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Sex-related local movement in adult Rock Kestrels in the eastern Cape Province, South Africa.—Long-distance migration in the Rock Kestrel (*Falco tinnunculus rupicolus*) has not been recorded in southern Africa (Moreau 1972), although it is a well-known phenomenon for its European conspecific the Common Kestrel (*F. t. tinnunculus*) (Village 1990). Of 776 Rock Kestrels ringed in southern Africa, nine birds have been recovered, of which only one was found farther than 30 km from where it was ringed (SAFRING, pers. comm.). Partial local movement of Rock Kestrels in South Africa, especially altitudinal movements, have been reported by several authors (Rowan 1964, Tarboton and Allan 1984, Hockey et al. 1989). It remains unclear, however, whether these movements are sex- or age-related, whether the kestrels return to the same area, and how long they are absent from their breeding sites.

Study area and methods.—Rock Kestrels are found throughout southern Africa but are most common in the drier mountainous regions. They feed mostly on invertebrates, reptiles, and small mammals and breed on cliffs or in old nests of Pied and Black crows (*Corvus albus* and *C. capensis*, respectively) in trees from August to February (Steyn 1982). I studied 10 territorial pairs of Rock Kestrels in the foothills of the Winterberg Mountain Range (32°10′S, 26°20′E), Tarkastad District, South Africa from April 1990 to June 1991. The average annual rainfall is 426.4 mm with an average daily maximum temperature of 19.0°C in winter and 29.1°C in summer. Kestrels were caught using a bal-chatri trap (Berger and Mueller 1959) and marked individually with color rings. Each territory was searched for kestrels at least once a week. First- and last-sighting dates were used as a measure of arrival and departure dates.

Results and discussion.—On average, females left their territories before males, were away longer, and returned after males. All the females, except one, and six of the males left their territories for longer than 25 days (N = 10 pairs). Of the five pairs for which the date of departure was known for both individuals, the female always left before the male (Table 1). In these pairs, the male returned before the female in three instances, with one returning at the same time as the female and one after the female. All the kestrels that left their territories during winter returned to the same territories prior to the breeding season. The male that returned after his female, and one other male, lost their territories to males that occupied the territories during their absence. One of these new males paired with the resident female, and the other paired with a new female.

Prey-strike rates have been shown to follow cyclic vole availability in kestrels in the Netherlands (Rijnsdorp et al. 1981). Prey-strike rates during perch hunting, the predominant hunting method in this study, were used as an indication of food availability to individual kestrels (Table 2). Although prey-strike rate can be highly misleading if there are large differences in prey size, arthropods weighing between 0.1 and 3 g comprised 97.9% (N = 1962 prey items) of the diet (Van Zyl, unpubl. data). Prey-strike rates decreased until birds left the area with an increase on their return.

TABLE 1

DIFFERENCES IN DEPARTURE, ABSENCE AND ARRIVAL TIMES OF FIVE ADULT KESTREL PAIRS FOR WHICH EXACT DEPARTURE AND ARRIVAL DATES WERE KNOWN

Movement status	Males (SE)	Females (SE)	Paired t-value
Departure	29.8 (7.9)	23.2 (6.8)	2.93*
Absence	54.6 (14.4)	90.8 (11.2)	2.78*
Arrival	84.4 (13.3)	114.0 (5.2)	2.03

Departure and arrival dates are in days starting from 1 April, while durations of absence are in days away.
* $P < 0.05$

In this study, the adult kestrel movements can be interpreted as partial local movement, since not all individuals left the study area, and the short period that they were away suggests that they did not move far.

Kestrels that stayed in their territories during the winter were able to retain their territories and hence had a high chance of breeding the following season. The poor food supply during winter suggests that they ran the risk of starvation. Conversely, the kestrels that left the area

TABLE 2

INDIVIDUAL STRIKE RATES ($\text{STR}\cdot\text{H}^{-1}$ PERCH HUNTING) DURING WINTER 1990 AS AN INDICATION OF FOOD AVAILABILITY TO KESTRELS

Territory	Sex	May	June	July	August	September	October
Oxford	M	?[a]	2.1	?	?	4.2	Predated
		(0)	(29)	(0)	(0)	(43)	
Oxford	F	2.2	Absent	Absent	Absent	1.2	1.2
		(27)				(167)	(49)
Sumhill	M	?	?	1.4	1.2	5.5	?
		(0)	(0)	(216)	(204)	(66)	(0)
Sumhill	F	?	3.7	2.9	2.3	?	4.6
		(0)	(131)	(333)	(131)	(0)	(26)
Spring	M	2.6	1.7	Absent	1.7	Evicted	
		(70)	(456)		(35)		
Spring	F	2.5	2.0	Absent	1.5	Left area	
		(144)	(182)		(40)		
Fair View	M	1.5	Absent	Absent	Absent	8.3	Evicted
		(111)				(80)	
Fair View	F	?	Absent	Absent	Absent	3.0	4.3
		(0)				(239)	(196)
Lochie	M	?	2.1	3.0	2.9	3.1	3.5
		(0)	(286)	(345)	(389)	(688)	(69)
Lochie	F	3.5	Absent	Absent	2.2	2.1	3.8
		(137)			(440)	(623)	(350)

[a] Question marks indicate months for which no foraging data were available for the specific individual. Observation time spent perch hunting in minutes is given in brackets. The Spring and Fair View male kestrels were evicted by adult male kestrels that had moved into the territories prior to their return.

would have a higher survival but would possibly not have a territory on their return, and would forego a breeding attempt. There is, therefore, a trade-off between the chance to breed and the risk of mortality during winter. I suggest that both male and female kestrels are influenced to leave the area because of a critical food shortage, and that females return once the food supply is adequate. Males are able to leave later because of lower energetic requirements due to their smaller body size (males are 7.3% smaller than females; N = 57; unpubl. data). I suggest that males return early to procure and maintain a territory before the return of the females, even though food availability might still be low. Territorial behaviour was most frequently observed during the early breeding season in kestrels in England (Wiklund and Village 1992). In two instances where males returned to their territories relatively late in the season (August), they both lost their territories to males which had arrived earlier or did not leave. The longer that males were absent from their territories the greater was the chance of losing their territories, especially in the early breeding season when the floater population was at its peak. While males' early return was essential to maintain a territory, females needed only to return once food conditions were adequate. Females paired with the resident males of the territories, and, in one case, a new male. Strike rates of the single female that left her territory after it was taken over by a new male indicate that prey availability was poor. This may have been the reason for her leaving rather than the new male. The fact that the new pair in that territory failed to breed that season, is further evidence of the poor food availability. The small number of floating kestrels suggests that food supply remains the limiting resource throughout the year.

Village (1985) reported a similar movement of kestrels in and out of his Scotland study area. There was, however, an influx of wintering kestrels which was not observed in this study, suggesting that food conditions were too poor to maintain a large winter population. In Scotland, there was a similar bias towards males during winter, with females returning, on average, only four days later than males. Village's observations supported Piechocki's (1982) view that male kestrels settled in a territory first and then attracted a female. In contrast, data from this study support the idea that females return to their breeding sites rather than to prospective males. No females changed territories from 1990 to 1991, nor were they seen in any territory other than their own. Removing males and observing female pairing patterns would test whether females select sites rather than males. Female Merlins *Falco columbarius* have also been reported to return to breeding sites rather than their mates (Warkentin et al. 1991).

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Daily movements of Northern Bobwhite broods in southern Texas.—Understanding the potential mobility of individuals is important when describing the spatial distribution of a species' habitat components. Information concerning the daily movements of Northern Bobwhite (*Colinus virginianus*) broods is lacking, making descriptions of optimum brood habitat difficult. We here present information on daily home ranges and minimum distances traveled of radio-marked Northern Bobwhite broods in southern Texas.

Study area and methods.—We conducted field work from March through August 1989 and 1990 on the Zachry Randado Ranch in Jim Hogg and Zapata counties, Texas. The dominant plant community on the ranch was mesquite (*Prosopis glandulosa*)-mixed brush (Drawe and Higginbotham 1980). Annual precipitation in the area averages 58.2 cm and summer temperatures are high (July mean is 31°C) (N.O.A.A. 1989–1990).

Adult bobwhite were captured with grain sorghum-baited funnel traps (Wilbur 1967) during March and April. Captured females were fitted with backpack-mounted radio transmitters (Marshall and Kupa 1963) weighing either 4.3 or 8.5 g in 1989 and 4.3 g in 1990. Radio-marked females were located 2–6 times/week, and consecutive identical location estimates identified hens that were incubating.

If a radio-marked female hatched at least one egg, we waited until chicks were 3–6 days old before monitoring the brood. Thereafter, we obtained one location series/week for broods until they reached six weeks of age. A location series consisted of five location estimates/day, with one location each during 03:00–06:00, 08:00–09:30, 12:00–14:00, 18:00–20:00, and 22:00–23:00 CST. We estimated brood locations by approaching within approximately 30 m of the radio-marked female and then partially circling its estimated location (White and Garrott 1990:42). Location estimates were plotted on an aerial photograph of the study area (scale 1:4800).

We examined night roost sites to learn if radio-marked females and their chicks became separated. If no chick feces were found at the sites, separation was confirmed by flushing females and directly observing chicks or if hens exhibited brood-tending behavior (short, fluttering flight and excited calling).