

FORAGING HABITS, HUNTING AND BREEDING SUCCESS OF LANNER FALCONS (*Falco biarmicus*) IN ISRAEL

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ABSTRACT.—The distribution of Lanner Falcons (*Falco biarmicus*) is restricted to the Mediterranean region and Africa. During 1987–89, data were collected on foraging habits and reproductive success on two breeding pairs of Lanner Falcons at Sede Boquer, in the Negev Desert highlands, Israel. Three hundred and thirty two capture attempts of birds, mammals and insects by the Lanner Falcons were observed, of which 163 (49.1%) were successful. The falcons also pounced on 9 rodents from a perch, or walked on the ground and gathered invertebrates on 27 occasions. A male also hunted bats. Pairs hunted cooperatively during the courtship period prior to egg laying, and also when young accompanied one of the parents on hunting forays. During the fledging period, the male and the female again hunted cooperatively. The overall hatching success for both pairs during the five pair-years was 95.2% and total fledging success was 78.3%.

Hábitos en la alimentación, cacería y reproducción de halcones de la especie *Falco biarmicus*, en Israel

EXTRACTO.—La distribución de halcones de la especie *Falco biarmicus* está restringida a la región mediterránea y África. Durante 1987–89 se han recogido datos sobre los hábitos de caza y de reproducción de dos parejas de halcones (*F.b.*), en Sede Boquer, en las alturas del desierto Negev en Israel. Se observaron 332 intentos, hechos por estos halcones, para la captura de aves, de mamíferos y de insectos. De estos intentos 163 (49.1%) tuvieron éxito. Los halcones también embistieron desde una percha sobre 9 roedores; o recolectaron invertebrados, en 27 ocasiones, caminando sobre el suelo. Un halcón macho también cazó murciélagos. La caza cooperativa en las parejas ocurrió durante el periodo del cortejo, antes de la puesta de los huevos, y también cuando las crías acompañaron a uno de los padres en sus salidas de cacería. Durante el periodo de los primeros vuelos de las crías, los padres nuevamente cazaron cooperativamente. El total de incubaciones con éxito para ambas parejas durante los 5 años/pareja fue de 92.5%; y el total de éxito en los primeros vuelos fue de 78.3%.

[Traducción de Eudoxio Paredes-Ruiz]

The distribution of Lanner Falcons (*Falco biarmicus*) is restricted to the Mediterranean region (Cade 1982, Salvo 1984) and Africa, especially south of Sahara (Brown et al. 1982) where they inhabit arid regions that receive less than 625 mm of rain per year (Brown 1970). About twenty resident breeding pairs are known from Israel (Yosef 1988). They nest between Eilat in the south to Samaria in the north (Frumkin 1986). During 1987–89, I collected data on foraging habits and reproductive success on two breeding pairs of Lanner Falcons at Sede Boquer, in the Negev Desert highlands, Israel.

STUDY AREA AND METHODS

The study was done in the vicinity of Sede Boquer (30° 52'N 34° 47'E; 475 m above sea level) in the Negev Desert highlands, that are part of the Saharo-Arabian desert belt. This area is arid, with 250–300 biologically dry days per year (UNESCO 1977).

One pair of falcons nested to the west of Divshon Canyon, the second pair nested in the Akev Canyon. I visited nest ledges several times a month, at irregular intervals throughout the year and carried out weekly observations during the breeding season (February–June). During egg laying and incubation, I limited visits to 10 min or less, while I observed through a 20× telescope and/or 10 × 40 binoculars. The nest of the western pair was first discovered in April 1978 by personnel of the Sede Boquer Field Study Center. Although records were kept of the pair's nesting attempts, no data on clutch size, hatching success or fledging success were available prior to my

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Table 1. Food habits of Lanner Falcons at Sede Boqer, Israel.

	PAIR		TOTAL ITEMS	PERCENT
	EASTERN	WESTERN		
Prey taken	72	91	163	100.0
Prey caught in the air			136	82.9
Prey caught from perch			3	1.6
Prey caught by walking			27	15.5
Birds				
<i>Alectoris chukar</i>	29	40	72	43.1
<i>Pterocles</i> sp.	10	11	21	12.6
<i>Columba livia</i>	9	5	15	9.0
<i>Ammoperdix heyi</i>	3	2	5	3.0
<i>Passer</i> sp.	1	3	4	2.4
<i>Streptopelia</i> sp.	—	2	2	1.2
<i>Galerida</i> sp.	1	—	1	0.6
Unidentified	7	4	11	6.6
Total	60	67	127	78.5
Mammals				
<i>Psammomys obesus</i>	2	—	2	1.2
<i>Lepus capensis</i>	1	—	1	0.6
Insectivorous bats	—	5	5	3.0
Unidentified	1	—	1	0.6
Total	4	5	9	5.4
Invertebrates				
Ants	7	6	13	7.7
Grasshoppers	—	5	5	3.0
Beetles	1	4	5	3.0
Unidentified	—	4	4	2.4
Total	8	19	27	16.1

study. The nest of the eastern pair was discovered in 1984 (Frumkin 1986). I collected data on nesting success from the western nest in 1987-89 and eastern nest in 1988-89.

RESULTS AND DISCUSSION

Food Habits and Hunting. All foraging observations were made on the flat loessal plain, Sede Zin, located to the north of the Zin riverbed, in the immediate vicinity of the nest sites (approximate 1 km radius). I observed 332 capture attempts by the Lanner Falcons of birds, mammals and insects. Of these 163 (49.1%) were successful. The western pair made 153 capture attempts and was successful in 91 (59.5%). The eastern pair made 179 attempts of birds, of which 72 (40.2%) were successful. In 82.9% of observations the prey was caught in flight. Most birds (63.2%) were taken from a stoop, often after the falcon had been circling high. At times (5.2% of

observations) a falcon dropped below the prey and grasped it from below and behind.

Sixty-nine of the bird prey items captured were chukars (*Alectoris chukar*; Table 1). Other identifiable birds were sandgrouse (*Pterocles* sp.), Rock Doves (*Columba livia*), Sand Partridges (*Ammoperdix heyi*), sparrows (*Passer* sp.), Ring-necked Doves (*Streptopelia* sp.), and larks (Alaudidae sp.).

The falcons also pounced on 9 rodents from a perch, or walked on the ground and gathered invertebrates on 27 occasions. This concurs with the descriptions of Lanner Falcons observed foraging in Africa (Brown et al. 1982). I saw a lanner capturing and carrying a Fat-tailed Sand Rat (*Psammomys obesus*) twice. The female of the eastern pair also was seen in flight with a hare (*Lepus capensis*) in its talons. Because of the proximity of the sighting to

Table 2. Hunting success of adult Lanner Falcons at Sede Boqer, Israel. Data are based on observations during 1987-89. Averages are represented ± 1 standard deviation. Data include various kinds of prey (birds, mammals and insects).

	WESTERN PAIR		EASTERN PAIR	
	MALE	FEMALE	MALE	FEMALE
ALONE				
Attempts	43	19	29	49
Kills	19	7	9	26
Percent successful	44.2	36.8	31.0	53.1
COURTSHIP COOPERATIVE HUNTING WITH MATE				
Attempts	11	11	11	11
Kills	5	6	7	7
Percent successful	45.5	54.5	63.6	63.6
BREEDING				
Attempts	34	3	37	4
Kills	14	1	16	2
Percent successful	41.2	33.3	43.2	50.0
COOPERATIVE HUNTING WITH YOUNG				
Attempt	19	13	19	19
Kills	8	8	11	13
Percent successful	42.1	61.5	57.9	68.4
Total attempts	107	46	179	83
Kills	46	22	95	48
Hunting success	43.3 \pm 4%	47.1 \pm 14%	53.7 \pm 7%	58.7 \pm 9%

the highway, it is possible that the hare was a scavenged road kill.

The western male also hunted bats. For three consecutive days, during March of 1989, I observed the male foraging at dusk over the community swimming pool. He circled overhead and dived towards bats that were skimming over the water. He chased the bats from behind and above, and caught 5 in 17 attempts (29%). One of the bats captured was a European Free-tailed Bat (*Tadarida teniotis*), the others were Kuhl's Pipistrel (*Pipistrellus kuhlii*). Two of the five bats were taken to the nesting cliff, the others were consumed in a nearby tree. On all occasions the wings were removed prior to ingestion. This concurs with similar observations by Tout (1986), Thomsett (1987) and van Jaarsveld (1988).

During late summer and autumn (mid-June to late November) all observations were of individual falcons hunting separately ($N = 47$) and feeding alone ($N = 22$; Table 2). They hunted cooperatively during the courtship period prior to egg laying, and also when young accompanied one of the parents on

hunting forays. Adult Lanner Falcons may use cooperative hunting to teach their young different hunting tactics, and to enhance hunting success (Hector 1986). Cooperative hunting has also been reported in Lanner Falcons from elsewhere in the species range (Cramp and Simmons 1980). In late December, males and females hunted cooperatively 11 times. The male mainly flushed and chased the prey (17 of 22 observations), usually in the direction of the female (14 of 22 observations). Upon detecting the female, the prey either turned back toward the male (7 observations) or kept flying into the flight path of the female, (12 observations).

From late February to April, when the female was on eggs or with nestlings, the male supplied almost all the food to the female and young (50 to 53 observed visits to nest). The female left the nest area for short periods, during which the male remained in the vicinity. Only rarely was she seen to hunt. On three occasions the female was observed to catch Rock doves. This concurs with descriptions by Brown et al. (1982).

During the fledging period, when young were in

Table 3. Breeding success of two pairs of Lanner Falcons in Israel. The pairs were observed during the years 1987-89.

	WESTERN PAIR			EASTERN PAIR		
	EGGS		YOUNG FLEDGED	EGGS		YOUNG FLEDGED
	LAID	HATCHED		LAID	HATCHED	
1987	4	4	4	—	—	—
1988	4	3	3	—	—	—
1989	5	5	3	4	4	4
Total	13	12	10	4	4	4
Average	4.3	4.0	3.3	8	8	8
Percent	100.0	92.3	76.9	4.0	4.0	4.0
				100.0	100.0	100.0

the vicinity of the nest, the male and the female again hunted cooperatively (32 of 38 observations). The parents then brought prey either to the nest or to the ledge on which the young were perched. After the young had fledged and were capable of flying some distance they accompanied their parents on hunting forays, but only one nestling at a time (70 observations). Young that did not participate remained on ledges in the vicinity of the nesting ledge. Following dispersal of the young, the male and the female remained in their territory, but hunted and fed separately.

Both males were less successful (Table 2) at hunting than their mates (48.9% and 43.3% compared to 58.7% and 47.1% respectively). Except for the western male, the falcons were least successful during the summer when hunting alone. Cooperative hunting between mates enhanced hunting success and was greatest prior to the breeding season. Females had greater success than males (Mann-Whitney U test, $P < 0.05$; Table 2) when cooperatively hunting with young. The overall hunting success of 49.1% is high compared to other *Falco* (e.g., Bird and Aubry 1982, Dekker 1987).

Nest Defense. Most territorial birds defend territories only against their own kind, but some also exclude other species with similar ecology. Some species defend only their nesting sites (Newton 1979). At the nest, Lanner Falcons attacked and drove away larger raptors such as Rough-legged Hawks (*Buteo lagopus*) and Golden Eagles (*Aquila chrysaetos*), but other falcons that nested in the vicinity, kestrels (*Falco tinnunculus*) and Barbary Falcons (*Falco pelegrinoides*), were not attacked. The two pairs of Lanner Falcons seemed to have 'mutually exclusive feeding territories' (Newton 1979).

Breeding Success. Both pairs laid eggs in scrapes on a cliff ledge (see also Brown et al. 1982). Clutches were completed toward the end of February and young hatched in the third or fourth week of March. The young fledged towards the end of April and dispersed from the parents' territory in mid-June.

In the 1987 breeding season, the western female laid 4 eggs, one each at 24 hr intervals. In the 1988 breeding season, the nest was observed when the first young started to hatch. The next day three young had hatched, indicating that young can hatch within 24 hours of each other and that incubation was penultimate or even ante-penultimate (Kridelbaugh 1983). This does not concur with Brown et al. (1982) who state that incubation begins with the first or second egg.

On three occasions I observed young dismember Rock Doves (190-290 g) at the age of 26 d (3 observations). At this age they hopped about the cliff face during the day, often occupying different ledges. Toward sundown, however, they congregated on the nesting ledge. After the young could fly short distances, they kept in vocal contact with each other and usually flew towards the parent with food. At approximately 60 d of age they accompanied their parents on hunting forays.

Reproductive success by the falcons is reported in Table 3. Average clutch size for both pairs was 4.2. Each of the pairs raised only one brood. The overall hatching success for both pairs during the five pair-years was 95.2% and is higher than the 71% found by Brown et al. (1982). Total fledging success was 78.3%. Pairs returned to nest on the same ledges in subsequent years.

Based on my study area, I cannot concur with the conclusions of Brown et al. (1982) and Osborne and

Colebrook-Robjent (1984) that Lanner Falcon nesting density is mainly dependent upon nest site availability. Nesting ledges similar to those used by the pairs studied were widely available and hence this factor was unlikely to limit density. I believe that other limiting factors, are yet to be discovered.

ACKNOWLEDGMENTS

I thank Burt Kotler, Oren Hasson, David Ward and Tom Grubb, Jr. for valuable comments on the manuscript. Dick Dekker, and T. Osborne helped in further improvement.

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Received 25 September 1990; accepted 11 March 1991