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HABITAT USE BY AND DISPERSAL OF SNAIL KITES IN FLORIDA DURING DROUGHT CONDITIONS

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Although originally ranging over most of peninsular Florida (Howell 1932), Snail (Everglade) Kites (*Rostrhamus sociabilis plumbeus*) have been restricted in recent years mostly to three areas in southern Florida: the western marshes of Lake Okeechobee; Conservation Area (CA) 3A; and CA2 (Sykes 1978, 1979, 1983). Severe drought in southern Florida in 1981 dried nearly all wetlands inhabited by kites. Water levels at Lake Okeechobee were at record lows (2.9 m msl) in July and August, drying 99% of the wetland area. Water remained about 1.5 m below scheduled levels until June 1982 when it quickly rose as a result of heavy summer rains. Only perimeter canals contained surface water from May-August 1981 in CA3A and March-August 1981 in CA2 when Tropical Storm Dennis (16-19 August) replenished surface water supplies. After reaching scheduled levels in September 1981, water decreased again until CA2 dried out in February and CA3A in early May 1982. In late May 1982, surface water rose quickly again to near normal levels.

As a result of habitat unavailability caused by this drought, Snail Kites dispersed throughout the Florida peninsula in search of foraging habitats with apple snails (*Pomacea paludosa*), practically their sole source of food (for exceptions see Sykes and Kale 1974, Woodin and Woodin 1981, Takekawa and Beissinger 1983, Beissinger in prep.). This paper documents the areas used by kites during the drought and throughout the following year when snail populations remained depressed and water levels remained low throughout southern Florida. We also discuss the use of a sighting clearinghouse as a tool for monitoring kite movements, and the importance of some marginal habitats for kites during low water periods.

METHODS

From January 1981-July 1981 and December 1981-August 1982, Beissinger (SRB) visited regularly all major areas used by kites, mostly Lake Okeechobee and CA3A in 1981, and CA3A, Lake Kissimmee, and Lake Tohopekaliga in

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1982. He visited potential kite habitat in central Florida, especially after kites had dispersed from southern Florida. Most searches were conducted from an airboat using transect and roost counts (Sykes 1979). Snail egg abundance and water levels were noted periodically.

The "Everglade Kite Sighting Hotline" was established at Loxahatchee National Wildlife Refuge in June 1981. Hotline sightings were solicited statewide by a series of newspaper articles, radio announcements, and the dissemination of an Everglade Kite news alert, which appeared in popular publications. Hotline reports were received by telephone, letter, or in person. Hotline sightings were verified by Takekawa (JET) by telephone and occasionally by a visit to the site. In verifying a sighting, a detailed description of the appearance of the bird was obtained as well as its behavior, vocalizations, and habitat. Observer experience and knowledge were evaluated and at times played an important role in the verification process.

In verifying hotline sightings, confusion sometimes occurred with Northern Harriers (*Circus cyaneus*) during winter months and American Swallow-tailed Kites (*Elanoides forficatus*) and Mississippi Kites (*Ictinia mississippiensis*) during summer months. Because Northern Harriers superficially resemble Snail Kites, behavioral cues were used to evaluate the reliability of questionable sightings. Fortunately, most hotline sightings were received in summer when harriers are seldom present. American Swallow-tailed Kites often were reported as Snail Kites because locally they sometimes are called "Everglade Kites" but were easily detected in interviews because of their strikingly different physical appearance. Mississippi Kites were distinguished by appearance, habitat, and geographic location. Based on the broad range of characteristics we evaluated for each sighting, and the unique behavior and appearance of Snail Kites, verifying hotline sightings was relatively easy.

Sighting locations were grouped into three categories based on kite use from 1970-1980 (Sykes 1979, 1983, pers. observ.). Primary areas were used extensively. Secondary areas received irregular or sporadic use. Drought-related areas received little or no kite use except during dry periods. Habitats in drought-related areas were further characterized: (1) canals, stratified by type of use and size (agricultural, urban, roadside, main); (2) marshes, classified by the duration of flooding as either seasonal or permanent; (3) artificially created marshes, including farm ponds, borrow pits or shellpits; (4) natural open water habitats were separated by size into lakes or ponds and all running water habitats were large enough to be designated as rivers; (5) dwarf cypress swamp consisted of sawgrass (*Cladium jamaicensis*) stands and aquatic sloughs with scattered cypress trees or tree islands (*Taxodium ascendens*, *T. distichum*); and (6) agricultural fields.

RESULTS

Locations of Snail Kite sightings from December 1980-August 1982 are summarized in Fig. 1 and Table 1. Below, sightings are discussed by general habitat categories. Observer initials follow each sighting in parentheses and are indexed in the Acknowledgments section.

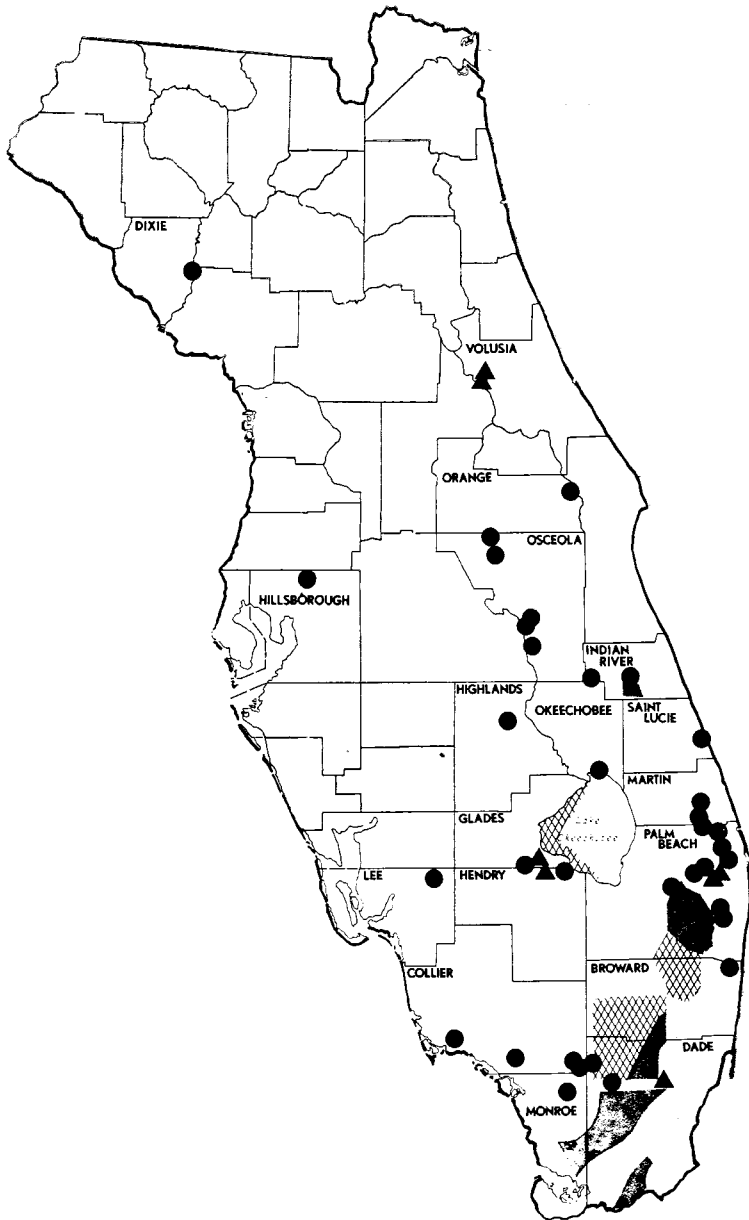


Fig. 1. Areas of primary and secondary use by Snail Kites and locations of drought-related sightings from April 1981-August 1982. Primary areas are crosshatched. Secondary areas are shaded. Single locations of drought-related sightings are shown by dots, and triangles represent two nearby locations.

TABLE 1. Drought-related sightings of Snail Kites in Florida from April 1981-August 1982 outside of primary and secondary areas. Habitat types are defined in the Methods section. The location and observers responsible for documenting each sighting appear in the appendix by the numbers listed below.

No.	County	Habitat	Dates	Number of Kites
1	Broward	Shell rock pit	May-Sept. 1981	2
2	Collier	Permanent marsh	30 April 1981	14
3	Collier	Borrow pit	6 May 1981	1
4	Collier	Turner River	16 Dec. 1981	1
5	Dade	Main canal	30 April 1981	1
6	Dade	Main canal	15 May 1981	1
7	Dade	Dwarf cypress	8 July 1981	2
8	Dade	Main canal	7 Sept. 1981	1
9	Dade	Dwarf cypress	1-5 Oct. 1981	1
10	Dixie	Suwanee River	5 June 1981	1
11	Glades	Lake Hiepochee	5 Feb. 1981- 29 Jan. 1982	2-17
12	Glades	Farm pond	8 May 1982	1
13	Glades	Caloosahatchee R.	18 Jan. 1982	1
14	Hendry	Agricultural canal	15 July 1981	1
15	Hendry	Agricultural canal	17 Aug. 1981	1
16	Hendry	Agricultural canal	29 Aug. 1981	1
17	Highlands	Lake Istokpoga	5 June, 27-28 Sept. 1981	0, 1
18	Hillsborough	Borrow pit, Seasonal marsh	6 June 1981	1
19	Indian River	Permanent marsh	24 April 1981, 14 May 1982	1, 3
20	Indian River	Roadside canal	26 April 1982	1
21	Lee	Caloosahatchee R.	3 Sept. 1981	1
22	Martin	Seasonal marsh	5-28 May, 29-31 Aug. 1981	1
23	Martin	Seasonal marsh	23 May 1982	2
24	Monroe	Dwarf cypress	12, 25 June 1982	7-8
25	Okeechobee	Borrow pit	2 Aug. 1981	1
26	Orange	St. Johns River	28 Oct. 1981	1
27	Osceola	Roadside canal	23 July 1981	1
28	Osceola	Lake Kissimmee	June 1981-Aug. 1982	3-25
29	Osceola	Lake Tohopekaliga	Oct. 1981-Aug. 1982	6-32
30	Palm Beach	Seasonal marsh	13-14 July 1981	1
31	Palm Beach	Seasonal marsh	19 Oct. 1981	1
32	Palm Beach	Agricultural canal	20 April 1982	1
33	Palm Beach	Seasonal marsh	21 April, 26 May 1982	1

No.	County	Habitat	Dates	Number of Kites
34	Palm Beach	Urban canal	6 May 1982	1
35	Palm Beach	Urban canal, Seasonal marsh	May 1981	1
36	Palm Beach	Main canal	May 1982	1-3
37	Palm Beach	Agricultural field	late May- 11 June 1982	1-2
38	Palm Beach	Agricultural canal	29 June 1982	1
39	Palm Beach	Main canal	20 June 1981	1
40	Palm Beach	Urban canal	19-21 June, 15 Aug. 1981	3, 1
41	Palm Beach	Urban canal	June-Sept. 1981, Jan. 1982	1-8
42	Palm Beach	Roadside canal, Permanent marsh	9 Sept. 1981, April-May 1982	1-2
43	St. Lucie	Permanent marsh	2 May 1982	1
44	Volusia	Permanent marsh	5-7 June 1981, 2 Dec. 1982	1
45	Volusia	Scoggin Creek	19 June 1981	2
46	Volusia	Spring Garden Creek	15 July 1982	1

PRIMARY AREAS

Lake Okeechobee (Glades, Hendry, and Palm Beach Counties).—Kites began to move away from Lake Okeechobee in winter 1981. In late January-March 1981, 100-120 kites were spread throughout the southwestern and northwestern shores (SRB) in contrast with 214 in December 1980 (Sykes 1983). As water levels dropped and lake margins dried out, kites concentrated in more interior areas near the mouth of Moonshine Bay, Fisheating Creek, and along the northwest shore to Horse Island. In mid-May 1981, SRB estimated the lake population to be 75 kites and counted only 58 birds from 9-15 June 1981. When water depths reached record lows in July and August 1981, nearly all kites had moved to sections of the rim canal near Moore Haven and Clewiston, the mouth of Harney Pond Canal, and along the northwest shore near Little Sarasota boat landing (SRB). Three kites were near Lake Harbor and Ritta Island where birds had not been seen in previous years (SRB). Radio tracking indicated frequent movements of kites on and away from the lake during June and July 1981 (Beissinger unpubl.). On 2 October 1981, two kites were on the rim canal near Moore Haven (MZ).

By late November 1981, James A. Rodgers found only two kites and Beissinger found only one kite near Ritta Island from 18-20 December 1981 during thorough censuses. Six kites were near Horse Island on 28 and 29 January 1982 (SRB) on a thorough search of the lake and they remained there until 2 February 1982 (NAC). Noel Chandler found no kites during five searches in February nor any on 2 April 1982. His kite sightings began again in April 1982 at Horse Island where 3 to 4 kites were regularly seen through mid-May and 19 were observed on 7 April. No birds were found during four searches in June (NAC) nor any on 8 and 23 July 1982 (SRB). Snail eggs were few and found only along open water edges of marshes near the main lake or canals.

In summary, Lake Okeechobee supported a sizeable kite population from winter through spring 1981 and was the only major area where large numbers of kites occurred during drought conditions throughout the summer of 1981. The lake probably served as an important survival habitat, but water levels remained low on the lake until summer 1982. As a result of prolonged low lake levels, kite use declined from fall 1981 to summer 1982.

Conservation Area 3A (Dade and Broward Counties).—In a thorough census, Sykes (1983) counted 305 kites in December 1980, making CA3A the area of highest kite concentration before the drought. Kite movement in CA3A was extensive in winter 1981 as water levels declined, illustrated by a drop in the number roosting behind the Miccosukee Restaurant on US 41 from slightly over 100 in December 1980 (PWS, DMC) to 25 on 24 January 1981 (SRB, DMC). However kite use remained high in CA3A as 108 birds were noted at an evening roost by SRB on 14 February 1981 in the southeast corner. On 22 April 1981, 30-40 kites were seen behind the Miccosukee Restaurant, many of these were attempting to nest (SRB). But, in response to drying conditions, kites had moved into surrounding canals where 12-16 birds were observed along a 17 km portion of the L-67A heading north from US 41 on 20 May while only four kites were seen at the Miccosukee roost (SRB). Helicopter searches on 1 and 4 June 1981 detected no kites and no standing water (SRB, DMC). Three sightings of one to three kites from June through August 1981 were limited to perimeter canals since the area was dry (DMC, MH, BC). After water levels rose in mid-August 1981, the frequency of kite sightings increased: 8 sightings from September-November totaling 41 kites (the largest was of 13 kites) were mostly from interior locations (PAC, WD, DRS, JLS, JDW, MZ).

In a census count in December 1981 James Rodgers found 78 kites. Counts in January 1982 totaled 154 birds and increased to 176 kites in March 1982 (SRB). The largest roosting concentration was behind the Miccosukee Restaurant on US 41 where Beissinger conducted five roost counts from January-March 1982 that yielded a mean of 95 kites ($SD = 8$). By 17 April 1982, when water levels were very low, this roost had shrunk to 11 kites. Subsequent counts in June and July each produced only three kites (SRB). Twice during this period, kites were seen again near perimeter canals (SH, PWS, BH). Generally, kite density was very low during summer 1982. Thorough airboat searches by Beissinger detected only five kites on 19 June 1982 and none from 26-28 July 1982. Scattered sightings included four birds just south of the Alligator Alley Rest Area on 18 July 1982 (JW), one on 25 July 1982 on the north side of US 41 opposite the Shark Valley entrance to Everglades National Park (JS), four to six kites at the north end of the L-28 gap on 3 August 1982 (MZ), and two kites 8 km south of Bridge 11 and SR 84 on 26 August (MA) and one there on 30 August (LR). Throughout the spring and summer months, snail eggs were uncommon and snail capture times for kites seemed long (SRB).

Thus, CA3A supported the major concentration of kites during both winters of our survey. In 1981, populations probably remained high until late April when drought conditions caused massive dispersal. Kites began regrouping in CA3A by September 1981 when water levels rose. In winter 1982, this area supported approximately 79% of the known birds in Florida (Beissinger unpubl.). Dispersal occurred again in April 1982 as a short term dry-down probably decreased already low snail populations. Despite reflooding and good water levels in June and July 1982, kites did not return to CA3A as snail populations were very low.

Conservation Area 2 (Broward and Palm Beach Counties).—In CA2A, one kite was seen in December 1980 (Sykes 1983). From February-August 1981, water levels in CA2A were very low as part of a scheduled dry-down. No kites were seen during helicopter searches on 1 and 4 June 1981 (SRB, DMC) and only one kite was seen, near water gauge 2-17, on 15 September 1981 (DRS). In early December 1981, one kite was noted on a thorough census (JAR) but by mid-January 1982 the area was drying again, and none were found on a 24 January 1982 airplane search (SRB). A few sightings occurred after reflooding in spring 1982, six or seven

kites on 28 March (ED), and eight in mid-May (PWS) in the south end near Sawgrass Recreation Area and two sightings in mid-May in the north end of one or two birds (RT, CW). A 20 June 1982 airplane search and a 21 June 1982 check of the southeast end located no kites, and snail eggs were scarce (SRB). In CA2B (Broward County), Sykes (1983) noted 115 kites in mid-December 1980. By 24 March 1981 Beissinger saw only 12 kites during a thorough search as water levels were low. None were seen during 1 and 4 June 1981 helicopter searches (SRB, DMC) when the area was completely dry. After reflooding, one kite was found in early December 1981 during a thorough search (JAR) and one on a 24 January 1982 flight (SRB). This area remained dry until late April 1982. Two kites were noted on a thorough search on 20 June 1982 although snail eggs were very scarce (SRB).

In summary, kites used CA2B in large numbers before water levels dropped rapidly in late winter 1981. Extended dry conditions from April-August 1981 and February-April 1982 probably greatly reduced snail populations, resulting in little use of CA2A or CA2B by kites from spring 1981 through summer 1982.

SECONDARY AREAS

Loxahatchee National Wildlife Refuge (Palm Beach County).—Water levels averaged approximately 0.4 m below scheduled levels throughout 1981. Although one-quarter to one-third of the refuge remained wet during the drought, much of the northern two-thirds held little standing water from April through mid-August 1981. Aerial wading bird surveys on 17 April, 8 May, 29 June and 24 July (PF, BP) produced no kite sightings. The only summer sighting occurred on 5 June 1981 when a group of seven kites was seen soaring over the refuge interior west of headquarters (EM, TL). Although water levels quickly rose over 0.4 m from mid to late August, they fell again in October, remaining below schedule through February 1982. A single kite was seen on 18 November 1981 at the southern tip of the refuge (TS). On 23 and 31 December 1981 (AG, GH), one kite was in the impoundments south of refuge headquarters. A 7 January 1982 aerial survey for deer produced a sighting of one kite in the interior of the refuge (JDW). No kites were located on monthly ground waterfowl surveys from October 1981-February 1982 (JET). Water rose in March and remained high through July 1982. Six sightings totaling 14 birds occurred sporadically from April through July at the headquarters impoundments

(DM, BH, PH, RVH, PWS, SP1). The canoe trail west of refuge headquarters received use by at least four foraging kites on 12 and 13 April 1982 (RVH, JET, JK, SM). On 28 July 1982 T.H. Koundakijan sighted a single kite 1 km south of refuge impoundments on the east side of L-40.

Conservation Area 3B (Dade County).—From January-August 1981, this area was dry. One kite was noted on 2 and 7 September 1981 (DMC) and 24 were seen on 15 October 1981 in the southwest corner (JDW). A thorough search in December 1981 yielded 13 kites as water levels were quickly falling (JAR). Airplane checks on 16 and 24 January 1982 detected four kites in the southwest corner (SRB). On 15 March 1982, 10 kites were observed (SRB) in the northeast corner 1 km west of M. P. Thompson Park on US 27. From April-May 1982, this area was dry. In late June, Pat Reynolds found 33 kites roosting about 1 km north of Everglades Safari on US 41.

Everglades National Park (Dade County).—A December 1980 survey found 14 kites (Sykes 1983). Water levels decreased through winter 1981, and by 20 February 1981 in a helicopter search, only three kites were located in Shark Valley Slough and none in Taylor Slough (OLB, SRB). Following below-average rainfall through the spring and summer, water levels were low in July 1981. A single sighting of one kite was reported on 3 August on the main park road 2.5 km south of Pa-hay-o-kee (LM). Tropical Storm Dennis raised water levels rapidly in August. On 18 August 1981, Doug Cuillard noted three kites south of the main park road over Royal Palm at the edge of Taylor Slough. A single kite was noted on 29 August 1981 on the main park road 100 m south of the entrance station approaching Taylor Slough (WB). Patricia Carrington saw three kites south of US 41 and west of the Shark Valley entrance road on 7 November 1981. By December, water levels were lower than during the same month of the previous year and only one kite was found in Shark Valley and none in Taylor Slough (JAR). Below average rainfall recorded during summer 1982 was offset by record discharges of water into the Park from the flooded conservation areas. Four kites were seen on 29 April along the Shark River Slough airboat trail between staff gauges 14 and 15 (BL). On 9 May, K. Overman saw four kites near Parotis Pond.

Headwaters St. Johns River (Indian River County).—A pair of kites was noted building a nest early in April 1981 (HWK) in the northeast end of the reservoir, and on 28 May 1981 the male was seen feeding a fledgling (SRB). One kite was observed in the north-

east corner on 22 March 1982 (SRB) and three on 14 May 1982 (SRB, NAC, RC), but no signs of breeding were noted, and snail numbers appeared low.

DROUGHT RELATED AREAS

Drought-related sightings of Snail Kites are summarized in Fig. 1 and Table 1. Kites were observed at 46 separate locations outside of primary and secondary areas. At some locations, kites were seen repeatedly (e.g., No. 22, 24, 35, 37, 40 in Table 1), sometimes during both years of our survey (e.g., No. 11, 19, 28, 29, 41, 42, 44), while at other locations kites were reported only once (e.g., No. 2-8, 12-16). Two sightings (No. 10, 18) were the first records of Snail Kites in those counties (Sykes in prep.).

Kites nested in two of the drought-related habitats, Lake Kissimmee and Lake Tohopekaliga, the first records of breeding on these lakes. Nesting was observed on Lake Kissimmee (Fig. 2) along the old riverbed and in the first cove on the east side just north of the SR 60 bridge. In 1981, a fledgling was seen with 12 adult kites but in 1982 up to 25 kites attempted 17 nests, fledging 5 young. Breeding was first documented on Lake Tohopekaliga in 1982 near Goblet's Cove where 32 kites built 39 nests, fledging 19 young. Kite populations on each lake declined to six or fewer birds during fall and early winter months when nesting had terminated.

Most habitats used by kites during the drought (Table 1) were quite different from the typical Everglades or lake marshes that kites use during wetter periods (Sykes 1983). Kites were most frequently observed along urban (Fig. 2), roadside, or agricultural canals. A few rivers in central Florida provided temporary refuge for scattered individuals. Small (2-5 ha) permanent and seasonal wetlands also were used frequently. In addition, very small (2 ha or less) artificial marshes such as borrow pits, shell ponds and farm ponds supported a few birds for short periods.

AREAS WITHOUT KITES

Snail Kites were not observed in other potential central Florida habitats searched during the height of the drought by Beissinger (Table 2). Most of these areas did not have marshes suitable for foraging by kites, and snail populations probably were low.

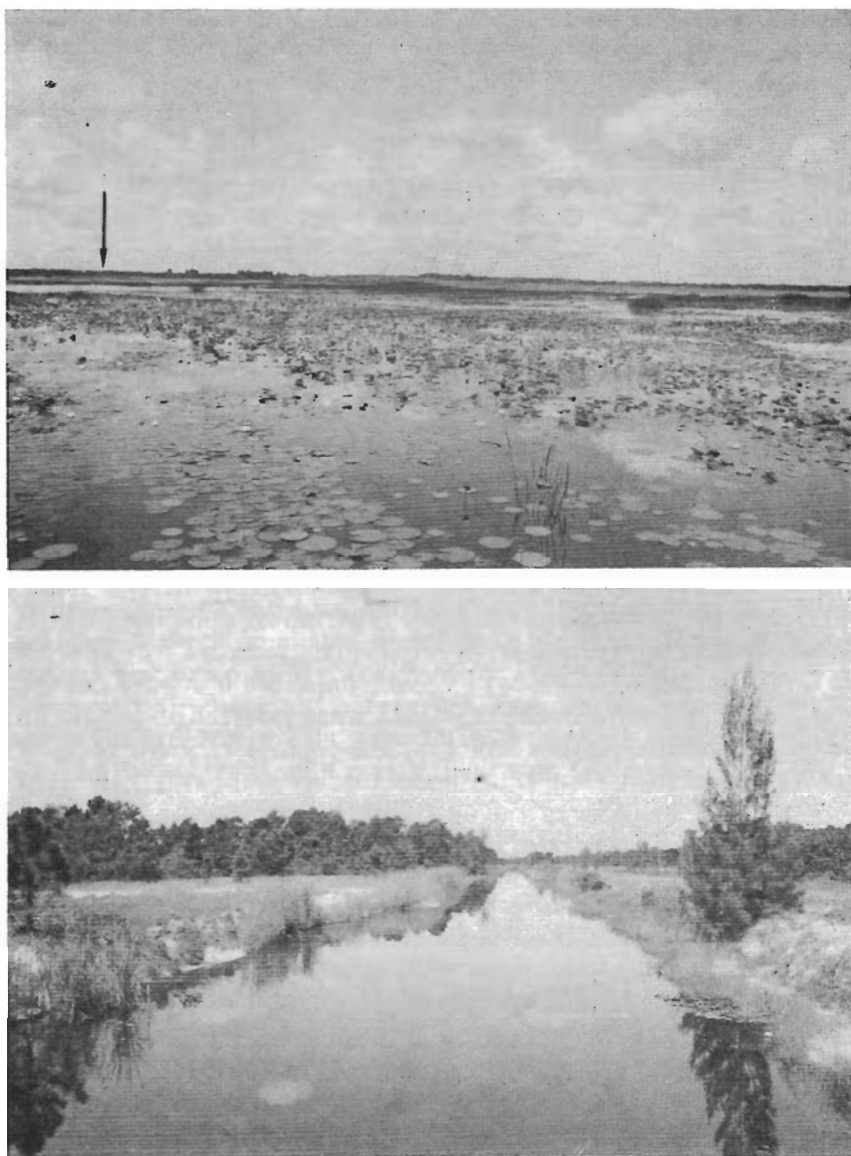


Fig. 2. Two drought-related habitats used extensively by Snail Kites. Top. Lake Kissimmee (Osceola Co.) where breeding was documented in the willow border indicated by the arrow. Note the extensive foraging habitat in the foreground. Bottom. The M-1 Canal in Royal Palm Beach (Palm Beach Co.) where kites often were observed foraging during the height of the drought in 1981.

TABLE 2. Areas searched in Florida in 1981 where no Snail Kites were observed. Locations appear in the appendix. Apple snail densities were judged by the presence of egg clusters.

No.	County	Habitat	Date	Snails
1	Alachua	Lake Orange & Area	18 June	Few
2	Citrus	Tsala-opoka Lakes	16 June	Few
3	Citrus	Withlacoochee R.	17 June	Few
4	Marion	Rodmans Reservoir	18 June	Common
5	Osceola	Cypress Lake	7 June	Few

KITE SIGHTING PROGRAM

Between June 1981 and September 1982, 155 sightings of Snail Kites were reported, 84% of which were judged to be reliable. The remainder included 13% that we judged to be of another species and 3% that had insufficient information. The most common misidentification was of the American Swallow-tailed Kite.

Over 55% of the sightings were reported by employees of government agencies, usually trained biologists or game wardens, and 97% of these were judged to be reliable; another 5% were observations made by the general public that were referred to the hotline by government employees. Many of the reports received from the general public were from experienced birders and naturalists. However, only 40, or 65%, of the 62 sightings reported by the general public, were verified to be of Snail Kites.

DISCUSSION

HABITAT USE AND DISPERSAL

As a result of drought conditions in southern Florida in 1981-82, massive dispersal of Snail Kites occurred. In 1981, kites were still concentrated in primary habitats. Movement was high during winter when water levels were nearly 1 m below normal. Massive dispersal away from primary habitats began in May with the onset of severe drought conditions and all primary areas dried. After flooding in August by Tropical Storm Dennis, kites returned to CA3A but not to the other primary areas. Massive dispersal occurred again in 1982 when water levels in southern Florida reached lows in April and May. Despite reflooding of primary areas in June, kites did not return immediately. The frequency of sightings

of kites reflected these two dispersal periods; sightings peaked from June-August 1981 and May-June 1982. Few sightings were reported in fall 1981 or winter 1982 when kites were concentrated in CA3A.

The only primary area receiving significant kite use in 1982 was CA3A. Of the three primary areas, CA3A was dry for the shortest duration, only four months compared to over a year for Lake Okeechobee. Because prolonged flooding of a marsh may be needed to sustain apple snail populations (Sykes 1979), snail survival during drought probably is inversely related to the length of the dry period. The nearly exclusive concentration of kites in CA3A in winter 1982 may reflect higher snail survival rates, higher pre-drought snail populations, or both.

Kites dispersed to two major regions (Fig. 1), the central lakes (Lake Tohopekaliga and Lake Kissimmee) and the east coast corridor (canals and seasonal or permanent wetlands in Broward, Palm Beach, and Martin Counties). Nearly a quarter of the known population in 1982 reached the central lakes (Beissinger unpubl.). This area not only provided survival habitat but snail populations were high enough to enable breeding to proceed. Although these were the first breeding records, it seems likely that central Florida always was an important refuge for kites during drought conditions because lakes in this region are permanent bodies of water capable of supporting snail populations even during low water conditions. The east coast corridor supported many scattered small groups of kites. Although much of the natural habitat in this region has been drained and developed, it has the highest rainfall in southern Florida (Thomas 1974), and kites might expect to find some wet areas here when most others are dry. The movement by kites to the east coast corridor during the 1981-82 drought, despite little marsh habitat remaining in this region, may be the result of a historical behavior that was strongly selected for during past drought conditions.

Lake Okeechobee was an important habitat for survival during the first year of drought. Kite numbers remained high through summer 1981, but prolonged low water conditions through spring 1982 resulted in little kite use. During the height of the drought, most sightings were along perimeter canals. Lake Okeechobee was an important kite refuge during the less severe 1971 drought (Chandler and Anderson 1974) and historically was probably an important refuge during dry seasons since at least some marsh areas always remained wet. In addition, Lake Okeechobee may

be a stop-over for kites that make their way north from the Everglades region into the central lakes.

The Headwaters of the St. Johns and the Loxahatchee National Wildlife Refuge were the only secondary areas that kites used during the height of the drought. Although one breeding pair was noted on the St. Johns, only a few kites were found there. Kites did not remain long at Loxahatchee and seemed to be passing through on their way to other east coast corridor habitats. Sightings in both of these areas occurred mostly at perimeter canals or impoundments rather than in the larger interior areas.

During the height of the drought in summer 1981, kites were seen most frequently in canals, especially in urban and agricultural areas and along roadsides. When water levels were finally replenished in 1982, sightings in small seasonal marshes increased. Kites were willing to move great distances and use very small patches of suboptimal habitats to survive the dry period.

Two key factors work directly or indirectly against kite survival in drought-related habitats. (1) Movement by kites from Everglades wilderness into more urban areas increases contact with humans. As kites are unwary of intruders when away from nest sites, they are easily shot and our data document at least two probable shootings in Palm Beach County (at locations No. 39 and 41 in Table 1). A publicity program conducted to increase public awareness of the kite's plight during drought periods could help alleviate shootings. (2) The amount of seasonal marshes has been decreasing because of drainage and development. Several marshes utilized by kites during this study are due for development in the near future (H. Johnson pers. comm.). We believe that our data show that these areas are important for kite survival during Florida's cyclic droughts and need to be preserved to insure survival during these periods.

Unfortunately, a quantitative analysis of the habitats used by kites during the 1981-82 drought is too difficult because of data biases. Sightings reflect areas that are frequented by people, such as roads, canals, and lakes. More remote areas such as permanent marshes received less coverage by observers and are probably under-represented in our data. We also noticed that the effectiveness of our publicity increased with time as nearly 1.6 times as many sightings were received in 1982 as in 1981.

KITE SIGHTING PROGRAM

The Everglade Kite Sighting Program proved to be an effective means of obtaining information on the dispersal of the kite population. Sightings revealed much about the extent and timing of dispersal. In addition, the program was used to supplement annual kite censuses conducted by biologists. Only a minimal amount of time and expense was required to procure the information.

The effectiveness of any sighting program is dependent upon observer accuracy and proper publicity. A strong verification process is needed in light of a substantial number of erroneous reports that may be received. Evaluation of multiple factors, such as appearance, behavior, habitat, and observer experience, was crucial to the verification process that we used in this study and is highly recommended for others involved in similar efforts with sighting programs. Publicity was aimed at reaching people that most likely would recognize kites and subsequently report sightings. Aside from the general public and Audubon members, special attention was given in this study to notifying personnel in regional, state, and federal agencies. Because sightings from employees of governmental agencies, many of whom were trained biologists, comprised well over half of those obtained by our sighting program, we suggest that other sighting programs should actively pursue this relatively reliable source of information. Due to its initial success, the Everglade Kite Sighting Program presently is being continued at Loxahatchee National Wildlife Refuge.

SUMMARY

In response to extended drought conditions in 1981-82, Snail Kites dispersed throughout the Florida peninsula. The timing of dispersal was related to dropping water levels at the onset of drought conditions. Sightings indicated that most kites moved to Lake Okeechobee (in 1981), the central lakes (in 1982) and the east coast corridor (in 1981 and 1982). Only Conservation Area 3A, which had the shortest period of dry-out, supported significant numbers of kites during higher water conditions in winter 1982. During the height of the drought, urban, roadside and agricultural canals attracted many small groups of kites or scattered individuals and were the most frequent sighting spots. Kites moved great distances to utilize very small patches of suboptimal habitat to survive the dry period. A sighting hotline was used successfully to document the dispersal of kites, and suggestions for the implementation of "hotlines" in gathering distributional data are discussed.

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APPENDIX

Locations followed by observer's initials in parentheses (see Acknowledgments section for a key to observers) for drought-related sightings (Table 1) and areas without kites (Table 2) by number.

Table 1: 1. Butler Rd. S of Hillsboro Blvd. and E of Turnpike (RK); 2. 28 km E of Naples on N side of US 41 (DMC); 3. N of US 41 and S of Jetport training strip (DMC); 4. Turner River 1.5 km N of US 41 and 16 km W of Monroe Station (DMC); 5. S of US 41 near Shark Valley entrance to Everglades N.P. (DMC); 6. C-111 canal 1 km W of SR 27 (DMC); 7. Big Cypress National Preserve on Eleven Mile Rd. 1 km N of US 41 (DS); 8. Near Krome Ave. and US 41 intersection (DMC); 9. E edge of Big Cypress National Preserve on W side of L-28, N of US 41 (MS); 10. Suwanee River 200 m S of Fanning Spring, Levi Co. in a canal on the Dixie Co. side of the river (CC); 11. Lake Hicpochee 8 km S of Moore Haven (SRB, RP, DB, TR, JAR); 12. 5 km W of Moore Haven on the N side of US 27 (RS); 13. Caloosahatchee River on N side of SR 80 11.5 km W of Moore Haven (LN); 14. 12 km W of Clewiston on S side of US 27 (SRB); 15. 3 km W of Clewiston on S side of US 27 (HQ, JQ); 16. E side of SR 80 near intersection of US 27 and SR 80 (ME); 17. Lake Istokpoga at inflow of Arbuckle Creek (SRB,

RM); 18. Intersection of SR 581 and Trout Creek Rd. N of Tampa (WBC, ML, GBP); 19. Directly NW of SR 60 and SR 512 (SRB, RC, NAC, HWK); 20. E side of Turnpike 19.5 km S of Fort Drum Plaza (DJ); 21. Caloosahatchee River near confluence with Hickey Creek (SR); 22. E side of SR 711 between 5 and 6.5 km N of the intersection with SR 706 (HJ, RST, MT); 23. SR 711 S of junction with SR 708 (JD, MD); 24. Big Cypress National Preserve along an airboat trail 1.5 km S of Pinecrest and the Loop Rd, N of Doctor Tiger's Hammock and W of Ben Hess Head (FD); 25. SR 441 2 km S of Okeechobee city limits on W side (RC); 26. St. Johns River just N. SR 50 bridge and Tosahatchee State Preserve (FH); 27. W side of Turnpike 6 km N of Kissimmee/St. Cloud exchange (RVH); 28. Lake Kissimmee 0-2 km N of SR 60 bridge and also 6-7 km NE of the boat landing at Co. Rd. 523A (SRB, FM, JAR); 29. Lake Tohopekaliga near Goblet's Cove (GW, SRB, JAR); 30. Jupiter Farm Rd. S of SR 706 and W of the Turnpike (RN); 31. N side of SR 704 adjacent to the S end of the West Palm Beach Water Catchment Area (RVH); 32. 1.5 km W of US 441 between Lake Worth and Lantana, W of Homeland entrance (FCC); 33. W of Jupiter on S side of SR 706, 1 km E of intersection with SR 711 (HJ); 34. West Palm Beach E side of US 441 between 704 and Belvedere Rd (RVH); 35. Callery-Judge Citrus Grove on Seminole Pratt-Whitney Rd., N of SR 80 and E of Lion Country Safari (GR); 36. C-18 boat ramp near PGA Blvd. bridge, 3 km W of Turnpike (LA); 37. Whitworth Farms E. of US 441 and 2.5 km S of intersection with SR 804 (JW, JET, SRB—See Takekawa and Beissinger 1983); 38. NW of Loxahatchee N.W.R. and L-7, 3 km SW of Twenty Mile Bend (SP2, JT); 39. West Palm Beach Canal, S of SR 80 (Southern Blvd) near Pioneer Rd. between the Florida Turnpike and US 441 (BF); 40. M-1 Canal (Fig. 2) in Royal Palm Beach, S of Okeechobee Blvd., W of Strathmore Gate and Indian Trail Villas (DRS); 41. 3 km portion of the M-1 Canal in Royal Palm Beach, parallel to 130th Ave N and 40th St, 3.5 km NW of the intersection of U.S. 441 and Okeechobee Blvd (SR 704) (RVH, JET, SRB, CZ); 42. North Palm Beach along the Florida Turnpike, between 4 km N of SR 704 (Okeechobee Blvd) exit and just N of SR 702 (45th St) (JB, SRB, BD, JET, RVH, BSN, PRM, RI); 43. Savannas County Park (SR 712 and Weatherbee Rd) (MD); 44. Lake Woodruff N.W.R. in impounded pools W of Spring Garden Lake (NC); 45. Lake Woodruff N.W.R. 1.5 km S of Lake Woodruff on Scoggin Creek (SRB); 46. Lake Woodruff N.W.R. on Spring Garden Creek 1.5 km N of refuge impoundments (NC).

Table 2: Lake Orange, Cross Creek, and Lochloosa near Evinston; 2. Henderson, Craft, Spivey, and Davis Lakes near Inverness and Hernando; 3. 25 km section between SR 44 and S 200; 4. R24-25 E, T11S; 5. 6.5 km S of Lake Tohopekaliga.