

## Avian responses to nest-box installation in steppes of the south-west of the Iberian Peninsula (Extremadura)

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**Abstract** - Occupation of nest-boxes by six middle-size species of birds in unwooded areas of Iberian peninsula was studied. The most frequent bird species nesting in boxes were Rollers (*Coracias garrulus*), Eurasian Kestrels (*Falco tinnunculus*) and Lesser Kestrels (*Falco naumanni*) suggesting that nests availability is the principal limitation for the colonization of open areas by these species. Unlike, Little Owls (*Athene noctua*), Scops Owls (*Otus scops*) and Barn Owls (*Tyto alba*) were sporadic nester in the boxes although they nested in the study area. The occupation trends varied between the species. The Roller, the Eurasian Kestrel and the Lesser Kestrel increased their occupations during the study period, possibly as a consequence of the selective advantages of artificial nest-sites in relation to natural nest-sites in the area.

### Introduction

The installation of artificial nest-boxes proved to be an useful method to study bird populations (Järvinen, 1980; Clutton-Brock, 1988). Many papers have pointed out population increases of little passerines (East and Perrins, 1988; Potti 1990) and of middle-size species (Hamerstrom *et al.*, 1973; Bloom and Hawks, 1983; Sánchez & Sánchez, 1991) in response to the addition of nest-boxes. However, other studies have reported interspecific variations in the responses to the installation (Bock & Flock, 1995; Purcell *et al.*, 1997), which are particularly important in passerine species (Karlsson and Nilsson, 1977; Potti, 1990; Slagsvold and Amundsen, 1993). Moreover, several authors have registered geographical variations in the response in the same species (Blondel, 1985), as well as different occupation percentage in relation to the quality of nest-boxes in the same locality (Pascual, 1993).

In 1986 the Forestry Agency of Extremadura installed nest-boxes on towers of power lines crossing wide unwooded areas in the region. Sánchez and Sánchez (1991) showed an increase in the number of breeding Rollers (*Coracias garrulus*) and of Eurasian Kestrels (*Falco tinnunculus*) during the 1986-1990 period in these nest-boxes. These authors put down this increase to the addition of nest sites in areas with limited natur-

al nest-sites, but they did not consider the variation in the number of available nest-boxes during the study period.

In the present paper we analyze the trends of the occupation of nest-boxes by non-passerine birds in steppes of the south-west of Extremadura during the 1986-1994 period. We test if the number of available holes is a limiting factor for the colonization of open areas by six middle-size species of birds. It is expected the stability of the occupation percentages of those species determined by the number of available nest-boxes in the study area. On the contrary, if there is a trend to the decrease or to increase of the percentage of occupied nest-boxes, other factor that justifies this tendency must be implicated.

### Study Area

Data were collected in steppe areas of Extremadura. These areas are characterized by the predominance of dry pastures (64.21%) and cereal crops (mainly wheat, barley and oats) (28.42%). Little surfaces are covered by shrublands (*Retama sphaerocarpa*) (3.12%), holm-oaks (1.11%), fruit trees (mainly almond-trees), and irrigated cultivation (Sánchez & Sánchez, 1991). In agreement with the bioclimatic classification given by Rivas-Martínez (1981) the

study area is included in the mesomediterranean climate. During May and June the mean temperature is 17.7°C and the mean rainfall is 11.6 mm.

## Methods

The installed nest-boxes had a base and roof surface of 32 x 18 cm and 19 cm of height. They have an opening of 6 x 18 cm that permits birds to entry the nest-box. The nest-boxes used were the design B described by Bolund (1987) and Negro (1987). They were installed in the period between 1986 and 1990. The number of nest-boxes installed was respectively 78 in 1986, 186 in 1988, 581 in 1989, 1344 in 1990, 1340 in 1991, 1321 in 1993 and 1371 in 1994. The abundance being  $9.43 \pm 0.26$  boxes per kilometer of power line. Nest-boxes were placed on towers of power lines in five different habitats (93 % of them was in pasture lands and cereal crops, and the remaining 7 % in irrigated land, shrublands (*Retama sphaerocarpa*) and areas with holm-oaks). Taking into account the occupation level in these last land uses we only show the results on pasture lands and cereal crops. We did not evaluate independently the evolution of the occupation in the two most representative land uses because they are selected by the study species in the same way (Sánchez and Sánchez, 1991). Nest-boxes were monitored regularly (once a fortnight) from the first of April to the 15 th of August from 1986 to 1994 (except for 1987 and 1992). The Kruskal-Wallis test was used to compare the median values of occupation of the species. Differences between any pair of species were tested by Mann-Whitney U-test using the sequential Bonferroni technique (Rice, 1989). The evolution of the occupation percentages for each species were analyzed by the Spearman correlation coefficient. The comparison of percentages was made by the application of the Chi-square test with Yates correction.

## Results

The median occupation percentage during the study period was different between species ( $H = 31.57$ ,  $d.f. = 5$ ,  $P < 0.0001$ ). Rollers and Eurasian Kestrels showed mean occupation percentages near to 20 %, and higher to those of the Lesser Kestrels (*Falco naumanni*), Little Owls (*Athene noctua*), Scops Owls (*Otus scops*) and Barn Owl (*Tyto alba*) (Mann-Whitney test;  $P < 0.01$  in the eight cases). However, Eurasian Kestrels and Rollers had not different mean occupation percentages ( $U = 27.0$ ,  $P = 0.749$ ). In the same way, Lesser Kestrels, Little Owls, Scops Owls and Barn Owls showed similar mean occupation

Table 1. Mean, median and standard deviation of the percentage of use of species that nested in boxes during the 1986-1994 period ( $n=7$ ) in extremaduran areas where the original trees have been removed.

Year	Mean	Median	Standard deviation
<i>C. garrulus</i>	20.45	22.20	8.28
<i>F. tinnunculus</i>	18.63	19.12	9.34
<i>F. naumanni</i>	0.73	0.37	0.75
<i>O. scops</i>	0.18	0.17	0.18
<i>A. noctua</i>	0.13	0.14	0.11
<i>T. alba</i>	0.32	0.07	0.45
% Total	40.45	42.32	17.66

percentages during the study period (Mann-Whitney test;  $P > 0.05$  in all the cases)(Table 1). Only the Lesser Kestrel had greater occupation percentages than 1 % in more than one breeding season (Fig. 1); while the rest of species were sporadic occupants of the nest-boxes, with mean occupation percentages lower than the 0.5 % during the study period (Table 1). The percentage of installed nest-boxes that were occupied by middle-size species increased significantly through the study period ( $r_s = 0.929$ ,  $n = 7$ ,  $P < 0.01$ ). A statistically significant increase in the Roller, the Eurasian Kestrels and the Lesser Kestrels occupation percentage was observed ( $r_s = 0.964$ ,  $n = 7$ ,  $P < 0.001$ ;  $r_s = 0.964$ ,  $n = 7$ ,  $P < 0.001$  and  $r_s = 0.883$ ,  $n = 7$ ,  $P < 0.001$  respectively; Fig. 1). Neither Little Owl ( $r_s = 0.385$ ,  $n = 7$ ,  $P > 0.05$ ), nor the Scops Owl ( $r_s = 0.306$ ,  $n = 7$ ,  $P > 0.05$ ) increased their occupation percentages during the study (Fig. 1). The Barn Owl was the only species that decreased its occupation percentage ( $r_s = -0.906$ ,  $n = 7$ ,  $P < 0.001$ )(Fig. 1).

## Discussion

Rollers and Eurasian Kestrels were the most common species in the nest-boxes through the study period. The importance of nest-boxes in the extension of range of Eurasian Kestrels had already been shown in unwooded areas of Holland (Cavé, 1968) and Great Britain (Village, 1983). However, a negative response of Eurasian Kestrel to nest-boxes addition was detected in upland forest of Wales, where these birds have enough available natural sites (Petty, 1985). In this sense, the installation of artificial platforms seems to increase the number of nest sites available to open country raptors (Hamerstrom, *et al.* 1973; Olendorff and Stoddart, 1974; Stahlecker and Griese, 1979; Craig and Trost, 1979; Bloom and Hawks, 1983). Our results confirm



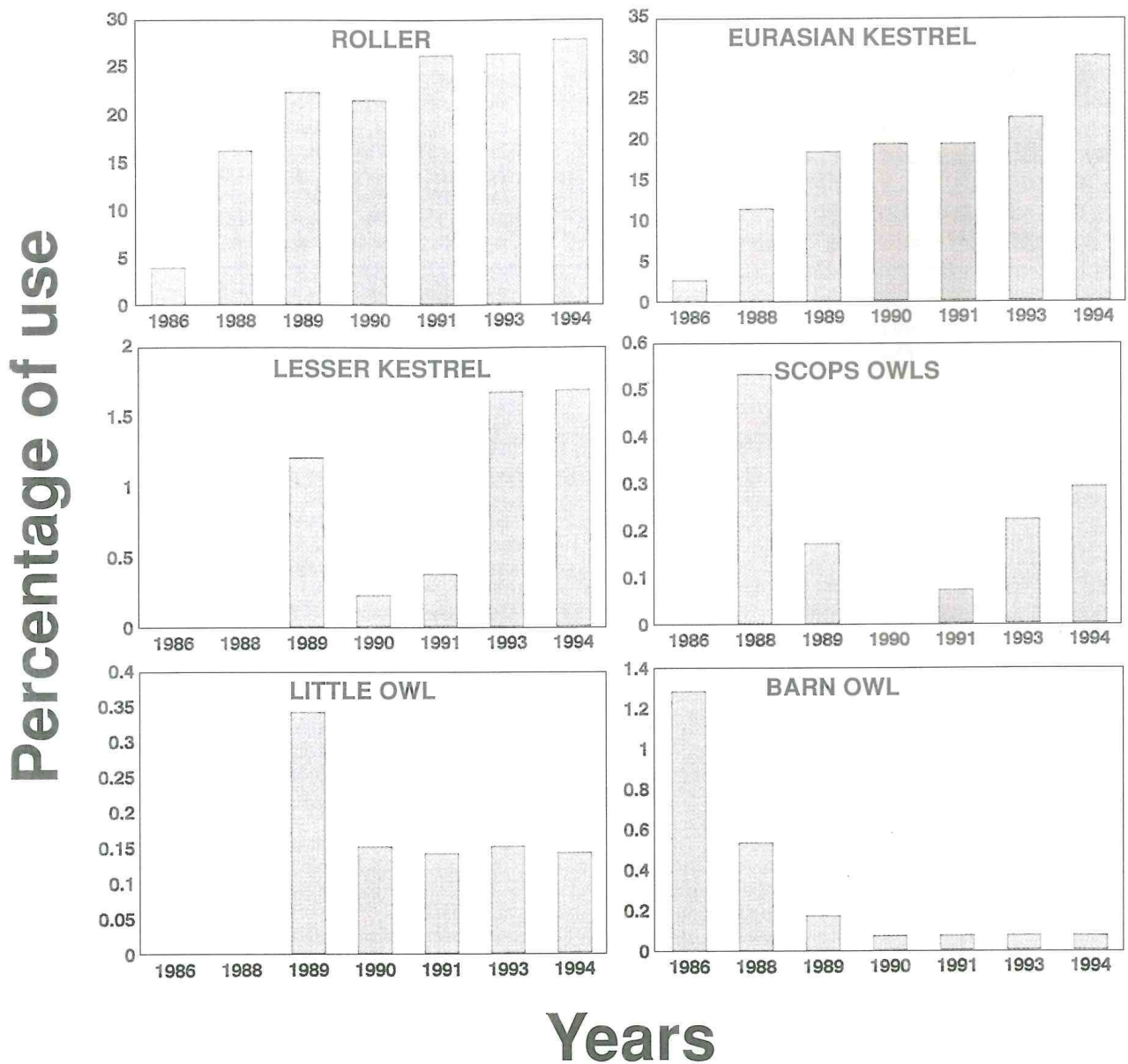


Fig. 1. Percentage of use of boxes by medium sized species in relation to years in extremaduran areas where the original trees have been removed.

this aspect because open country raptors such as the Eurasian Kestrel and the Lesser Kestrel showed higher occupation percentages than any other raptor (Little Owl, Scops Owl and Barn Owl). In relation to the Roller, the use of artificial nests during the reproduction was considered as an sporadic fact in woods of central Europe (Cramp and Simmons, 1988; Sosnowski and Chmielewski, 1996). However, our results point out that artificial nests are well-accepted by Rollers in areas with scarce nest-sites, showing higher occupation percentages than those reported in forest of Poland (5 % in Poland: Sosnowski and Chmielewski, 1996;  $\chi^2 = 10,37$ ;  $P < 0,005$ ). This circumstance suggests that nest-

site availability is a limiting factor in the Roller settlement in suitable open areas. The lack of trees does not seem a constraint for the distribution of Little Owls, Scops Owls and Barn Owls in opened areas. These three species were never in conflict with the three most common species in nest-boxes. Most nest-boxes were deserted by these three species, suggesting that interspecific competition never occurred. The causal factor of the scarce occupation percentage of these three species in nest-boxes could be the abundance of common stone piles and human constructions in the study area, in the roundabouts of nest-boxes, that are used for breed

respectively by Little Owls, and Scops Owls and Barn Owls (Avilés per.obs.).

Thus, the Roller, the Eurasian Kestrel and the Lesser Kestrel were the most common species in the nest-boxes and their occupation percentages increased probably as a consequence of benefits such as a reduction of the predation rates in the nestling period (Nilsson 1984 a,b, Robertson & Rendell 1990), as well as a reduction of the nesting infestation rate (Møller 1989, 1992). It has been shown that these benefits actually increased breeding success in nest-boxes (East & Perrins 1988, Gowaty & Bridges 1991, Kuitunen & Aleknonis 1992, Purcell et al. 1997). Conversely, Scops Owls, did not increase the occupation percentage, despite the increase in breeding number (Sánchez et al. 1996), suggesting that the detected population increase could be caused by the addition of new nest-sites, as in other nocturnal raptors (Newton 1979). With compared to Little Owls, and Barn Owls, Scops Owls always occupied the same boxes through the study period, being the evolution of their occupation percentages a consequence of the increased nest-boxes availability.

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