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OBSERVATIONS ON POST-FLEDGING DEPENDENCE OF KESTRELS (*Falco tinnunculus rupicolus*) IN AN URBAN ENVIRONMENT

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ABSTRACT.—Observations were made of duration of post-fledging dependence period (PFDP), behaviour, body mass and food requirements of artificially released Kestrels (*Falco tinnunculus rupicolus*) in urban Windhoek, Namibia. Mean PFDP was 41.5 d, slightly longer than recorded for Kestrels in temperate areas. Daily gross energy intake of captive fledglings was 256 kJ/d; similar to fledglings in temperate areas.

The southern African race of the Kestrel (*Falco tinnunculus rupicolus*) is widespread, common and has adapted to urban existence. The species is almost completely unstudied in southern Africa (Steyn 1982), which contrasts with temperate populations of the nominate race (*F. t. tinnunculus*) where detailed studies have been made of diet and energetics (Kirkwood 1979; Village 1982a; Masman et al. 1986), territoriality (Village 1982b; Pettifor 1983), breeding (Cavé 1968), moult, ageing and sexing (Village et al. 1980), and movements, mortality and distribution (Newton 1979; Cramp and Simmons 1980; Cade 1982).

At least 4 breeding sites occur within the inner city limits of Windhoek, Namibia, an area of about 12 km^2. The same nesting sites and home ranges have been used in consecutive years, unless disturbed by humans (JK, unpubl. data).

In temperate areas Kestrels have a diet consisting almost entirely of small mammals, especially the Common Vole (*Microtus arvalis*) (Masman 1983). There is evidence of differences in body size, productivity, lifespan and diet between the temperate and tropical populations of the species (Steyn 1982; Tarboton and Allan 1984; Kemp 1985; A. S. Robertson, *in litt.*; see also Cavé 1968; Newton 1979; Cramp and Simmons 1980).

Fledgling period is a time of high mortality for most avian species and may be one of the most critical periods of the avian life cycle (Newton 1979, 1984). First-year mortality has been reported to account for more than half of all recorded mortalities in European Kestrels (Cavé 1968; Newton 1984). Our study describes aspects of post-fledging dependence period (PFDP) of Kestrels in urban Windhoek, Namibia in 1984 and 1987.

METHODS

In February 1984 five unsexed, prematurely fledged kestrels were obtained from a human-disturbed nest site in Windhoek, Namibia (22°33'S, 17°10'E). The birds were maintained in captivity until 10 d after their estimated fledging age (30–34 d of age; JK, unpubl. data; Steyn 1982; Maclean 1985), and then released. Over the same period another urban nest containing 3 nestlings was monitored until the last fledgling disappeared from the vicinity of the nest site.

During 23–27 October 1987 four unsexed, prematurely fledged kestrels were captured below a Windhoek city building. One bird was unable to fly, had a low body mass and was particularly timid. The remaining 3 birds flew clumsily, but were readily caught. Two adult kestrels were in attendance during this period, and circled overhead or perched nearby when the young birds were captured. Judging from their inability to fly properly and incomplete growth of tail and wing feathers, these kestrels were near fledging age (30–34 d of age). On 2 November the birds were colour-ringed and weighed. On 4 November the fledgling kestrels were released.

Five fledglings held in captivity in 1984 were fed a diet of day-old-chicks, raw lean beef and a dietary supplement (Beefee, Centaur Product). The 1987 kestrels were fed a diet of raw lean beef, white mice, mealworms, locusts and crickets, as well as a dietary supplement. Water was available at all times. Food was provided twice daily for the first 10 d after release. Thereafter, food was provided once daily until about 10 d after the last bird was seen at the release-site.

Daily "wet" food intake was measured gravimetrically for the 5 fledglings in 1984 during an outdoor feeding trial which lasted 7 d. Wasted food and pellets were accounted for with corrections for dessication. Fledglings were weighed before and after the feeding trial, and inclement weather, ambient temperature and behavioural activities were noted daily during the trial. Mean daily food intake was determined by dividing the group's gross daily food intake by the number of birds in the group. Daily gross energy intake of fledglings was calculated from weight of food provided less wasted food and pellets, and known energy values of the food (Komen 1986).

Table 1. The PFDP of Kestrel fledglings released from captivity in 1987, compared with longest PFDP recorded for captive fledglings released in 1984, and that of wild fledglings observed in 1984. Column D represents the number of days between release date and first foraging absence of longer than 48 hrs. Data for White ring bird [in square brackets] represents combinative PFDP at primary and surrogate feeding site.

Kestrel Identity	A PFDP Days	B No. of Days Fledglings Returned to Release Site	B/A %	C No. of Days Fledglings not seen at Release Site	C/A %	Column D Days
1987						
Black ring	47	38	81	9	19	34
Yellow ring	54	36	67	18	33	21
Orange ring	42	28	67	14	33	17
White ring	26	23	89	3	11	26
[White ring	82	57	70	25	30	26]
1984						
Captive fledglings	43	—	—	—	—	—
Wild fledglings	37	—	—	—	—	—
Mean*	41.5	36.4	74.8	13.8	25.2	24.8
±S.E.	3.9	5.8	4.4	3.8	4.4	2.9

* Excludes combinative PFDP of White ring bird in square brackets.
PFDP = Post-fledging dependence period.

Duration of post-fledging dependence period (PFDP) was calculated as the number of days from release to last return to the release site.

Results

Duration of Post-Fledging Dependence Period. All 1987 fledglings were seen daily until 19 November, 26 d after release. Individual birds were then seen occasionally until 28 December (54 d after release), the last time any bird was seen at the release site.

The first bird to disappear, 26 d after release (White ring; Table 1), was reported 7 d later at a homestead about 40 km north of Windhoek. The bird was feeding largely independently, but occasionally took meat put out in the evenings and was reported to be quite tame (A. Mittendorf, pers. comm.). The bird was seen occasionally until 25 January, 50 d after adopting the surrogate feeding site.

The longest PFDP recorded at the primary release site was 54 d (Yellow ring). The Yellow ring fledgling was in poor condition at time of capture. In 1984 the last day on which a wild fledgling was seen near the nest-site was 37 d after fledging. In 1984 the last captive fledgling to be seen at the release site was 43 d after date of release (Table 1). Mean PFDP for all fledglings, excluding the White ring fledgling's extended PFDP, was 41.5 d (S.E. = ± 3.9 d).

As a measure of feeding independence, the shortest period recorded from release to first foraging sortie lasting a minimum of 2 d was 17 d (Orange ring). The longest period was 34 d (Black ring). A measure of feeding dependence, the number of days on which fledglings returned to feed at the release site during PFDP, ranged between 67% and 89% of total PFDP (Table 1).

At least 3 of 9 artificially released fledglings survived after their PFDP, and 1 reached adulthood. One 1984 fledgling was recaptured and released about 6 km from the release site, 105 d after initial release. Another 1984 fledgling was resighted carrying food about 1 km from the release site 485 d after date of release. A 1987 fledgling (Orange ring) was resighted perch-hunting about 4 km from the release site, 224 d after release.

Behaviour of Fledglings. During the first week after release, fledglings were noticeably clumsy in flight and landing technique. Fledglings spent much of their time exercising with wing flapping from rooftops, trees and telephone poles. Most activities were accompanied by frequent and noisy calling. Fledglings occupied the day with exercise, play, and

Table 2. Body mass (grams) of unsexed pre-fledging and post-fledging Kestrels, indicating change in body mass, number of days between first and last dates of weighing (Column D), and daily change in body mass (grams/day). Data for 1984 captive fledglings also represent body masses pre- and post-feeding trial (see Table 3).

BIRD IDENTITY	PRE-FLEDGING BODY MASS (GRAMS)	POST-FLEDGING BODY MASS (GRAMS)	CHANGE IN BODY MASS (GRAMS)	COLUMN D (DAYS)	DAILY CHANGE IN BODY MASS (GRAMS/DAY)
1987					
Black ring	190	220	30	6	+5.0
Yellow ring	165	210	45	10	+4.5
Orange ring	185	210	25	6	+4.2
White ring	180	215	35	6	+5.8
Mean	180.0	213.8	33.8		
±S.E.	5.4	2.4	4.3		
1984					
Captive fledglings					
31285	190	203	13	8	+1.6
31302	185	173	12	8	−1.5
31287	205	173	32	8	−4.0
31286	205	193	12	8	−1.5
31288	185	173	12	8	−1.5
Mean	194.0	183.0	16.2		
±S.E.	4.6	6.3	4.0		
Wild fledglings					
31284	200	—			
31283	190	—			
31301	210	—			
Mean	200.0				
±S.E.	5.8				

preening but remained within a radius of about 50 m of the aviary most of the time. Mock stalking and "capture" of objects representing prey (e.g., stones, grass tufts, etc.) were recorded on a number of occasions, mostly on the ground. Fledglings remained close together most of the time, bathing together, and allopreening was noted on a few occasions. Curiosity movements, including frequent head inversion (*sensu* Sherrod 1983) were particularly noticeable during the first week after release. Fledglings huddled together on the feeding platform at night.

During the second week after release individuals ranged further from the aviary, and 2 fledglings were seen catching lizards and insects on the ground. Fledglings attempted to steal food items from one another, even when excess food was available. Individuals asserted themselves, mantling food and calling loudly when siblings came too close. Aerial manoeuverability and judgement for landing space and prey items improved noticeably by the end of the third week after release. By this stage fledglings roosted alone among foilage of tall trees near the aviary.

Wild fledglings observed in 1984 performed simple aerial movements, and group play on ledges near the nest-site, including stalking and "capture" of prey remains. At later stages we observed a few aerial chases by fledglings of parent birds and siblings, and of other bird species [1 incident of a playful and loudly vocal "attack" on a Black Kite (*Milvus migrans*) and 2 incidents of chasing Palewinged Starlings (*Onychognathus nabouroup*)]. Adult-fledgling food transfers were initially conspicious by the submissiveness of fledglings, but fledglings became progressively more aggressive during food provision. Food transfers were initially associated with subdued fledgling vocalization, but calling later became more intense.

Table 3. "Wet" food intake (day-old-chicks (DOC) and raw lean beef (meat)) and daily gross energy intake (E) of five fledgling Kestrels during an outdoor feeding trial in 1984. Daily inclement weather, minimum and maximum ambient temperature and notes on activity are recorded.

DATE DD/MM	DOC/ BIRD GRAMS	E KJ WET*	MEAT/ BIRD GRAMS	E KJ WET*	SUM OF E KJ/ BIRD/ DAY	WEATHER	T_A (°C) MIN.	T_A (°C) MAX	ADDITIONAL NOTES
24/2	0.0	0.0	50.0	296.5	296.5	slight breeze, partially cloudy	17	31	very active, frequent flying, play
25/2	56.0	301.8	0.0	0.0	301.8	light breeze, partially overcast, late afternoon drizzle	19	33	active, some flying and play
26/2	34.6	186.5	0.0	0.0	186.5	no wind, overcast, late afternoon drizzle	20	31	active, some play
27/2	35.0	188.7	4.4	26.1	214.8	light breeze, overcast, late afternoon rain	19	30	active, some play
28/2	7.0	37.7	21.2	125.7	163.4	no wind, partial overcast	19	31	inactive most of day
29/2	14.0	75.5	32.4	192.1	267.6	light breeze, partially cloudy, afternoon rain	20	31	active, some flying, play
01/3	32.0	172.5	32.0	189.8	362.3	light breeze, partially overcast, no rain	17	30	very active, frequent flying and play
$\bar{x}$					256.1		19	31	
±S.E.					26.9		0.5	0.4	

* Energy content of food consumed; DOC = 5.39 kJ/g "wet," meat = 5.93 kJ/g "wet"; "wet" represents "wet" or fresh weight of food (Komen 1986).

The first prey-items believed to have been captured by individual wild fledglings included 2 large locusts (about 2 wks after fledging), and, at a later stage, a Striped Mouse (*Rhabdomys pumilio*). The adult birds were providing primarily *Agama* spp. lizards (e.g., *Agama planiceps*) to the fledglings, although other lizards (*Cordylus, Cordylosaurus* and *Pedioplanis* spp.), locusts, crickets and a few small birds were also recorded.

Body Mass and Food Intake of Fledglings. Table 2 presents body mass data for 3 wild pre-fledgling birds, 5 fledglings held in captivity in 1984 and 4 held in captivity in 1987. Mean pre-fledging body mass for all birds was 190.8 g (S.E. = ±3.6 g; N = 12) and mean post-fledging body mass was 196.7 g (S.E. = ±6.4 g; N = 9). There was no significant difference between pre- and post-fledging body mass (Student's t-Test; t = 0.8401; df = 19; P = 0.4113). However, the 1987 fledglings showed a gain in body mass ($\bar{x}$ = 33.8 g ± S.E. = 4.3 g, N = 4; or 4.9 g/d) between pre-fledging and post-fledging weighing dates, whereas during the feeding trial in 1984, 4 of 5 fledglings showed a loss in body mass over a period of 8 days ($\bar{x}$ = 16.2 g ± S.E. = 4.0 g, N = 4; or 2.1 g/d).

Table 3 presents a breakdown of fledgling daily "wet" food intake and daily gross energy intake daily gross energy intake was calculated as 256.1 kJ/d (S.E. = ±26.9 kJ/d).

DISCUSSION

Disparity exists in the amount of information available for tropical versus temperate populations of the Kestrel. In southern Africa Steyn (1982) reported that Kestrel PFDP lasted about 1 mo, following a nestling period of 34 d. In the present study, mean duration of PFDP was 41.5 d; PFDP of the European Kestrel has been reported as being between

3.5–4 wks (Newton 1979) and 30 d (Masman 1983). Such implies that tropical, urban fledglings require about 11 d longer to become independent. During a comparative study of artificial and wild Peregrine Falcon (*Falco peregrinus*) fledglings, Sherrod (1983) showed that PFDP of wild fledglings appeared to be longer. Smaller male Peregrine Falcons had shorter PFDPs than female fledglings, and Sherrod cautioned that environmental constraints such as food resource might affect the duration of PFDP from season to season.

Excess food available to artificially released Kestrel fledglings did not apparently delay independence or ultimate dispersal [all dispersed when food was still supplied; see also Sherrod (1983)]. When released artificially, young kestrels are well fed and do not have to compete among themselves for food and are free to wander and experiment with flying and hunting. At some stage they learn to hunt for themselves, and then spend more time and energy finding and killing their own prey.

Daily gross energy intake of captive fledglings in this study was 256 kJ/d and probably as high as would be expected for wild fledglings at high daily ambient temp (Table 3; cf. Masman 1983; Masman et al. 1986). Indirect support rests with the fact that 4 of 5 fledglings lost weight during feeding trials. Kirkwood (1980) showed the gross energy intake of young free-flying, temperate Kestrels to be 251–276 kJ/d; similar to Kestrels in this study. The highest mean daily gross energy intake recorded for active adult Kestrels feeding young in temperate areas has been reported as 594 kJ/d (Masman et al. 1986).

Gross energy values of lizards vary according to species, size, condition and season, but are probably close to 5.7–6.3 kJ/g "wet" (C. S. Sapsford, pers. comm.). Accordingly, a daily gross energy intake of 256 kJ would require the consumption of between 41–45 g of lizards. In the Windhoek area equivalent intake would be 2–3 medium sized *Agama planiceps* lizards (mass range 4–38 g; JK, unpublished data).

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