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THE ECOLOGY OF THE MANGROVES OF SOUTH FLORIDA:
A COMMUNITY PROFILE

by

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CHAPTER 9. COMMUNITY COMPONENTS - BIRDS

9.1 ECOLOGICAL RELATIONSHIPS

Because mangroves present a more diverse structural habitat than most coastal ecosystems, they should harbor a greater variety of birdlife than areas such as salt marshes, mud flats, and beaches (MacArthur and MacArthur 1961). The shallow water and exposed sediments below mangroves are available for probing shorebirds. Longer-legged wading birds utilize these shallow areas as well as deeper waters along mangrove-lined pools and waterways. Surface-feeding and diving birds would be expected in similar areas as the wading birds. The major difference between mangrove swamps and other coastal ecosystems is the availability of the trunks, limbs, and foliage comprising the tree canopy. This enables a variety of passerine and non-passerine birds, which are not found commonly in other wetland areas, to use mangrove swamps. It also allows extensive breeding activity by a number of tree-nesting birds.

The composition of the avifauna community in mangrove ecosystems is, in fact, highly diverse. Cawkell (1964) recorded 45 species from the mangroves of Gambia (Africa). Haverschmidt (1965) reported 87 species of birds which utilized mangroves in Surinam (S. America). French (1966) listed 94 species from the Caroni mangrove swamp in Trinidad while Bacon (1970) found 137 in the same swamp. In Malaya, Nisbet (1968) reported 121 species in mangrove swamps and Field (1968) observed 76 from the mangroves of Sierra Leone (Africa).

Use of mangrove ecosystems by birds in Florida has not been recorded in detail. Ninety-two species have been observed in the mangrove habitat of Sanibel Island, Florida (L. Narcisse, J.N. "Ding" Darling Natl. Wildlife Refuge, Sanibel Is., Fla.; personal communication 1981). Robertson (1955) and Robertson and Kushlan (1974) reported on the entire breeding bird fauna of peninsular south Florida, including mangrove regions. Based on limited surveys, these authors reported only 17 species as utilizing mangroves for breeding purposes. Because their studies did not consider migrants or non-breeding

residents, a significant fraction of the avifauna community was omitted.

Based on information gleaned from the literature, we have compiled a list of 181 species of birds that use Florida mangrove areas for feeding, nesting, roosting, or other activities (Appendix D). Criteria for listing these species is the same as that used for listing reptiles and amphibians (see Chapter 8 of this volume).

Often references were found stating that a given species in Florida occurred in "wet coastal hammocks", "coastal wet forests" or the like, without a specific reference to mangroves. These species were not included in Appendix D. Thus, this list is a conservative estimate of the avifauna associated with Florida mangrove swamps. Sources for each listing are provided even though many are redundant. Food habit data are based on Howell (1932) and Martin et al. (1951). Estimates of abundance were derived from bird lists published by the U.S. Fish and Wildlife Service for the J.N. "Ding" Darling National Wildlife Refuge at Sanibel Island, Florida, and by the Everglades Natural History Association for Everglades National Park. Frequently, species were recorded from mangrove swamps at one location, but not the other.

We have divided the mangrove avifauna into six groups based on similarities in methods of procuring food. These groups (guilds) are the wading birds, probing shorebirds, floating and diving waterbirds, aerially-searching birds, birds of prey, and arboreal birds. This last group is something of a catch-all group, but is composed mainly of birds that feed and/or nest in the mangrove canopy.

9.2 WADING BIRDS

Herons, egrets, ibises, bitterns, and spoonbills are the most conspicuous group of birds found in mangroves (Figure 14) and are by far the most studied and best understood. Eighteen species (and one important subspecies) are reported from south Florida mangroves.



Figure 14. A variety of wading birds feeding in a mangrove-lined pool near Flamingo, Florida. Photograph by David Scott.

Mangrove swamps provide two functions for wading birds. First, they function as feeding grounds. Two-thirds of these species feed almost exclusively on fishes. Although much of their diet is provided by freshwater and non-mangrove marine areas, all of them feed frequently in mangrove swamps. White ibis feed predominantly on crabs of the genus Uca when feeding in mangroves (Kushlan and Kushlan 1975; Kushlan 1979). Mollusks and invertebrates of the sediments are principal foods of the roseate spoonbill although some fish are eaten (Allen 1942). Yellow-crowned night herons and American bitterns eat crabs, crayfish, frogs, and mice in addition to fishes. Snails of the genus Pomacea are fed upon almost exclusively by the limpkin. The sandhill crane is an anomaly in this group since a majority of its food is vegetable matter, especially roots and rhizomes of Cyperus and Sagittaria. Its use of mangroves is probably minimal, occurring where inland coastal marshes adjoin mangroves (Kushlan, unpubl. data). The remaining 12 species are essentially piscivorous although they differ somewhat in the species and sizes of fishes that they consume.

Mangrove swamps also serve as breeding habitat for wading birds. With the exception of the limpkin, sandhill crane, and the two bitterns, all wading bird species in Appendix D build their nests in all three species of mangrove trees (Maxwell and Kale 1977; Girard and Taylor 1979). The species often aggregate in large breeding colonies with several thousand nesting pairs (Kushlan and White 1977a). The Louisiana heron, snowy egret, and cattle egret are the most numerous breeders in south Florida mangroves (based on data in Kushlan and White 1977a).

In wet years over 90% of the south Florida population of white ibis breed in the interior, freshwater wetlands of the Everglades; during these times the mangroves are apparently unimportant, supporting less than 10% of the population (Kushlan 1976, 1977a, b). During drought years, however, production is sustained solely by breeding colonies located in mangroves near the coast (Kushlan 1977a,

b). Mangroves are critically important for the survival of the white ibis population even though they appear to be utilized to a lesser extent than freshwater habitats. This pattern of larger but less stable breeding colonies using inland marshes and smaller but more stable colonies using mangroves is also characteristic of heron populations (Kushlan and Frohring, in prep.).

Table 5 gives the number of active nests observed in mangrove regions during the 1974-75 nesting season and the percentage this represents of the entire south Florida breeding population for the nine most abundant species of waders and three associated species. The dependence of roseate spoonbills, great blue herons, Louisiana herons, brown pelicans, and double-crested cormorants on mangrove regions is evident. Nesting by the reddish egret was not quantified during this study although Kushlan and White (1977a) indicated that the only nests of this species which they saw were, in fact, in mangroves. Further observations indicate that this species nests in mangroves exclusively (Kushlan, pers. comm.). Similarly, the great white heron is highly dependent upon mangroves for nesting; they use the tiny mangrove islets which abound along the Florida Keys and in Florida Bay (Howell 1932).

During many years the Everglades population of wood storks is known to nest almost solely in mangroves (Ogden et al. 1976); this population comprises approximately one-third of the total south Florida population. Successful breeding of all these mangrove nesters is undoubtedly correlated with the abundant supply of fishes associated with mangroves. Meeting the energetic demands of growing young is somewhat easier in habitats with abundant prey. This is especially important for the wood stork which requires that its prey be concentrated into small pools by falling water levels during the dry season before it can nest successfully (Kahl 1964; Kushlan et al. 1975; Ogden et al. 1978). Breeding activity by wading birds in mangroves along the southwest and southern Florida

Table 5. Nesting statistics of wading birds and associated species in south Florida, 1974-1975 (based on data in Kushlan and White 1977a).

Species	Active nests in mangroves	% of total active nests in south Florida
White ibis	1914	7
Roseate spoonbill	500	100
Wood stork	1335	31
Great blue heron	458	92
Great egret	1812	39
Snowy egret	2377	46
Little blue heron	71	15
Louisiana heron	3410	70
Cattle egret	2180	13
Brown pelican	741	100
Double-crested cormorant	1744	83

coasts takes place throughout the year (Table 6); at least one species of wader breeds during every month. Colonies on the mangrove islands in Florida Bay were noted to be active nesting sites during all months of the year except September and October (Kushlan and White 1977a).

The seasonal movements of wood storks and white ibises between the various south Florida ecosystems were described by Ogden et al. (1978) and Kushlan (1979). Mangrove ecosystems appear to be most heavily used for feeding in summer (white ibis) and early winter (white ibis and wood stork). The remaining species of wading birds appear to use mangrove areas most heavily in the winter months, reflecting the influx of migrants from farther north.

Wading birds play an important role in nutrient cycling in the coastal mangrove zone. McIvor (pers. observ.) has noted increased turbidity, greater algal biomass, and decreased fish abundance around red mangrove islets with nesting frigate birds and cormorants. Onuf et al. (1977) reported results from a small (100 bird) rookery on a mangrove islet on the east coast of Florida. Additions of ammonium-nitrogen from the bird's droppings exceeded 1 g/m²/day. Water beneath the mangroves contained five times more ammonium and phosphate than water beneath mangroves without rookeries. Although the wading birds were shown to be a vector for concentrating nutrients, it must be noted that this is a localized phenomenon restricted to the areas around rookeries in the mangrove zone. The effect would be larger around larger rookeries. Onuf et al. (1977) also reported that mangroves in the area of the rookery had increased levels of primary production, higher stem and foliar nitrogen levels, and higher herbivore grazing impact than mangroves without rookeries. Lewis and Lewis (1978) stated that mangroves in large rookeries may eventually be killed due to stripping of leaves and branches for nesting material and by poisoning due to large volumes of urea and ammonia that are deposited in bird guano. This latter effect would be more

pronounced in rookeries within mangrove regions subject to infrequent tidal flushing.

9.3 PROBING SHOREBIRDS

Birds in this group are commonly found associated with intertidal and shallow water habitats. Wolff (1969) and Schneider (1978) have shown that plovers and sandpipers are opportunistic feeders, taking the most abundant, proper-sized invertebrates present in whatever habitat the birds happen to occupy.

Of the 25 species included in this guild (Appendix D), two are year-round residents (clapper rail and willet), two breed in mangrove areas (clapper rail and black-necked stilt), and the remainder are transients or winter residents. Baker and Baker (1973) indicated that winter was the most crucial time for shorebirds, in terms of survival. Coincidentally, winter is the time when most shorebirds use mangrove areas. The invertebrate fauna (mollusks, crustaceans, and aquatic insects) which occur on the sediments under intertidal mangroves forms the principal diet of these species. Willets and greater yellowlegs eat a large amount of fishes, especially Fundulus, in addition to invertebrates. Many of the species listed in this guild obtain a significant portion of their energy requirements from other habitats, particularly sandy beaches, marshes, and freshwater prairies. Of the species in this guild, the clapper rail is probably most dependent on mangroves for survival in south Florida (Robertson 1955), although in other geographical locations they frequent salt and brackish marshes.

9.4 FLOATING AND DIVING WATER BIRDS

Twenty-nine species of ducks, grebes, loons, cormorants, and gallinules were identified as populating mangrove areas in south Florida (Appendix D). Eight species are year-round residents while the remainder are present only during migration or as winter visitors.

Table 6. Timing of nesting by wading birds and associated species in south Florida. Adapted from data in Kushlan and White (1977a), Kushlan and McEwan (in press).

Species	Months											
	S	O	N	D	J	F	M	A	M	J	J	A
White ibis	-----				-----							
Wood stork					-----							
Roseate spoonbill					-----							
Great blue/white heron					-----							
Great egret	-----											
Little blue heron					-----							
Cattle egret	-----				-----							
Double-crested cormorant	-----											
Brown pelican					-----							

From the standpoint of feeding, members of this guild are highly heterogeneous. Piscivorous species include the cormorant, anhinga, pelicans, and mergansers. Herbivorous species include the pintail, mallard, wigeon, mottled duck, and teals. A third group feeds primarily on benthic mollusks and invertebrates. Scaup, canvasback, redhead, and gallinules belong to this group. The ducks in this last group also consume a significant fraction of plant material.

Species of this guild are permanent residents and usually breed in mangrove swamps. As shown in Table 5, the brown pelican and double-crested cormorant are highly dependent upon mangroves for nesting in south Florida even though both will build nests in any available tree in other geographical regions. It seems that when mangroves are available, they are the preferred nesting site. The anhinga breeds in mangrove regions but is more commonly found inland near freshwater (J. A. Kushlan, So. Fla. Res. Ctr., Everglades Natl. Park, Homestead, Fla.; personal communication 1981). For the other species listed in this guild, mangrove swamps provide a common but not a required habitat; all of these species utilize a variety of aquatic environments.

Kushlan et al. (in prep.) provide recent data on the abundance and distribution of 22 species of waterfowl and the American coot in south Florida estuaries. The American coot is by far the most abundant species, accounting for just over 50% of the total population. Six species of ducks were responsible for more than 99% of the individuals seen: blue-winged teal (41%), lesser scaup (24%), pintail (18%), American wigeon (9%), ring-necked duck (5%), and shoveler (3%). The major habitats included in these authors' surveys were coastal prairie and marshes, mangrove forests, and mangrove-lined bays and waterways of the Everglades National Park.

From these data it appears that waterfowl and coots are most abundant in regions where mangrove, wet coastal prairies, marshes, and open water are interspersed. Overall, the Everglades

estuaries support from 5% to 10% of the total wintering waterfowl population in Florida (Goodwin 1979; Kushlan et al. in prep.). As Kushlan et al. point out, however, the Everglades are not managed for single species or groups of species as are areas of Florida supporting larger waterfowl populations. Although the importance of south Florida's mangrove estuaries to continental waterfowl populations may be small, the effect of 70,000 ducks and coots on these estuaries probably is not (Kushlan et al. in prep.).

Kushlan (personal communication) thinks that the estuaries of the Everglades have an important survival value for some segments of the American white pelican population. In winter, approximately 25% of the white pelicans are found in Florida Bay and 75% in the Cape Sable region. They feed primarily in freshwater regions of coastal marshes and prairies and use mangroves where they adjoin this type of habitat.

9.5 AERIALY-SEARCHING BIRDS

Gulls, terns, the kingfisher, the black skimmer, and the fish crow comprise this guild of omnivorous and piscivorous species (Appendix D). These birds hunt in ponds, creeks, and waterways adjacent to mangrove stands. Many fishes and invertebrates upon which they feed come from mangrove-based food webs. Only six of the 14 species are year-round residents of south Florida. The least tern is an abundant summer resident and the remainder are winter residents or transients.

Only the fish crow actually nests in mangroves. Gulls and terns prefer open sandy areas for nesting (Kushlan and White 1977b) and use mangrove ecosystems only for feeding. All of the species in this guild are recorded from a variety of coastal and inland wetland habitats.

9.6 BIRDS OF PREY

This guild is composed of 20 species of hawks, falcons, vultures, and owls

which utilize mangrove swamps in south Florida (Appendix D). The magnificent frigatebird has been included in this group because of its habit of robbing many of these birds of their prey. Prey consumed by this guild includes snakes, lizards, frogs (red-shouldered hawk, swallow-tailed kite), small birds (short-tailed hawk), waterfowl (peregrine falcon, great-horned owl), fishes (osprey, bald eagle), and carrion (black and turkey vultures).

Eleven of these species are permanent residents, one a summer resident, and the remainder are winter residents. Their use of mangrove areas varies greatly. The magnificent frigatebird, which occurs principally in extreme southern Florida and the Florida Keys, utilizes small overwash mangrove islands for both roosts and nesting colonies. Both species of vultures are widely distributed in south Florida mangrove regions; large colonial roosts can be found in mangrove swamps near the coast. Swallow-tailed kites are common over the entire Florida mangrove region (Robertson 1955; Snyder 1974). Snyder (1974) reports extensively on the breeding biology of the swallow-tailed kites in south Florida. The nests he observed were all located in black mangroves although they do nest in other habitats.

The bald eagle, osprey (Figure 15), and peregrine falcon are dependent upon mangrove ecosystems for their continued existence in south Florida. Both the bald eagle and osprey feed extensively on the wealth of fishes found associated with mangrove ecosystems. Additionally, mangroves are used as roosts and support structures for nests. Nisbet (1968) indicated that in Malaysia the most important role of mangroves for birds may be as wintering habitat for palaeartic migrants, of which the peregrine falcon is one. Kushlan (pers. comm.) stated that recent surveys have shown falcons to winter in mangroves, particularly along the shore of Florida Bay where they establish territories. They forage on concentrations of shorebirds and waterfowl. These prey species of the peregrine

are common inhabitants of mangrove areas. This could also be true for the merlin, which like the peregrine falcon, feeds on waterfowl and shorebirds. The remaining species in this guild are probably not so dependent on mangroves; although they may be common in mangrove ecosystems, they utilize other habitats as well.

9.7 ARBOREAL BIRDS

This guild is the largest (71 species) and most diverse group inhabiting mangrove forests. Included are pigeons, cuckoos, woodpeckers, flycatchers, thrushes, vireos, warblers, blackbirds, and sparrows. We have lumped this diverse group together because they utilize mangrove ecosystems in remarkably similar ways. Invertebrates, particularly insects, make up a significant portion of most of these birds' diets, although the white-crowned pigeon, mourning dove, and many of the fringilids (cardinal, towhee) eat a variety of seeds, berries, and fruits.

As the name given this guild implies, these birds use the habitat provided by the mangrove canopy. Many birds also use the trunk, branches, and aerial roots for feeding. Several different types of searching patterns are used. Hawking of insects is the primary mode of feeding by the cuckoos, chuck-wills-widows, the kingbirds, and the flycatchers. Gleaning is employed by most of the warblers. Woodpeckers and the prothonotary warbler are classic probers.

Several of the birds in this guild are heavily dependent upon mangrove areas. The prairie warbler and the yellow warbler are subspecies of more widespread North American species (see Appendix D for scientific names). They are found largely within mangrove areas (Robertson and Kushlan 1974). The white-crowned pigeon, mangrove cuckoo, gray kingbird, and black-whiskered vireo are of recent West Indian origin. They first moved into the mangrove-covered regions of south Florida from source areas in the islands of the Caribbean. Confined at first to mangrove



Figure 15. Osprey returning to its nest in a red mangrove tree near Whitewater Bay. Photograph by David Scott.

swamps, all but the mangrove cuckoo have expanded their range in peninsular Florida by using non-mangrove habitat. In this vein it is interesting to note that many species of rare and/or irregular occurrence in south Florida are of West Indian origin and use mangroves to a considerable extent. These include the Bahama pintail, masked duck, Caribbean coot, loggerhead kingbird, thick-billed vireo, and stripe-headed tanager (Robertson and Kushlan 1974).

Twenty-four of the species in this guild are permanent residents, 27 are winter, and 6 are summer residents. Fourteen species are seen only during migrations.

9.8 ASSOCIATIONS BETWEEN MANGROVE COMMUNITY TYPES AND BIRDS

Estimating the degree of use of mangrove swamps by birds as we have done (Appendix D) is open to criticism because of the paucity of information upon which to base judgements. Estimating which mangrove community types (see section 1, Figure 4) are used by which birds is open to even more severe criticism. For this reason the following comments should be regarded as general and preliminary.

In terms of utilization by avifauna, the scrub mangrove swamps are probably the least utilized mangrove community type. Because the canopy is poorly developed, most of the arboreal species are absent, although Emlen (1977) recorded the red-winged blackbird, hairy woodpecker, northern waterthrush, yellow-rumped warbler, common yellowthroat, orange-crowned warbler, palm warbler, yellow warbler, mourning dove, and gray kingbird in scrub mangroves on Grand Bahama Island. Of 25 different habitats surveyed by Emlen (1977), the yellow warbler and gray kingbird were found in the scrub mangroves only. Aerially-searching and wading birds might use scrub mangroves if fishes are present.

Overwash mangrove islands are utilized in a variety of ways by all of the bird guilds. Most of the wading birds

plus the magnificent frigatebird, the anhinga, the cormorant, and the brown pelican use overwash islands for nesting (Kushlan and White 1977a). Wading and aerially-searching birds commonly feed in close proximity to overwash islands. A variety of migrating arboreal and probing species use the islands for feeding and roosting. Yellow and palm warblers are common around mangrove islands in Florida Bay as are the black-bellied plover, ruddy turnstone, willet, dunlin, and short-billed dowitcher. Rafts of ducks are common near the inshore islands and birds of prey such as the osprey, the bald eagle, and both vultures use mangrove islands for roosting and nesting.

Fringe and riverine mangrove communities are important feeding areas for wading and probing birds. Floating and diving and aerially-searching birds use the lakes and waterways adjacent to these mangrove communities for feeding. Many of the wading birds nest in fringe and riverine forests. For example, when the wood ibis nests in coastal areas, it uses these mangrove communities almost exclusively (Kushlan, personal communication). Most of the arboreal birds and birds of prey associated with mangroves are found in these two types of communities. This is not surprising since the tree canopy is extremely well-developed and offers roosting, feeding and nesting opportunities.

Hammock and basin mangrove communities are so diverse in size, location, and proximity to other communities that it is difficult to make many general statements about their avifauna. Since there often is little standing water in hammock forests, wading and diving birds probably are not common. Proximity to terrestrial communities in some cases may increase the diversity of arboreal species in both hammock and basin forests; proximity to open areas may increase the likelihood of birds of prey.

It seems safe to conclude that each of the six mangrove community types has some value to the avifauna. This value differs according to community type and

kind of bird group under consideration. Certainly, more information is needed, particularly concerning the dependence of rare or endangered species on specific community types.

9.9 MANGROVES AS WINTER HABITAT FOR NORTH AMERICAN MIGRANT LAND BIRDS

An interesting observation based on the data in this chapter is the seemingly important role that mangrove ecosystems play in providing wintering habitat for migrants of North American origin. Lack and Lack (1972) studied the wintering warbler community in Jamaica. In four natural habitats including mangrove forest, lowland dry limestone forest, mid-level wet limestone forest, and montane cloud forest, a total of 174, 131, 61, and 49 warblers (individuals) were seen, respectively. When computed on a per hour of observation basis, the difference is more striking with 22 warblers per hour seen in mangroves and only 1, 2, and 1 seen in the other forest habitats, respectively. For all passerines considered together, 26 passerines/hour were seen in mangroves with 5, 13, and 3 respectively in the other forest habitats. On a

species basis only 9 were recorded from mangroves whereas 19, 13, and 16 species, respectively, were seen in the other habitats. This large number of species from the other habitats appears to result from the sighting of rare species after many hours of observation. Only 9 hours were spent by Lack and Lack (1972) in the mangroves whereas between 30 and 86 hours were spent in other habitats. More time in the mangrove zone would have undoubtedly resulted in more species (and individuals) observed (Preston 1979).

Hutto (1980) presented extensive data concerning the composition of migratory land bird communities in Mexico in winter for 13 habitat types. Mangrove areas tended to have more migrant species than most natural habitats (except gallery forests) and also had a greater density of individuals than other habitats (again except for gallery forests). In both Lack and Lack's and Hutto's studies, disturbed and edge habitats had the highest number of species and greatest density of individuals. The percentage of the avifauna community composed of migrants was highest in mangrove habitats, however. From this we can infer the importance of mangroves in the maintenance of North American migrant land birds.