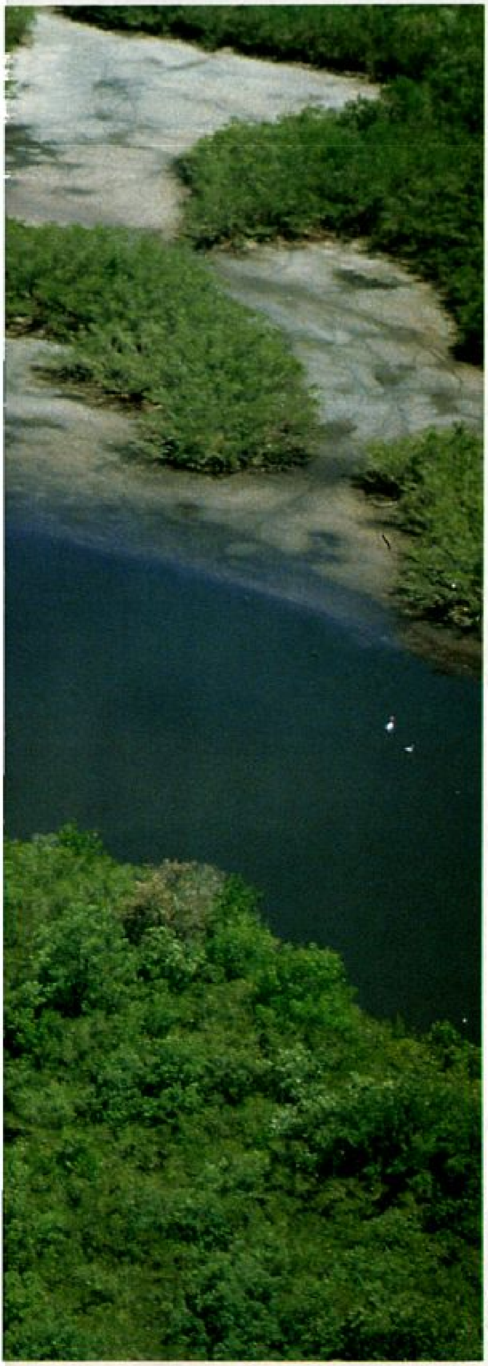
Status and conservation of wading birds in the Everglades

G. Thomas Bancroft

WETLANDS HAVE HISTORICALLY been considered wasteland and considerable private and public money has been invested in draining and "reclaiming" these areas. By the mid-1970s more than one-half the wetland acreage in the United States had been drained (Conservation Foundation 1988, U.S. Fish and Wildlife Service 1989). In recent decades, however, the public has begun to appreciate the numerous inherent benefits that wetlands provide including habitats for aquatic, avian, and terrestrial wildlife; nursery areas for commercial and recreational fisheries; flood damage reduction; and reduction of water pollution through absorption of excess nutrients. These revelations have led to the recommendation of a plan formulated by the Conservation Foundation to ensure no net loss of wetlands in the future (Conservation Foundation 1988). In 1988, the National Audubon Society formalized their long-standing commitment to the conservation and restoration of wetlands by designating it one of their five high-priority campaigns. Protection and restoration of the vast wetlands in South Florida is part of that campaign.

Historically, the Florida peninsula south of Lake Okeechobee was primarily a vast, seasonally-flooded wetland. Within that region, the Everglades covered 9900 km^2 (Parker 1974) and the Big Cypress Swamp an additional 7900 km^2 (McPherson 1974). At the height of the rainy season, most of the area was covered by a shallow sheet of fresh water up to 65 km wide which flowed slowly (<3m/day, Light *et al.* 1989) south from Lake Okeechobee, eventually turning



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southwest and connecting with the brackish-water mangrove area adjacent to the Gulf of Mexico (Fig. 1). This "river of grass" known as the Everglades, was made up of a mosaic of sawgrass (*Cladium jamaicense*) marshes, spike rush (*Eleocharis cellulosa*) sloughs and tree islands. To the west, the waters of the Big Cypress Swamp flowed south into the Gulf of Mexico and southeast into the Everglades. Pine flatwoods extended along the northwest border of the Everglades and a narrow strip of finger glades and pine flatwoods ran along the eastern edge The high ground of the Atlantic Coastal Ridge prevented most of the surface water from flowing east into the Atlantic Ocean.

One of the primary sources of the water in this vast wetland system is rainfall, which is distinctly seasonal in South Florida (Thomas 1974; Fig. 2). Over 80% of the annual rain (mean = 1357 mm, s.d. = 259, n = 25 years) falls in a six-month period, from mid-May through mid-November (Fig. 2). Rainfall amounts can vary significantly from year-to-year. During the period 1958-1987, annual rainfall varied from 975 mm in 1971 to 1908 mm in 1969. Water levels recorded at a gage located in the sawgrass marsh in Everglades National Park over a wet-through-dry season (1987–1988), illustrate a typical annual progression (Fig. 3). Water levels were at their highest at the end of the rainy season in early fall. Through the following dry season, levels receded to a mid-May low that was below ground level at this station and then quickly rose in June when summer rains began. Temporary peaks in this pattern, called reversals, were caused by local rainfall or upstream flow.

This natural cycle has been altered considerably over the past 100 years by man's attempts to drain the Everglades (Tebeau 1974, Light *et al.* 1989). In 1848, Buckingham Smith surveyed the Everglades and concluded that drainage and "reclamation" was a good idea. In the 1880s, Hamilton Disston began the construction of drainage canals around Lake Okeechobee. These plans included connecting Lake Okeechobee to the Caloosahatchee River *via* a canal that diverted water through the Caloosahatchee River to the Gulf of Mexico, bypassing the Everglades entirely. At the turn of the century, Governor Napoleon Broward promoted a plan to lower water levels five feet in the Northern Everglades and construction of an extensive network of canals and levees began in 1905. By 1947, when Everglades National Park was established, 698 km of canals draining the northern Everglades were already in place and included a series of canals that increased the volume of water that flowed into the Atlantic Ocean and the Gulf of Mexico. After 1947, the drainage project continued, eventually expanding the system to more than 2222 km of canals and levees (Fig. 4; Light *et al.* 1989). By diverting water through canals, this system effectively lowered water levels and decreased sheet flow in the Everglades, decreased the acreage of wetlands south of Lake Okeechobee by 35% (Browder 1978) and, possibly, reduced the volume of water that flows through the southern Everglades and into Florida Bay (Smith *et al.* 1989). In addition, virtually all of the finger glades in the pine flatwoods along the eastern border were drained.

This water management process effectively divided the original freshwater Everglades into three major areas (Fig. 4). The northern section is the Everglades Agricultural Area (3100 km^2) which lies immediately south of Lake Okeechobee (Tebeau 1974). This area of drained marsh is now used to grow sugar cane, rice, sod, and vegetables. The Water Conservation Areas (3400 km^2; Tebeau 1974) are located between the agricultural fields and Everglades National Park. These marshes are surrounded and crossed by a network of canals and levees. Water levels within each conservation area are highly regulated by a series of pumps and gates. The Water Conservation Areas serve multiple purposes. They are managed to provide water storage and flood protection for municipal and agricultural regions as well as to provide undeveloped lands for wildlife. The Everglades south of Tamiami Trail (U.S. Hwy. 41) includes Everglades National Park and remains a relatively natural marsh except for the eastern edge, which is overdrained. This section, known as the Northeast Shark Slough or East Everglades, has multiple owners and is being considered for addition to Everglades National Park.

Historical status of wading birds

The large concentrations of wading birds that congregate in the Everglades during the dry season are an internationally renowned phenomenon. Their presence is due in large part to the unique configuration of the Everglades marshes. Small variations in topography allow formation of isolated pools as water levels recede. These pools trap and concentrate aquatic animals produced in the flooded marshes during the wet season, and attract large numbers of wad-

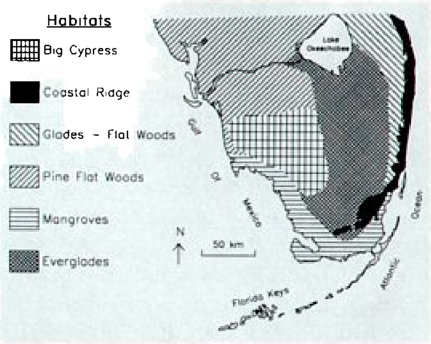


Figure 1. The habitats of south Florida before man began to drain the wetlands. Adapted from Parker 1974.

ing birds that move into the Everglades system to feed on the trapped prey (Kushlan 1976a). Historically, these wading birds nested in large colonies along the southwestern edge of the system where the freshwater Everglades spreads through the mangrove belt that borders Florida Bay and the Gulf of Mexico (Allen 1964, Robertson and Kushlan 1974, Ogden 1978, Kushlan and Frohring 1986).

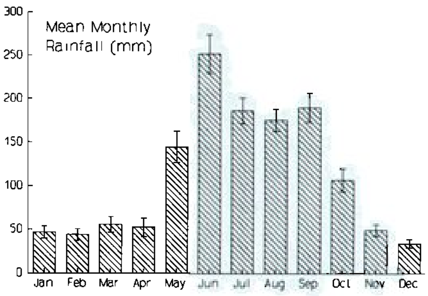


Figure 2. Mean monthly rainfall (histogram) from 1958 through 1987 at 40 mile bend along U.S. 41 in the Everglades. The vertical lines show 95% confidence limits around the means (data from U. S. Weather Service).

By the turn of the century, market hunters invaded these colonies, killing incredible numbers of breeding birds for food and the plume trade. Public outrage over this wanton slaughter focused national attention on the Everglades and helped to bring about the laws that stopped the plume trade. Thus protected, wading bird populations recovered and reached peak numbers during the 1930s (Robertson and Kushlan 1974, Ogden 1978, Kushlan and Frohring 1986, Ogden in press). Reports of the spectacular colonies along the southern edge helped to stimulate the creation of Everglades National Park in 1947 (Robertson 1959).

While the existence of these large Everglades colonies is well documented, the actual size of the colonies and the numbers of birds utilizing them are extremely controversial (Robertson and Kushlan 1974, Ogden 1978, Frohring *et al.* 1988). In an effort to more accurately document these numbers, John C. Ogden (in press) has recently evaluated the notes and reports of the Audubon wardens and sanctuary staff who spent considerable time protecting these colonies

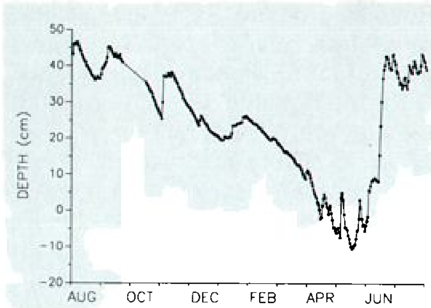


Figure 3. Water levels at a gage in the sawgrass marsh in Everglades National Park from August 1987 through June 1988 (data courtesy of Everglades National Park).

in the 1930s. Odgen estimates that during years of good nesting, between 125,000 and 150,000 pairs of wading birds attempted to nest: approximately 4000 pairs of Wood Storks (*Mycteria americana*), 20,000 pairs of herons and egrets [Tricolored and Little Blue herons (*Egretta tricolor* and *E. caerulea*), Snowy and Great egrets (*Egretta thula* and *Casmerodius albus*)]and the balance, White Ibises. Total numbers varied substantially between years depending on whether or not White Ibises (*Eudocimus albus*) attempted to nest.

Recent status of wading birds

Relatively little information exists regarding the status of wading birds between the 1930s and the 1960s and,

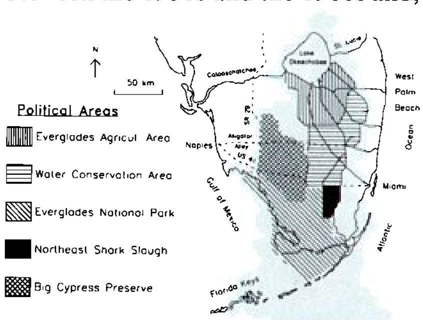


Figure 4. Current geographic areas in the Everglades region of south Florida. Canals are shown by solid lines and roads are shown by dashed lines.

*Wood Storks (*Mycteria americana*). This species is one most affected by fluctuating water levels in the Everglades, and as such is an indicator for the health of the park Photograph/Tom J. Ulrich.*

except for Wood Storks, surveys during the 1960s were neither particularly complete nor consistent.

Wood Stork

The number of Wood Stork pairs nesting in the Everglades during the 1960s varied considerably from year to year (Fig. 5) (Ogden and Nesbitt 1979, Ogden *et al.* 1987, Ogden in press). During 1959 through 1961, and again in 1965, more than 2000 pairs nested annually in the Everglades. A third peak of nesting occurred in 1967 and 1968 when between 2000 and 3000 pairs nested each year. During the 1970s, however,

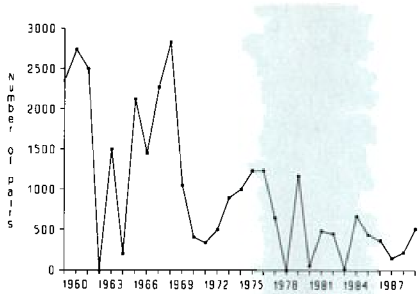


Figure 5. The number of Wood Stork pairs nesting during each spring in Everglades National Park and the Water Conservation Areas (from Ogden et al. 1987, Ogden in press).

nesting effort never reached levels approaching those of the 1960s. In four years in the 1970s between 1000 and 1300, but no more than 1500, pairs attempted to nest. The 1980s were even worse for Wood Storks: in no year did more than 1000 pairs attempt to nest although more than 500 pairs attempted nesting in 1982, 1984, and 1989. During at least one of these years, 1989, it is doubtful that many of the birds successfully produced independent young (pers. obs.). In that year, there was virtually no surface water remaining in the freshwater Everglades when young were ready to fledge, severely limiting the number of good foraging sites available for these young birds. Across the three decades, the mean number of pairs attempting to nest decreased significantly from 1800 pairs in the 1960s to 700 pairs in the 1970s to 400 pairs in the 1980s. This precipitous decline in nesting contributed to the listing of the species as endangered by the federal government in 1984 (Federal Register 28 February 1984). Because the Wood Stork's foraging ecology is so tightly linked to water depth and drying patterns, this species' decline is a key indicator that critical elements of the Everglades ecosystem have been changed.

*White Ibises (*Eudocimus albus*). Though indications are mixed, this species has been in general decline in the Everglades since the 1930s. Photograph/Dieter B. Melhorn.*

White Ibis

During the 1930s, White Ibises were the most numerous nesting wading birds with 100,000 to 120,000 pairs nesting during good years (Odgen in press). It was estimated that 66,000 White Ibis pairs had attempted to nest in 1931 and 40,000 pairs in 1937 at the East River colony (Kushlan *et al.* 1984). In 1940, approximately 48,000 pairs attempted to nest in a colony on Broad River. Surveys were not complete during the 1960s but colonies with combined totals of over 5000 pairs were found within Everglades National Park in several years (Kushlan *et al.* 1984). In 1975 and 1976, approximately 12,000 and 16,000 pairs nested, whereas in 1977 and 1978 fewer than 1000 and 100, respectively, nested (Table 1). Between the 1960s and the 1970s the location of the large nesting colonies of White Ibises shifted out of Everglades National Park north into the Water Conservation Areas. In the late 1980s, few ibises nested within the Park, and most were concentrated in the northern Water Conservation Areas. The maximum nesting effort during the late 1980s occurred in 1988 when over 10,000 pairs attempted nesting, including over 8500 pairs in Loxahatchee National Wildlife Refuge (Water Conservation Area I; Mark Maffei pers. comm.). Fewer birds nested in 1986 (2503 pairs), 1987 (4130), and 1989 (1635). These limited records suggest that the total number of pairs of White Ibises nesting in the Everglades has decreased from the 1930s and continued to decline in the 1970s and 1980s. They also indicate a northward shift of the primary nesting sites out of Everglades National Park and into the Water Conservation Areas.

Great Egret

Nesting populations of Great Egrets also appear to have decreased from the 1930s levels. Over 7000 pairs probably nested during good years in the 1930s (Odgen 1978, pers. comm.). During the 1970s and 1980s breeding populations decreased, averaging slightly more than 2000 pairs during each period (Table 1). No significant change in the number of nesting pairs occurred between these decades.

Small herons

Odgen (in press) estimated that up to 20,000 pairs of small herons (Snowy Egrets and Tricolored Herons) attempted to nest during good years in the 1930s. The number of Snowy Egret pairs nesting from 1975 through 1978, averaged only 3400 with a peak year of 5200 pairs in 1976 (Table 1). By the late 1980s, nesting attempts had declined 75% from the 1970s levels and averaged only 946 pairs per year between 1986 and 1989 with a peak of 1400 pairs in 1988.

By the mid-1970s an average of

Table 1. The number of wading bird pairs nesting in mainland Everglades National Park and the Water Conservation Areas

Species	1970s				1980s			
	1975[1]	1976[2,3]	1977[2,3]	1978[2,3]	1986[3,4]	1987[3,4]	1988[3,5]	1989[3,6]
White Ibis	11,924	16,500	620	50	2503	4130	10,592	1635
Glossy Ibis	0	50	96	0	0	0	0	0
Roseate Spoonbill	3	0	0	0	10	4	0	4
Wood Stork	1235	1238	658	0	275	100	220	515
Great Blue Heron	37	70	60	115	0	250	37	81
Great Egret	2899	1860	2190	1895	1751	2005	3069	1851
Snowy Egret	4474	5165	3646	560	1319	537	1423	506
Little Blue Heron	78	355	25	139	437	723	122	135
Tricolored Heron	2901	835	2102	475	1133	1383	1016	651
Total	23,551	26,073	9397	3234	7428	9132	16,479	5378

Data taken from: 1. Kushlan and White 1977; 2. Nesbitt *et al.* 1982; 3. NAS files; 4. Frederick and Collopy 1988; 5. P. Frederick, pers. comm.; 6. J.C. Ogden, pers. comm.

*Tricolored Heron (*Egretta tricolor*). Photograph/Ralph D. Curtin.*

only 1600 pairs of Tricolored Herons nested each year with a peak nesting attempt of 2900 in 1975 (Table 1). Between 1986 and 1989, nesting attempts decreased by a third with an average of slightly more than 1000 pairs of Tricolored Herons attempting to nest with a peak nesting of 1400 pairs in 1987.

Summary

In the 1930s, and probably through the 1960s, the center of nesting was in Everglades National Park. Following completion of the water control system during the early 1960s, the center of nesting for White Ibises, Great Egrets and possibly Tricolored Herons shifted out of mainland Everglades National Park and into the Water Conservation Areas. By the 1980s, generally more pairs of these species were nesting in the Water Conservation Areas than were nesting in mainland Everglades National Park. Since the 1930s, the number of pairs nesting in the Everglades decreased 50% for Great Egrets, 70–80% for Snowy Egrets and Tricolored Herons, and 90% for White Ibises and Wood Storks (Odgen in press).

Numbers of foraging birds

Clearly, nesting populations of wading birds in the Everglades have decreased over the past 50 years. The system, however, remains an important feeding area for many nonbreeding birds. In 1984, Martin Fleming of Everglades National Park initiated a systematic survey to examine the distribution and number of wading birds of various species feeding in Everglades National Park. With the cooperation of the South Florida Water Management District, Florida Game and Fresh Water Fish Commission, and National Audubon Society, the surveys were expanded in 1985 to cover Big Cypress National Preserve and the Water Conservation Areas.

The number of birds nesting in the Everglades represents only a fraction of the maximum number counted during a given dry season. Even during the late spring when many of the migrants had gone, fewer than half of the total number counted within the area appeared to be attending nests. During May, the total number of birds foraging in the Everglades ranged from 40,000 to 70,000 (Fleming in press; Hoffman *et al.* 1989). Only 15,000 to 30,000 of these birds were nesting (Table 1). The remainder were either young who had not reached reproductive age or adults who did not attempt to nest during that year. Our telemetry work confirms that not all adult small herons attempt to nest each year (unpubl. data).

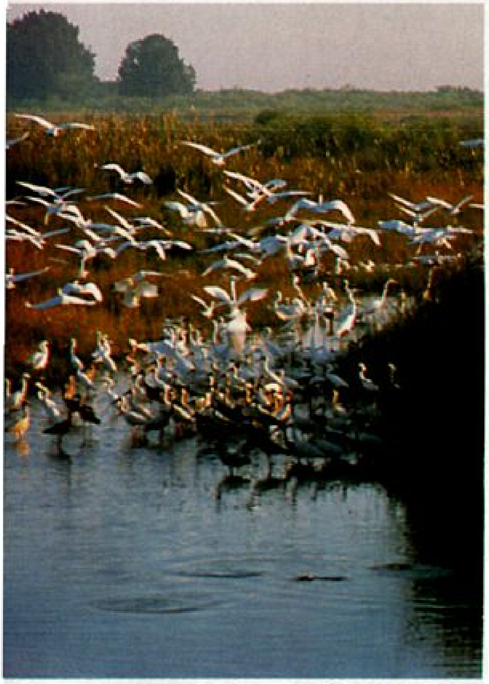
The number of wading birds foraging within the Everglades and Big Cypress fluctuates substantially during the year. During the dry season, combined populations of all wading birds ranged from a low of 60,000 to a peak of 190,000 to 210,000 birds between January and March (Fleming *et al.*, in press). During peak months, approximately two-thirds of the birds were in the Water Conservation Areas (Hoffman *et al.* 1989, unpubl. data). The White Ibis was the most common species and made up one-half to two-thirds of the total and accounted for most of the seasonal variation in numbers.

White Ibis use of the Everglades illustrates the importance of this area as a staging ground for migrants preparing to fly north (Hoffman *et al.* 1989). In the Water Conservation Areas, numbers during the dry season (December to beginning of June) vary by as much as a factor of 8, building to a peak of 75,000 to 90,000 birds between January and March. These populations are 5 to 20 times larger than the numbers that currently nest. During normal rainfall or wet years, three-quarters of the ibises leave by the beginning of April but in dry years

Mixed foraging flock of waders in the Florida Everglades. Included are Great and Snowy egrets, plus adult and immature White Ibis. Photograph/Wayne Hoffman

large numbers remain through April The ibises moving into the Everglades during January through March come from outside the Everglades-Big Cypress system, from either elsewhere in Florida or from farther south. These ibises moving into the Everglades (especially the Water Conservation Areas) appear to be using the area as feeding grounds to prepare for flights farther north. If conditions improved they might possibly stay and breed within the Everglades as appeared to have happened in 1988 when the number of White Ibis pairs nesting in South Carolina decreased by about 10,000 pairs from previous years' levels (K. Bildstein pers. comm.). Some ibises that nested in Loxahatchee National Wildlife Refuge in 1988, may have been birds that might have flown north to South Carolina had conditions not been so favorable in the Everglades that year.

Great Blue Herons (*Ardea herodias*) and Great Egrets have shown much smaller fluctuations in numbers. Within the conservation areas, numbers ranged during the dry season from 2000 to 3000 for Great Blue Herons and 10,000 to 20,000 for Great Egrets. Major shifts outside these ranges occurred when the system was either extremely dry or deeply flooded. Population estimates



for Great Egrets reached a peak during February or March of each year (Hoffman *et al.* 1989; Fleming *et al.*, in press) before decreasing substantially by April. This apparent exodus in March suggests that some birds are moving out of the system at that time, possibly migrating north to breed.

The Everglades are also an important nursery ground for young of the endangered Wood Stork. The Water Conservation Areas are a critical portion of the remaining stork habitat. Of the estimated 14,000 to 20,000 storks left in North America (north of Mexico), 1200–2000 use the Water Conservation Areas in wet years (Bancroft, Hoffman, Sawicki in prep). In dry years, when other foraging habitat is less available, 40–57% of the population uses these marshes. Considering the entire Everglades, from 15–20% (3000 birds) of the North American population uses the area during wet winters and from 50–70% uses it during dry years (10,000 birds; Fleming *et al.*, in press). A high proportion of these birds were immature, and must have come from the more productive northern colonies in central and north Florida, Georgia, and South Carolina. Although the Everglades no longer hosts most of the Wood Stork colonies in North America (Odgen *et al.* 1987), it clearly remains critical feeding habitat for the North American population.

Probable cause for the decline

Following the protection provided by National Audubon Society wardens and the cessation of the plume trade after 1910, the number of wading birds in the Everglades quickly grew to the levels of the 1930s. Colony sites have been protected since the 1930s and little hunting or physical harassment of the birds have been reported. Thus, loss of colony sites and direct human interference are not likely causes for the decline. Changes in the quantity, distribution, timing, and flow of water have affected food-prey populations in the marshes and the mechanism that makes these prey available to the birds.

Wading birds require relatively shallow water to forage efficiently. The small herons wade and forage best in water that is less than 15 cm deep (Custer and Osborn 1978, Jenni 1969, Kushlan 1976b, Powell 1987). White Ibises can wade in water up to 17 cm deep but their foraging efficiency goes down when the water becomes deeper than 10 cm because they must submerge their heads (Kushlan 1976b, Powell 1987). Great Egrets and Great Blue Herons (39 cm) can forage in deeper water (25 cm and 39 cm, respectively: Powell 1987). Wood Storks, although relatively long-legged, require shallow water and concentrated prey to forage efficiently (Kushlan *et al.* 1975). They use a tactile technique and if prey are dispersed they have difficulty obtaining sufficient quantities.

Breeding wading birds are tied to their colony for a substantial period of time while they incubate their eggs and care for their young. The nesting cycle of Snowy Egrets, Tricolored and Little Blue herons is 90 days (unpubl. data). The larger wading birds have longer cycles. During the nesting cycle, the birds are limited in their choice of foraging locations by the constraints of time spent in the colony, flight time to foraging grounds and time needed to catch enough prey for themselves and for their young. Our work shows that Great and Snowy egrets and Tricolored Herons regularly fly 10 to 20 km to forage. They successfully raise young when foraging conditions within these distances are favorable. However, following water level reversals when foraging conditions deteriorate, numerous birds abandon their nests presumably because they no longer have enough time to capture food for themselves and their young. For a high proportion of the birds in a colony to successfully produce young, there must be a continuous pattern of drying through the Everglades that results in a succession of pools with high concentrations of prey. Water events, either rainfall or man induced, that reverse the pattern of drying apparently cause large scale failures (Frederick and Collopy 1989; unpubl. data).

With the completion of the water control system in the Everglades during the 1960s, many wading birds began nesting later in the annual cycle. Some of the best evidence for this is provided by Wood Storks (Kahl 1964; Odgen in press). Wood Storks in Everglades National Park began nesting during November or December during the 1960s. During the late 1970s and 1980s they generally did not initiate nesting until February or March. By starting late they had little chance of fledging young before the summer rains caused water levels to rise in the marshes. Young that did fledge had to learn to forage under conditions of rising water and dispersed prey. Snowy Egrets, Great Egrets, and Tricolored Herons also have shown a delay in the timing of nesting making it difficult for them to complete the nesting cycle before foraging conditions deteriorate with the onset of summer rains (Odgen 1978).

The major water control structures in the Water Conservation Areas were completed during the 1960s (Light *et al.* 1989). In 1962, the gates under the Tamiami Trail (U.S. Hwy. 41) were closed, stopping all water flow out of the Water Conservation Areas and into Everglades National Park. Because of the outcry resulting from the drought and fires in the park which followed, these gates were reopened and a minimum water release schedule was put in place that was to mimic natural conditions. This plan, however, allowed for extra releases of water for flood control or water management reasons. These unnatural pulses of water caused a rise in water levels and presumably abandonment of nesting attempts by birds. The system of canals, levees, pumps and gates has apparently caused a shift in the pattern of drying in the Everglades

(Kushlan 1987). The northern ends of the Water Conservation Areas are now overdrained and water accumulates unnaturally in the southern ends. Northeast Shark Slough (East Everglades) was cut off from normal water flow by the construction of the Water Conservation Areas and the L67e canal and levee. The L67e canal runs south from the Tamiami Trail along the eastern border of Everglades National Park and cuts off water flow from Northeast Shark Slough into the Park (Fig. 4). The final drying pool in the system has been shifted north out of the Everglades National Park and into Water Conservation Area 3A. This is particularly apparent during drought years.

An additional threat

Water quality has also decreased in parts of the Everglades. Phosphorus has been identified as a key nutrient entering the Everglades from adjacent agricultural areas (Davis 1989). The natural Everglades was a nutrient-poor ecosystem and the addition of phosphorus causes rapid changes in periphyton communities and a shift from a sawgrass community to cattails (*Typha domingensis*). These two shifts cause a decrease in the wildlife value of the system. Because of increased phosphorus loading, some areas in the northern parts of the Water Conservation Areas have extensive cattail stands and little or no wading bird use (pers. obs.).

Heavy metal and pesticide influx from adjacent areas is also of major concern. Recently the Florida Game and Fresh Water Fish Commission closed the alligator harvest in the Water Conservation Areas and recommended that people not eat fish caught in the Everglades because of high concentrations of mercury in their tissues. Mercury is accumulated in higher trophic levels and its prevalence in the system might cause problems for top predators such as wading birds and eagles. The source of the mercury is not known but recently it has been found throughout the Water Conservation Areas and Everglades National Park.

Possible solution

By the beginning of the 1980s, the consensus was that the quantity, timing, distribution and flow of water through the Everglades and especially into Everglades National Park was not correct for maintaining a healthy ecosystem and a healthy wading bird population. Everglades National Park called for improvements in the timing and quantity of flows into the Park (Light *et al.* 1989). It requested that Northeast Shark Slough be reflooded and that the L67e canal and levee be removed so that sheet flow could be reestablished between Northeast Shark Slough and Everglades National Park. The South Florida Water Management District developed a rain-driven model for determining releases of water through the structures along the Tamiami Trail (MacVicar 1984). This plan called for releases to be determined by the amount of water currently in Conservation Areas 3A and 3B and the amount of rain that had fallen over the previous two weeks. The Army Corps of Engineers is currently working on a General Design Memorandum which calls for structural changes in the water management system to restore sheet flow to Northeast Shark Slough and Everglades National Park. The General Design Memorandum calls for additional structures between Water Conservation Areas 3A and 3B to improve flow into 3B and new structures under the Tamiami Trail to improve flow from 3B into Northeast Shark Slough. The L67e canal is projected to be filled or at least the levees broken so as to allow sheet flow to continue from Northeast Shark Slough into Everglades National Park. For sheet flow in Northeast Shark Slough to be restored, an 8 square mile area of agriculture and human residences that have spilled into the Slough will have to be provided with flood protection A major political lobbying effort will be needed to push the final General Design Memorandum through Congress and to find the funding for the changes recommended. Congress recently passed a bill that would add Northeast Shark Slough-East Everglades Area to Everglades National Park, but has not yet appropriated funding. This addition is critical for the restoration of the Everglades because it would improve the protection and management of this area.

*Yellow-crowned Night-Heron (*Nyctanassa violacea*) showing nuptial plumes. Photograph/L. Page Brown.*

An integrative approach

Restoration and maintenance of the Everglades will require the effective integration of numerous projects and proposed changes by various agencies The South Florida Water Management District is attempting this feat through the development of a SWIM (Surface Water Improvement and Management) plan for the Everglades (SWIM 1989). This plan calls for the enhancement of the natural resources of the Water Conservation Areas and Everglades National Park through improvements in the management of the hydroperiod of the system, water quality, and control of exotic plants. The adoption of this plan, and the successful funding of its components, will provide an important mechanism for restoring the Everglades and, if successful, improving conditions for wading birds in the system. Considerable private and public effort will be required to insure that an environmentally sound plan is adopted; the final version will reflect the political strengths of the agricultural business, developers, and environmentalists.

If, in fact, a plan is implemented that improves conditions in the Everglades, the status of wading birds using the system will be one of the first indicators of success, as they were one of the first indicators of deterioration Continued monitoring of these populations over the next decade should indicate how effective our efforts have been.

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