SNAIL KITE USE OF THE FRESHWATER MARSHES OF SOUTH FLORIDA

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Although the Snail Kite (*Rostrhamus sociabilis plumbeus*) once ranged widely throughout the freshwater marshes of Florida (Howell 1932), in recent years habitat loss and modification have greatly reduced the species' range (Sprunt 1945, 1947, 1950, Stieglitz and Thompson 1967, Sykes 1978, 1979). Kites in Florida were restricted principally to the headwaters of the St. Johns River, the Savannas, Lake Okeechobee, Loxahatchee Slough, and the Everglades from 1967 through 1980, although other areas were used for short periods. In this paper I describe the area, and habitats used by kites between 1967 and 1980 and discuss their importance to maintenance of the kite population.

METHODS

Freshwater marshes of southern Florida (south of 28° N Latitude) were visited and the presence of Snail Kites observed each year from 1967 through 1980, and standardized censuses were conducted annually in November and December 1969 through 1980, by methods explained elsewhere (Sykes 1979, 1982). I also used observations of contributors. I did not include in this report sightings of transient birds outside their principal use areas. Small marshes in the northern half of the Florida peninsula and in the Big Cypress Region of Collier County have not been included because of incomplete data. I determined the extent of marsh habitat, past and present, from published sources and field investigations. I plotted former and extant marshes on Florida Department of Transportation general highway maps for the counties (scale 1:126720) and on U.S. Geological Survey maps (1:24000). I measured the areas plotted twice with a compensating polar planimeter and averaged the readings. The habitats are shown in detail in Sykes (1984). Water levels discussed for Lake Kissimmee, Lake Okeechobee, and the Everglades Region were obtained from the "Monthly report of operations" of the U.S. Army Corps of Engineers, Jacksonville District, Florida, and I measured water depths at selected sites.

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Study Areas

Lake Kissimmee is a shallow central Florida lake halfway between Orlando and Lake Okeechobee with the channelized Kissimmee River passing through it. Narrow marshes bordering most of the east, north, and northwest sides were used by kites. A few small marshes are also scattered along the west side. The manipulated water level ranges widely from 12 to 16 m mean sea level (msl), drying the marsh for long periods in some years and flooding it deeply in others.

The St. Johns River in eastern Florida drains north through a series of shallow lakes. The headwaters is a broad freshwater marsh extending south from Lake Helen Blazes. The original unbroken marsh was similar in appearance to the Everglades (Sincock 1958). Drainage began in 1910 (Kettle 1912), and with the completion of the C-54 Canal in 1970, the last vestige of natural marsh in the area was drained. South of S.R. 60, completed in 1931 (A.L. Goodwin pers. comm.), the water table was lowered as much as 1.8 m. Approximately 608 km^2 (62%) of the original marsh have been drained, and most of the remaining is dry for most of the year with water hyacinth (*Eichhornia crassipes*) clogging the open-water areas. Three reservoirs, water depths 0.1 to 1.2 m, provide the only kite habitat in the St. Johns: the St. Johns Reservoir (712 ha), created in 1968 (Jack Purvis pers. comm.) (Indian River County); the Cloud Lake Reservoir (259 ha), completed in 1960 (John C. Norris pers. comm.) (northern St. Lucie County); and the Strazzulla Reservoir (65 ha) constructed in 1960 (Terry Mackey pers. comm.) (on the SW corner of Cloud Lake). These impoundments are used for water storage for citrus groves.

The Savannas is a long narrow freshwater marsh, water depths 0.1 to 1.5 m, between Ft. Pierce and Jensen Beach, lying west of and parallel to the Indian River. The marsh averages less than 1 km wide and is traversed by two roads and a railroad track. Only the northern 4 km of marsh north of Weatherbee Road in Savannas County Park is used by kites. About 7% of the historical marsh has been lost. Water levels are kept high by pumping.

Lake Okeechobee, lying in a shallow basin in southcentral Florida, is 60 km north to south and 50 km east to west. Most of the lake is open water but large marshes 0.8 to 14.5 km wide on the west side, extending from the Kissimmee River to Clewiston, are used by kites. Relatively little marsh exists on the north and east sides of the lake. Land elevations in the marshes range from 3 to 4.6 m msl and occasionally higher (Pesnell and Brown 1977). Water inflow is primarily from the north and west, and outflow is south into the Everglades (Parker et al. 1955). The lake level has fluctuated from 3.1 in 1956 and 1971 to 6.1 m msl in 1912. Before widespread drainage and construction of the levee system, it was generally assumed that the lake level commonly fluctuated around 6.1 m msl (Pesnell and Brown 1977). From 1967 through 1980, the lake level ranged from 3.1 to 5.4 m msl and was controlled by levees and locks. Most of the marsh vegetation within the levee system is a result of much lower lake levels since 1912. Prior to 1912 marshes were mainly outside the location of the present levee system (Harshberger 1914, Pesnell and Brown 1977). These marshes are used by kites extensively. The punk-tree (*Melaleuca quinquenervia*) has invaded north into the southern fringe of the marsh from the rim-canal. Water hyacinth occurs along the edge of the marshes and at a few scattered sites elsewhere. This plant is periodically controlled by herbi-

cide applications, but the effect is temporary. Alteration of water level regimes on Lake Okeechobee began when four large canals, the Hillsboro, Miami, New River, and West Palm Beach, were dug between 1906 and 1921 to drain the lake through the Everglades to the Atlantic Ocean. The St. Lucie Canal was dug in 1926 (Tebeau 1971). Between 1920 and 1926 a low muck levee was built on the south and east sides of the lake. The first levee around the lake was constructed between 1932 and 1938, and the present levee system was completed in 1978.

The Loxahatchee Slough is a long relatively narrow wetland, water depths 0 to 1.1 m, west of West Palm Beach and was formerly connected to the Everglades to the southwest. Drainage of the area began in 1913, and water movement was further altered by construction of a railroad across the middle of the slough in 1926 (Stockbridge and Perry 1926). After 1959, the C-18 Canal drained the northern part. Historically the slough was heavily used by kites, at least in some years (Howell 1932, Sykes 1984), but at present only the Lake Park Reservoir is occasionally used by the birds. All other remaining portions of the slough are dry much of each year.

The Everglades (Fig. 1) occupies a shallow basin extending 161 km from Lake Okeechobee to Florida Bay and is 48-80 km wide. Land elevations range from 5.8 m msl near Lake Okeechobee to 0.3 m msl in the south. The original

Fig. 1. Snail Kite habitat in southeastern Conservation Area 3A, Broward County, Florida. An aquatic slough white water lily (*Nymphaea odorata*) is in the foreground and sawgrass (*Cladium jamaicensis*) stands and a tree island are in the background. Kites hunt for apple snails over the sloughs.

marsh has been reduced about 45%. The remainder is managed in the Loxahatchee N.W.R. (CA1), Conservation Areas (CA2A, CA2B, CA3A, and CA3B), Holey Land, Rotenberger Tract, Everglades National Park, East Everglades, and Southeast Everglades. Natural water flow begins in the upper Kissimmee Valley near Orlando and moves south through a chain of lakes and the Kissimmee River into Lake Okeechobee and then into the Everglades. Historically, during periods of high water when the level of Lake Okeechobee reached 4.5 m msl, about 31 km of shoreline overflowed into the Everglades. The sheet flow of water slowly moved south and emptied into Florida Bay, the Gulf of Mexico, and into the Atlantic Ocean through short rivers, creeks, and underground flow. Before drainage the slope was 4.6 m in 161 km (0.3%) (Parker et al. 1955). Fires, in combination with water levels, sheet flow, and time and duration of flooding, have significantly affected the extent and composition of the various plant communities in the region (Robertson 1953, Loveless 1959, Hofstetter 1973, 1974). Sawgrass (*Cladium jamaicensis*) composes 60-70% of the total area of the Everglades, and wet prairies cover the next largest tracts. During the present study slough depths ranged from 0.0 to 1.6 m. Sloughs are the habitat most used by kites. The sloughs on the east and south sides of the conservation areas, because of the lower ground surface elevations, remain wetter longer than sloughs elsewhere in the Everglades, and some may retain a little water in severe drought years. As a result kites use these areas consistently. The punk-tree is steadily invading the Everglades along the entire east side and if not controlled will eventually convert the system from an open marsh to a swamp. This exotic tree appears to make rapid advances during droughts and when water levels are lowered exposing the marsh substrate.

Drainage of the Everglades began on a grand scale in 1906 and continued intermittently into the 1970's. Between 1906 and 1928, six major canals were dug: the North and South New River canals, started in 1906 and completed in 1912; the Miami Canal, 1909-1912; the Hillsboro Canal, 1910-1913; the West Palm Beach Canal, 1913-1921; and the Tamiami Canal, 1916-1928 (Anonymous 1956). The conservation areas were created between 1950 and the early 1960's by building an extensive levee system with water control structures and pumps (Tebeau 1971). Their main function was one of water storage and flood control, and at the time they were planned and built, little consideration was given to the needs of fish and wildlife. Since their construction, the wetter parts of the conservation areas have been used by the Snail Kite.

RESULTS

Lake Okeechobee and CA3A were used most consistently by Snail Kites over the 14-year period and have supported the major part of the population since 1970 (Table 1, Fig. 2, 3). From 1967 until 1971, CA2A supported the greatest number of kites, but in the last decade was used sporadically by a few birds. Loxahatchee N.W.R. was used heavily in 1969 and the early 1970's but for the last five years kite numbers there have been low and its use sporadic. All other localities listed in Table 1 were used irregularly during the study.

TABLE 1. Maximum number of Snail Kites recorded in principal habitats in Florida, 1967-1980.[1]

Locality	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Annual Mean
Lake Kissimmee	—	—					1							1	0.1
St. Johns Reservoir	—	—	3		10	19	12	15	5	4	2	2			5.1
Cloud Lake Reservoir	—	—	—	—	—	6	13	1	2						1.6
Strazzulla Reservoir	—	—	—	—	—	4	7	5	2		1				1.4
The Savannas	—	—	—	—	—	—	—	1			4	3	3	1	0.9
Lake Okeechobee	5	6	3	5	31	21	42	41	39	51	48	46	114	214	47.6
Lake Park Reservoir	—	—	—	2					1	3	6				0.9
Loxahatchee N. W. R.			31	45	6	4	21	23	20	6	5	3	1		11.8
CA2A	39	50	91	38	43	7		2	7	5	2			1	20.4
CA2B				20	20							6	41	115	14.4
CA3A	6	2	1	65	44	53	63	48	62	84	100	212	273	305	94.1
CA3B				1									4		0.4
Everglades Natl. Park	8		9	13	14				1			3	3	15	4.7
East Everglades													10	1	0.9

[1]The numbers represent counts at irregular intervals or results of annual censuses (November-December 1969-1980), whichever were greater. Blank spaces in the columns indicate that no kites were recorded that year and a dash (—) means the area was not checked.

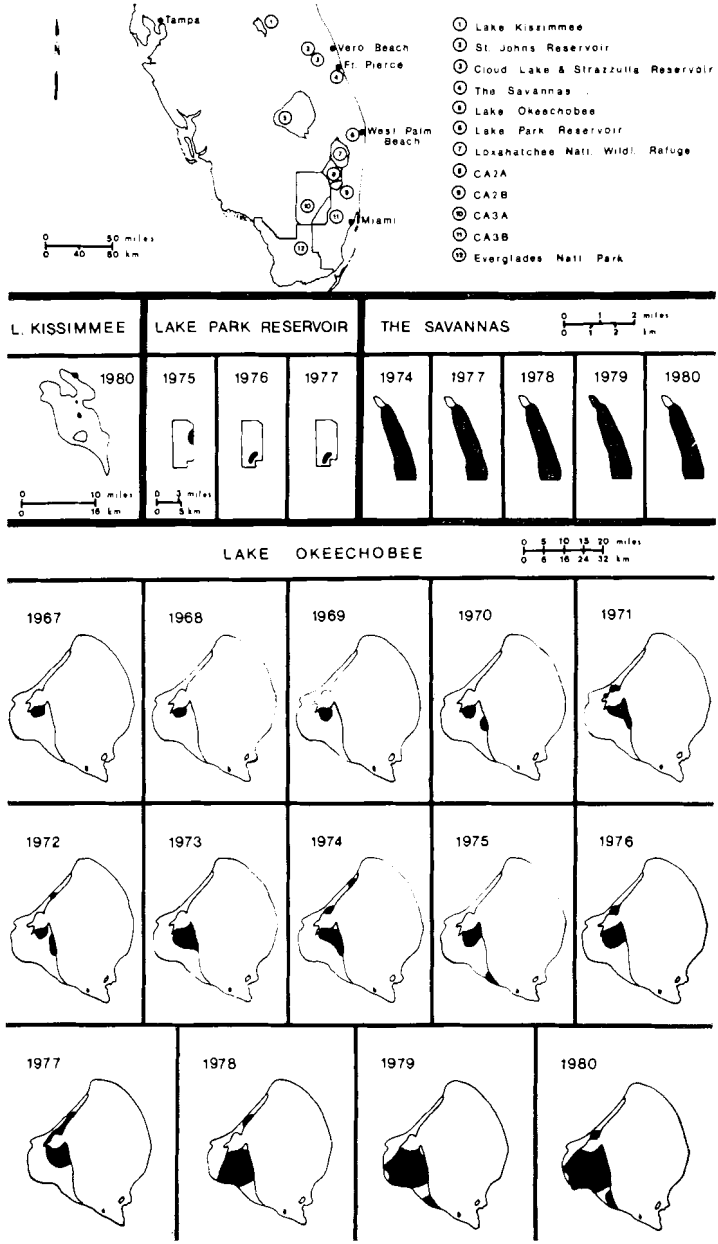

Fig. 2. Snail Kite occurrence at Lake Kissimmee, the Lake Park Reservoir, the Savannas, and Lake Okeechobee, 1967-1980. The location of all areas in this figure are shown in the map at the top. Areas having kite activity are shaded black. No map is shown for periods when no kites were recorded.

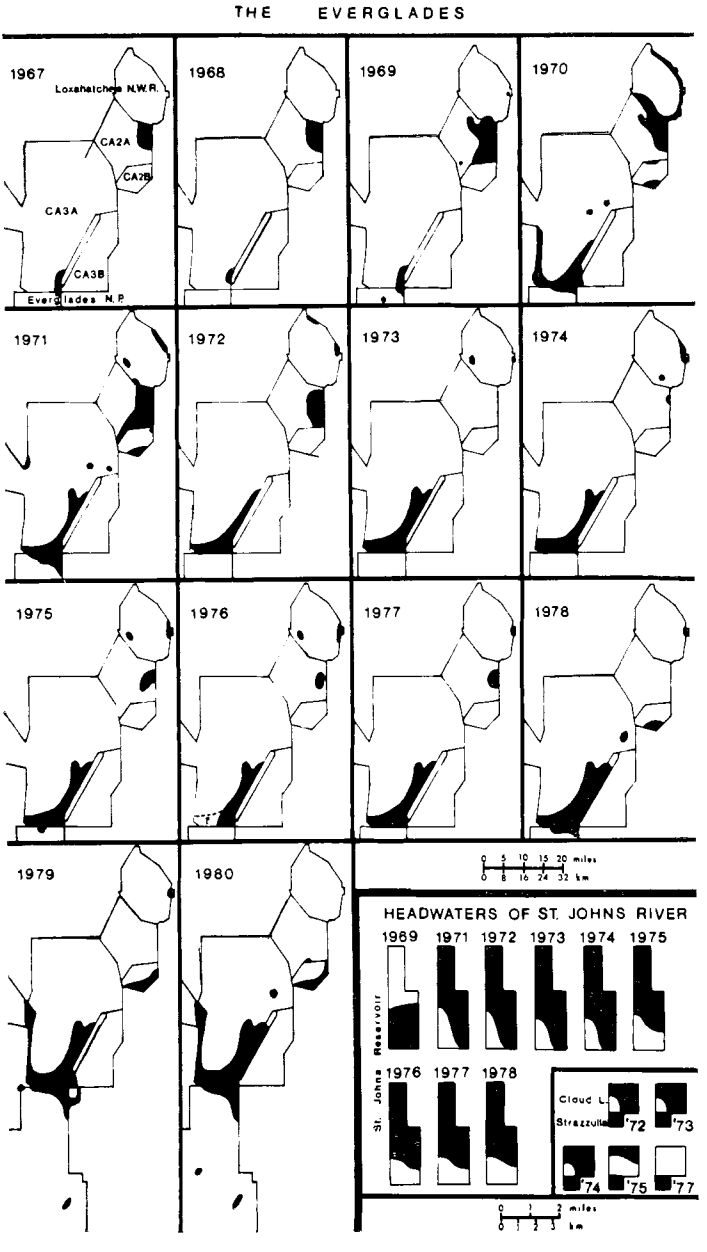

Fig. 3. Snail Kite occurrence in the Everglades Region (Loxahatchee N.W.R., CA2A, CA2B, CA3A, CA3B, and Everglades National Park) and on the Headwaters of the St. Johns River (St. Johns, Cloud Lake, and Strazzulla reservoirs), 1967-1980. Locations of these areas are shown at the top of Fig. 2. Areas having kite activity are shaded black. No map is shown for periods when no kites were recorded.

In drought year 1971, kites dispersed widely, and some individuals moved north through the peninsula into parts of the historic range that had not been occupied for many years (Sykes 1979, 1984). At the same time lone birds were observed in many localities in southern Florida where they are not usually found when wet conditions prevail in the principal habitats (Sykes 1984). Similar results were observed in the drought years of 1981-1982 by Beissinger and Takekawa (1983).

Kite presence at some localities was affected by changing habitat conditions, including water levels, relative abundance of the apple snail (*Pomacea paludosa*), and composition and size of plant communities, whereas in other places kite use changed without an obvious change in the habitat. Some areas, such as Lake Okeechobee and CA3A, usually are occupied by kites throughout the year; other areas received seasonal use (e.g. the reservoirs on the headwaters of the St. Johns which were used primarily during the spring, summer, and early fall). In most years individuals from more northern sites tended to move to the southern part of the state during the colder months.

I have only two records of kites using Lake Kissimmee through 1980. Lone birds were seen in 1973 (not in Fig. 2) (Kenneth Morrison *fide* Joseph D. Carroll, Jr. pers. comm.) and in 1980 (Fig. 2). Beissinger and Takekawa (1983) reported more intensive use of Lake Kissimmee in 1981-82. Kites used the headwaters of the St. Johns River (Fig. 2), steadily from 1971-1978 the St. Johns Reservoir, and from 1972-1975 Cloud Lake and Strazzulla reservoirs. Kite generally frequented all the marsh in the Savannas except north of the railroad track, although in 1979 a nest was found there (Helen and William Dowling pers. comm.).

The main areas that the birds used in the marshes on the west side of Lake Okeechobee (Fig. 2) were at Horse Island Cove, Government Cut to Monkey Box, Monkey Box to Observation Shoal and the southern part of Moonshine Bay, the north end of the Old Moore Haven Canal, Turner's Cove, Blue Hole, Observation Island and Moonshine Bay south to Uncle Joe's Fish Camp on the South Rim Canal, west to the Old Moore Haven Canal, and the marsh between the Old Moore Haven Canal west and northwest to Government Cut (and former site of Sportsman's Village). The increase in area occupied by kites on the lake from 1978 through 1980 resulted from lake levels being raised 0.6 m (from a maximum regulation schedule of 15.5 to 17.5 feet msl). In the Lake Park Reservoir (Fig. 2) kites were found at the two largest expanses of wet prairie.

At the Loxahatchee N.W.R. kites were primarily along the east and south sides. The flooding of small impoundments of Compartment C just south of headquarters on the east side of the refuge periodically attracted small numbers of kites. In CA2A the east half had the greatest use, whereas in CA2B the southern portion had the most use, although some birds were found along the east side in 1979 and 1980. The occurrence of kites in CA3A from 1967 to 1980 was mainly in the eastern sector along L-67A Levee from the Tamiami Trail (U.S. Hwy. 41) north to within 5 km of the Miami Canal, and along the southern sector from L-67A Levee west to L-28 Levee and from the Tamiami Trail north for several kilometers. Substantial kite use along L-28 Levee from the Tamiami trail north to the Tieback Levee (about 31 km north of the Trail) and beyond was recorded in 1970, 1979, and 1980. In 1978 and 1980, kites used CA3A several kilometers southwest of what was formerly Andytown (now the highway interchange of I-75, U.S. Hwy. 27, and S.R. 84). No kites were in CA3A north of Alligator Alley (S.R. 84) during the 14-year period. Occurrence in the Pocket (marsh between CA3A and CA3B enclosed by levees L-67A and L-67C) was regular on a short-term basis by 1-10 individuals from eastern CA3A. Kites occurred in southwest CA3B sporadically in small numbers. From 1967-1980, kite use in the Everglades National Park was primarily in the Shark Valley Slough just south of the Tamiami Trail, with some present in 1979 and 1980 in Taylor Slough in the southeastern part of the park (see Kushlan and Bass 1983).

Substantial losses of freshwater marshes in Florida that have occurred since the early 1900's have altered habitat and reduced the distribution and population level of the Snail Kite. Before drainage, the principal large tracts of marsh in the southern part of the peninsula were estimated to have occupied between 13,000 and 14,000 km^2 [existing marsh is about 7000 km^2] (Table 2). Now, the 10 freshwater marsh systems (Table 2) that constituted most of the pre-drainage habitat of the kite have been reduced in size, and the Palm Beach coastal marshes have been completely eliminated. These coastal marshes were formerly along the west side of the old beach ridges and extended from the present location of North Palm Beach south through lakes Mangonia, Clear, Osborne, and Ida to northern Boca Raton.

Existing marshes in southern Florida comprise only 6949 km^2 or 51% of the original wetland available for kite use (Table 2). This massive reduction of habitat and subsequent alterations were

TABLE 2. Approximate size of freshwater marshes, changes in the amount of potential habitat, and use of such areas by the Snail Kite.[1]

Wetland System	County	Size of marsh habitat (km²) Pre-drainage	Remaining	% Change	Kite use 1967-1980	% remaining used by kites
Headwaters St. Johns River	Brevard, Indian River, St. Lucie	977	369	- 62	11	3
The Savannas	Martin, St. Lucie	14	13	- 7	2	16
Kissimmee River	Glades, Highlands, Polk, Okeechobee, Osceola	256	44[2]	- 83	0	0
Indian Prairie-Isotokpoga Marsh	Glades, Highlands	711	41	- 94	0	0
Marshes W Lake Okeechobee	Glades	133	63	- 53	0	0
Caloosahatchee River Basin	Glades, Hendry	327	17	- 95	2	10
Lake Okeechobee Marshes	Glades, Hendry, Martin, Okeechobee, Palm Beach	0[3]	380	+100	304	80
Palm Beach Coastal Marshes	Palm Beach	146	0	-100	0	0
Loxahatchee Slough	Palm Beach	143	52	- 64	7	14
The Everglades	10 S. Florida counties	10,862	5,970	- 45	896	15
Total		13,569	6,949	- 49	1,222	18

[1]Small marshes in the northern half of the peninsula and in the Big Cypress Region of Collier County have not been included because of incomplete data.

[2]Data from R. L. Goodrick and J. F. Milleson (pers. comm.).

[3]According to Pesnell and Brown (1977) most of the marsh at Lake Okeechobee was located outside of the existing levee system as a consequence of predrainage hydrological conditions. The original marsh outside the present levee system is included in the marshes west of Lake Okeechobee.

probably responsible for the reduced distribution and population of the Snail Kite, leading directly to endangerment. From 1967-1980, 1222 km² were used by kites. This represents only 18% of the marsh habitat presently available, and only a part of this percentage was used at any one time.

Discussion

The apple snail is abundant and available as food for the Snail Kite only when marshes have been flooded for a period of several years. When the marsh dries because of natural drought or drainage, snails are unavailable to the kite (Sykes 1979). The importance of the apple snail to the Snail Kite has been widely discussed (Howell 1932, Bent 1937, Sprunt 1945, 1947, Stieglitz and Thompson 1967, Snyder and Snyder 1969, Sykes and Kale 1974, Sykes 1978, 1979).

Although natural droughts occur about once every 5 to 10 years (Parker et al. 1955, Thomas 1974), droughts probably did not exert as prolonged and severe effects upon the kite prior to drainage and heavy use of fresh water by man. In severe droughts, such as in 1971, 1981, and 1982, the marshes of Lake Okeechobee and the northern Everglades go dry, except for the large canals, a few of the deeper sloughs, and alligator holes. During such conditions, habitat for the Snail Kite is drastically reduced and temporarily eliminated over large areas. The birds are forced to disperse, and many individuals do not survive (Sykes 1979, 1983, Beissinger and Takekawa 1983).

Artificial drainage of South Florida marshes for the past 70 years has been detrimental to the kite. Water from Lake Okeechobee and the Everglades was drained continuously by large canals to the southeast coast from 1912 until 1946, when control structures were placed at the seaward ends of these canals (Klein et al. 1974). During this 34-year period, kite habitat continued to disappear, and the water table in southeast Florida was permanently lowered in some places by as much as 1.5 m (Parker 1951, Parker et al. 1955).

In the Everglades, water management has replaced the historic sheet-flow of fresh water that uniformly flooded the marsh with pools of water in the conservation areas. The once unbroken marsh is now divided into compartments by levees and highway corridors that function as additional levees. Large areas of existing marsh are dry for part of each year and are not used by kites. In contrast some parts of the conservation areas are flooded too deeply

for too long and other sections are not flooded sufficiently or for too short a period. A seasonal cycle of slow fluctuating water levels is necessary to maintain the natural plant communities and associated fauna of the Everglades (Robertson 1953, Loveless 1959, Hofstetter 1973, 1974, Klein et al. 1974, Gleason 1974).

The abundance of apple snails undoubtedly is the key to kite use of a given area. However, no reliable technique to census these mollusks in marshes has been perfected. The presence of kites is an indication of a good snail population in an area, and in the warmer months the presence of snail egg masses can provide a crude index. Knowledge of the snail's ecology is also inadequate for sound management, and a study to obtain such data is a high priority. Factors other than abundance of apple snails may determine whether kites occupy an area. For instance, the number of kites using CA2A decreased significantly from 1969 to 1970 although apple snails were still relatively abundant.

Water levels on the reservoirs of the headwaters of the St. Johns River were erratic during the study, and the water carried heavy loads of agricultural chemicals. This may have accounted for low apple snail populations in some years and reduced kite use. The effects on apple snail populations of these chemical compounds may be detrimental and need to be studied.

From 1967 through 1980, parts of the marshes at Lake Okeechobee and in the eastern and southern parts of CA3A had substantial apple snail populations and were used steadily by kites. Lake Okeechobee had higher water levels from 1978 through 1980 (because water schedules were revised; range of maximum levels: 4.5-5.1 m msl in January and December 1978; 4.5-5.4 m msl in July and October 1979; and 4.2-5.3 m msl in December and January 1980) than from 1967-1977. In 1979 and 1980 water levels were also high in CA3A. The favorable conditions associated with higher water levels (i.e. abundant and available snail populations) on both the lake and in CA3A combined with the rapid kite population increase during these years (Sykes 1979, 1983) probably accounted for the increased kite occupation at these localities during the last several years of study.

During 1967-1980 the snail population on the Loxahatchee N.W.R. was relatively low compared to Lake Okeechobee and CA3A, but the cause is not known. The snail population in CA2A was very high in the late 1960's through 1970 but was drastically reduced by the 1971 drought and again in 1973 when the South Florida Water Management District dried the area in an attempt

to restore some of the plant communities that had disappeared. Since 1970, the snail population in this area has not regained its former abundance (Sykes 1979, in prep.).

Intensive management for a single species is neither practical nor desirable at Lake Okeechobee, in the conservation areas, and in the Everglades National Park. In most years parts of these areas afford some habitat for kites, but conditions change drastically during droughts (Sykes 1979, 1983, Beissinger and Takekawa 1983). Therefore, I recommend that selected "islands" of habitat or potential habitat (areas that can be developed where necessary), scattered within the historic range, be managed for kites to enable a large number to survive through critical dry periods when the larger habitats are temporarily unsuitable. Such management units would lessen population crashes during droughts. The management units should be paired or clustered so that while one is available for use by the birds another in the same general locality can be rejuvenated (i.e., drained, burned, scarified, or otherwise modified). Kites show a definite preference for expansive open marshes with an abundant apple snail population. Therefore management units should be as large as practical, and none less than 40 ha. Because kites are nomadic they can readily locate managed units.

The marshes most heavily utilized by kites consisted of 50 to 75% wet prairies and aquatic sloughs, 25 to 40% sawgrass, and 5 to 15% willows, tree islands, and other components. Managers should strive for a mix of the most important plant communities with irregular configurations and maximum edge effect within the percentage ranges given. An example might be a management unit with a combination of wet prairie and aquatic slough around its perimeter with a stand of sawgrass in its central portion that also contains a small clump or two of willows (*Salix caroliniana*) or small willow strand with a few individual small willows, pond apples (*Annona glabra*), dahoon hollies (*Ilex cassine*), and buttonbushes (*Cephalanthus occidentalis*) scattered over the entire area to provide convenient perches. Water levels in the management units should be fluctuated to simulate the natural hydroperiod; water depths should be lowest from late April to early May, slowly rise to a high in November, and then slowly return to the early May low. Water depths should range from 0.2 to 1.0 m. It is important that all water level changes be gradual to avoid disruptive conditions.

When "island" habitat units are first established or following a periodic drying, it might be necessary to introduce apple snails

into the area to obtain the desired high mollusk population density. Such a seeding operation was determined to be feasible where the snail population is low or has been eliminated because of previous conditions (Martin and Doebel 1973). The managed areas should be drained, dried out, and burned about every 6 to 10 years—the inland freshwater marshes of Florida evolved under conditions of periodic drought during which uncontrolled fires occurred (Cohen 1974).

I conclude that some areas will have to be managed specifically for the Snail Kite if we wish to retain a population in Florida because the existing habitats under present conditions are highly unstable and under pressure for additional uses, and further modifications will occur. Only through maintenance of the remaining large marsh systems in as close as possible to their natural condition and the creation of smaller "island" habitat units for drought use will the availability of suitable habitat for the Snail Kite in Florida be assured.

SUMMARY

Of the principal habitats used by the Snail Kite in Florida from 1967-1980, Lake Okeechobee and CA3A had the most consistent use, had the greatest amount of area used, and supported the major portion of the population. The spatial use from year to year for each locality is compared. About 49% (6620 km^2) of the original potential kite habitat in southern Florida has been lost and of that portion remaining, only 18% (1222 km^2) was used by kites from 1967 through 1980. The lack of water to flood the marsh habitat in drought years is the most critical factor confronting the species.

The loss of suitable freshwater marsh habitat has been the single most important factor responsible for the decline of the Snail Kite in Florida. With the human population increasing in the state and the resulting demands for more land development and fresh water, further loss of existing wetlands is inevitable. In drought years the demands for surface waters exceed the supply, and there is insufficient water to maintain flooded conditions in most existing kite habitats. I recommend that the large natural habitats be preserved maintaining as close as possible to a natural hydrologic regime and that selected key smaller areas not less than 40 ha, scattered within the historic range of the kite in Florida but outside the Lake Okeechobee marshes, the conservation areas, and the Everglades National Park, be managed specifically for this species to reduce population crashes during droughts, Such areas would also benefit other wildlife.

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