

# Selection of breeding habitats by the Roller (*Coracias garrulus*) in farming areas of the southwestern Iberian peninsula

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Abstract: AVILÉS, J. M., & E. COSTILLO (1998): Selection of breeding habitats by the Roller (*Coracias garrulus*) in farming areas of the southwestern Iberian Peninsula. *Vogelwarte* 39: 242–247.

The selection of breeding habitats by Rollers (*Coracias garrulus*) is analysed in the southwestern Iberian Peninsula. Rollers selected positively areas where two years set-aside occurs ("posfós") with holm-oak trees, though this substrate was scarce in the area. However, this habitat showed most potential preys for this species as well as the largest preys. The species preferred areas with trees to those without them when all the available areas had the same food availability. The territories of Rollers were different to those of Kestrels, a competitor for nest sites in open areas. However, the Rollers did not show a statistically significant negative selection by Kestrel (*Falco tinnunculus*) territories. The major food availability, the major prey size in "posfós" with holm-oak trees, as well as the existence of natural perches in this habitat are suggested as causal factors of the selection of breeding territories by Rollers.

Key words: nesting habitats, selection, *Coracias garrulus*, food availability, *Falco tinnunculus*.

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## 1. Introduction

The Roller (*Coracias garrulus*) is a medium sized *Coraciiformes* that breeds from North Africa to the West of Himalayas (CRAMP & SIMMONS 1988). TUCKER & HEATH (1994) have pointed out a decrease of the Palearctic breeding population since the beginning of the 19 century, according to previous studies showing its extinction in some countries of the Western Palearctic (BRACKO 1986, LEMMETYINEN 1987, SAMWALD & SAMWALD 1989, ROBEL 1991). In the Iberian Peninsula, TUCKER & HEATH (1994) estimated the number of breeding pairs of this species between 4.100 and 11.000, which are distributed in the centre and south of the Peninsula. However, there are many basic data concerning its biology that are unknown yet (DÍAZ et al. 1996, AVILÉS 1997).

Except for general descriptions of the principal habitats of the species in the Palearctic region (CRAMP & SIMMONS 1988), there are no studies about the habitat selection by Rollers. In the Iberian Peninsula, some studies have shown their main habitats (BERNIS 1966, RUFINO 1989). However, the spatial scale of all these studies is too wide and so they can be associated with geographical patterns (WIENS 1985). The influence of factors that act in a minor scale has been shown in the habitat selection of other insectivorous species and they have not been studied for the Roller. In this context, we proposed to examine three basic questions by studying a population of this species breeding in artificial nests located in agricultural areas of the Iberian Peninsula:

- 1) Do Rollers choose to breed in those most abundant habitats or do they prefer an specific type of habitat around the nest?
- 2) If food availability or suitable foraging sites are determinant factors on nest habitat selection for Rollers, as has been shown in other insectivorous birds (LI & MARTIN 1991, VALIDO et al. 1994), they have to choose those habitats with a higher food availability and with the best foraging conditions.
- 3) As an alternative hypothesis we analyse if the competition with the Kestrel is the factor that influences the selection of breeding territories by Rollers. Taking into account that Kestrels nest in high densities in nest-boxes in the study area (SÁNCHEZ & SÁNCHEZ 1991, this paper) and win the encounters with Rollers (pers. obs.), it could be expected that Rollers will use those habitats that have not been positively selected by Kestrels.

## 2. Study Area

We studied the breeding population of Rollers in La Serena (39°03'N, 5°14'W), an area located in the Southwest of the Iberian Peninsula. The area is characterised by the predominance of dry pastures (64.2%) and cereal crops (mainly wheat, barley and oats) (28.4%). Included in these crops there are little surfaces of shrublands (*Retama sphaerocarpa*) (3.1%) and areas with holm-oaks (1.1%), as well as fruit trees (mainly almond-trees) and irrigated crops (SÁNCHEZ & SÁNCHEZ 1991). The exploitation system of land in the area implicates the existence of four phases in each parcel during the Roller breeding period: Cereal crops (wheat, barley and oats), stubbles (those cereal crops that have already been harvested), fallows (areas that have not been sown that year but have been ploughed to facilitate their oxygenation) and „posíos“ (areas where two years set-aside occurs in the study area, they are characterised by the predominance of herbaceous plants). 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. The climate data are from 1988–1991 period and were obtained from the meteorological station of Orellana that is included in the study area.

In 1986 the Forestry Agency of Extremadura began a conservation project in the area that consisted on the placement of wooded middle-sized nest-boxes in steppe areas. The supports of electric power lines were used to place the nest boxes (for further details about the type and location of nest boxes see SÁNCHEZ & SÁNCHEZ 1991).

## 3. Methods

The field work was made during the first three weeks of June in 1995 which coincides with the breeding peak of the species in the area (AVILÉS 1997). We visited a total of 243 nest boxes, 30 with Rollers and 136 with Kestrels.

We analysed nest-habitat selection by these two species by comparing the used habitat during the breeding period with the available habitat. The habitat use was defined as the percentage of nest-boxes occupied by the species in each type of land use. Taking into account the short home range of the Roller in the studied population, (The mean foraging distance from the nest was  $165.0 \pm 171.2$  m, and 66.7% of the foraging flights were into an area with a radius of 100 m,  $n = 30$ , AVILÉS per. obs.), each nest-box was assigned to the habitat where it was included. The availability is defined as the percentage of nest-boxes located in each land use. The date of the onset of laying was not obtained in the study period for the two considered species, however this date did not vary more than a week between 1989, 1990 and 1991, the Roller being earlier than the Kestrel in 1991 and later in 1989 and 1990 (AVILÉS pers. obs.).

### Arthropods availability

To study arthropods availability we used a set of pitfall traps that were put in four rows of four pitfall traps one metre distant one to another. They were poured to one third of their capacity with 10% formaldehyde, and were put in the three most representative habitats of the study area („posíos“, stubbles and fallows, Table 2). Prey availability was analysed in the study area by considering the preferred prey of adults (CRAMP & SIMMONS 1988) and chicks during the nidicolous period (AVILÉS & PAREJO 1997). The places to put the pitfalls were chosen at random and we sampled each habitat twice. We considered that food availability and tree density was independent because of the low tree density in all habitats. The pitfall traps were revised and poured once a day in order to avoid their saturation and prey items were collected after 48 hours. This method has been shown as suitable to study the soil arthropods (WOLDA 1990), though it also attracts some others groups of animals not always from the soil.

The obtained samples of arthropods were identified to order and classified on 0.1 g classes. After the identification of preys, the sample was put on a filter-paper and was dried at 60° C to constant weight (MARTÍNEZ et al. 1992). The mean biomass of each taxa was calculated by weighting all the animals of the taxa in a balance with a precision of 0.0001 g. We ignored the data from fallows owing to the fact that the samples obtained were less than 1% of the values of the samples in „posíos“ and stubbles. Data are expressed as frequencies because of the small number of preys got in each trap.

To compare distributions we used the Chi-squared test. The same test with the Yates correction was used to compare proportions (ZAR 1996).

We used the Savage index (SAVAGE 1931) to compare the used and available habitat. The index ranges from 0 to infinite; values approach 0 for increasing avoidance, and to infinite for increasing preference. The index as-

Table 1: Athropods biomass in „posíos“ and stubbles in the Serena.  
Tab. 1: Athropodenbiomasse in „posíos“ und Stoppelbrachen in der Serena.

Prey type	"POSÍO"			STUBBLE		
	Biomass (g)/ha	Biomass %	Prey mean mass (g)	Biomass (g)/ha	Biomass %	Prey mean mass (g)
<i>Coleoptera</i>	85394.00	73.41	0.182	11377.33	23.31	0.155
<i>Arachnidae</i>	8446.66	7.26	0.316	116.66	0.24	0.008
<i>Orthoptera</i>	19848.66	17.06	0.119	438.66	0.90	0.065
<i>Tisanura</i>	44.00	0.03	0.006	0.00	0.00	0.00
<i>Scorpionidae</i>	1672.00	1.43	0.205	0.00	0.00	0.00
<i>Isopoda</i>	31.33	0.03	0.004	4.00	0.01	0.0006
<i>Miriapoda</i>	88.00	0.08	0.013	0.00	0.00	0.00
<i>Formicidae</i>	792.00	0.68	0.002	33606.00	68.87	0.007
<i>Julidae</i>	0.00	0.00	0.000	3257.35	6.66	0.163
TOTAL	116316.65	100		48800.00	100	

sumes the value 1 when use is proportional to availability. After this, we proved the selection hypothesis for each habitat by means of the a posteriori method given by MANLY et al. (1993) that uses a Chi-square table with 1 degree of freedom.

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#### 4. Results

##### 4.1. Food availability

The most frequent prey in the Roller chick diet during their nidicolous period (*Coleoptera*, *Arachnida*, *Orthoptera* and *Miriapoda*, that are 90% of prey items and 93% biomass based on AVILÉS & PAREJO 1997) were more abundant in "posíos" (62.1%) than in stubbles (18.2%) ( $\chi^2 = 298.8$ ,  $df = 1$ ,  $p < 0.01$ ), being a major percentage of the total biomass in the first habitat (97.8%) than in the other (24.5%) ( $\chi^2 = 35.5$ ,  $df = 1$ ,  $p < 0.001$ ) (Table 1).

In "posíos" the most common preys were those of the 0.1–0.2 g dry class, being significantly more frequent than in the other two pooled classes ( $\chi^2 = 47.7$ ,  $df = 1$ ,  $p < 0.01$ ). The most common preys in stubbles were those of the minor sizes, being these significantly more frequent than the other two size classes pooled ( $\chi^2 = 1452.1$ ,  $df = 1$ ,  $p < 0.01$ ) (Figure 1).

The arthropods distribution in each mass class was significantly different between "posíos" and stubbles ( $\chi^2 = 1186.1$ ,  $df = 2$ ,  $p < 0.01$ ). The proportion of animals included in the weight class with minor masses was significantly higher in stubbles than in "posíos" ( $\chi^2 = 1222.0$ ,  $df = 1$ ,  $p < 0.01$ ) and in "posíos" the proportion of preys included in the 0.1–0.2 g and 0.2–0.3 g classes was higher than in stubbles ( $\chi^2 = 1037.7$ ,  $df = 1$ ,  $p < 0.01$  and  $\chi^2 = 23.6$ ,  $df = 1$ ,  $p < 0.01$ , respectively) (Figure 1).

##### 4.2. Territory selection

The used territories by Rollers and Kestrels during reproduction were significantly different ( $\chi^2 = 40.1$ ,  $df = 4$ ,  $p < 0.01$ ). In order to do this analysis we removed stubbles with holm-oaks and cereal crops because of their small sample size. The proportion of used nests by Rollers in fallows and "posíos" with holm-oaks was higher than those used by Kestrels ( $\chi^2 = 7.3$ ,  $df = 1$ ,  $p < 0.01$  and  $\chi^2 = 14.9$ ,  $df = 1$ ,  $p < 0.01$ , respectively). However, the proportion of used nests by Kestrels was higher in "posíos" and stubbles ( $\chi^2 = 12.4$ ,  $df = 1$ ,  $p < 0.01$  and  $\chi^2 = 12.8$ ,  $df = 1$ ,  $p < 0.001$ , respectively).

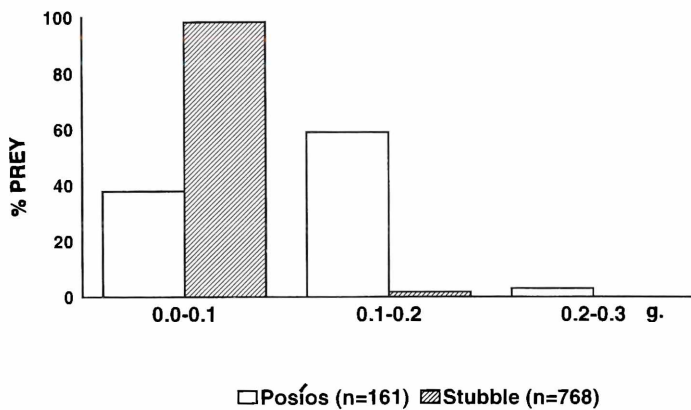


Fig. 1: Size distribution of prey in the two mainly used habitats by Rollers in the Serena.  
n = sample size.

Abb. 1: Größenverteilung von Beutetieren in den zwei bevorzugt von der Blauracke genutzten Habitaten in der Serena.  
n = Stichprobengröße.

The distribution of habitats where Rollers nests were located was different to the distribution of available habitats in the study area when the two less representative habitats were removed (see table 2) ( $\chi^2 = 181.3$ ,  $df = 4$ ,  $p < 0.01$ ). The species showed a significant positive selection for “posíos” with holm-oaks and a negative selection for stubbles (Table 2).

Kestrels do not select nest habitat randomly among available habitats (the two less representative habitats were removed: cereal crops and stubbles with holm-oaks) ( $\chi^2 = 49.1$ ,  $df = 4$ ,  $p < 0.01$ ). They selected “posíos” and the rest of habitats were used in a direct relation to their availability (Table 3).

## 5. Discussion

The studied population of Rollers showed a clear preference for several habitats, in an independent way of the availability of these habitats in the study area. For nest place the species showed a negative selection for stubbles and a positive selection for „posíos“ with holm-oaks. This habitat had a higher availability of preys for the species, as well as preys of bigger size. These factors have been suggested to be determinants in the selection of territories by other bird species (MARTIN 1987, ALONSO et al. 1991, VALIDO et al. 1994), a phenomenon that has been explained with the decrease in time that birds have to spend foraging when there is a good food availability (see review in STEPHENS & KREBS 1986) and with the increased ingestion rate per prey item when there are big preys (PYKE 1984).

In relation to the quality of foraging places the preference of the Roller for „posíos“ with holm-oaks gives idea about the importance of the quality of these places on the selection of breeding territories in this species. Holm-oaks are used by Rollers as perches where to begin their hunting flights (AVILÉS, pers. obs.), a behaviour that has been previously registered (GLUTZ & BAUER 1985). In this sense some authors relate the density or presence of perches with the quality of foraging places, and therefore, with the selection of them in some wading birds (BURGER 1985), and some raptors (JANES 1985). In this way WIDEN (1994) showed the preference of *Buteo buteo* and *Falco tinnunculus* for cleared wooded areas with artificial perches in opposite to those areas without perches. In our study area this factor acquires more importance because Kestrels, that have a density of

Table 2: Selection of different habitat types by Rollers during the 1995 breeding season in the Serena. Significant preferences for each habitat type are showed as – (negative) and + (positive).

Tab. 2: Wahl verschiedener Habitattypen von Blauracken während der Brutseason 1995 in der Serena. Signifikante Präferenzen für jeden Habitattyp sind mit – (negativ) und + (positiv) dargestellt.

Habitat	nestbox available	nestbox used	Savage index	
Stubble	65	4	0.49	– (p = 0.08)
„Posíos“	112	11	0.79	
Fallow	32	5	1.26	
„Posíos“ with holm-oaks	15	5	2.72	
Stubble with holm-oaks	7	2	2.35	
Sowed	2	1	4.12	+ (p < 0.05)
Fruit-trees	10	2	1.61	
Total	243	30		

Table 3: Selection of different habitat types by Kestrel during the 1995 breeding season in the Serena. Significant preferences for each habitat type are showed as – (negative) and + (positive).

Tab. 3: Wahl verschiedener Habitattypen von Turmfalken während der Brutseason 1995 in der Serena. Signifikante Präferenzen für jeden Habitattyp sind mit – (negativ) und + (positiv) dargestellt.

Substrate	nestbox available	nestbox used	Savage index	
Stubble	65	34	0.66	+ (p < 0.05)
„Posíos“	112	74	1.18	
Fallow	32	12	0.67	
„Posíos“ with holm-oaks	15	5	0.59	
Stubble with holm-oaks	7	3	0.78	
Sowed	2	0	0	
Fruit-trees	10	8	1.41	
Total	243	136		

5.59 pairs per Km as opposed to Rollers with 1.23 pairs per km, have a territorial behaviour (VILLAGE 1983) and use as perches even those posts with Rollers nests (AVILÉS pers. obs.). So Kestrels can use areas without natural perches as „posíos“ without trees, which have high prey availability for this species, as it has been shown by VEIGA (1985) in mediterranean areas, and they can reduce the costs related with travels between nest-sites and foraging places (STEPHENS & KREBS 1986). This fact is explained with the differences between the breeding territories in the two species. Rollers could be excluded from artificial perches, and so from „posíos“ without trees and it could be that the selection of territories of Rollers would be related with Kestrel competitive exclusion mechanisms. But Rollers do not select negatively those habitats positively selected by Kestrels and so we can not confirm this hypothesis.

As a conclusion, we can say that Rollers select during the breeding period their nesting habitats in relation to their potential prey availability, the prey sizes, as well as the foraging places with natural perches. However, there is only indirect evidence that points out a spatial segregation between Kestrels and Rollers nest-sites.

6. Zusammenfassung

In Untersuchungen zur Habitatwahl der Blauracke in landwirtschaftlich genutzten Gebieten der südwestlichen Iberischen Halbinsel konnte die überragende Bedeutung von „posíos“ (zweijährige Brachflächen mit Stein-eichenbeständen) als Bruthabitate aufgezeigt werden. Obgleich derartige Landschaftstypen im Untersuchungs-

gebiet eher selten sind, verfügen sie über das größte Angebot bevorzugter Beutetiere und Beutetiergrößen. Bei vergleichbarem Nahrungsangebot bevorzugen Blauracken baumbestandene Flächen gegenüber solchen ohne Bäume. Die Blaurackenterritorien unterscheiden sich von denen des Turmfalken, der als Konkurrent um Nisthöhlen in der Offenlandschaft gilt. Dennoch wird nach den vorliegenden Befunden das Siedlungsverhalten der Blauracke nicht durch die Turmfalkendichte beeinflusst. Vielmehr können die Verfügbarkeit bevorzugter Beutetiere und Beutetiergrößen sowie geeignete Ansitzwarten in Steineichenbrachen als bestimmende Faktoren für die Wahl von Brutterritorien angesehen werden.

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