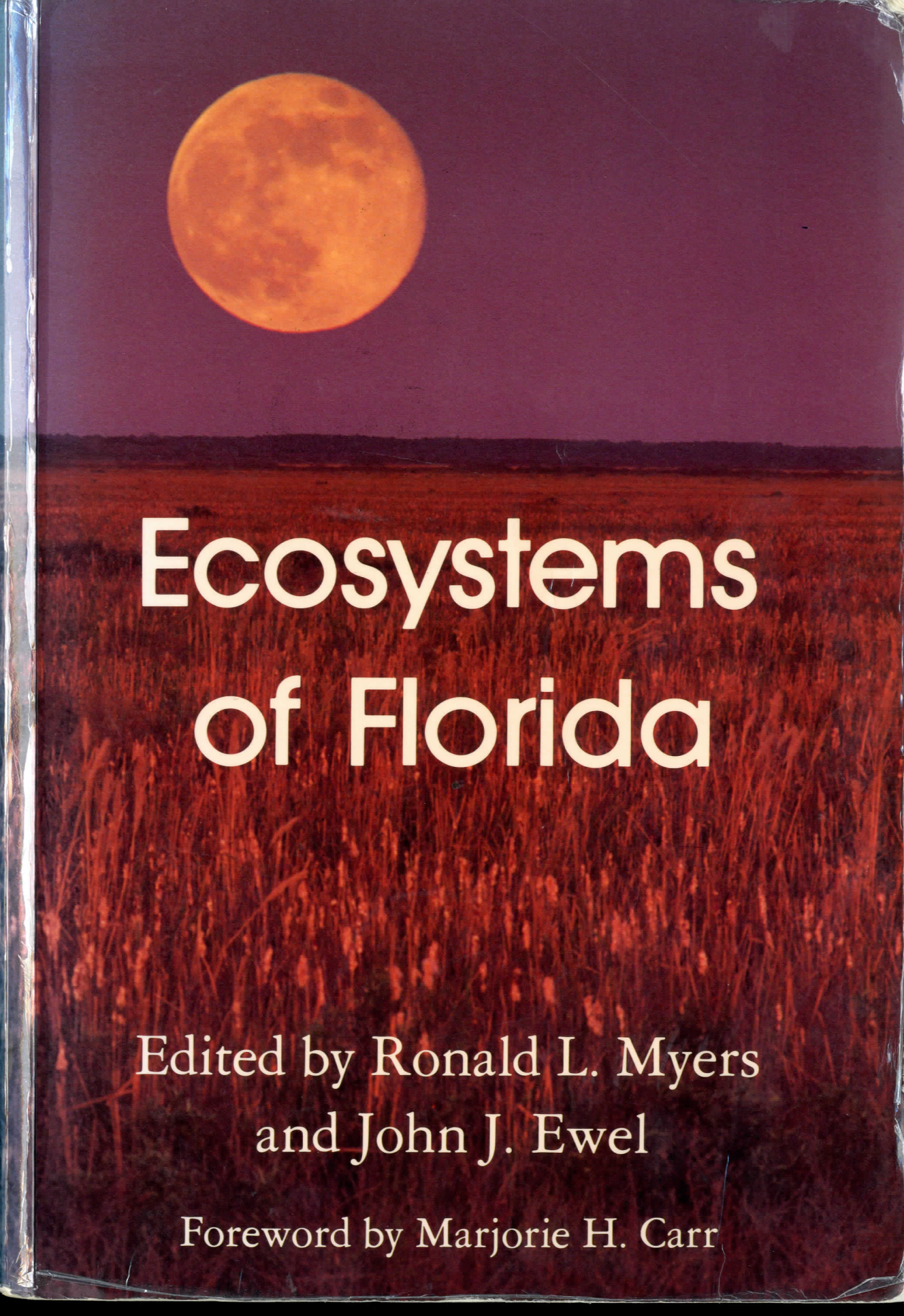
Ecosystems
of Florida
Edited by Ronald L. Myers
and John J. Ewel
Foreword by Marjorie H. Carr

Merritt Island National Wildlife Refuge. Photo by Robert Thompson.

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University of Central Florida Press/Orlando

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Contents

by sediments and plankton blooms reduces the depths to which sea grass and coral reefs can live. Eutrophication also stimulates benthic algal growth, which can prevent larval corals from recruiting, and increases microbial use of oxygen, reducing its availability in the environment. To the north, beach renourishment to counter erosion on the barrier islands of Dade, Broward, and Palm Beach counties has damaged reefs. Increased sedimentation rates, burial, and physical damage by dredge cables and anchors have all occurred there (Courtenay et al., 1974; Jaap, 1984; Goldberg et al., 1985).

Why Preserve Florida's Reefs?

Economic incentives for effective reef management are compelling and involve the sustained vitality of the commercial and recreational fishing and diving industries. These industries contribute not only to Florida's economy but also to the quality of life for residents and visitors.

A long-term incentive is the protection of low elevation human settlements, especially in the Florida Keys. The importance of Florida's shallow water reefs as offshore breakwaters is taken for granted. Sea level is rising several centimeters per decade; healthy coral reefs can build at that rate and thus continue to function as a self-tending breakwater. However, pollution not only will kill most corals but also will stimulate bioerosion of the reef framework, compounding the problem of rising sea level.

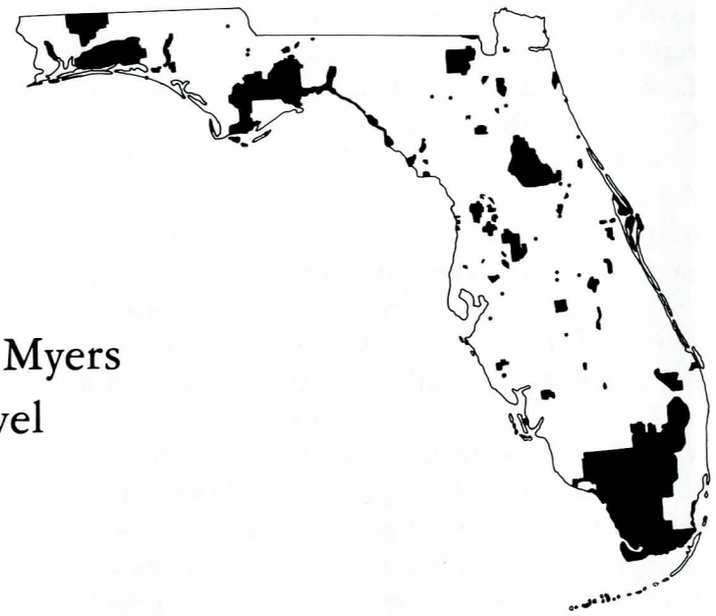
Finally, society has an ethical responsibility to conserve unique natural resources for future generations. Rational management seeks to maintain the organic evolutionary process responsible for the diversity of life found in the biosphere (Bradbury and Reichelt, 1981).

Part V

Conclusion

18

Problems, Prospects, and Strategies for Conservation



Ronald L. Myers
John J. Ewel

> Where do you go when all the fair places have been ruined? Where do you go from Florida?
>
> Raymond F. Dasmann, *No Further Retreat*

Florida's burgeoning human population is frequently identified as its primary environmental problem. Yet its population growth, coupled with the accompanying economic prosperity, has made possible much that is good for conservation, too. Most immigrants are attracted to Florida because of the quality of its environment: mild winters, lush forests, sunshine, clean air, and ready access to lakes, rivers, and seas. Floridians not only are interested in environmental quality but also are willing to invest in conservation, as demonstrated by the success of countless bond issues as well as private sector conservation activities.

In 1971, Raymond F. Dasmann wrote *No Further Retreat*, an overview of what had been lost in Florida and an outline of a strategy to save what remained. The inevitable was conceded: development would continue as

Map: *black areas* are managed areas with significant natural habitat.

Florida's population increased. The book is an odd mixture of lament, indignation, and optimism. Dasmann pointed out that much had been lost, particularly during the first seven decades of this century. Unbridled subdivision of the Florida landscape was rampant. But much had been saved, too, however precariously. He concluded that "the opportunity to win exists in Florida. The consequences of failure are unacceptable."

Two milestones have been passed since Dasmann wrote those words: Florida's population has doubled, and conservation and environmental concerns in the state have come of age. Growth and development continue, but further colossal environmental boondoggles, such as the Cross-Florida Barge Canal, are unlikely. Nor will the likes of a Gulf America Corporation again be able to do to wetlands what was done to those of southwest Florida. Today's efforts to save the last vestiges of natural Florida may involve fighting over crumbs, but also under discussion is restoration—actually undoing some of the monumental mistakes of the past.

It may be possible to put the meanders back into the Kissimmee River (fig. 18.1) and to rid the Oklawaha River of Rodman Pool and see it flowing free again. Companies now restore phosphate strip-mined lands and oil well pads; in addition, the raw materials extracted are taxed to purchase environmentally significant lands elsewhere (fig. 18.2). The Florida panther (*Felis concolor coryi*) is approaching oblivion (fig. 18.3), but Floridians are determined not to let it go. There is talk of re-introduction and recovery. The State of Florida is acquiring lands and considering corridors to connect them. For the panther itself the effort may be futile, but the cat has become the icon of conservation in Florida. Lands acquired for it will also capture less charismatic species and their habitats; corridors it might use may be used by others. In addition, Florida residents have decided to support the cause of all nongame wildlife in the state by assessing a fee when new arrivals register their automobiles.

Florida residents and visitors may soon see an Apalachicola River that is no longer dredged and national forests where maintaining natural communities takes precedence over producing timber. With nearly 2 million visitors a year, Ocala National Forest alone rivals many national parks in use by visitors. Its wildland and recreation values are superseding those of more traditional forest uses. It may even be possible to gain control over at least one of Florida's troublesome naturalized aliens: the Australian cajeput (*Melaleuca quinquenervia*). A movement is building in Florida; long a mecca for the naturalist, the state is now an exciting place for the conservation-minded.

Conservation Status of Florida Ecosystems

Two themes recur in this book: today each ecosystem is a mere fraction of what it was at the beginning of this century, and nature can no longer maintain the examples that are protected without biological management.

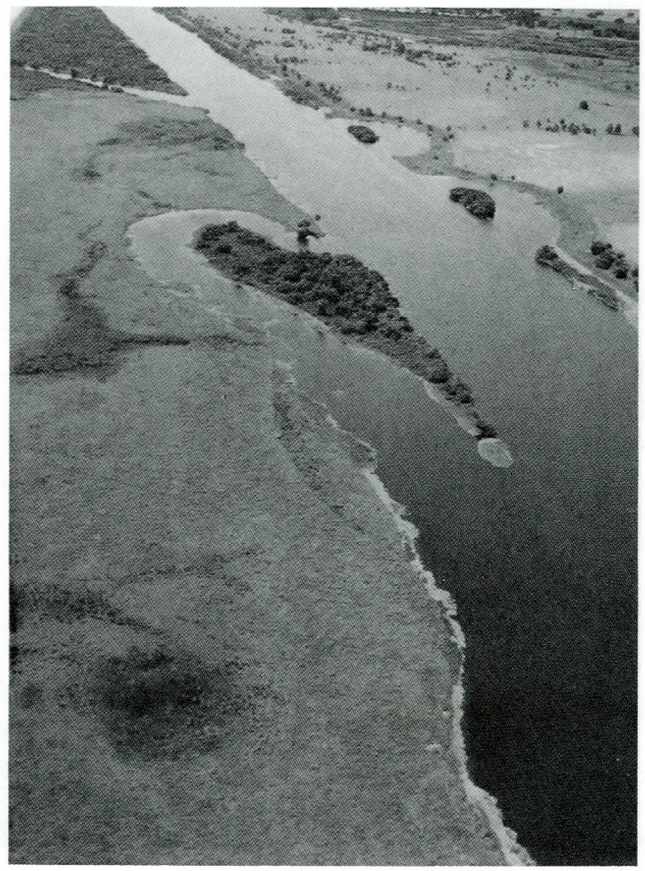


Fig. 18.1. Relict channel fragments of the Kissimmee River straddle the excavated banks of the artificial drainage canal linking Lake Kissimmee to Lake Okeechobee near State Road 70 in Okeechobee County. Photo by Allan Horton.

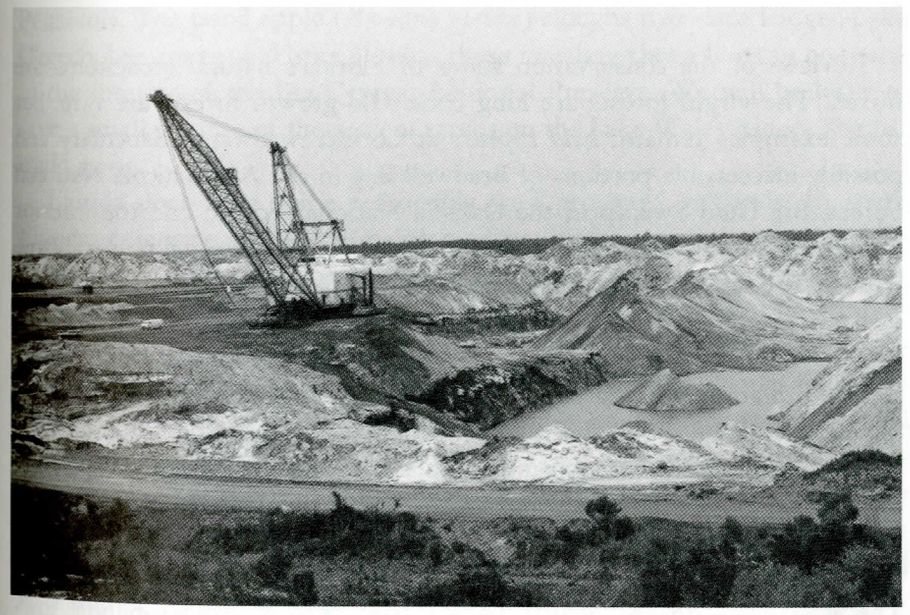


Fig. 18.2. Phosphate strip mining operation in Polk County.

Fig. 18.3. Florida panther. Photo by J. N. Layne.

Reviews of the conservation status of Florida's natural ecosystems are mixed. The virgin forests are long gone. Old-growth forests are rare, but some examples remain: *bald cypress* at Corkscrew Swamp Sanctuary and possibly inaccessible portions of Bradwell Bay in the Apalachicola National Forest, Big Gum Swamp in the Osceola National Forest, and the interior sloughs of Tosohatchee State Reserve; *slash pine stands* in the pine/cabbage palm flatwoods of Tosohatchee; *south Florida slash pine sandhills and flatwoods* at Archbold Biological Station; *subtropical pine rockland* on Big Pine Key; *bottomland hardwood forest* of Woodyard Hammock at Tall Timbers Research Station; a 65 ha pocket of *upland hardwood forest* in San Felasco State Preserve; and some inaccessible *tropical hammocks* in the Everglades.

There are surely other examples, but they are unlikely to be pristine woods. Old-growth longleaf pine forests, which might have covered more than half of the state, are gone. The flatwoods complex of communities still is extensive, but in places its character has been altered beyond recognition. The pine/grass/pitcher plant savannas (fig. 18.4) of the Panhandle lowlands once stretched from at least the Ochlockonee River westward to the Florida Parishes of Louisiana (at one time part of Florida) and served as a

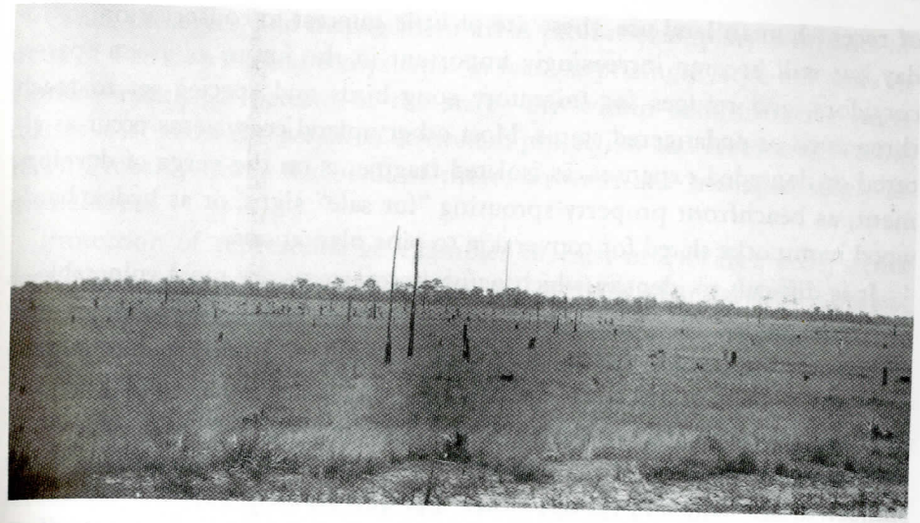


Fig. 18.4. Lowland savanna with intact ground cover community, Bay County north of Panama City in 1936. The original photo caption read, "Cut-over, denuded, burned wastelands. Note lack of seedlings or seed trees." Photo by H. E. Whitehead. From Florida State Archives.

vast matrix for seepage areas, bogs, titi-lined drainages, and cypress sloughs and bays fringed with slash pine forests. In a matter of a few decades, they have been reduced to ecotonal status between titi swamps and pine plantations. Tate's Hell in Franklin County was once savanna-like; today it is a mosaic of titi thickets and slash pine plantations. Remnant savannas occur in Apalachicola National Forest and the unprotected Garçon Point near Pensacola. The pond apple (*Annona glabra*) sloughs that once fringed Lake Okeechobee are gone. Hints of what these may have been like can be found in the interior of the Big Cypress National Preserve. We will be lucky to save a small fraction of the ancient scrubs on the Lake Wales Ridge. The list could go on.

Florida does have some reasonably well protected wetlands. In south Florida, extensive tracts are maintained in freshwater marshes and mangrove swamps—the marshes in Everglades National Park, Big Cypress National Preserve, the conservation areas of the South Florida Water Management District, Loxahatchee National Wildlife Refuge, and the mangrove swamps in Everglades National Park and Rookery Bay National Estuarine Research Reserve. In north Florida, salt marshes and estuaries are protected in a nearly unbroken crescent that extends along the Gulf coast from Chassahowitzka National Wildlife Refuge northward through Waccasassa Bay State Preserve, Cedar Keys and Lower Suwannee River national wildlife refuges, The Nature Conservancy's Big Bend purchase (Big Bend, Aucilla, and Jena wildlife management areas) to St. Marks National Wildlife Refuge.

The only upland associations that appear to be secure are second-growth broad-leaved forests and young even-aged pine stands. Considered artifacts

of recent human land use, these are of little interest to conservationists today but will become increasingly important in the future as green spaces, corridors, and refuges for migratory song birds and species yet to reach threatened or endangered status. Most other upland ecosystems occur as altered or degraded expanses, as isolated fragments on the verge of development, as beachfront property sprouting "for sale" signs, or as hydric hardwood hammocks slated for conversion to pine plantations.

It is difficult to identify which natural ecosystems are most vulnerable—all are in danger. Wetlands are afforded the most legislated protection, but all ecosystem groups—wetland, upland, aquatic, and marine—are threatened: coral reefs and inshore marine habitats face offshore oil drilling and increased turbidity; lakes, streams, and estuaries receive contaminated runoff and seepage; wetlands that do not fall within the legislative definition are subject to drainage and filling; scrubs face development because they afford few other uses and are high and dry; the pineland ground cover suffers from intensive site preparation; flatwoods and dry prairies in the lower peninsula are being converted to citrus groves; and all pyric communities are changing because fires no longer sweep across an uninterrupted landscape, while liability and air quality concerns are restricting the use of prescribed fires.

On the positive side, significant lands are being purchased by the State of Florida for conservation and recreational purposes. In 1972, the Florida Legislature established the Environmentally Endangered Lands (EEL) Program to acquire lands containing relatively unaltered ecosystems or providing critical habitat for endangered species. Acquisitions comprised 149,952 ha, including Paynes Prairie, San Felasco Hammock, Rock Springs Run, and Cape St. George. In 1979, the EEL Program was folded into the broader Conservation and Recreation Lands (CARL) Program. Both programs have been funded from an excise tax on the severance of minerals, primarily phosphate, and from a percentage of a documentary excise tax. Under the CARL program, an additional 49,724 ha have been purchased, and fifty-nine projects totaling 211,617 ha are being evaluated.

Freshwater aquatic ecosystems are finally receiving attention. In response to the degradation of the water quality and scenic values of its rivers, Florida in 1981 expanded the documentary stamp tax fee to create a Save Our Rivers Program. It has allowed the state's water management districts to acquire riparian lands deemed necessary to maintain water quality. Lakes have received similar attention. Few of Florida's 7800 lakes lack shoreline development. Two of the largest, Lake Okeechobee and Lake Apopka, once prime bass fishing lakes, have been so severely polluted that special efforts are under way to restore them. In 1987, Florida established the Surface Water Improvement and Management Program (SWIM) to promote lake restoration.

Parks, preserves, and management areas protect exemplary remnants of most of Florida's natural ecosystems. In fact, surprisingly large amounts of Florida—nearly 20 percent of the state—are within administrative units that at least allow for *potential* ecosystem protection and restoration (table 18.1). Probably fewer than half of these, however, are managed solely as natural areas.

Protection of representative examples of each of Florida's ecosystems does not ensure sufficient habitat for all of their characteristic species. Wide-ranging species like the Florida panther and the black bear are victims not only of habitat loss but also of limits imposed by habitat size. They have little future in Florida unless large blocks of their habitats are set aside.

Many species with special habitat requirements are also becoming victims of habitat loss. Beaches remain, but sea turtles rarely find them suitable for nesting. Two federally endangered plants, Harper's beauty (*Harperocallis flava*) and Bartram's ixia (*Sphenostigma coelestinum*), prefer natural seeps but are now found primarily in roadside ditches. The *Sarracenia* species (pitcher plants) may soon be joining them there. Most isolated scrub islands are too small to maintain scrub jays, which have stringent requirements for territory size.

Table 18.1. Managed areas in Florida possessing significant natural habitats

Agency/organization	No. units	Area (hectares)
Federal		
National Park Service		
National parks, monuments, preserves, and seashores	10	1,003,958
(Wilderness areas)	(1)	(524,899)
U.S. Forest Service		
National forests	3	444,569
(Wilderness areas)	(7)	(29,704)
(Research natural areas)	(2)	(341)
U.S. Air Force		
Military reservations	2	230,449
U.S. Fish and Wildlife Service		
National wildlife refuges	26	210,502
(Wilderness areas)	(11)	(20,750)
National Oceanic and Atmospheric Administration		
Estuarine reserves and marine sanctuaries (upland only)	4	329
State		
Florida Game and Fresh Water Fish Commission		
Wildlife management areas	34	285,490
Wildlife and environmental areas (state-owned only)	7	19,940

(*continued*)

Table 18.1. (continued)

Agency/organization	No. units	Area (hectares)
Water management districts		
St. Johns River	37	71,589
Southwest Florida	40	56,820
South Florida	10	44,634
Northwest Florida	3	35,913
Suwannee River	23	6,577
Florida Division of Recreation and Parks		
State preserves	8	48,889
State parks	37	45,268
State reserves	9	30,857
State recreation areas	47	16,983
State botanical sites	3	581
Historic sites	8	435
State gardens	4	180
Archaeological sites	5	118
Geologic sites	1	26
Florida Division of Forestry		
State forests	5	132,522
State universities	3	1,740
County		
Parks, reserves, and nature centers	>70	5,821
Private		
The Nature Conservancy	33	8,475
National Audubon Society	6	6,867
Other	36	8,290
	TOTAL	2,487,372

Note: Where administrative jurisdiction overlaps, the unit is included under the lead agency. Not included are 70,755 ha of submerged lands associated with some units or 40 aquatic preserves totaling 1,420,541 ha. One hectare = 2.47 acres.

Anticipated Changes

We envision four major threats to conservation and ecosystem management in Florida in the years ahead: land conversion, fire exclusion, exotic species, and water use demands.

Land Conversion

At one time, the conversion of natural ecosystems to farms and tree plantations was the major agent of landscape change in Florida. In the future, housing developments, suburban sprawl, city growth, and new roads are likely to be the greatest threats to natural communities. One important difference between these two types of conversion is that deforestation for farming or forestry is reversible, whereas concrete and asphalt are essentially permanent. Once urbanized, a forest is gone for good.

Furthermore, most construction occurs on uplands. Unlike legislatively protected wetlands, uplands are afforded little protection. An effective conservation strategy for Florida requires the identification and protection of significant areas of uplands as well as wetlands.

The waste associated with much upland development is appalling. Take, for example, 1500 acres of farm or forest, divide it into 300 lots, dig 300 wells, plant one septic tank on each plot, and add a home for three people. You will have accommodated just one day's worth of immigrants to Florida. This five-acre-ization of Florida consumes vast areas while supporting low population densities, a luxury that Floridians will not be able to afford for long if the quality of the environment is to be protected.

Fire

The expansion of housing developments and highways does not bode well for the continued use of the most important tool available to any land manager in Florida: fire (fig. 18.5). Smoke and fire are simply not compatible with suburban residents and travelers. Resource managers must prepare now for the days when burning regulations will become increasingly restrictive. The wisdom of conserving small tracts should be reconsidered, given the difficulty of conducting prescribed burns in these sites. It is also important to investigate less desirable management alternatives to fire, such as mowing, grazing, herbicides, and water level manipulation.

Fig. 18.5. Prescribed burning for ecosystem maintenance and restoration at Lower Wekiva River State Reserve, Seminole County. This reserve is located just north of the rapidly growing Orlando metropolitan area.

Exotics

Naturalized alien species present a special threat to the ecosystems of south Florida. Many plants and animals have been intentionally introduced over the years, while others have found their way to south Florida as unnoticed hitchhikers. The southern third of the peninsula is island-like, surrounded on three sides by water and on one side by frost. Like other islands, it appears to have an impoverished native biota, making it vulnerable to invasions of new species. Furthermore, modifications of south Florida's landscape by drainage, diking, burning outside the natural fire season, urbanization, and rock plowing have created vacant habitats ripe for colonization; some nonnative species have been exceptionally successful at moving into such areas.

There is some argument as to whether exotic species actively displace natives or whether they primarily colonize disturbed habitats that are not optimum sites for native species. Whichever is the case, habitat permanently occupied by aliens is unavailable to natives. Exotic species usurp resources that might be used by the native flora and fauna, resulting in a tradeoff that biologists and conservationists find objectionable. Exotic trees also change the aspect of the landscape. The afforestation of the treeless Everglades marshes by Australian cajeputs is not a welcome sight. Furthermore, many of south Florida's exotic plants are serviced by an exotic fauna. The seeds of peppertrees (*Schinus terebinthifolius*) from Brazil are dispersed by the red-whiskered bulbul (*Pycnonotus jocosus*) from India (Owre, 1973), though dispersal by Florida's resident mockingbirds (*Mimus polyglottos*) and wintering robins (*Turdus migratorius*) and waxwings (*Bombycilla cedrorum*) is infinitely more important at this time. Introduced parrots (*Aratinga* spp., *Amazona* spp.) probably would not thrive in southeast Florida without exotic fruiting trees, especially the figs. The wasp that pollinates the most widely planted exotic fig (*Ficus benjamina*) in Florida has recently found its way to Miami (D. McKey, Univ. of Miami, personal communication).

Potentially pestiferous species are seldom recognized as serious threats until their foothold is firm. For example, few people are aware that cogon grass (*Imperata cylindrica*), a pantropical grass whose spread is facilitated by fire, is moving southward down the Florida peninsula and invading disturbed pineland. The tenacity with which this species has held on to formerly forested areas in the Philippines and elsewhere should cause concern in Florida. Some exotics, like the brown anole (*Anolis sagrei*), seem destined to occur in all urban and suburban parts of Florida. The armadillo (*Dasypus novemcinctus*) occupies virtually all of Florida by now.

Anyone who has gazed over a canal filled with walking catfish and two-spot cichlids to watch parrots and parakeets cavorting in an overgrown fencerow of Australian pines, cajeputs, and peppertrees knows that exotics are in south Florida to stay. Exotic species invasions can be slowed, and perhaps even prevented, by maintaining vigorous, healthy communities of native species (Ewel, 1986). Where exotic species already dominate, however, resource managers must be prepared to face new challenges: crown fires racing through dense stands of cajeput, displacement of sparse species from intercommunity transition zones (fig. 18.6), and subtle impacts of new vegetation on hydrology, to mention only a few.

Substrate modification, such as rock plowing, diking, strip-mining, and bedding, has created soils and topographic features heretofore unknown to Florida. These human-created soils, or *anthrosols*, are likely to support new ecosystems in which exotic species play dominant roles. The Hole-in-the-Doughnut in Everglades National Park exemplifies this situation. Despite efforts by the National Park Service to restore native vegetation to this rock plowed land, a peppertree/wax myrtle/saltbush ecosystem persists there.

Water

Finally, there is the perennial issue of the use and limits of Florida's surface waters and groundwater. Development in Florida has been accomplished at the cost of immense damage to its water supplies: saltwater intrusion, contamination with agricultural pesticides and toxic wastes, and nutrient enrichment from fertilizers and sewage. Few Floridians realize that most of Florida's population draws from the same underground "river," the Floridan Aquifer, and its interconnected "tributaries." As with any watershed, impacts

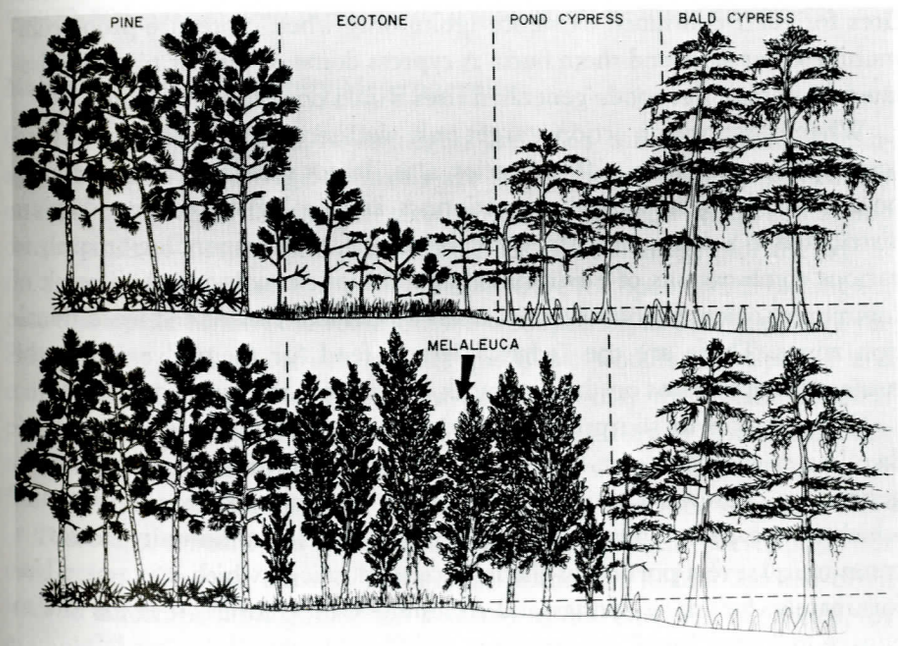


Fig. 18.6. *Melaleuca quinquenervia*, the Australian cajeput, readily invades the transition between flatwoods and pond cypress swamps. From Myers, 1984.

at the upper reaches affect quality and quantity downstream. On the bright side, in the past twenty years Florida has made tremendous progress in protecting its water and associated wetlands. The water storage and purification services that wetlands provide are no longer questioned. The role of uplands as recharge areas may be receiving the attention it deserves.

Conservation Issues and Strategies for the Future

Tomorrow's conservation issues will center on the four anticipated changes already discussed. Coping with the problems associated with land conversion, fire exclusion, the spread of alien species, and water quality degradation requires ecosystem-level strategies.

Retention of Interconnectedness

Land conversion leads to landscape fragmentation followed by piecemeal conservation efforts. One inevitable consequence is the loss of the interconnections among ecosystems. The water quality of the freshwater ponds of the Middle Keys, for example, depends on the surrounding pine and hardwood forests; the Key deer that inhabit those forests rely on the ponds for water. The oyster beds of Apalachicola Bay are dependent on the waters percolating through upland substrates located considerable distances upriver.

Land-water links are relatively obvious. Other connections are equally important, yet more subtle. Many communities that depend on occasional fires for their continued existence ignite only when more fire-prone communities that surround them burn. A cypress dome or pitcher plant bog isolated from pine flatwoods-generated fires would not survive for long.

When conservation actions target only well-recognized community types, some species inevitably suffer. Species, alas, do not recognize the community boundaries delineated by conservationists and ecologists. Rather, they are distributed in a continuum across the landscape, each responding uniquely to various combinations of environmental and biotic conditions. As a result of community-oriented conservation, many vulnerable species end up in transition zones. These are the "edges," left to fend for themselves while the manager concentrates on the hammock, the spring, the scrub, or the seep.

One solution to the problems of interconnected ecosystems and edge-dwelling species is to save larger units than would at first seem necessary. In general, to conserve a system, one must protect the next largest system of which it is a part. Thus, to save a species, save its community; to save a community, save a portion of the landscape mosaic of which it is a part. Unfortunately, for many species and communities in Florida, it is too late to engage in "ocean liner" conservation; the lifeboats are all that are left.

In comparison with other eastern states, however, Florida has done remarkably well with respect to protection of large landscape units. On a recent map of the conterminous forty-eight states illustrating areas more than 8 km from a road, one of the largest shaded areas is in the Everglades and Big Cypress Swamp of south Florida. Yet little is being done to capitalize on other opportunities. Pine flatwoods—consisting of a matrix of pine forests, pine savannas, seeps, bogs, meadows, swamps, and ponds—still occupy large areas of Florida (thanks to their economic value) and harbor species of concern to conservationists, but there is no effort under way to conserve a large unit of this landscape mosaic. In the south-central peninsula lie the flatwood landscapes of the Cecil M. Webb and J. W. Corbett wildlife management areas and the Ringling-MacArthur Reserve of Sarasota County, but no extensive flatwood landscapes are protected in the northern peninsula or the Panhandle, though opportunities still exist.

Another solution involves linking reserves through strips or corridors of natural communities (Harris, 1984). Corridors are appropriate under two circumstances. First, they are useful when they can expand the habitat available to a wide-ranging animal. A black bear or a panther, for example, might be accommodated in two reserves linked by a corridor through which the animal could commute from one habitat to the other, even though either reserve alone would be too small to maintain the animal. Second, corridors that facilitate gene flow among members of a population that might otherwise be genetically isolated are a useful conservation investment. The key to the utility of corridors is that something must move along them. If not, a corridor becomes nothing more than a long, slender, hard-to-manage reserve, and conservation investments might better be made elsewhere.

Maintenance of Community Heterogeneity

Once an area is protected, its managers are faced with a number of management dilemmas. Triage decisions are sometimes necessary, particularly on small preserves. For example, scrub jays do not inhabit scrubs containing dense stands of mature sand pine. Should scrubs be managed for the jays at the expense of the pine? Is it preferable to strive for open stands of longleaf pine that would benefit the red-cockaded woodpecker, at the expense of the Sherman fox squirrel, which prefers pine/oak woodlands? Species and communities become trendy. Experts point out that the upland longleaf pine forests have been reduced to 3 percent of their former distribution, not recognizing or acknowledging that associated oak woods have had a similar fate. Thus, current management prescriptions target only the former.

There is a tendency to look for a single management prescription for each community type, but rigid adherence to these is ill-founded and often leads to landscape homogenization and loss of diversity. All flatwoods, for example, should not look alike. Historic landscapes are useful models for management only if community dynamics are also appreciated. Many examples of each community need to be protected if the natural variability among

sites is to be preserved. Frequently, the focus is on the flashy, the rare, and the unusual as targets of protection and management, while the hordes of species in the "lower" classes of organisms—arthropods, fungi, lichens, and slime molds that not only contribute to biological diversity but also perform important ecosystem functions—are ignored.

Ecosystem-Level Conservation

Preservation of rare species and communities is a noble conservation goal, but it has two unfortunate drawbacks: it promotes a piecemeal approach to preservation, and it frequently results in species or communities being ignored until they become endangered. The Herculean efforts made to protect these rarities sometimes involve the purchase of either exorbitantly expensive and unmanageable remnants or sites where the species' natural habitat no longer exists. Impossible to burn, subject to exotic species invasions, and isolated from associated systems, they are likely transitory and of little global significance.

Although decline toward endangerment and extinction is progressive, the imperiled species and communities of tomorrow are seldom identified beforehand. In the long run, large units of the natural landscape probably capture more biological diversity than do small units containing species or communities that are currently sparse. The biological importance of Lake Wales Ridge scrub and the Dade County pine rocklands was recognized decades ago. Fortunately, a significant portion of the latter was included in Everglades National Park. In the case of scrub, the opportunity for an intact natural landscape no longer exists, and the future of the few protected pieces is uncertain. Although small conservation units do serve the important function of preserving biological curiosities for education and scientific study, an ecosystem-level approach contributes to achieving our primary goal: *sustaining the biosphere.*

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