THE WILSON BULLETIN

A QUARTERLY MAGAZINE OF ORNITHOLOGY

Published by the Wilson Ornithological Society

VOL. 91, NO. 4 DECEMBER 1979 PAGES 495–652

Wilson Bull., 91(4), 1979, pp. 495–511

STATUS OF THE EVERGLADE KITE IN FLORIDA—1968–1978

PAUL W. SYKES, JR.

The Florida Everglade Kite (*Rostrhamus sociabilis plumbeus*) was discovered on 29 April 1844, by Edward Harris (1844), who secured an immature male (ANSP 1942, Acad. Nat. Sci. Philadelphia) near the headwaters of the Miami River, in what is now Dade County, Florida. Recently, Amadon (1975) reviewed the taxonomy of *R. sociabilis* and concluded that *R. s. levis* of Cuba is not subspecifically distinct from *plumbeus* of Florida. *R. sociabilis* is still common in Cuba (Schwartz and Klinikowski 1963, Garrido and Montana 1975), but the Florida population of the species has been threatened with extinction for several decades.

There were no reliable counts or population estimates of the Everglade Kite in Florida before the 1920's, probably because of the inaccessibility of the terrain within the range of the species there. Howell (1932:169) provided a general idea of kite abundance when he mentioned "scattered flocks of a hundred or more birds frequently being found in a limited area." Sprunt (1945), the first to report a serious population decline, thought that only 50–100 kites were left in 1945. He had observed a steady decline at Lake Okeechobee and disappearance of the species from the headwaters of the St. Johns River. In 1950 Sprunt (1950) estimated there were no more than 100, and probably fewer than 60; and in 1954 no more than 50–75 (Sprunt 1954). In 1963 Sprunt (1963) estimated ca. 6 birds remaining, based on sightings at Lake Okeechobee and the Loxahatchee National Wildlife Refuge. Stieglitz and Thompson (1967) reported 8 kites in 1963 on the Loxahatchee Refuge, 17 on the refuge and 2 at Lake Okeechobee in 1964, 8 in Conservation Area 2A (CA2A) and 2 at Lake Okeechobee in 1965, and 21 in CA2A in 1966.

The Florida Everglade Kite was declared endangered in 1966 by the Committee on Rare and Endangered Wildlife Species, and in 1967 the present study was initiated as part of the Endangered Wildlife Research

Young Everglade Kites *(Rostrhamus sociabilis)* at the nest.

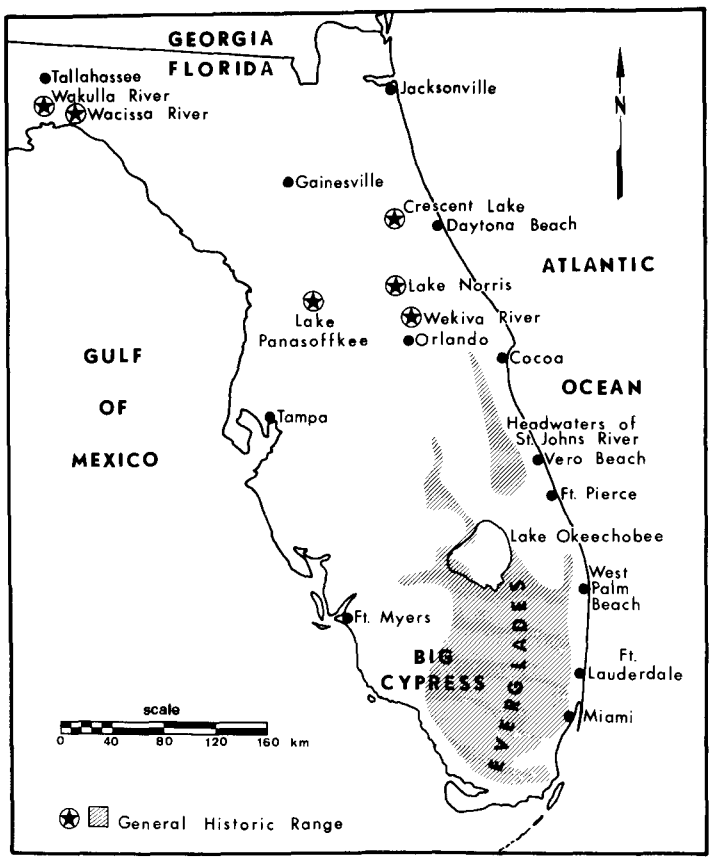

FIG. 1. The historic range of the Everglade Kite in Florida.

Program of the Fish and Wildlife Service. In initial studies in the fall of 1967 I counted a minimum of 47 birds: 39 in CA2A, 6 in CA3A, and 2 at Lake Okeechobee, and in 1968 I estimated there were at least 50 to 70 individuals in southern Florida. This paper reviews the recent history and general habitat requirements of the species and some associated problems. The results of color-marking birds of known age, censusing, and findings on age of sexual maturity, population movements, productivity, longevity, and population status are presented in some detail.

STUDY AREA AND METHODS

Range in Florida.—The historic range of the Everglade Kite (Howell 1932) is shown in Fig. 1. At present the kite is confined principally to the headwaters of the St. Johns River (man-made impoundments in Indian River and St. Lucie counties) and the west side of Lake

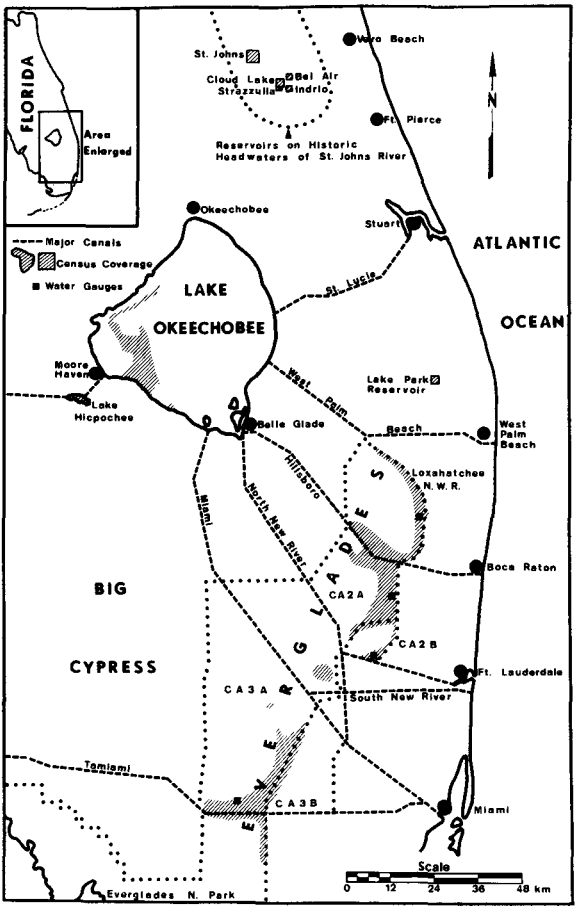

FIG. 2. Present range and areas in Florida censused 1969–1978. The 5 reservoirs on the headwaters of the St. Johns River and the Lake Park Reservoir are not to scale or shown in their true configurations.

Okeechobee southward through the Everglades (Loxahatchee National Wildlife Refuge, Conservation Areas 2A, 2B, 3A, and 3B, and the northern part of Everglades National Park) (Fig. 2). Wandering individuals are sometimes seen elsewhere within the former range and occasionally beyond it.

General habitat requirements.—This raptor generally inhabits large freshwater marshes with unobstructed air space and low vegetation. There are usually few tree islands in wetlands occupied by the kite, although there are generally scattered shrubs or small, low trees, mainly willow (*Salix caroliniana*), dahoon holly (*Ilex cassine*), wax myrtle (*Myrica cerifera*), pond apple (*Annona glabra*), and bald cypress (*Taxodium distichum*), which serve as perches and nesting sites. The kite hunts mainly over the extensive, shallow (water depth 0.2–1.3 m)

sloughs of white waterlily (*Nymphaea odorata*) and wet prairies or flats of spikerush (*Eleocharis elongata* and *E. cellulosa*) that retain some surface water through the dry season in most years (Loveless 1959). Such areas occur in extensive stands of sawgrass (*Cladium jamaicensis*) or cattails (*Typha domingensis* and *T. angustifolia*) or on flat river courses and margins of large shallow lakes. Continuous flooding of a marsh for a period of several years is needed to develop and sustain an adequate supply of the apple snail (*Pomacea paludosa*). This snail is normally the only food taken by kites in Florida (Sykes and Kale 1974). Apple snails remain active only when the marsh is inundated. If the marsh dries up, snail numbers are drastically reduced by predation and the survivors burrow into the bottom and become unavailable to kites.

Originally, more than a fourth of peninsular Florida was covered with surface water much of each year (Tebeau 1971). The initiation of drainage in the peninsula was in the 1881–1894 period. Construction of the major works began in 1905 and has continued intermittently to the present (Parker et al. 1955, Anon. 1957, Tebeau 1971, Johnson 1974). This widespread drainage has permanently lowered the water table as much as 1.5 m in some places in southern Florida (Parker 1951, Klein et al. 1974) and up to 2.1 m on the headwaters of the St. Johns River. Large tracts of freshwater marsh have been eliminated and much of what remains has been modified so that it is no longer suitable habitat for kites.

From 1910 until 1950, little effort was made to control runoff of fresh water from the Everglades through major canals emptying into the tidal estuaries of the southeastern Atlantic coast. In the late 1940's the U.S. Army Corps of Engineers began development of the Central and Southern Florida Flood Control Project and in 1949 the Central and Southern Florida Flood Control District (now the South Florida Water Management District) was created. With the construction of that project and formation of the district, the flow of water to the sea was controlled and 3 conservation areas were created in the Everglades ecosystem to store water and reduce flooding in developed coastal areas (Parker et al. 1955, Tebeau 1971, Leach et al. 1972, and Klein et al. 1974). The creation of the conservation areas has secondarily been of great benefit to the kite population by flooding parts, or all of the area for several years. However, because of demands for fresh water for agricultural, municipal and industrial uses, there is not enough to maintain large areas of flooded habitat suitable for kites on a long term basis. Prior to the creation of the conservation areas the Everglades was dry much of the time, and man-created fires were frequent and widespread (Robertson 1953, Hofstetter 1974).

In addition to loss of habitat from drainage, large areas of marsh are heavily infested with water hyacinth (*Eichhornia crassipes*). This plant was introduced into Florida on the St. Johns River in 1884 (House Document No. 37, 85th Congress 1957) and was well established in the southern part of the state by the 1920's (Johnson 1974). If uncontrolled, the water hyacinth propagates rapidly and forms dense blankets of vegetation. Since kites hunt visually, areas thus obscured cannot be used by them.

Methods.—I conducted preliminary investigations from the fall of 1967 through the summer of 1969 to locate kite habitat in Florida, to determine the best time of year to census, and to become familiar with the kites behavior and activities. The censuses started in 1969 were the first organized effort to census kites in most of its present habitat. Because the bird is gregarious, relatively approachable and conspicuous, I censused by direct counting (census and count as used in this paper are synonyms). With an airboat I ran standardized transects through the available habitat, and counted birds arriving at night roosts in late afternoon, and from a vehicle on the levee and road system in, or adjacent to kite habitat. Approximately 85–90% of the time in the field was spent in airboats; the remainder in vehicles on the levee system.

Replicate censuses were made on the transects at each locality in 1976 and the results

TABLE 1

NUMBERS, PERCENTAGE OF FLEDGED YOUNG, AND SUBSEQUENT SIGHTINGS OF EVERGLADE KITE NESTLINGS BANDED 1968–1976

	Banded		Observed after banding			
			Two months or more		One year or more	
Year	Total	Percent of known fledged young	Number	Percent[1]	Number	Percent[1]
1968	15	63	6	40	3	20
1969	7	54	3	43	2	29
1970	9	75	2	22	2	22
1971[2]	0	—	—	—	—	—
1972	3	43	0	0	0	0
1973	13	45	1	8	1	8
1974	10	91	3	30	3	30
1975	2	6	1	50	0	0
1976	5	17	0	0	0	0
Total	64	—	16	—	11	—
Mean/year[3]	8.0	49	2.0	24	1.4	14

[1] Percent of those banded for given year.
[2] Year of drought; no nesting activity observed.
[3] Excluding 1971.

(total for the first day at all localities compared with total for the second day at same localities) differed numerically by 8 birds. Duplicate counts were not made at roost sites. I recorded kites by locality, time and population category and completed each census within a 10–14 day period. I recognized 3 population categories by plumage characteristics: (1) gray–males 3 years and older; (2) brown–all females and first and second year males; and (3) unknown–individuals too poorly seen to assign to either of the above groups.

In the airboat I used, seats were mounted 1.5 m above the bottom of the boat, and with the marsh flooded, the observer has an unobstructed view. The noise of the engine flushed kites at distances up to 100–150 m. The birds would rise, fly about for several minutes, and then settle again into the marsh, allowing sufficient time to check each individual. Censusing from an airplane and helicopter proved unsatisfactory.

Areas covered on the annual censuses (Fig. 2) included: 5 reservoirs on the historic headwaters of the St. Johns River (St. Johns in Indian River County; and Cloud Lake, Strazzulla, Bel Air, and Indrio in St. Lucie County), the Savannas at Ft. Pierce (St. Lucie County), flooded portion of the marsh on the west side of Lake Okeechobee, Lake Hicpochee, Lake Park Reservoir (Palm Beach County) in the Loxahatchee Slough (=Marsh), eastern and southern Loxahatchee National Wildlife Refuse (=Conservation Area 1), eastern and southern CA2A, northern and southern CA2B, eastern and southern CA3A, western CA3B, and northern Everglades National Park.

Nests were found by 2 methods: (1) searching the marsh where birds were present, and (2) watching the activities of individuals. The latter technique was the more efficient and all nests in a given area could be found in this manner. Because most adults were not banded it was not possible to conclusively distinguish between initial and renesting attempts. A new structure is built at each nesting. The birds nest in loose colonies and nesting territories are

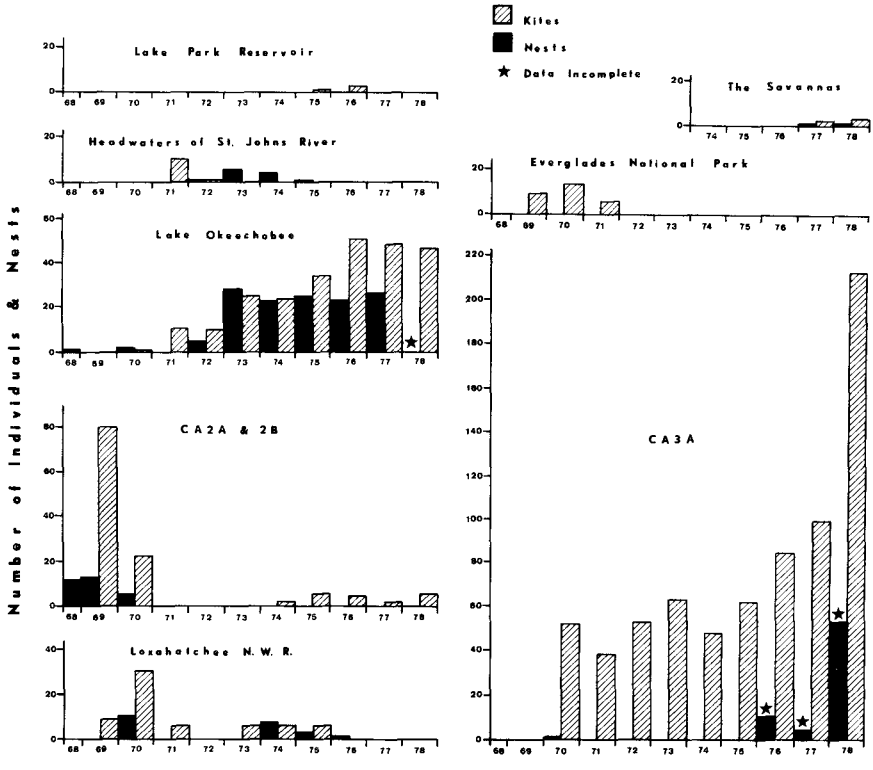

FIG. 3. Distribution of Everglade Kite nesting (1968–1978) and wintering (1969–1978) (based on census Nov.–Dec.) in Florida.

not established. A successful nest was one from which 1 or more young were fledged (take first true flight). I did not study kite reproduction after 1976.

Nestlings were banded at 20–30 days of age with USFWS aluminum bands in combination with colored plastic bands. Sixty-four nestling kites were color-banded from 1968 through 1976 (Table 1). This is 40% of the young known to have fledged during that period ($\bar{x}$ = 9.0 banded per year excluding 1971 when no young were produced). No attempt was made to band adults. Linear regression was used to test for population increases over time.

RESULTS

Age at sexual maturity.—Male kite nestlings obtained from the Province of Buenos Aires, Argentina, and raised at the Patuxent Wildlife Research Center, Laurel, Maryland, attained subadult plumage in their third year and adult plumage in the fourth (Glen Smart, pers. comm.). Haverschmidt (1970) reported subadult plumaged *R. s. sociabilis* breeding in Surinam, but did not know the ages of the individuals involved. Allan Brooks collected a breeding *R. s. plumbeus* subadult male (MVZ 99638) at West

Palm Beach on 19 March 1921. In Florida I found males in subadult plumage breeding in April and May 1968, and February and March 1970; and Rod Chandler (pers. comm.) found one breeding in February 1973. A female I color-banded as a nestling on 23 March 1970, was nesting in June 1973. Thus, at least some individuals breed at the age of 3 years, and possibly younger.

Population movements.—This species roosts gregariously, nests in loose colonies, and individuals usually associate freely during daily activities (Howell 1932, Haverschmidt 1954, 1970; Brown and Amadon 1968). However, Snyder and Snyder (1970) described several kites defending temporary hunting territories in an area of the Everglades with a high snail population, a previously undescribed phenomenon for the species. Since 1968 I have witnessed intraspecific aggression over a hunting territory only once and that between 2 males in CA3A.

My field work, beginning in 1967, has shown that kites are nomadic in Florida. Since widespread water manipulation has affected their food supply, kites must be nomadic to survive. Wintering and nesting activities of the species are shown for 8 major areas used by kites in recent years (Fig. 3). From 1968 through 1970, CA2A and CA2B were used by kites, but little since then. In contrast, Lake Okeechobee, lightly used from 1968 through 1971, has had heavy use since then and is currently a major breeding site. No kites were found in CA3A in 1968 and 1969, but it has been the primary wintering ground for the Florida population since then and the major nesting area since the mid 1970's. Loxahatchee Refuge has had only sporadic use since routine observations began in the 1950's.

Observations of marked known-age kites clearly demonstrate that the change in the pattern of use of the 8 major areas is not simply attributable to rapid fluctuations in sedentary populations. For example, a female I banded in eastern CA2A in March 1968 was seen on the west side of Lake Okeechobee in the spring of 1976 (Rod Chandler, pers. comm.), and a female banded in CA2A in 1969 was seen in April 1974 on the St. Johns Reservoir, in November 1975 in CA2A, in March 1976 on Loxahatchee Refuge, and in December 1976 in CA2A. Another female banded on the refuge in April 1970 was seen in CA3A in December 1970, at its nest at Lake Okeechobee in June 1973, and at its nest at Loxahatchee Refuge in March 1974, and in CA3A in November 1974. A bird of unknown sex banded on Loxahatchee Refuge in April 1970 was seen in CA3A in December 1970, and at Lake Okeechobee in December 1971.

The nomadic behavior exhibited by this kite in recent years, probably represents a normal response to changes in water levels and food availability. Howell (1932) reported that a search of Loxahatchee Slough in 1923 failed to reveal a single kite, although the species bred there in abundance in 1921. Very likely the birds had simply moved elsewhere.

TABLE 2
EVERGLADE KITE REPRODUCTION 1968–1976

Year	Nests					Young	
	Observed	Successful	Failed	Results unknown	Percent successful	Total number fledged	Fledged per successful nest[1]
1968	13	11	2	0	84.6	24	2.2
1969	13	8	2	3	80.0	13	1.6
1970	19	8	10	1	44.4	12	1.5
1971[2]	0	—	—	—	—	0	—
1972	6	3	3	0	50.0	7	2.3
1973	34	12	22	0	35.3	29	2.4
1974	35	6	29	0	17.1	11	1.8
1975	29	14	15	0	48.3	35	2.5
1976	34	22	8	4	73.3	30	1.4
Totals	183	84	91	8	48.0	161	1.9
Mean/year[3]	22.9	10.5	11.4	1.0	54.1	20.1	2.0
SE	4.07	2.05	3.53	—	8.28	3.74	0.15

[1] Only those nests in which the exact number of young fledged is known were used to derive these figures.
[2] Severe drought conditions throughout peninsular Florida; no nesting attempts observed.
[3] Excluding 1971.

Sex and age ratios.—The sex ratio in the Florida kite population is unknown. Adult kites are sexually dimorphic in plumage and females average slightly larger than males (Friedmann 1950), but the size difference is impossible to detect in the field. Also, ages cannot be determined under field conditions. The plumages of adult females and all immatures are similar. Immatures can be distinguished from adult females at close range by iris color (carmine in adult females, brown in immatures). The time required for the eye color change is not known. The plumage of older adult females tends to darken with some slaty-black on the crown, nape and upper back, but most of the plumage retains an overall brownish cast. This latter feature can be seen under field conditions and enables one to distinguish old females from 3-year old males. The whitish throat is retained but reduced in size. The 3-year old males have more gray throughout the plumage than the darkest of the adult females. For the above reasons, the age and sex classes that can be determined consistently in the field are gray adult and subadult males, and brown females and immature males. There is no accurate, reliable method of sexing kites of these age groups in the hand.

Natality.—I estimated about 70–80% of the nests were found each year from 1968 through 1974. Each nest was observed at varying intervals until the young fledged or the nest failed. From 1968 through 1976, breeding

TABLE 3
EVERGLADE KITE NESTING SUCCESS BY LOCALITY IN FLORIDA 1968–1976

Year		Nests			
			Successful		
		Observed	Number	Percent[1]	Percent of total[2]
1968	Lake Okeechobee	1	1	100	9
	CA2A	12	10	83	91
1969	CA2A	13	8	80	100
			+3 unknown	—	—
1970	Lake Okeechobee	2	1	50	12.5
	Loxahatchee N.W.R.	11	5	50	62.5
			+1 unknown		
	CA2A	4	1	33	12.5
			+1 unknown	—	—
	CA2B	1	0	0	0
	CA3A	1	1	100	12.5
1971	—	0	—	—	—
1972	Headwaters St. Johns River	1	1	100	33
	Lake Okeechobee	5	2	40	66
1973	Headwaters St. Johns River	6	3	50	25
	Lake Okeechobee	28	9	32	75
1974	Headwaters St. Johns River	4	0	0	0
	Lake Okeechobee	23	6	26	100
	Loxahatchee N.W.R.	8	0	0	0
1975	Headwaters St. Johns River	1	1	100	7
	Lake Okeechobee	25	13	52	93
	Loxahatchee N.W.R.	3	0	0	0
1976	Lake Okeechobee	23	18	78	82
	Loxahatchee N.W.R.	1	1 unknown	—	—
	CA3A	10	4	40	18

[1] Nests for which results are unknown are excluded from the calculations.
[2] Same as 1.

success was determined for 175 nests with a success rate of 48.0% (Table 2). There was a statistically significant increase ($r = 0.685$, $P < 0.05$) in the number of nests observed (excluding 1971) (Table 2), but no significant change in nesting success, failure, percent successful, number fledged, or number fledged per successful nest for 1968–1976. During this period 161 young were known to have fledged, $\bar{x} = 20.1$ young per year, or 1.9

(=2.0 per year) per successful nest (N = 84). No young were produced in the drought-year 1971 and only 7 young were known to fledge in 1972. Among pairs in which at least 1 member was subadult (3-year old birds; 6 males and 1 female), 4 nests (57%) were successful.

Nesting success by localities is given in Table 3. In 1968 and 1969 most breeding activity was in the eastern part of CA2A; and in 1970 it shifted to the eastern edge of Loxahatchee N.W.R. From the 1971 drought through 1975, nesting has occurred primarily on the southwest side of Lake Okeechobee, and 1976 through 1978 on the lake and in southeastern CA3A. Nesting results from year to year have been variable (Tables 2 and 3) with the most successful nesting observed in CA2A in 1968, when 84.6% of the nests fledged young. During the period 1973–1976 the greatest nesting success was at Lake Okeechobee.

Mortality.—I could not measure kite mortality (excluding nestlings) for the period 1969 through 1978 as not enough birds were marked. Nestling mortality for the 1968–1974 period (omitting 1971) was 41% (96 young fledged from 163 eggs that hatched). Mortality was attributable to parasites, predators, weather, and accidents (Sykes, unpubl.). Although causes of natural mortality among all other age classes are undocumented, disease, predation and accidents undoubtedly are involved, and some individuals probably starved in drier years. Learning to hunt for snails, and to do so proficiently, appears difficult for young kites and many probably do not survive that stage of development. For example, on several occasions I observed young, recently out of the nest and not attended by parents, with the wing, tail and ventral feathers wet (when it had not been raining) and with most rectrices and several primaries and secondaries in disarray. If this plumage condition were to occur frequently, or last for several days during the time hunting skills were being perfected an individual might be rendered flightless and hence not survive. Older birds hold the wings and tail high when hunting and seldom touch the emergent vegetation or get the remiges and rectrices wet when capturing their prey.

Of the 64 color-banded nestlings (Table 1), 16 (25%) were subsequently seen 2 or more months and 11 (17.2%) 1 or more years after they were banded. However, since not all kites were examined for bands in the wild these sightings cannot be converted into survival statistics.

Illegal shooting is still a problem, particularly during the waterfowl hunting season (in southern Florida this is generally from late November to 20 January). The slow, low-level flight and lack of fear of man make kites easy targets for the uninformed or the intentional violator. Sprunt (1945) reported this problem at Lake Okeechobee in the 1940's. More recently I have 2 records of kites that were killed by shooting in 1971 (J. W. Dineen, R. A. Martz, and B. G. Murray, Jr., pers. comm.), and I have observed

TABLE 4
ANNUAL EVERGLADE KITE CENSUSES 1969–1978

Year	Population categories						Number of individuals
	Gray birds[1]		Brown birds[2]		Unknowns		
	Number	Percent[3]	Number	Percent	Number	Percent	
1969	20	20	76	78	2	2	98
1970	21	18	87	72	12	10	120
1971	23	32	49	68	0	0	72
1972	23	35	36	55	6	9	65
1973	41	43	52	55	2	2	95
1974	38	47	33	41	10	12	81
1975	47	43	52	47	11	10	110
1976	52	37	76	53	14	10	142
1977	58	38	91	60	3	2	152
1978	66	25	187	70	14	5	267
Mean/year	38.9	—	73.9	—	7.4	—	120.2
SE	5.30	—	14.12	—	1.71	—	18.61

[1] Adult and subadult males.
[2] Females and immature males.
[3] Percentage of total count.

kites during and after each waterfowl hunting season with flight feathers that appeared to have been damaged by shot. Such damage is evident by broken rachises still attached, missing distal portions of the remiges or rectrices, or holes in vanes of the feathers. How many are lost to illegal shooting and that go undetected is unknown, but with such a small population each loss is significant.

Longevity.—Nine of the surviving *R. s. sociabilis* that were taken as nestlings in northern Argentina (in December 1965 and 1966, and January 1967), and held in captivity at Patuxent Wildlife Research Center, are 12 and 13 years old. The females are still in good egg production and the males are producing viable sperm (George Gee, pers. comm.). A female banded on 8 October 1969, in CA2A was seen on 13 December 1976, at that same locality; a female (first of the species ever banded), banded in the same general area as the preceding on 21 March 1968, was seen at Lake Okeechobee in April and May 1976 (Rod Chandler pers. comm.); a female banded 18 April 1969, in CA2A was seen on 21 November 1977, in CA3A; and a kite banded 7 April 1968, in CA2A was seen at Lake Okeechobee on 23 February 1977 (Rod Chandler, pers. comm.). These birds were 7.2, 8.1, 8.6, and 8.8 years old, respectively. The life expectancy of the Everglade Kite in the wild is not known, but they seem relatively long lived, based upon the above observations. Some individuals probably live 10 years and perhaps much longer.

TABLE 5

SAMPLE OF ANNUAL CENSUSES CHECKED FOR BANDS AND THE PERCENTAGE OF BANDED BIRDS FOUND WITHIN EACH POPULATION CATEGORY

Year	Percent of census total checked for bands	Banded birds in checked sample of each population component			
		Gray birds[1]		Brown birds[2]	
		Number	Percent[3]	Number	Percent
1969	27	5	19	22	81
1970	17	7	33	14	67
1971	25	7	38	11	61
1972[4]	1	0	0	1	100
1973	10	4	40	6	60
1974	29	8	33	16	67
1975	20	5	22	17	77
1976	23	7	21	26	79
1977	15	5	21	18	78
1978	0	—	—	—	—
Mean/year	17	4.8	—	13.1	—

[1] Adult and subadult males.
[2] Females and immature males.
[3] Percentage found to be banded among the sample checked.
[4] The data are incomplete because visibility was too poor to check for bands the day 81% of the birds were observed.

Population status.—Ten censuses were conducted from mid-November to mid-December from 1969 through 1978. The minimum numbers of individuals observed are given in Table 4. For the 10-year period $\bar{x} = 120.2$, with a low of 65 in 1972 and a high of 267 in 1978. I recorded from 2.1 to 6.2 birds/h of effort on the transects; $\bar{x} = 3.1$ based on 38.2 h/census ($\bar{x}$).

Banded birds that were checked for bands on the annual censuses are summarized in Table 5. Because of the problem of keeping track of individuals in the course of censusing, only an average of 17% (4.8% gray, 14.1% brown) have been inspected for bands on the censuses.

The kite population increased to a high of 120 in 1970 (Fig. 4) following a series of wet years with high water levels. In 1971 southern Florida experienced a severe drought and most of the freshwater marshes dried up, resulting in a sharp decrease in the kite population that continued through 1972. Since the 1971–1972 period, the number of kites has increased, with a minor decline in 1974 (Fig. 4). The decrease in 1974 is attributed to a low recruitment rate (Tables 2 and 3) resulting from low water conditions at Lake Okeechobee, CA2A, and CA3A, and complete nesting failure at Loxahatchee. From 1974 through 1978 the population has increased significantly ($r = 0.92$, $P < 0.025$) (Fig. 4). This latter in-

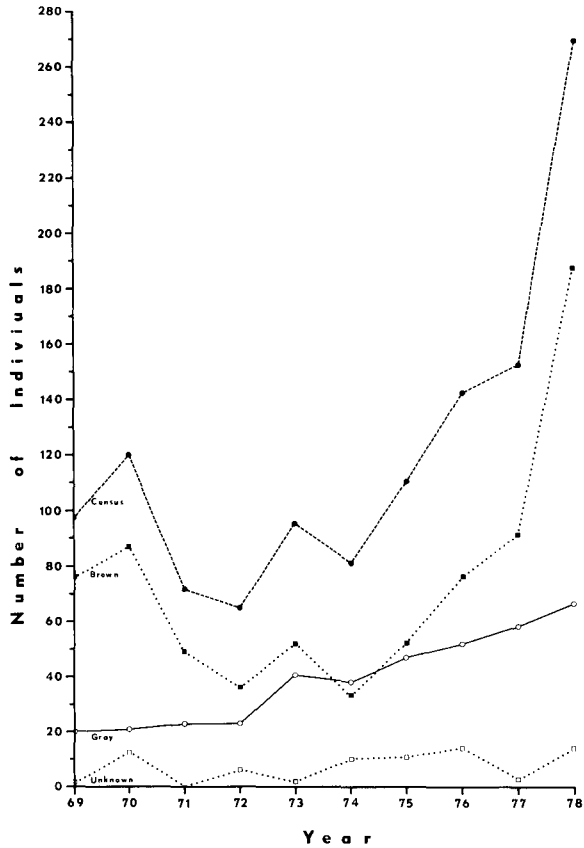

FIG. 4. Population categories of the Everglade Kite in Florida on annual censuses 1969–1978.

crease is apparently the result of favorable water conditions and an abundance of snails in certain portions of the marsh on the west side of Lake Okeechobee and the southeastern edge of CA3A.

The number of brown kites has roughly paralleled the census totals (Fig. 4), whereas the gray birds (breeding males) have shown a constant slow increase irrespective of the fluctuating census results, except in 1974. This steady increase in the number of gray birds (Table 4) is highly significant ($r = 0.97$, $P < 0.001$). There is no significant trend among the brown birds because reproductive success is so variable, and adult females cannot readily be distinguished from birds up to 2 years old. Since 1974 the ratio of brown to gray birds appears normal. The number of brown kites has

ranged from 187 in 1978 to 33 in 1974 ($\bar{x}$ = 73.9) (Table 4). Taking the low of 33 as an accurate figure, the brown categories of the population had increased by 566% by the end of 1978. The ratio of brown to gray in 1978 was approximately 1.8:1, excluding the 14 birds in the unknown category.

The number of adult and subadult males increased from 20–66 from 1969 through 1978 (Table 4 and Fig. 4), or 330%. Only 2% of all gray-plumaged birds recorded over the 10-year period were subadult males. In 1978, males 3 or more years old comprised 25% of the census total.

DISCUSSION

Previous estimates of the kite population in Florida are not directly comparable to the results of my study because I censused more kite habitat and used different techniques. I censused in November and December because kites in Florida congregate more at this time than in other months and water levels are high enough to permit access to all regularly censused marshes. Censusing in other months gave less reliable estimates of population size because of dispersal, breeding activities and lower water levels or a combination of these. Low water not only makes access more difficult but also reduces visibility as the height of the marsh vegetation is relatively constant, but the height of the observer on the airboat and observational effectiveness increases or decreases in relation to water level.

The population of Everglade Kites was probably never as low as Sprunt's (1963) estimate of about 6 birds in the early 1960's, but the number could have been as low as 20–25 individuals based upon the data presented by Stieglitz and Thompson (1967). The higher totals from censuses may be more accurate than the lows because they were recorded when the kites were more concentrated, the lows when they were more dispersed. Although counts at night roosts were not incorporated into the censuses until 1973, results of censuses for 1969–1972 and 1973–1978 are believed to be reasonably comparable.

The age categories of the population have probably not been counted with equal accuracy because immatures tend to wander farther from the main population than adults, and the amount of dispersal differs from year to year. This could explain the variation in the number of brown birds in different years. This is further complicated by the number of kites recorded as unknowns.

Each year, following breeding, some birds disperse, but during the drought of 1971 they were scattered more widely than usual over the entire Florida peninsula. The reduced food supply resulting from dry conditions apparently raised the mortality rate. In 1971 there was no recruitment to

the population from reproduction and when the census was taken only 72 individuals could be found. Although dispersal might have affected the actual number of birds seen, it was obvious that the population had decreased. In 1972 nesting attempts were at least 60% below the 1968–1970 period, and only 65 individuals were recorded on the census. Dry conditions prevailed in 1974 and there was a corresponding decrease in the kite population (Fig. 4). There is no evidence to indicate movement between the Florida population and that in Cuba, but whether such movements occur remains to be determined.

The Everglade Kite population in Florida (since 1974) and the number of gray birds (1969–1978) have shown a strong and highly significant ($r = 0.92$, $P < 0.025$ and $r = 0.97$, $P < 0.001$ respectively) increase during a series of years with high water levels. The increase in gray birds has resulted in more nesting (Table 2 and Fig. 3). If favorable water conditions continue in the major areas, this population increase is expected to continue.

Censuses for the 10-year period revealed a low of 65 birds in 1972 and a high of 267 in 1978. This represents the greatest number of kites in Florida since the 1920's or 1930's. Although the kite population has adjusted to habitat loss since completion of the first drainage works, most areas now used by kites are committed to other water management programs, meaning less water in the future. It is vital to the survival of the kite population in Florida that habitat units be developed and managed. Such units could supplement already scarce habitat and insure sufficient resources to support the kite population through critical periods of low water.

SUMMARY

The population status of the Everglade Kite (*Rostrhamus sociabilis plumbeus*) was studied in Florida from 1968 through 1978. Sixty-four nestlings (40% of known fledged young) were leg-banded with unique color combinations, and of these, 17.2% were seen 1 or more years after they were banded. Kites were capable of breeding at 3 years of age or possibly younger. The population was nomadic; its sex ratio unknown. From 1968 through 1976 breeding success was determined for 175 nests, of which 48% were successful: 161 young were fledged, $\bar{x} = 20.1$ per year, or 1.9 per successful nest (N = 84). The percentage of successful nests ranged from 17.1 (N = 35) in 1974 to 84.6 (N = 13) in 1968 ($\bar{x} = 54.1$ per year). From 1968 through 1976 there was a significant increase ($r = 0.685$, $P < 0.05$) in the number of nests observed (excluding 1971, and reproduction was not studied in 1977 and 1978). The mortality rate for young in the nest was 41%. Some individuals live for at least 8+ years. The mean number of kites for 10 annual censuses was 120.2 with a range of 65 (1972) to 267 (1978). The severe drought of 1971 resulted in a significant decrease in the population for that year and 1972, with no nesting attempts being observed in the dry year. From 1974 through 1978 the population increased significantly ($r = 0.92$, $P < 0.025$), apparently the result of favorable water conditions and increased food supply. The loss of suitable habitat is the major problem facing

the species in Florida. A high water level is essential, as this affects food supply and its availability, as well as nesting success.

ACKNOWLEDGMENTS

Appreciation is expressed to the following for their assistance in the field: William J. Bolte, John H. Doebel, Warren W. Hagenbuck, A. Ronald Hight, Marvin T. Hurdle, Joseph E. Johnston, Herbert W. Kale, II, Ralph M. Keel, Jr., Howard P. Langridge, John Lindell, Thomas W. Martin, James L. Pilgreen, Ronald C. Snider, Helen A. Snyder, Noel F. R. Snyder, Charles W. Strickland, James M. Williams, and Erwin Winte. In particular, I wish to thank Roderick Chandler for his aid with some of the field work and for generously providing copies of his field notes on kite activities over the years at Lake Okeechobee and to Even L. Rude for keeping the airboat operational. I am grateful to Gary L. Hensler, James D. Nichols, Chandler S. Robbins, William B. Robertson, Jr., and Noel F. R. Snyder for reading the manuscript and making helpful suggestions for its improvement. Many others who contributed to the study in various ways are thanked.

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U.S. FISH AND WILDLIFE SERVICE, PATUXENT WILDLIFE RESEARCH CENTER, FIELD STATION, P.O. BOX 2077, DELRAY BEACH, FLORIDA 33444. ACCEPTED 1 APR. 1979.

COLOR PLATE

The color plate Frontispiece of young Everglade Kites at the nest has been made possible by an endowment established by Dr. George M. Sutton.