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PATTERNS OF WINTER DISTRIBUTION AND ABUNDANCE OF LESSER KESTRELS (*Falco naumanni*) IN SPAIN

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ABSTRACT.—During 1988–1989 we studied a wintering population of Lesser Kestrel (*Falco naumanni*) in the south of Spain, by mapping the area in which they occurred and estimating their numbers. Adults of both sexes remained during winter in the vicinity of the colony at which they had previously bred. The percentage of sedentary birds to total breeders varied from 6 to 88%. All juveniles left the colonies during winter, migrating to Africa. All colonies with sedentary birds are located in areas of farmland in the Guadalquivir river valley. This area has milder winters than the rest of the breeding range and almost never experiences frost, presumably favoring the winter activity of insects on which kestrels feed. During winter, Lesser Kestrels used communal roosts close to the colony, where they went regularly at dawn and dusk to visit the nest-holes they would be using during the next breeding season. Individuals equipped with PVC color bands showed that migrants returned to the colony from Africa gradually between February to April. Adults were the first to arrive, followed by juveniles born the previous year.

Patrones de distribución y abundacia invernales de Cernícalos Primillas (*Falco naumanni*) en España

EXTRACTO.—Durante 1988 y 1989 censamos y obtuvimos el área de distribución de una población invernante de Cernícalos Primillas (*Falco naumanni*). Adultos de ambos sexos permanecieron en invierno en las cercanías de las colonias donde habían criado con anterioridad. El porcentaje de aves sedentarias respecto al total de reproductores osciló entre el 6 y el 88%. Todos los jóvenes abandonaron las colonias en invierno, migrando a Africa. Las colonias con invernantes estaban localizadas en áreas agrícolas del valle del Guadalquivir. Esta zona tiene inviernos más templados que el resto del área de cría de la especie, y raramente sufre heladas, lo que debe favorecer la actividad de los insectos que sirven de alimento a los cernícalos en invierno.

Los cernícalos utilizaban dormideros comunales en las proximidades de las colonias y acudían a éstas al amanecer y al atardecer con el fin de visitar los nidos que utilizarían en la siguiente reproducción. Los controles de individuos anillados mostraron que los migrantes regresaban gradualmente a las colonias desde Africa entre febrero y abril, apareciendo primero los adultos y después los jóvenes nacidos en el año anterior.

The Lesser Kestrel (*Falco naumanni*) is thought to have different breeding and wintering grounds (Cramp and Simmons 1980). It breeds from the Mediterranean to Central Asia and winters in Africa south of the Sahara desert (Moreau 1972). Small numbers of wintering kestrels have been reported, nevertheless, in the south of Spain (Irby 1895, Riddell 1945) and in Morocco (Heim de Balsac and Mayaud 1962, Thiollay 1974). Bernis (1980) doubted that they were really wintering birds and suggested that they may be late migrants, early spring arrivals, or both. This phenomenon has received little attention, although an extension of the wintering area has been noted in Andalusia (Andrada and Franco 1975) and wintering birds reported in some other localities (Torres et al. 1981, Rodríguez and Hernández 1986).

Our aims have been to identify the area where Lesser Kestrels occur during winter in Spain, then to estimate ages, origins and the proportion of each sex, and finally to record the phenology of the migratory subpopulation.

STUDY AREA AND METHODS

During the 1988 breeding season, 312 localities were visited in Andalusia, the only region in Spain in which Lesser Kestrels have been previously recorded during winter. A total of 112 breeding colonies were located and surveyed. Colonies were mainly in old buildings (castles and churches) in urban areas. In five colonies, most of the juveniles and some adults were marked with PVC color bands, so that they could be identified later individually.

From mid-October to the end of November we again visited 38 colonies regularly distributed over the whole breeding area, to locate and count birds staying in winter. We selected 11 colonies in which wintering birds were

found and counted them again between December and January, to detect changes in the number of individuals throughout the season. We surveyed colonies because we had previously observed that kestrels remained attached to breeding colonies during winter and are never abundant far from their breeding grounds (de Juana and Gomez 1987).

We surveyed each colony for an average of 2 hr at dawn or dusk and recorded the maximum number of individuals seen together. To establish the daily pattern of colony attendance, we counted kestrels twice every 15 min from dawn to dusk at one of the colonies. Kestrels were counted with binoculars and, when possible, sex and age were assessed. Sexes are dimorphic in adult plumage; first year males have distinctive plumage (Cramp and Simmons 1980) but first year females are difficult to differentiate from adults even in the hand. A 40× telescope was used to read PVC color bands.

To record whether colonies were also used as roosts, we checked nests at night at three colonies every 15 d from December to May. To establish first arrival dates, we checked colonies located outside the area with a winter population of kestrels. Nine colonies were visited in Extremadura, NW of the Guadalquivir river valley, from January until we had observed kestrels in all of them. We then continued weekly visits to the colonies in which kestrels had been banded the previous year, to establish arrival dates for kestrels not observed during winter. One of these colonies was visited 2–4 d every week from 14 February to the end of breeding. The computer program Surfer (Golden Software Inc. 1987) was used to generate contour maps of breeding and winter distribution.

RESULTS

Winter Distribution and Abundance. Lesser Kestrels were observed during winter at 24 of the 38 colonies that we visited. Data from each colony are summarized in Table 1 and used in Figure 1 to generate contour maps of breeding and winter distribution. Colonies in which Lesser Kestrels remained during winter were located along the river valley, in farmland areas of central and southwest Andalusia. Average altitude was significantly lower in colonies with wintering kestrels, 172 m (N = 24), than in those without, 369 (N = 14) (Mann-Whitney U = 90.5, P < 0.05), which were located at the borders of the valley.

Sex Ratio and Ages. Of the individuals observed during winter, 64.7% could be sexed (N = 275). Of these, 60% were adult males and 40% females of unknown age (χ^2 = 6.88, P < 0.01). We did not observe juveniles. Five banded birds (1 male and 4 females) seen in winter had been banded as breeders at the same colonies the year before (Table 2).

Colony Attendance. Lesser Kestrels showed a bimodal pattern of colony attendance in winter (Fig. 2). Kestrels came to the colony at dawn after leaving

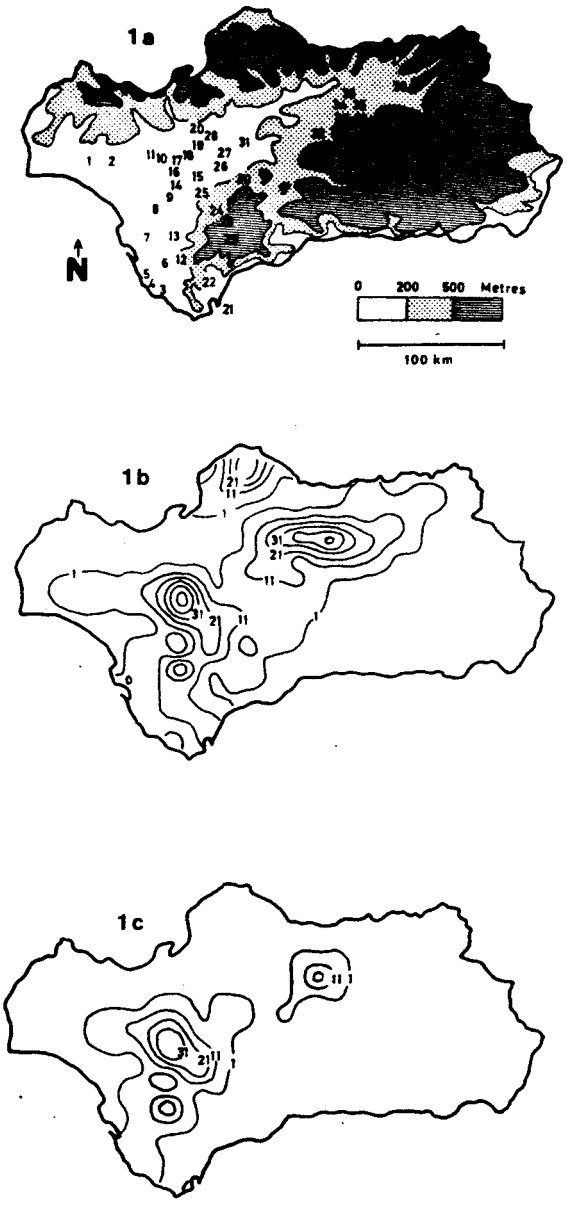

Figure 1. The distribution of Lesser Kestrels in Andalusia, Spain. 1a) Location of the 38 kestrel colonies visited in winter is shown using numbers that correspond to Table 1. 1b) Contour map of the breeding distribution, with contour intervals of 10 pairs. 1c) Contour map of the winter distribution and abundance pattern.

Table 1. Number of Lesser Kestrels counted during winter at various altitudes in Andalusia, Spain, in 1988. "M : F" represents the male : female ratio, "PAIRS" represents the number of pairs during the previous breeding season, "PERCENT WINTERING" is the percentage of breeders observed during winter.

COLONIES	NUMBER WINTERING	M : F	PAIRS	PERCENT WINTERING	ALTITUDE (m)
1	0		15		39
2	10	6/1	6	83	166
3	7	2/2	4	88	93
4	0		3		10
5	4	2/1	3	66	17
6	0		11		304
7	2	1/1	7	14	87
8	4		10	20	38
9	0		2		71
10	21	7/8	35	30	12
11	0		2		152
12	0		35		211
13	34	22/12	66	26	200
14	4	3/1	10	20	53
15	17	10/5	45	18	120
16	14	6/6	12	58	90
17	14	1/1	27	26	140
18	3	1/2	3	50	150
19	20	2/5	60	16	253
20	13	6/7	8	81	39
21[a]	?		15	?	200
22	0		28		257
23	0		25		600
24	0		6		623
25	30	12/6	40	37	258
26	23	15/7	35	33	149
27[b]	4	2/2	?	?	183
28[b]	7	4/3	?	?	131
29	0		?	?	723
30	2	1/0	15	7	300
31	10	1/0	20	25	110
32	2	1/1	15	6	444
33	0		22		388
34	0		14		473
35	24		35	34	437
36	6	2/0	37	8	458
37	0		28		573
38	0		17		748
Total	275	107/71	716		

[a] Confirmed presence of kestrels in winter.
[b] Colony found during winter.

the roost, and at dusk before going to the roost. While at the colony, they visited the holes in the walls of the buildings which are used for breeding in spring, and defended them from other individuals. The roosting behavior changed through the winter. Early in the winter all the kestrels left the colony at dusk and roosted communally somewhere else. We located the winter communal roosts of two colonies at a distance of 4 and 5 km respectively, on electric pylons. However, on 19 February, we caught a pair of kestrels roosting at one nest and a solitary female at another, at a colony in which 30 individuals had

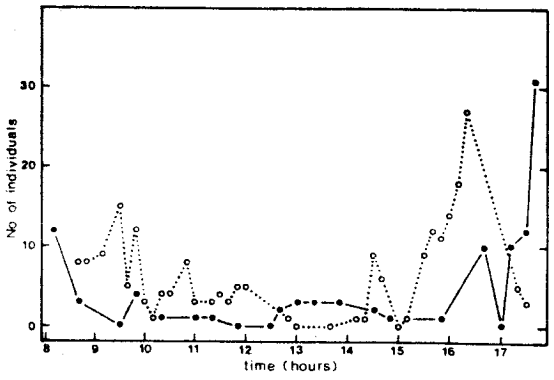

Figure 2. Hourly attendance patterns of Lesser Kestrels at colony 17 during two whole days. Solid circle, 15 February 1989. Open circle, 17 February 1989.

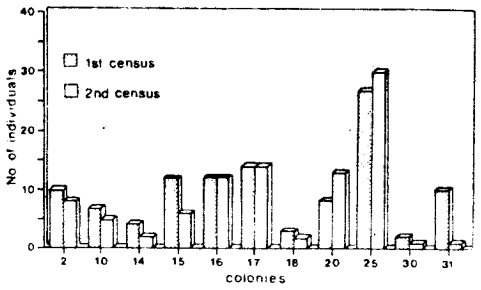

Figure 3. Number of Lesser Kestrels recorded in first and second winter surveys of 11 selected colonies. Colony numbers as in Table 1.

been counted at dusk. On 18 March, 12 pairs of kestrels were observed roosting at the same colony.

The number of kestrels remained stable through the winter as shown by the concordance of first and second countings in 11 selected colonies (Spearman Rank Correlation Coefficient $r_s = 0.78$, $P < 0.05$; Fig. 3), and was always lower than that of the breeders in 1988, ranging from 6 to 88%. First arrivals from African wintering grounds took place between 4–12 February at 9 colonies visited in Extremadura (Table 3), as previously recorded by other authors (Irby 1895, Andrada and Franco 1975). First arriving males were all in full adult plumage and seemed to outnumber females (Table 3). At colony 17, first sightings of birds banded with PVC bands showed that adult males were the first to arrive in spring and that first year males and females arrived gradually thereafter during March and April (Table 4).

Discussion

Temperature is probably a major environmental factor associated with winter distribution and abundance of Lesser Kestrel. The Guadalquivir river valley has relatively little frost (0–20 days) and high January temperatures for the breeding range of the species in Spain. Mild climate is caused by the temperate Atlantic influence which penetrates deeply to the interior along the river valley. Rainfall in the area, around 400–600 mm, is mainly during autumn and winter (Font Tullot 1983). A similar association with mild temperature has been found in the winter distribution of the American Kestrel (*Falco sparverius*; Root 1988) and the European Kestrel (*F. tinnunculus*; Village 1990). These weather conditions are probably important for the Lesser Kestrel's prey, which is almost exclusively insects. The kestrel's winter diet in the area consists mainly of beetles, grasshoppers and flying ants (Franco and Andrada 1977).

The kestrel's biased sex ratio may have been an artifact of behavioral differences, since males defend nests more actively (unpubl. data) and could be more easily observed near the colony. However, Village (1990) also observed that a higher proportion of males remained during winter in the breeding territories of European Kestrels in Scotland, and the sex ratio bias was correlated with winter harshness. In fact, among falcons which exhibit partial migration, males tend to remain on the breeding grounds through winter more often than females (European Kestrel Village 1990, Gyrfalcon (*F. rusticolus*) Platt 1976, and Peregrine Falcon (*F. peregrinus*) Mearns

Table 2. Number of Lesser Kestrels marked with PVC color bands in the 1988 breeding season and number of banded kestrels observed at the same colonies during the following winter. Colony numbers as in Table 1.

Colony Number	Banded		Observed	
	Adults	Juveniles	Adults	Juveniles
15	18	95	1	0
16	2	13	1	0
17	4	37	0	0
19	1	19	0	0
25	8	37	3	0
Total	33	199	5	0

Table 3. First arriving Lesser Kestrels at colonies in Extremadura, Spain in 1989.

COLONY	NO. INDIVIDUALS ♂	♀	SEX UNKNOWN	TOTAL	DATE (1989)
Campanario			4	4	4 February
Acedera	3	1	1	5	5 February
Oliva	3	2		5	10 February
Guareña	3	3		6	10 February
Medellin	2	2		4	10 February
Merida	2	2		4	11 February
Los Santos	1	1		2	11 February
Zafra	1	1		2	11 February
Fuentedecantos	6	3		9	11 February
Total	21	15	5	49	
Percent	58	42			

1982). Only a winter Merlin (*F. columbarius*) population in Saskatchewan, where younger males and older females were overrepresented, contrasts with this general pattern, possibly for genetic reasons (Warkentin et al. 1990). Our observations confirm that only adults are present during winter, as Riddell (1945) had previously suggested. This follows the commonest strategy in bird species with partial migration, where the young make up the bulk of the migrants, whereas adults predominate as residents (Gauthreaux 1982).

Table 4. First sightings in 1989 of kestrels banded during the 1988 breeding season. Data are from colony 17 during 2–4 observation days between 15 February and 15 May (M = male, F = female, AD = banded as adult, JV = banded as nestling).

DATE (1989)	SEX	AGE
6 March	M	AD
7 March	M	JV
20 March	M	JV
28 March	M	JV
28 March	F	JV
3 April	F	JV
3 April	F	JV
3 April	M	JV
3 April	M	JV
6 April	F	JV
18 April	M	JV
18 April	M	JV
18 April	F	JV
8 May	M	JV

The Guadalquivir river valley would not be a wintering ground for kestrels from other areas, as Pereira (1984) proposed, but an area with a partially sedentary population. The number of wintering kestrels being lower than the breeding population also agrees with our hypothesis that they are sedentary adults. Considering that 19% of breeding adults seem to winter in the area, and a breeding population of 2000 pairs has been estimated in Andalusia (Gonzalez et al. 1990), we estimate a total winter population of 760 kestrels. As they are distributed over an area of 20 700 km², there is a winter density of 1 individual per 27 km², much lower than winter densities of 1 individual per 6.2 km² estimated in South Africa by Siegfried and Skead (1971).

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