WADING BIRD PRESERVATION IN EVERGLADES NATIONAL PARK

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Everglades National Park was established to preserve the subtropical wilderness ecosystems of southern Florida. High among the causes for which its founders fought was the abundant bird-life of the area, especially the great population of wading birds that caught the attention and aroused the concern of the American public. These birds were not only conspicuous elements of the fauna but were also critical to the ecological functioning of their ecosystem (Kushlan 1976a). Everglades National Park (Figure 1) is a large area of several diverse but intimately related ecosystems. The management goal of this park service area is to perpetuate the natural functioning of these systems in their essential wilderness character. Thus with the park's large size and ecologically sound management goals, it should be expected that the future of its wading bird resources should be secure. Unfortunately they are not. The reasons for their ecological insecurity serve as lessons in the design and management of natural reserves.

WADING BIRDS IN THE EVERGLADES

Southern Florida wading birds include 16 species of herons, bitterns, ibis, spoonbills and storks. Their historic nesting populations have fluctuated considerably over the past century (Figure 2). The estimated primeval populations were reduced in the 1800's because of plume hunting but made a significant recovery by the 1930's (Robertson and Kushlan 1974). Populations again fell thereafter because of habitat changes until by 1975 the nine most abundant species numbered only about 130,000 birds (Kushlan and White 1977). Population changes within the area of the park were even more drastic than those in south Florida as a whole. Under natural conditions most of the birds nested in the lower Everglades, in what is now Everglades National Park. By 1975, the populations nesting in the park had been reduced to 20% of the remaining south Florida population. These 25,400 birds represent 97% reduction from population levels in the park area during the previous century. Thus reduction of both regional and especially park populations has been severe.

To judge the causes for the decline and predict the future of park wading bird populations, it is useful to examine the responses of individual species to environmental changes. Two for which data are available include the species that is presently and was historically the most abundant wading bird in the Everglades, the white ibis (*Eudocimus albus*), and one of the most specialized species, the wood stork (*Mycteria americana*). These have been studied by Kushlan (1976a, 1976b) and Kushlan et al. (1975), respectively, and the data below draw from these studies.

The white ibis is usually the most abundant species nesting within the large inland colonies. Since 1962 it has nested in the southern Everglades of Everglades National Park only irregularly (Figure 3). This is because the species has responded to changing environmental conditions by shifting colony sites from traditional locations within the park to other areas (Figure 4). The traditional park sites are now seldom used by ibis, and its largest colonies have recently been located north of the park. Colonies are established when and where food availability becomes adequate. Thus the white ibis population appears to be persisting regionally because of its ability to move out of the park to other areas of south Florida.

The wood stork has not changed nesting sites rapidly and continues to nest near its traditional sites in Everglades National Park. The nesting population in the park has declined since 1962, yearly fluctuations now being within measurement error of available techniques (Figure 5). The traditional nesting period is November and December and nesting begun in these months was successful in about half the years (Figure 6). Before 1972 most nesting began in these months but after 1962 nesting shifted to later months and consequently nesting failed more often (Figure 6). After 1962 the timing of nesting correlated with the rate at which the Everglades dried (Figure 7). Abandonment of colonies was also related to hydrologic conditions (Table 1). Water level rises in excess of about 3 cm caused desertion of colonies. The wood stork depends on high concentrations of fish made available by rapidly falling water levels during the dry season. Rising water levels cause dispersal of these concentrating fish, decreasing their availability to nesting storks. Thus the remnant wood stork population that has remained in the park depends on specific water conditions that have not been adequate to permit successful nesting at a natural frequency.

TABLE 1. Relation of water level rises to desertion of nesting colonies by Wood Storks.

Month of nesting	Magnitude of water level rise <3 cm	>3 cm
1	0%[a] (4)[b]	100% (1)
2	0% (1)	100% (13)
3	0% (1)	- (0)

[a]Percentage of instances of desertion.

[b]Number of instances of water level rise.

There have been two aspects to the recent decline in wading bird numbers in the interior Everglades. From the 1930's to the early 1960's, a regionwide decline was associated with general loss of foraging habitat. In 1962 the levee system nearly enclosing shallow reservoirs called Water Conservation Areas (Figure 1) was completed immediately north of the park and surface water movement into park marshes was changed from a shallow, broad-fronted surface to a regulated discharge restricted to four spillways. Several changes in nesting patterns noted above correlate with the installation of these structures during 1962 and ecological processes of the Everglades depend on the volume, seasonality and spatial distribution of surface water discharge from upgradient areas, the interruption and channelization of this discharge alters the functional characteristics of the park systems dependent on it and thus the ecological viability of those systems and that of some of its component species populations.

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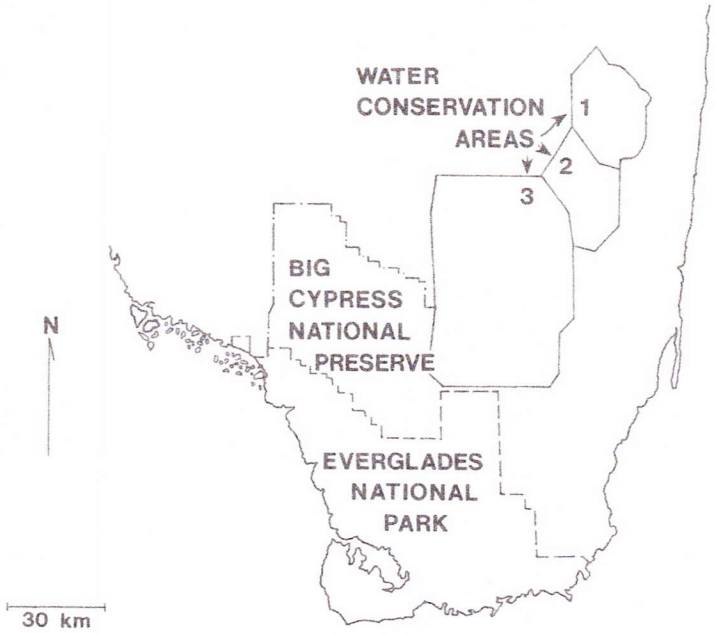

FIGURE 1. Map of southern Florida showing the contiguous preserves of Everglades National Park, Big Cypress National Preserve and three Water Conservation Areas.

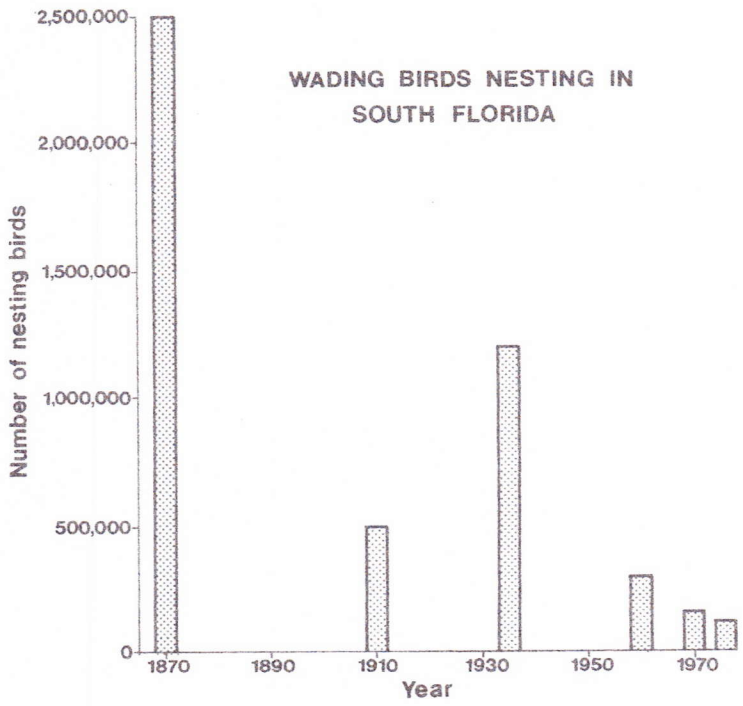

FIGURE 2. Estimated wading bird populations nesting in southern Florida. Years graphed are those for which estimates are available.

Evidence from wading bird ecology suggests that the natural ecological processes are not being perpetuated in the park. The adaptability of a generalized species such as the white ibis permits it to make range changes to accommodate changing conditions. It thus appears able to achieve an equilibrated regional population. However selecting habitats north of its traditional areas of the southern Everglades may imply that feeding habitat in the park is now relatively unsuitable. The wood stork continues to use traditional nesting sites but its low success associated with high dependence on water conditions also implies that an altered ecological system exists. Conversely, movement of wading bird colonies out of the park and lowered impact of the decreasing wood stork population deprives the system of the ecological impact of these birds and further alters the systems functional characteristics.

Thus Everglades National Park does not appear to be maintaining some populations of wading birds. Since both park site and management strategy appear beneficial to preserving these species it becomes worthwhile to examine the roles of both in the preservation of the species components of Everglades and by extension of analogous preserves.

THE ROLE OF SIZE

Determining the role of size in the perpetuation of nature preserves has not been an easy task, especially for those preserves on continents. Application of concepts derived from biogeographical theory have been discussed at length (e.g., Terborgh 1974, 1975; Sullivan and Shaffer 1975; Diamond 1975). However, purely theoretical species-area considerations have not yet been proven useful (Preston 1962). More autoecological approaches can also be taken (Simberloff and Able 1976). Setting the size limits of continental preserves at the critical habitat requirements of extinction-prone species has been suggested (Terborgh 1974; Sullivan and Shaffer 1975).

Everglades National Park is a large preserve, containing 5670 km^2, 7 to 9 times larger than the minimal areas proposed for a continental preserve by Sullivan and Shaffer (1975). The fresh and estuarine marshes and swamps composed about 4250 km^2. However the total preserved area of southern Florida is considerably larger (Figure 1). Everglades National Park is bounded by the Big Cypress National Preserve of 2370 km^2 and three Water Conservation Areas of 3490 km^2 that extend the effective area of preserved wetlands to over 10,000 km^2.

The existence of large contiguous preserved areas of wetland habitat provides a means of regional persistence of some populations. It may probably also maintain nesting wading bird populations in the park at higher levels than if these areas did not exist because they provided additional habitat. They nonetheless fail to insure the preservation of natural processes in Everglades National Park because the areas are isolated from each other by levees and roads that restrict or redistribute water flow and render each segment an independently functioning isolate. Previously, different areas of the system functioned synergistically. The impact of unusual water conditions in one area was probably soon diffused to other areas by the relatively unrestricted movement of surface water. This effectively buffered the system from atypical conditions and increased the year to year predictability of environmental events, particularly the geographic pattern of food availability, and made the southern Everglades the best wading bird habitat of the region. Now the southern Florida wetland ecosystem is functionally segmented despite its large area. What size alone failed to preserve were the functional characteristics of the system, still but faintly known, that depend upon the flow and natural movement of surface water from one area to another and the predictable regionwide pattern of drying that annually occurs in the dry season. By not preserving the entire functioning unit, the functional aspects of the system cannot be preserved intact.

This aspect of size is not accounted for by species-area considerations nor by consideration of species richness vs. habitat diversity alone. When a piece of an ecosystem is set aside as a preserve, the functional characteristics of the system within the preserved area will change. The nature of the new system will depend upon what parts of the original land area are preserved and upon land use changes adjacent to the preserve. If there are not adjacent changes and the preserve is not isolated structurally or ecologically, there should be few changes. As adjacent areas change however impact will also occur in the preserve. If the preserve is completely isolated quickly, change will also occur quickly. The consolidation of a new ecological system in a demarcated continental preserve will usually require time and will not be entirely achieved until changes in nearby land areas cease having additional impact. Only at such time, at a new level of organiization, does a continental preserve become sufficiently like an island preserve to exhibit an island-like self containment. At that point, in a stabilized ecosystem, species may still be lost because of size constraints. In such a new system these will be the least adundant and probably therefore the least critical species and the loss of such relatively rare species may bring about minimal additional change in the isolated system. In comparison with the initial system however the difference will be profound.

MANAGEMENT STRATEGIES

Many management strategies exist for mature preserves. One often proposed is that of preserving organic diversity. Because of the key role of species richness in island biogeographic theory, applying such concepts to nature preserves is premised on accepting the management goal of preserving maximum species richness (Wilson and Willis 1974; Terborgh 1974; Sullivan and Shaffer 1975). This is generally, but not always (Wilson and Willis 1974), meant to be the richness of naturally occurring species. It is generally proposed that the preservation of ecosystem processes or of entire biological communities is necessary for species preservation. Preserving ecosystem processes is the management goal of many preserves including natural areas of the U.S. National Park Service (NPS 1975). Other acceptable management goals range to single species management. When natural habitats no longer support a critical population level, a preserve may be actively manipulated to conserve a species with the remainder of the ecosystem being altered and total species diversity reduced. Management calling for ecosystem perpetuation may also in practice be inimical to preservation of natural species richness. This is because ecosystem perpetuation may be approached but not achieved in many continental preserves as described above for Everglades National Park.

There undoubtedly exist management options yet to be elaborated that may result in achieving a closer approximation of natural processes in Everglades National Park albeit not a return to its natural ecologic state. If we assume that these exist and that implementation occurs, we may then project possible effects on species richness. In nesting wading birds, we can predict that white ibis will probably maintain a regional population that may or may not return in numbers to the park.

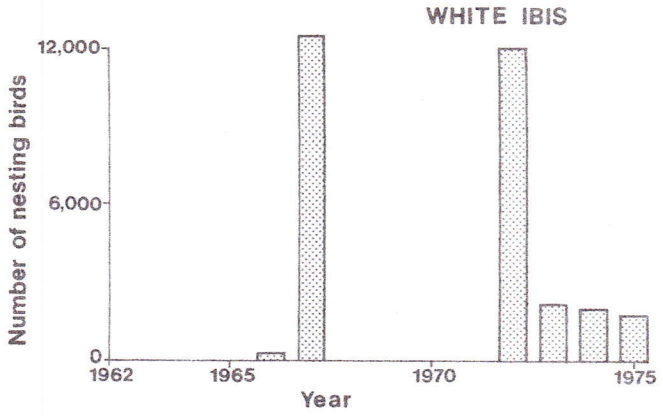

FIGURE 3. Number of white ibis nesting in interior Everglades National Park. No ibis nested in years for which there is no bar.

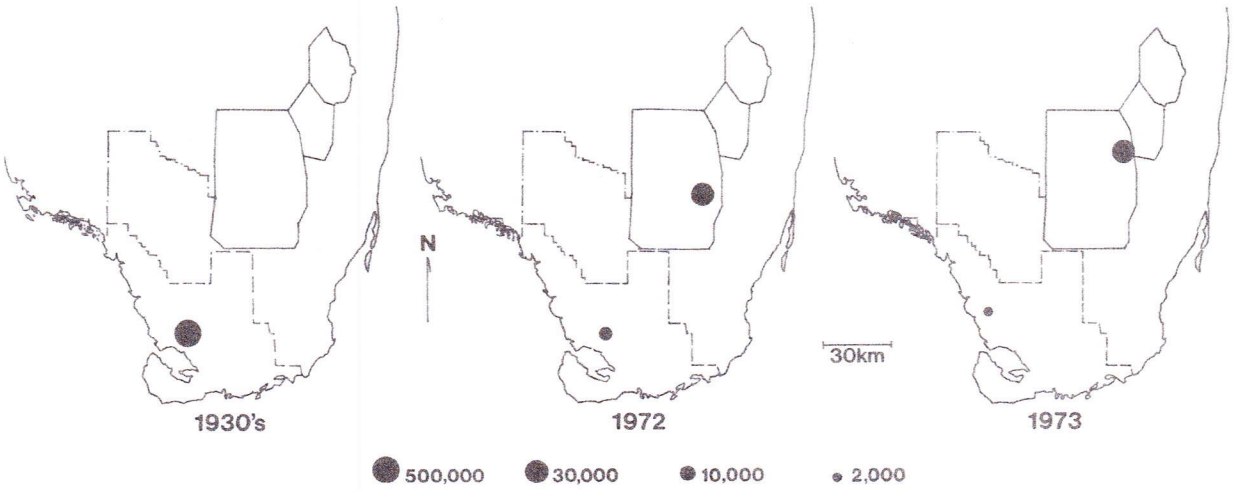

FIGURE 4. Location of white ibis nesting colonies in interior southern Florida. Size of dot indicates approximate magnitude of the nesting population.

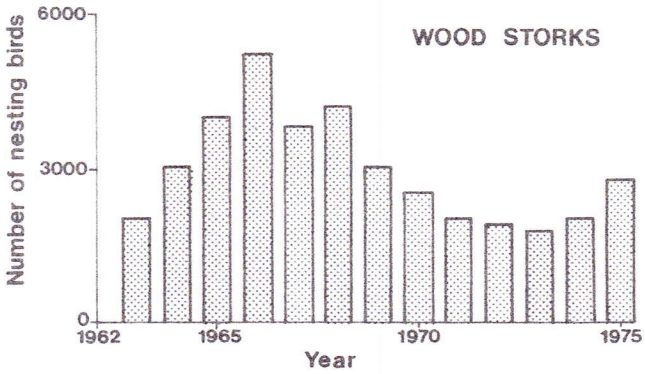

FIGURE 5. Number of wood storks nesting in interior Everglades National Park.

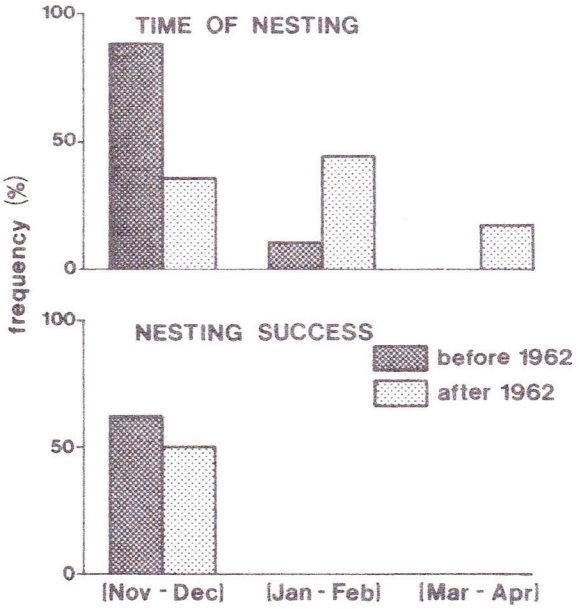

FIGURE 6. Timing and success of wood stork nesting in Everglades National Park before and after 1962. Time of nesting is expressed as a percentage of the total nesting attempts for two periods, 1953-61 and 1963-73. Nesting success is the percentage of the attempts made in each period that were successful.

Although we cannot predict its equilibrium population level, we can predict its probable continual occurrence at some level in the park. The wood stork may or may not be perpetuated in the park. Environmental conditions surrounding the park and changed equilibrium populations of associated species suggest that even the best management strategy may not be sufficient to perpetuate the wood stork in the park.

Thus a management dilemma is faced. The closest approach to maintaining most of the natural processes within the park may not be sufficient for maintaining natural species richness. In fact the relatively early truncation of the larger, more specialized members of ecological guilds is predictable in demarcated preserves. However on a management level important decisions must be made in the face of regional, or perhaps, continental extirpation of a species. Should the management strategy of a preserve attempting to perpetuate natural processes be altered for the benefit of that highly endangered species? In the case of the wood stork this might mean management accelerating drying rates or provisioning of artificial fish ponds. Or should a preserve attempt to achieve the closest approximation of natural conditions for most components of the system realizing the probable loss of species? The best may be a combined strategy. Large parks could be managed to preserve ecological processes and therefore preserve the vast majority of their biota, but may lose species. Additional preserves would be managed for the perpetuation of a particular endangered species. Recognizing the inevitability of extirpation in no way countermands the necessity to attempt to maintain all species as part of their naturally functioning ecosystem. Nor does it reduce necessity to maintain the worldwide rate of species extinction at a natural level. It does however pose the possibility of failure within limited areas and require the formulation of alternative strategies that do not disrupt the management of large preserves.

Such alternate strategies for managing an endangered species may pose a conflict in American preserves. The legal ability to manage for ecosystems at the expense of an extremely specialized species runs counter to endangered species regulations whereby an agency may undertake no action, including no action, that would further reduce critical populations of an endangered species. Perhaps providing in some areas for specific, highly manipulative management for individual species preservation and permitting in others management to approach as close as possible the maintenance of natural ecosystem processes despite some species loss may be the strategy that preserves as much as possible of the natural world.

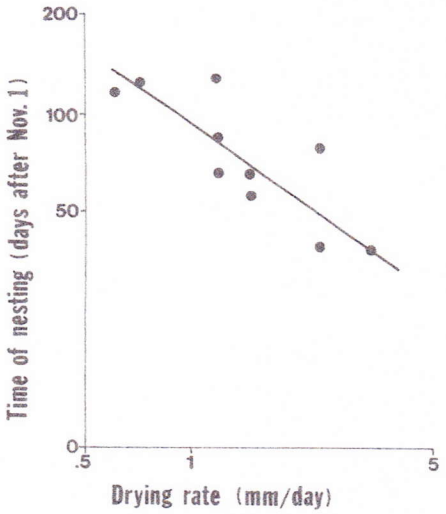

FIGURE 7. Relation between time of nesting of wood storks and the rate of drying in the southern Everglades.

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