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TRENDS IN NUMBERS OF AMERICAN KESTRELS ON ROADSIDE COUNTS IN SOUTHCENTRAL FLORIDA FROM 1968 TO 1976

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Two subspecies of the American Kestrel (*Falco sparverius*) regularly occur in Florida: *F. s. paulus*, the resident race, and *F. s. sparverius*, a migrant and winter resident. Although *paulus* is declining (Wiley 1978) and the general abundance of kestrels in Florida in winter is attributed to the presence of northern birds, little quantitative information is available on seasonal and yearly trends in abundance of this species in the state. I made roadside counts of kestrels in the Lake Wales Ridge section of Highlands County over the eight-year period 1968-1976 to determine the extent of seasonal and year-to-year variation in population levels in this region. Comparable data provided by Peter and Margo Cone from the Florida Keys for the fall to spring period in 1974-75, 1976-77, and 1977-78 are also included in this report.

DESCRIPTION OF STUDY AREAS AND METHODS

The census route was a 7.1 km section of State Route 17 extending from U.S. 27 on the north to State Route 70 on the south. This narrow, lightly-traveled road traverses gently rolling sand hills largely planted with citrus groves. The road has grassy shoulders 3-4 m wide. Along most of its length (6.3 km) the route is bordered by citrus groves on one side and a dry, brushy railroad right-of-way on the other. Several large commercial buildings and paved parking areas are located along the northern 0.2 km of the route, and the southernmost 0.6 km stretch goes through an area of bayhead and swamp thicket vegetation. The northern half of the road was widened and repaved during the winter and spring of 1975-76. The construction did not cause any major habitat alteration or apparent disruption of the kestrel population along the route. In June 1976 most of the utility poles along the road were removed. Counts were discontinued at this time on the assumption that since the poles had been favorite kestrel perching sites and alternate sites were relatively scarce data from further censuses would not be comparable to the period when the poles were present. Casual observations during the following several years indicated that kestrel utilization of this stretch of road was indeed altered by the absence of the poles.

The area traversed by the survey route is generally representative of the habitats and land-use pattern of the southern portion of the Lake Wales Ridge, which is characterized by predominantly xeric scrub or woodland vegetation, citrus groves, and scattered development.

In contrast, the habitats off the ridge, a few miles to the east and west of the survey route, consist of extensive grasslands, pine flatwoods, and scattered marshes, swamps, and hammocks.

Kestrels perched or in flight within 0.4 km of the road were counted from a vehicle traveling 32-48 kph. A total of 675 counts was made during 286 weeks in the period 8 August 1968 through 13 June 1976. Censuses were made at least once a month except for August 1969 and June 1971 and 1972. In 69 of the total of 93 months in which censuses were conducted, one or more counts were made in at least 3 weeks of the month. The number of counts per week ranged from one to seven, with a mean of 2.5. Often two counts were made at different times on the same day. More counts were made from September to April, when kestrels were usually present, than from May to August, when kestrels were seldom observed. Thirty-eight percent of the censuses were made between 0700 and 1100, 21% between 1100 and 1500, and 41% between 1500 and 1900 E.S.T.

Peter and Margo Cone's roadside counts were made in the same manner as mine along a 13.2 km stretch of U.S. 1 from Bahia Honda to Big Pine Key, Monroe County, during the periods 11 October 1974—16 April 1975 (46 counts), 16 October 1976—20 April 1977 (12 counts) and 24 September 1977—21 April 1978 (25 counts). Most of the route was along narrow strips of land extending about 15 to 60 m on each side of the road. Vegetation was predominantly mangroves and thickets of Brazilian pepper (*Schinus terebinthifolius*) and buttonwood (*Conocarpus erectus*). This section of road had only a few scattered houses and was bordered by a utility line.

Results and Discussion

The number of kestrels recorded per census on the Highlands County route ranged from 0 to 12. Most individuals were observed in the stretch bordered by citrus groves and the brushy railroad right-of-way. Although locations of individuals were not specifically recorded, kestrels tended to occur in the same stretch of road from census to census within a given year and from one year to another. Tabb (1977) noted a tendency for kestrels retrapped from one to six years after banding to be in the same areas in which they were originally captured. Mean number of individuals recorded per census at various times of day were as follows: 1.9 between 0700 and 1100, 2.9 between 1100 and 1500; and 2.4 between 1500 and 1900. These differences are significant at the $P < .001$ level (X^2 test).

Although sex was not routinely determined, an attempt was made to record the sex of all kestrels observed on 27 censuses between March 1975 and April 1976. Of a total of 59 individuals for which sex was noted, 52 (88%) were males and 7 (12%), females. This difference is highly significant ($P > .001$, X^2 test). Males comprised 82% of 27 individuals of known sex in October, November, and January, compared with 94% of 31 sexed individuals in March and April. Although not statistically significant ($P < .05$, X^2 test), the seasonal difference in sex ratio suggests that males may be more prevalent in spring than during fall and winter. The single individual of known sex recorded in summer (June-August) was a male observed 8 June 1973. Comparative data on sex ratios in other parts of Florida are scarce. Peacock (1972) recorded a sex ratio of 15% males to

85% females along the Gulf Coast in Pinellas County from October to March 1971-72. Of 17 recaptured banded wintering kestrels in southern Florida, 3 (18%) were males and 14 (82%), females (Tabb 1977). Studies of kestrels in other parts of the range (e.g. Koplin 1973, Mills 1976) have revealed marked variation in sex ratios in different habitats in winter, and a similar phenomenon may occur in Florida.

Weekly maximum numbers of individuals recorded from June of one year through July of the next from 1968-69 to 1975-76 are shown in Figure 1. Kestrels were scarce on the census route from mid-April to mid-September. Only twice (8 June 1973, 17 August 1970) in 50 counts during June, July, and August were birds observed (single individuals each time). In contrast, kestrels were regularly present on the route from late September or early October to early April. The beginning of the fall build-up of numbers ranged from 30 August in 1968 to 14 October in 1975 and from 19 September to 6 October in other years. Latest spring dates, ignoring occasional isolated later sightings of single individuals, extended from 31 March in 1970 to 27 April in 1968 and from 5 to 16 April in remaining years.

The marked difference between summer and winter numbers suggests that the *paulus* population in the southern Lake Wales Ridge region is very low and that the abundance of kestrels in winter reflects an influx of the subspecies *sparverius*. One factor complicating this interpretation is the possibility of seasonal habitat shifts in *paulus* that may result in individuals of this race being less frequent in open habitats along roads at some seasons than at others. Observations on marked *paulus* individuals at the Archbold Biological Station located about one mile from the census route have revealed a tendency for the birds to be in fairly heavily wooded pinelands during the breeding season and to shift to more open areas along roads and citrus groves during the winter months (Layne, unpublished data). Thus, the population of *paulus* actually may not have been as low as suggested by the rare presence of kestrels on the census route in summer, and the birds in winter may have included both local and northern individuals. However, my observations of suitable kestrel nesting habitats in Highlands County during the breeding season support the conclusion that *paulus* is in fact scarce in this region of Florida and that the birds present in the winter are predominantly the subspecies *sparverius*. Probably all kestrels seen on the route from May through August were *paulus*, although the possibility that some were late-departing or early-arriving northern birds cannot be dismissed. Further evidence of the scarcity of kestrels in summer in southcentral Florida was presented by Layne et al. (1977).

In addition to the striking difference in summer and winter populations on the census route, the data for most years also indicate distinct

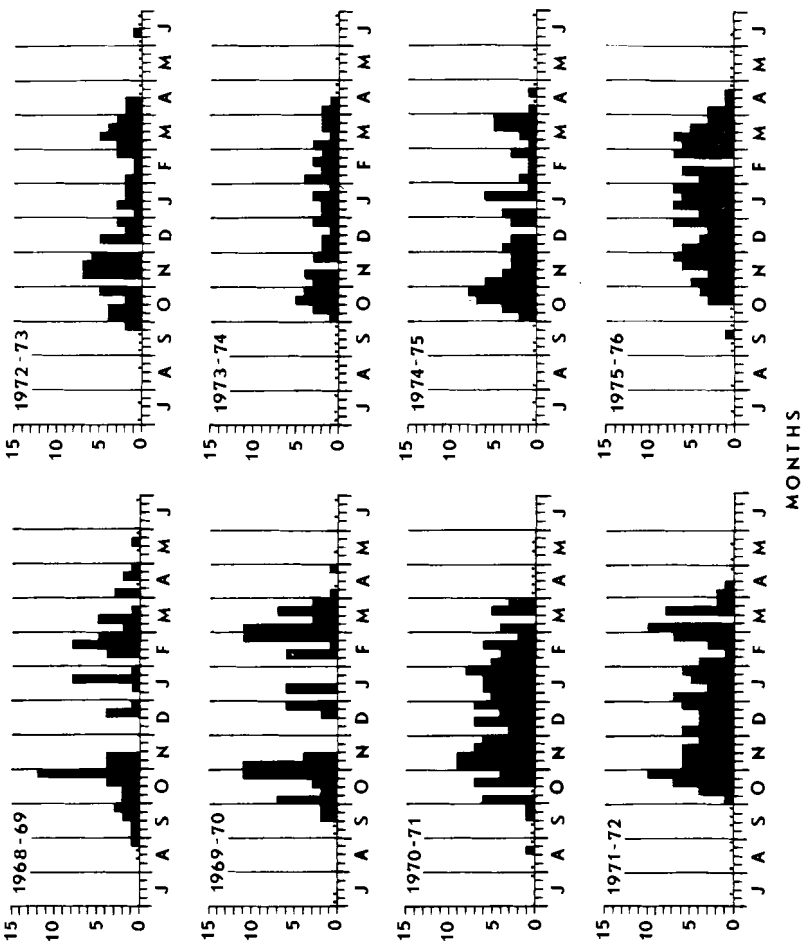

Fig. 1. Maximum numbers of American Kestrels recorded for a given week from August 1968 through June 1976 on roadside surveys in Highlands County, Florida. Weeks in which censuses were made but no American Kestrels recorded are indicated by dots on the horizontal axis.

changes in numbers through the fall to spring period when northern birds were present. In all years except 1975-76, numbers of kestrels reached a peak in fall, then declined during the winter months. In some years a second peak of abundance occurred in spring. This bimodal pattern is most evident in 1969-70, 1971-72, 1972-73, and 1974-75, with the spring peak being as pronounced as the fall peak in 1969-70 and 1971-72. Dates of the fall peaks extended from about 20 October to 19 November and of spring peaks from about 28 February to 22 March. No fall or spring peaks were evident in 1975-76. The fall and spring peaks probably represent "waves" of migrants moving through the region in addition to the resident winter population. This interpretation suggests that kestrels should tend to appear somewhat later in fall and depart earlier in spring in extreme south Florida. Comparing the data from the Keys (Table 1) with that from Highlands County in 1974-75, the maximum number in fall occurred the first week of December in the Keys and the second week of October in Highlands County. No birds were recorded on the Keys after the last week in March of that year, whereas on the Highlands County census route the last bird did not leave until the second week of April. It is also interesting to note the hint of a bimodal pattern, with late fall-early winter and spring peaks, in the counts from the Keys in 1974-75. The less complete data for 1976-77 and 1977-78 also suggest a major peak of abundance in late October but give no clear indication of a spring peak. The Cone's notes on their surveys in the Keys state that the highest counts of kestrels in fall were associated with passage of cold fronts with N or NNE winds and that at such times many birds were observed over water in the vicinity of bridges instead of hunting from utility wires along the road, as was usually the case when fewer kestrels were present. Fall and spring peaks in extreme southern Florida may be produced by waves of overseas migrants leaving from and returning to the state. In this connection, Peter Cone (pers. comm.) informed me that a friend of his observed several hundred dead kestrels on the Marquesas Keys about 30 km W of Key West in November or December 1975 or 1976 after passage of a cold front.

The highest number of kestrels observed on a single census each year on the Highlands County survey route ranged from 5 (0.70/km) in 1973-74 to 12 (1.69/km) in 1968-69, with a mean of 8.8 (1.24/km) for all years. Because of the apparent augmentation of the local population by transients moving through the region in fall and spring discussed above, I believe the best index of the local wintering population level is given by the mean of counts from mid-November through February, when numbers were most stable. Thus calculated, the average winter population for all years was 3.4 (0.48/km), with a range of 1.8 (0.25/km) to 5.0 (0.71/km).

Comparative quantitative data on winter kestrel populations in other

TABLE 1

Numbers (means in parentheses) of kestrels observed along a 13.2 km section of U.S. 1 between Bahia Honda and Big Pine Key, Monroe County, from fall to spring in 1974-75, 1976-77, and 1977-78 by Peter and Margo Cone.

Month and week		1974-75	1976-77	1977-78
September	IV			1
October	II	5,7,7 (6.3)		40
	III	7,9 (8.0)	6,11,22 (13.0)	17,51 (34.0)
	IV	7,12 (9.5)	16	
November	I	11		
	II	9,10 (9.5)		8
	III	6		8
December	I	9,12,16 (12.3)		
	II	7		10,12 (11.0)
January	II		8	7
	III			5,6 (5.5)
	IV	5,6 (5.5)	12	5,5,6 (5.3)
February	I	2,3,4,5 (3.5)	8	6,6 (6.0)
	II	5,6,9,12 (8.0)		1
	III	3,6,7 (5.3		7
	IV	4,6,8,9 (6.2)		
March	I	3,5,5,7,10 (6.0)		5
	II	4,4,7 (5.0)		5
	III	3	4	3
	IV	1,3 (2.0)	3,5 (4.0)	3
April	I			2,5 (3.5)
	II	0,0	2	
	III	0	0	0

parts of the state are scarce. Layne et al. (1977) reported 0.19, 0.37, and 0.12/km in winter (late December-January) roadside counts from 1974 to 1976 in Charlotte, DeSoto, and Hardee counties, respectively. Sprunt (1954) noted up to 13 birds/mile (8.01/km) in the Keys. The maximum and average winter numbers, respectively, recorded in the Keys by Peter and Margo Cone were 1.21/km and 0.52/km in 1974-75, 1.67/km and 0.71/km in 1976-77, and 3.86/km and 0.49/km in 1977-78. These data suggest that average winter populations in that section of the Keys are not appreciably different from those of the Highlands County census route. However, Bystrak (1974), using Christmas Bird Count (CBC) data, showed the central Florida area, which includes the Highlands County census route, as having the lowest density (1-5 birds/10 party hours) of any region in Florida, with the Upper Keys and Lower Keys having populations of more than 20 and 5-20 birds/10 party hours, respectively. These conflicting figures illustrate the difficulty of making broad generalizations on regional kestrel winter populations based on relatively few sampling sites and different census methods.

Average winter populations on the Highlands County census route each year were as follows: 1968-69, 3.7 (0.53/km); 1969-70, 4.4 (0.62/km); 1970-71, 4.1 (0.58/km); 1971-72, 4.3 (0.61/km); 1972-73, 2.4 (0.34/km); 1973-74, 1.8 (0.25/km); 1974-75, 2.4 (0.33/km); 1975-76, 5.0 (0.71/km). These figures indicate a marked reduction in kestrel numbers during three consecutive winters, 1972-73 to 1974-75, with recovery in 1975-76. Analysis of CBC data for Florida from 1968 through 1975 (*American Birds*, vols. 23-30, 1969-1976) suggests that this decline was part of a general state-wide trend. Table 2 gives the number of kestrels per 10 party hours from 27 localities throughout the state for which CBCs are available for at least 7 out of the 8 years covered by my study. The lowest values recorded at each locality on seven or eight CBCs are strongly concentrated (74%) in the three winter periods 1972-73 to 1974-75. The percentage of lowest values recorded for each of these years is 11.1, 44.4, and 18.5, respectively, compared with a range of 3.7 to 11.1 in the remaining years. The difference in frequencies of minimum values between years is highly significant ($P < .001$, X^2 test). Unlike the results from the Highlands County roadside census, the CBCs point to a continuation of low populations in 1975-76 at a number of localities in other parts of the state. At about half the sites in Table 2, CBCs in 1975-76 were distinctly lower than the general level of counts prior to 1972-73.

As the CBCs from 1972-73 to 1975-76 do not show a pattern of unusually low numbers in some areas with unusually high numbers in others, a shift in the distribution of wintering kestrels within the state cannot account for the general trend of low populations during this interval. This leaves an actual reduction in the population of northern birds and/or

a change in migratory patterns resulting in fewer individuals wintering in Florida as possible explanations of the decline in numbers. Although a decrease in the *F. s. sparverius* population that is the source of wintering kestrels in Florida cannot be excluded, circumstantial evidence suggests that variation in the number of kestrels migrating to Florida in response to winter weather conditions farther north is the major cause of the observed population trends. During the period of this study, winters in northeastern North America, as reported in The Changing Seasons and Regional Reports sections of *American Birds*, were generally cold from 1968-69 to 1970-71 and more open and mild from 1971-72 to 1973-74. In 1975-76 warm weather extended into December, and mild conditions prevailed during most of February and March. Thus the winter kestrel population in the Highlands County study area was high in years of cold northern winters and low in years of mild winters, and the same general pattern is reflected in the CBCs, suggesting that in the warmer winters

TABLE 2

Number of kestrels per 10 party hours recorded on Christmas Bird Counts at 27 Florida localities from 1968-69 to 1975-76. Lowest indices for the period at each locality are underlined.

Locality	1968-1969	1969-1970	1970-1971	1971-1972	1972-1973	1973-1974	1974-1975	1975-1976
Bay County	2.90	2.27	2.50	2.00	1.77	1.54	2.38	1.65
Bradenton	9.80	8.66	10.17	3.90	5.82	3.35	5.49	4.44
Cocoa	13.21	10.38	9.38	6.12	6.95	10.65	9.12	11.15
Coot Bay - Everglades	5.73	5.15	3.57	2.23	2.41	0.72	1.48	1.11
Dade County		11.51	9.88	6.80	8.61	6.50	5.50	5.94
Ft. Lauderdale	15.75	16.69	19.07	14.62	15.19	10.31	14.26	12.26
Ft. Myers	9.29	7.50	8.84	13.19	6.20	7.12	8.52	14.69
Ft. Pierce	10.93	11.11	20.00	13.91		14.07	20.43	12.27
Gainesville	5.93	3.33	6.74	11.35	5.92	5.00	4.50	5.58
Jacksonville	4.41	4.21	4.35	4.27		2.95	2.93	2.75
Key Largo - Plantation Key	17.95	16.09	14.04	17.44	12.13	9.87	10.67	10.00
Kissimmee Valley	19.58	8.96	11.33	11.60	16.45	9.17	13.73	8.90

fewer kestrels migrated to Florida. Additional support for this hypothesis is given by Finch's (1974) compilation of CBCs of hawks and eagles in the Northeastern Maritime Region from 1968 to 1973, in which numbers of kestrels showed a distinct upward trend from 1971 to 1973, possibly as a result of greater numbers of local birds remaining over winter. The tendency for birds to stay farther north was apparently a general phenomenon during the years of warm winters. For example, Robertson (1975) noted that the generally mild early winter of 1974-75 led to an unusually high number (over 200 species) of birds that lingered or wintered north of their "normal" seasonal range.

As noted above, the 1975-76 population trend on the Highlands County survey route differed from other years in showing no indication of fall or spring peaks. In that year the kestrels also tended to arrive later than in other years. These differences may reflect the long mild fall period of that year, with kestrels staying longer in the north and perhaps not

TABLE 2. continued

Lakeland	7.43	8.85	8.82	5.20	2.50	2.83	2.43	3.71
Lake Wales		5.35	4.44	5.35	4.20	2.38	4.12	3.72
Lower Keys	19.26	19.13	15.00	17.10	13.15	21.71	18.26	12.32
Mt. Dora	6.88	7.21	4.79	7.67	10.50	5.15	3.86	6.67
Myakka River State Park	4.51	5.00	3.50	3.60	3.89	3.16	5.26	7.30
Naples	2.91	6.47	10.43	5.95	8.74	3.24	2.19	4.01
Orlando	7.92	2.98	10.62	3.44	4.32	2.04	3.48	4.41
Pensacola	2.34	2.94	3.67	2.80	3.24	0.96	1.19	1.96
St. Marks	3.03	0.97	1.08	2.24	1.84	0.80	1.01	1.11
St. Petersburg	3.95	3.29	2.17	4.14	3.51	4.09	3.64	3.33
Sanibel-Captiva		5.23	4.23	3.57	3.33	7.56	6.05	5.23
Sarasota	7.21	4.74	4.89	5.63	4.44	2.00	2.60	7.68
So. Brevard County	22.00	12.57	20.79	17.35	15.90	12.85	9.19	11.08
Stuart	11.06	10.14	14.66	11.65	2.24	5.91	13.55	7.07
West Palm Beach	9.71	5.76	8.08	6.31	6.32	5.52	9.75	9.81

moving as far south. DeSante (1976) noted that an unusual number of late-lingering species occurred throughout North America in 1975-76. Stevenson (1976) also commented on the tendency for cold-sensitive species to stay farther north in Florida that year.

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