uses.

1.5. **Protect pond swamps from pollution**. Pond swamps should be protected from both point source and non-point source pollution. Special measures should be developed to protect them from agricultural runoff from surrounding farmlands.

2. **Manage pond swamps within the context of restoration objectives.**

2.1. **Restore natural fire regimes**. Emphasize landscape-scale burning that permits fires to burn into the edges of wetlands naturally. Minimize swamp-edge firebreaks.

2.2. **Control exotic plants and animals**. Control melaleuca invasion. Aggressively seek out and eliminate infestations of Japanese climbing fern and skunk vine. Control feral hog populations (with consideration for panther food base). Monitor behavior of other exotics in pond swamps and promptly initiate control programs for those that threaten to become problematic.

2.3. **Restore hydrology**. Within the context of regional hydrological restoration, manage pond swamps to maintain hydroperiods and water levels within the ranges found in natural systems.

2.4. **Restore soils**. Restore hydrological patterns and control fire to permit accumulation of peat in drained or burned swamps. In severely degraded systems, consider increasing water and nutrient levels on a temporary basis to accelerate the soil development process.

2.5. **Restore ecosystem structure and composition** by manipulating existing populations of native species, augmenting populations of native species, and reintroducing extirpated plants and animals.

2.6. **Protect seepage swamps from point source and non-point source pollution.** Design restoration projects to restore entire landscapes of integrated upland and wetland communities so that wetlands are buffered from agricultural and urban runoff.

3. **Maintain pond swamps in a natural condition.**

3.1. **Provide analogs for ecosystem functions such as fire regimes.**

3.2. **Continue to control exotic plants and animals in perpetuity.**

3.3. **Monitor for extirpations and extinctions,** and negative population trends of keystone and rare species, including pollinators, dispersers and soil organisms**.**

3.4. **Monitor and correct for both point source and non-point source pollution.**

4. **Restore pond swamps where they have been destroyed by human activities.** Use research conducted by the Florida Institute of Phosphate Research, the University of Florida Center for Wetlands, and others to recreate pond swamps according to the guidelines of the Society for Ecological Restoration.

4.1. **Restore ecosystem structure,** including soils and soil organisms, hydrology, plants, and animals.

4.2. **Restore ecosystem functions** by controlling exotics and aggressive native weeds, restoring natural fire regimes, and restoring natural biological interactions (food webs, nutrient cycling, *etc*.).

4.3. **Restore ecosystem composition** by introducing rare and late-succession species.

4.4. **Protect pond swamps from both point-source and non-point-source pollution.**

5. **Create pond swamp analogs where natural communities have been destroyed by human activities to the extent that a legitimate natural community can no longer be restored.**

5.1. **Restoration of ecosystem structure** would need to consider physical landforms, drainage patterns, soils and soils organisms, and endemic flora and fauna.

5.2. **Restoration of ecosystem functions** would include controlling exotics and aggressive native weeds, restoring hydrologic processes, restoring fire regimes, and creating natural biological interactions (food webs, nutrient cycling, *etc*.)

5.3. **Restoration of ecosystem composition** would need to consider late-succession species, rare species, and protection of the community from pollution (point source and non-point source).

6. **Connect appropriate habitats.**

6.1. **Connect ecological systems.** Pal-Mar, a project in northern Palm Beach and southern Martin Counties, is a critical connection between J.W. Corbett WMA and Jonathan Dickinson SP. When acquired, this will complete a 50,587 ha (125,000 acre) ecological greenway stretching from Dupuis Reserve close to Lake Okeechobee to Jonathan Dickinson SP.

The Belle Meade project will provide a significant linkage between Collier-Seminole SP and the future Golden Gates Estates SF.

6.2. **Protect/restore landscape matrix.** Preserve/restore flatwoods and prairies adjacent to pond swamps wherever possible. Change wetland permitting regulations so that flatwoods buffers can be restored as wetland mitigation.

6.3. **Assure maintenance of linkages critical to key species and functions.**

7. **Conduct research.**

7.1. **Determine distribution of remaining habitat.**

7.1.1. **Develop strategies for gathering, synthesizing, and groundtruthing data to permit better identification of pond swamps.** In particular, devise ways to more readily distinguish FNAI's basin swamp in GIS mapping and clarify the distinction between wet flatwoods and dwarf cypress savanna (especially where the original community is obscured by melaleuca invasion) on National Wetlands Inventory maps.

7.1.2. **Assess and supplement available data**.

7.2. **Improve reference ecosystem information regarding community composition, biodiversity, and site-to-site variability.**

7.3. **Investigate roles of pollinators, mycorrhizae, seed dispersers, and other critical or keystone species.**

7.4. Evaluate predator-prey relationships in landscape context.

8. Monitor community-level processes, community structure, and community composition.

9. Increase public awareness of pond swamp communities.