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# Analysis of Florida-related banding data for the American Kestrel

James N. Layne

The breeding population of the American Kestrel (*Falco sparverius paulus*) in Florida is undergoing a continuing decline (Wiley 1978 (1979)), and kestrels are now scarce in the state during the summer months, particularly in the southern peninsular region. In contrast, kestrels are generally common in Florida from fall to spring, indicating that the state is an important wintering area for the species. Wintering or migrating kestrels in Florida are presumably *F.s. sparverius* (Sprunt 1954). With the exception of Lincer and Sherburne's (1974) report of 3 individuals banded in New York and recovered in southern Florida, the geographic sources of migrating and wintering kestrels in Florida are unknown. This report examines seasonal incidence and geographic distribution of bandings and recoveries, sex ratios, and longevity of kestrels banded in Florida or banded elsewhere and recovered in Florida.

Computer listings of all kestrels banded in Florida and all Florida-related recoveries processed through August 1979 were provided by the Bird Banding Laboratory, Office of Migratory Bird Management, U.S. Fish and Wildlife Service. These records include a total of 1,810 kestrels banded in the state since 1955 and 94 recoveries. 50 (2.8%) of the kestrels banded in Florida were recovered. Of these, 31 were recovered in Florida and 19 outside the state. The remaining 44 recoveries were of birds banded elsewhere and recovered in Florida.

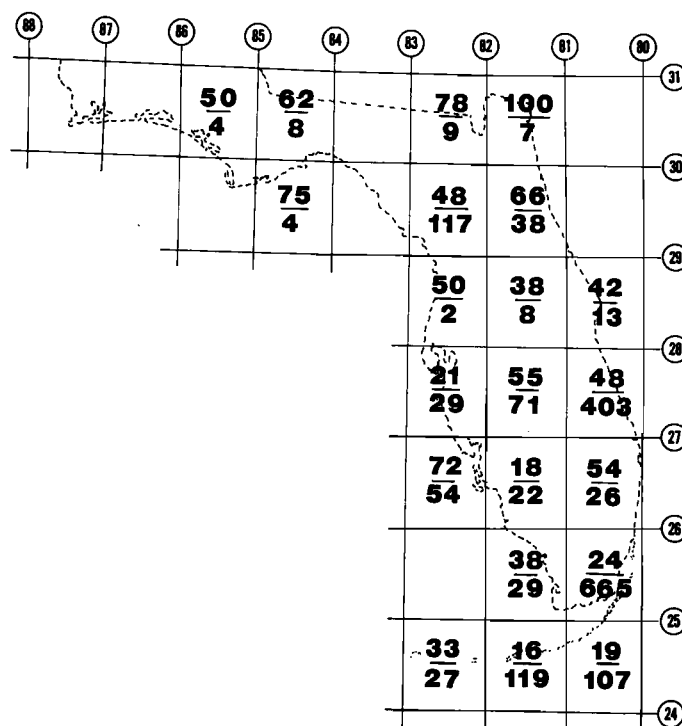
## Seasonal and regional distribution of kestrel bandings in Florida

Numbers of kestrels banded in Florida in different months ranged from a low of 5 in August to a high of 437 in December (Table 1). 97% (N=1,759) of the birds were banded in the September to April period and 3% (N=51) from May through August. About half (26) of the latter were banded at or near the Archbold Biological Station in Highlands County in south-central Florida and the remainder in the central and north-central parts of the State. Figure 1 shows the total numbers (lower figures) of kestrels banded in Florida from September through April by 1-deg. blocks of longitude and latitude. The months with lowest numbers of captures during this period were September (21) and March

**Table 1. Numbers of American Kestrels banded in Florida by month, 1955 — August 1979.**

Month	Males	Females	Sex unknown	Total
January	111	277	3	391
February	179	223	—	402
March	47	59	3	109
April	17	6	—	23*
May	9	7	8	24
June	7	5	—	12
July	4	1	1	6
August	2	3	—	5
September	5	16	—	21
October	64	109	—	173
November	73	134	—	207
December	133	304	—	437
Total	651	1144	15	1810

\* Includes 4 (3 males, 1 female) *F.s. paulus* nestlings.



(19). 70% (N=1,230) of the 1,759 bandings during the September-April interval were in the 3-month period December-February. Presumably most of the kestrels banded in the May-August period were *F.s. paulus* and most full-fledged birds banded in the September-April interval were *F.s. sparverius*. However, 4 nestling *paulus* were banded in April, and it is possible that a few adults of this subspecies also are included in the September-April sample, although no kestrels banded during this period have been recovered in Florida during the summer.

**Table 2. Sex ratios by month of kestrels during fall-spring in six 1-degree blocks of latitude and longitude.**

(Values are number of males and females with percentage of males in parentheses.)

Block Lat. Long.	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
29-30	1-2	1-2	5-5	8-6	19-24	15-17	1-4	6-1
82-83	(33)	(33)	(50)	(57)	(44)	(47)	(20)	(86)
27-28	0-11	36-30	17-17	51-60	14-18	53-43	21-32	
80-81	(0)	(55)	(50)	(46)	(44)	(55)	(40)	
27-28	1-0		7-5	0-1	2-1	19-17	5-7	5-1
81-82	(100)		(58)	(0)	(67)	(53)	(42)	(83)
25-26	0-3	14-36	34-78	51-173	51-162	11-46	2-4	
80-81	(0)	(28)	(30)	(23)	(24)	(19)	(33)	
24-25		0-2	0-9	7-15	9-32	4-29		
80-81		(0)	(0)	(32)	(22)	(12)		
24-25		3-14	1-12	5-32	2-24	8-18		
81-82		(18)	(8)	(14)	(8)	(31)		

## Sex ratio

Of 25 non-nestling kestrels banded in Florida from May through August and presumed to be residents, 16 (64%) were males and 9 (36%) were females. This sex ratio does not differ significantly from 50:50 ( $X^2 = 1.96$ , d.f.=1,  $P>0.10$ ). The sex ratio of 1,492 known-sex individuals banded in the September-April period was 35% (N=525) males and 65% (N=967) females, which departs significantly from a 50:50 ratio ( $X^2 = 130.94$ , d.f.=1,  $P<0.001$ ).

The upper figures in Figure 1 are the percentages of males among kestrels banded from September to April in 1-deg. blocks of longitude and latitude. These data indicate a trend toward a higher proportion of males in the northern part of the state than in the southern part. The increase in frequency of males in 1-deg. bands of latitude going from south to north is significant ( $X^2 = 97.12$ , d.f.=6,  $P<0.001$ ).

Sex ratios from September through April in the 6 1-deg. blocks with the best monthly sample sizes do not show any consistent seasonal trends (Table 2). However, in 2 of the blocks (29-30/82-83 and 27-28/81-82) there is an indication of a substantially higher proportion of males in April. Roadside censuses in south-central Florida also suggested an increase in males in spring (Layne, 1980).

Of 47 recoveries of Florida-banded kestrels that were dead, injured, or obtained under circumstances where survival was unlikely, 40% were males and 60% females. This compares with a sex ratio of 34% males and 66% females for the kestrels banded in the same 1-deg. blocks. The difference is not significant ( $X^2 = 1.00$ , d.f.=1,  $P>0.25$ ). 32 kestrels banded elsewhere and recovered dead or injured in Florida included 19 (59%) males and 32 (41%) females. Of an additional 8 recoveries coded as previously banded and trapped and released in a different 10-min. block, 2 birds banded in Florida and 4 of 6 banded elsewhere were females.

## Geographic and seasonal distribution of recoveries

Only 1 of the 51 kestrels banded from May through August and presumed to be *F.s. paulus* was recovered. This was an individual of unknown sex banded as a nestling in Hillsborough County (10-min. block 28°00', 82°20') on 22 May 1968 and recovered dead 14 July 1968 in the same 10-min. block.

The remaining 30 individuals banded and recovered in Florida were both banded and recovered in the September-April period and thus were probably all, or nearly all, migrating or wintering *F.s. sparverius*. All of the recoveries were from peninsular Florida, with 75% from the southern part (below 28° lat.). Of 20 kestrels banded and recovered in the same fall-spring (September-April) period, 11 (6 males, 5 females) were recovered in the same 10-min. block, and 8 (3 males, 5 females) in an adjacent 10-min. block. A female in the Florida Keys was recovered 3 blocks away from the one in which banded. Kestrels recovered in an adjacent 10-min. block were banded and recovered between 11 October and 10 March (exact date not known for 1 individual recovered in March). The female in the Florida Keys, recovered three 10-min. blocks away from the one in which banded, was banded 3 January and recovered 10 January 1970. The dates of banding and recovery of birds recovered outside the 10-min. block in which originally banded suggest that their movements were not associated with migration.

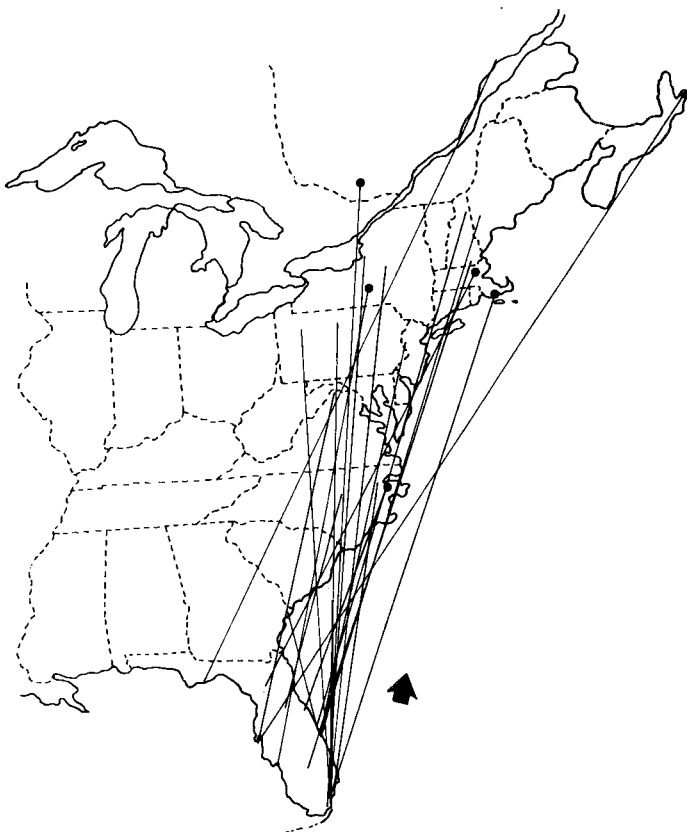


Figure 2. Encounters of kestrels banded in Florida and recovered elsewhere. Solid dots represent fledged birds banded in May, June, July, or August, presumably in the summer range.

10 individuals (3 males, 7 females) were banded in one fall-spring period and recovered in another. These included 3 (1 male, 2 females) recovered in the same 10-min. block, 6 (2 males, 4 females) in an adjacent 10-min. block, and 1 (female) 3 blocks away from the one in which banded. Intervals between banding and recoveries of these birds were (number of individuals in parentheses): 1 year (6), 2 years (1), 3 years (2), and 4 years (2). The 2 kestrels with the longest interval (4 years) between banding and recovery were recovered in the same 10-min. block. The female recovered the greatest distance from the locality of banding was in the Keys. She was banded in February 1969 and recovered in December 1971.

Figure 2 shows sites of banding and recovery of 19 (7 males, 12 females) kestrels banded in Florida and recovered elsewhere. Recoveries were from 9 states and 2 Canadian provinces as follows (number of recoveries in parentheses): Georgia (1), Maine (1), Massachusetts (2), New Hampshire (2), New Jersey (1), New York (3), North Carolina (3), Pennsylvania (2), Virginia (1), Nova Scotia (1), and Quebec (2). Months of banding and number of individuals banded were November (3), December (4), January (3), February (6), March

(2), and May (1). Thus, 84% of the birds were banded in late fall and winter (November-February), supporting the contention that most kestrels in Florida in winter are northern birds. The individual banded in May was a male stated to be sick and may have been a late migrant because of that. Months of recoveries of 18 individuals were March (3), April (6), May (3), June (2), August (1), September (1), October (1), and November (1). Month of recovery of one individual was not recorded. 63% of the recoveries were during the spring migration period (March-May). Kestrels considered to be in their summer range at the time of recovery (June-August) were recorded from Massachusetts (2), New York (1), North Carolina (1), Nova Scotia (1), and Quebec (1). The earliest spring dates of recoveries of kestrels banded in Florida the same year were 25 March and 27 March for birds recovered in New Jersey and Pennsylvania, respectively. Latest fall dates of recoveries were of a female banded in Florida in December 1959 and caught due to injury in New Hampshire in October (date not recorded) 1965 and another female banded 9 January 1960 and found dead in Quebec in November 1962. These unusually late dates for such northern localities suggest the possibility that the birds were staying north for the winter in those years. However, the injured bird may have been prevented from migrating, and the dead individual may not have been recovered for some time after death.

The maximum straight-line distance between banding and recovery sites was approximately 2860 km for a female banded in Pinellas County (27°40', 82°40') on 6 February 1972 and recovered in Nova Scotia on 3 May 1972. The shortest interval between banding and recovery was for a female banded 17 March 1967 in Indian River County (27°40', 80°20') and found dead 7 April in New Hampshire (44°40', 71°00'). Her minimum rate of movement was approximately 100 km per day.

Figure 3 shows locations of banding and recovery of the 44 (22 males, 19 females, 3 unknown sex) kestrels banded outside Florida and recovered in the state. Most of the recovery sites were in the peninsula, with over half (N=24) in the southern part below 28° lat. Only 4 recoveries (9%) were from the panhandle region. Banding localities included 6 states and 2 Canadian provinces: Massachusetts (1), New Jersey (28), New York (2), Pennsylvania (1), Virginia (5), West Virginia (1), Nova Scotia (2), and Ontario (4). 5 nestling kestrels were banded during June and July in New York (1), Pennsylvania (1), Virginia (1), and southern Ontario (2); and 3 adults banded in New Jersey (1) in May and Nova Scotia (2) in July were probably also in their summer range. The remaining 36 birds may have been migrating at the time of banding in April

(3), September (15), and October (18). 24 (67%) of these birds were banded in the fall at the Cape May Point Hawk Banding Station, NJ.

Months of recoveries in Florida (number of recoveries in parentheses) were August (11), October (9), November (8), December (4), January (9), February (9), March (2), April (1), and May (1), with 89% of the recoveries occurring in the October-February period. The earliest fall recovery was a female banded in New Jersey (38°50', 74°50') 4 October 1976 and found dead in Dade County (25°40', 80°10') on 21 August 1977. The latest spring recoveries were a female banded in New Jersey (38°50', 74°50') 12 October 1975 and trapped on Loggerhead Key in the Dry Tortugas, Monroe County (24°30', 82°50') on 16 April 1977, and a male banded in Virginia (37°00', 75°50') 16 October 1968 and found as a skeleton in St. Lucie County (27°30', 80°10') on 21 May 1969. Since the latter individual had obviously been dead for some time, its recovery date does not necessarily prove that northern birds remain in Florida as late as May.

The maximum straight-line distance, very nearly 2700 km, between banding and recovery localities of kestrels banded elsewhere and recovered in Florida was for a female banded in Nova Scotia (45°00', 64°20') 25 July 1976 and found dead in the Florida Keys (24°40' 81°00') on 9 November 1976. The shortest time intervals between banding and recovery were for 3 females banded at Cape May, New Jersey (38°50', 74°50'). One banded 29 September 1977 was found dead on 11 October 1977 in south-central Florida (27°30', 81°30'), and two banded on 10 October 1976 were recovered in northeast Florida (30°10', 81°50') on 25 October (caught due to injury) and southwest Florida (26°30', 82°10') on 26 October (found dead). The minimum speed of travel of these individuals ranged from approximately 80 to 120 km/day.

## Longevity

The mean interval between banding and recovery of 78 kestrels recovered dead or in a condition in which survival was unlikely was 8.3 months (months of banding and recovery counted as full months, regardless of actual dates of banding and recovery). 45 (58%) recoveries were within 3 months of banding, 15 (19%) between 4 and 12 months, 11 (14%) between 13 and 24 months, and 7 (9%) over 24 months. The mean and the maximum longevity of 38 males were 6.2 and 48 months, respectively, compared with 10.3 and 70 for 40 females. Only 2 (5%) of the males survived over 24 months compared with 5 (13%) of the females. Although a sex difference in survival is suggested, frequencies of males and females surviving 3 months or

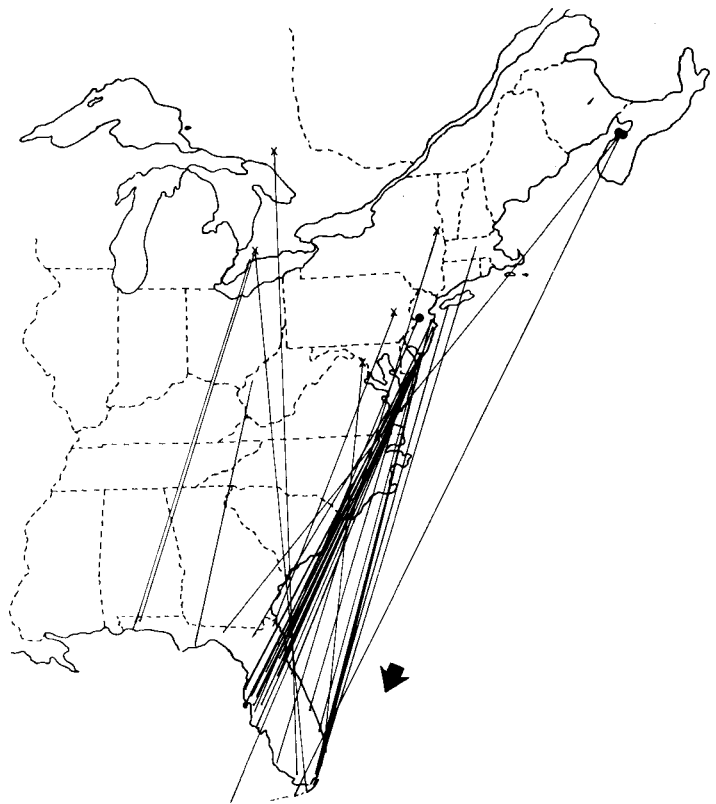


Figure 3. Encounters of kestrels banded outside Florida and recovered in the state. Solid dots indicate birds banded from May through August and X's represent individuals banded as nestlings.

less, 4-12 months, and 13 months or more are not significantly different ( $X^2 = 2.27$ , d.f. = 2,  $P > 0.25$ ). Of 9 kestrels recorded as trapped and released, 2 males were captured 5 and 28 months after banding and 7 females from 6 to 49 ( $\bar{x} = 25.9$ ) months after banding.

51 of the kestrels recovered had been banded or were recovered in the range of *sparverius*. Except for 1 individual found as a skeleton in May, the remainder were banded and recovered in Florida between September and April and were probably all, or nearly all, northern birds. The only known *paulus* (sex not recorded) recovered was banded as a nestling and survived 2 months (22 May - 14 July 1968).

Of 5 nestling *sparverius* banded in June and July in New York, Pennsylvania, Virginia, and Ontario, 1 female was trapped and released and 1 found entangled 8 months after banding, a male was found dead 18 months following banding, and 2 individuals of unknown sex were found dead 16 and 33 months after banding.

Of 33 recoveries of birds killed, injured, or incapacitated by known causes, 17 (52%) involved death or injury from motor vehicles.

## Discussion

Through 1978, bandings and recoveries of kestrels in Florida were concentrated seasonally in the fall-spring period and geographically in the peninsular region of the state. Although the seasonal difference is undoubtedly partly due to variation in the intensity of banding efforts at different times of the year, it also reflects an actual difference in summer and winter kestrel populations in the state. Roadside census data showing the magnitude of the increase in kestrels in winter at one locality in south-central Florida were presented by Layne (1980). Further evidence that the dramatic increase of kestrels in Florida in fall and winter is largely attributable to an influx of northern birds is the fact that no kestrel banded in Florida from September to April has been subsequently recovered in the state in summer. 33 banding records and 1 recovery from the Tortugas together with reports of the usual occurrence of kestrels on these islands in spring and fall (W.B. Robertson, Jr., and Tom Smylie, pers. comm.) suggest that northern birds regularly migrate beyond the Florida mainland and Keys. Layne (1980) also presented evidence for this.

Banding records indicate that there is an overall predominance of females among kestrels in Florida during the fall-spring period and that females may tend to winter farther south in the state than males. However, since banding has not been conducted with equal intensity in all major regions of the state and sex ratios may vary markedly between localities a few miles apart as a result of sex differences in habitat use (personal observations), the overall greater proportion of females and latitudinal trend in sex ratio in kestrels banded in Florida may be an artifact of incomplete geographic sampling. In addition, sex differences in the behavior of wintering birds may result in one sex being more vulnerable to capture. For example, females may more readily attack larger prey such as white mice commonly used as bait in trapping when relatively abundant insect prey are available. However, if the differences suggested by the present data are real, two interpretations are possible: 1) males have a greater tendency to remain in the summer range or not to migrate as far south as females and/or 2) males have a higher mortality rate than females. Circumstantial evidence for the latter is the somewhat higher proportion of male recoveries (40%) compared with the proportion (34%) of males banded in the same areas and the tendency for males to survive shorter periods following banding than females did, although neither difference is statistically significant on the basis of present sample sizes.

Recoveries of presumed northern kestrels banded and recovered in Florida indicate a strong tendency for



individuals to remain in a given area during one winter and to return to that area in subsequent years. The data also suggest that females may be somewhat more mobile than males. In south Florida and the Keys, Tabb (1977) recaptured 17 kestrels in approximately the same location as banded from 1 to 6 years after banding. The maximum movements recorded within Florida were in the Keys, suggesting that in this region of narrow, linearly-arranged islands kestrels may tend to shift their ranges more.

The present recovery data indicate that the geographic origin of kestrels wintering in Florida is the eastern U.S. and Canada. Nestlings and adults banded from May to August and presumed to be in their summer range were recorded from a fairly narrow zone extending from North Carolina north to Nova Scotia and west to southeastern Ontario. There is no obvious segregation of kestrels from different parts of the breeding range in Florida in winter. Although the 2 birds from the westernmost banding site were also recovered far-



the west in Florida, 2 other individuals banded in the same region were recovered in extreme southern Florida. It should be noted, however, that this picture of the geographic sources and distribution of wintering kestrels in Florida may be distorted by regional differences in the level of banding activity and probability of recoveries. As banding activity probably tends to be concentrated along the Atlantic coast, particularly in fall, birds migrating through this area probably have a higher chance of being banded than those coming from farther west. Birds wintering in south Florida, particularly along the southeast coast and Keys, also may have had a higher chance of being recovered due to the denser human population and presence of several active banders during the 1960's and early 1970's. Thus, even if there were a substantial number of kestrels migrating to Florida from regions farther west and a tendency of these birds to winter in the panhandle, there would be less chance of documenting it because of the lower probabilities of such birds being banded and recovered.

## Summary

Florida-related American Kestrel banding records from 1955 through August 1979 include a total of 1,810 individuals banded in Florida and 94 recoveries. Most of the bandings were in the peninsular region, and 97% of the birds were banded from September to April. Sexes of 51 individuals that were banded from May through August did not differ significantly from 50:50, whereas there was an overall predominance of females in the fall-spring sample, with males being relatively more frequent in the northern part of the state. Recovery sites of 19 kestrels banded in Florida and recovered elsewhere and banding localities of 44 individuals banded elsewhere and recovered in Florida were in a relatively narrow zone extending from Georgia to Nova Scotia west to southeastern Ontario, western Pennsylvania, and western West Virginia. The maximum straight-line distance between banding and recovery localities was approximately 2860 km. Minimum speed of migration of 4 individuals ranged from 80 to 120 km/day. The mean interval between banding and recovery was 8.3 months. Males survived an average of 6.2 months compared with 10.3 months for females.

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