ISSN : 0002-4619

3521 : DIET AND PREY TYPE SELECTION BY ROLLERS *Coracias garrulus* DURING THE BREEDING SEASON IN SOUTHWEST OF THE IBERIAN PENINSULA

Le régime alimentaire et la sélection des proies du Rollier d'Europe en période de nidification ont été étudiés par l'analyse des pelotes de réjection et par l'évaluation de la nourriture disponible dans le Sud de l'Espagne. Les Insectes Orthoptères représentent la catégorie de proies les plus fréquemment consommée, suivie par les coléoptères et les *Araneae*, alors que les micromammifères ne sont capturés qu'épisodiquement. En revanche, ces derniers constituent la biomasse la plus élevée du régime alimentaire. Chez les Insectes Arthropodes, ce sont les orthoptères qui représentent la biomasse la plus forte, suivis par les coléoptères et les *Araneae*. Le régime alimentaire du Rollier semble déterminé par la taille des proies capturées et probablement par le degré de "capturabilité".

Mots clés: Régime alimentaire, Sélection des proies, Rollier d'Europe, *Coracias garrulus*, Espagne.

INTRODUCTION

The Roller *Coracias garrulus* is widely distributed across the Palearctic region (CRAMP & SIMMONS, 1988). The majority of their breeding populations are declining, probably due to the loss of suitable habitats as a consequence of the recent agricultural intensification (TUCKER & HEATH, 1994). Although their breeding populations are highly fragmented (AVILÉS 1999), rollers have a stronghold in Spain, where numbers are thought to be stable and have been recently estimated around 6,000 pairs (HAGEMEIJER & BLAIR 1997). In the Iberian Peninsula the Roller mainly breeds in open unwooded areas exploiting the holes of the scarce trees and those offered by human constructions (FOLCH, 1996).

The available information on the diet of the Roller is very scarce and mainly restricted to northern latitudes. So, a predominance of insects in the diet of the species has been reported in Hungary (CRAMP & SIMMONS, 1988), Germany (HAENSEL, 1966) and Poland (SOSNOWSKI & CHMIELEWSKI, 1996). In the Mediterranean area only the study of CASSOLA & LOVARY (1979) reflects the diet composition from rests collected at one nest when chicks had fledged, and recently, the chick diet has been assessed in Spain from samples collected by the ligature methods (AVILÉS & PAREJO, 1997). However, they did not attempt to relate food abundance with usage, although a relationship between the decline of available preys for the species and their populational declines has been typically assumed (TUCKER & HEATH, 1994). Food type selection may be an important parameter for predicting the effects of farm management practices on breeding populations of rollers and could also be used to develop integrated land management programmes to enhance Roller food supplies in areas already used by the species.

In this study we estimate the diet composition of adult rollers during their reproduction in open areas of the Southwest of Spain. We assess diet preferences of the species by quantifying use and abundance of prey types in the study area.

STUDY AREA AND METHODS

The study was undertaken in the Serena region (39°03' N, 5°14'W) in the Southwest of Spain. It is in the mesomediterranean climate area (RIVAS-MARTÍNEZ, 1981) and during May and June the mean temperature is 17.7° C and the mean rainfall is 11.6 mm. The area is characterised by the predominance of dry pastures and cereal crops (AVILÉS *et al.*, 2000).

Twenty-one pellets were carefully collected in three visits under 5 nest-boxes occupied by breeding rollers since 26 of April to 24 of May of 1998. The same number of pellets was approximately collected in each nest. Pellets were disintegrated and separated into fragments identified with a zoom binocular microscope (x 6-10) by comparison with the collection at the University of Extremadura and considering CHALINE *et al.* (1974), MOREBY (1987) and LEPLEY (1994) studies. We counted one prey item based on the minimum number of individuals estimated from anatomical fragments.

The diet was expressed as the percentage that each prey category in relation to the total number of consumed preys (% F). The percentage of biomass (% B) of each taxa was estimated considering the weight of the arthropods obtained in 1995 in the study area (AVILÉS & COSTILLO, 1998). We excluded the Dermaptera because they did not appear in that study and represented a low biomass portion in our data. The weight of the consumed small mammals by Roller was taken from BLANCO (1998).

Rollers mainly feed within 150 m. of distance from the nest during the breeding season in our study area (AVILÉS & COSTILLO, 1998), and, generally, they hunt their preys on the ground (CRAMP & SIMMONS, 1988). We estimated arthropods availability in these foraging locations on 10 of May by direct observation of the arthropods present in 25 randomly selected squares of 25 x 25 cm situated on the ground within

150 m. from the nest of the five studied pairs. We counted the number of available preys per arthropod taxa in each square and we estimated the availability of each prey type as the sum of the individuals of each prey taxa found in the 25 squares. The available biomass of each prey type in the study area was estimated considering the weights by taxa reported by AVILÉS & COSTILLO (1998).

Prey type preference was checked by means of the SAVAGE electivity index. $W_i = U_i/D_i$, (SAVAGE, 1931) where $U_i = u_i/u_+$, u_i was the number of items of each prey type consumed by the species and u_+ was the total number of items consumed. $D_i = d_i/d_+$, d_i was the total number of each arthropod taxa available, d_+ the total number of available arthropods in our samples. The index ranges from 0 to infinite; values approach 0 for increasing avoidance, and to infinite for increasing preference. The index assumes a value of 1 when usage is proportional to availability. The departure of the consumption of each taxa from a distribution proportional to its availability was tested using the statistic $(W_i-1)^2/es(W_i)^2$, which follows a c^2 distribution with 1 degree of freedom. $[es(W_i)]$ is the standard error of the index approximately given by $v[(1-D_i)/(u_+ D_i)]$ (MANLY *et al.*, 1993).

To check Roller preferences related to prey biomass we used again the Savage electivity index. So, u_i was the biomass of each prey type consumed by the species and u_+ was the total biomass consumed, while d_i was the biomass of each available arthropod taxa, and d_+ the total available biomass of arthropods in our samples.

RESULTS AND DISCUSSION

The diet of the Roller in the Serena region was mainly based in the consumption of terrestrial and slow flying arthropods, being the small mammals sporadically taken (TAB. I). Within the arthropods, the Orthoptera were the most frequently consumed prey type, followed by Coleoptera, *Araneae* and Hymenoptera (TAB. I). Chilopoda and Dermaptera were the less consumed arthropod prey types (TAB 1). This predominance of the Orthoptera in the diet in the south of the species distributional range has been previously documented by CRAMP & SIMMONS (1988) and confirmed by data reported on chick diet in the Serena region (AVILÉS & PAREJO, 1997). However, CASSOLA & LOVARY (1979) in Italy detected a very low occurrence of this prey type, although they collected only data from one breeding pair. The importance of the Orthoptera could reflect the higher abundance of this prey type in southern areas than in the center and northern of Europe where Coleoptera are more frequent (GANGWERE & MORALES AGACINO, 1970). So, in Germany (HAENSEL, 1966) and Poland (SOSNOWSKI & CHMIELEWSKI, 1996) the Coleoptera are the more taken prey type by Rollers.

TABLE I.– Diet composition of the Roller in southwestern Spain. N: number of preys in each taxa; % F: percentage that each taxa means in relation to the total number of consumed preys; % B: percentage of biomass that each taxa means in relation to the total ingested biomass (see methods).

Composition du régime alimentaire du Rollier d'Europe dans le Sud-Ouest de l'Espagne. N = nombre de proies de chaque taxon; % F = pourcentage de chaque taxon en fonction du nombre de proies consommées; % B = pourcentage en biomasse de chaque taxon en fonction de la biomasse totale ingérée (voir méthodes).

Prey Type	N	% F	% B
Araneae			
Araneidae			
Lycosa sp.	6	2.05	
Araneae others	11	3.75	
Coleoptera		12.64	7.93
Meloidae	4	1.37	
Staphylinidae	19	6.49	
Coleoptera others	14	4.78	
Dermaptera		0.34	
Forficulidae	1	0.34	
Hymenoptera		3.41	0.02
Formicidae	10	3.41	
Orthoptera		75.77	31.10
Acrididae	212	72.36	
Tettigoniidae	10	3.41	
Chilopoda		1.02	0.05
Scolopendromorpha	3	1.02	
Insectivora		0.34	11.01
Soricidae			
Crocidura russula	1	0.34	
Rodentia		0.68	43.57
Muridae			
Mus musculus	2	0.68	
Total	293	100.00	100.00

In our study area the most abundant medium and large size arthropod prey type were the Orthoptera, followed by *Araneae* and Coleoptera (FIG. 1). However, only Orthoptera and Coleoptera were positively selected by rollers while *Araneae* were avoided (FIG. 1). Then, other factors different from abundance must be implied in Roller prey choice. So, prey size must be important taking into account that the most abundant prey type in the study area were the Hymenoptera and they were avoided (FIG. 1). In the other hand, Orthoptera and Coleoptera are probably

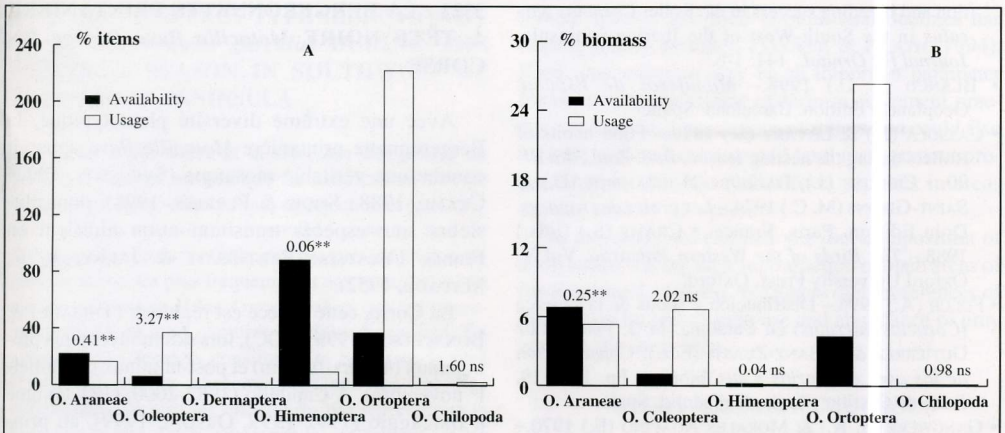

FIG. 1.– Comparison between the number of invertebrate items available and used by the Roller (A) and between the total invertebrate biomass available and used by the Roller (B) in southwestern Spain. The total numbers of preys obtained from the 25 randomly selected squares of 25 x 25 cm situated on the ground were 155, while the total biomass that they represented were 12.64 g. The value (Wi) and the significance of the SAVAGE index is shown above each prey category: $P < 0.05$: **; $P > 0.05$: ns.

Comparaison entre le nombre d'invertébrés disponibles capturés par le Rollier d'Europe (A) et entre le nombre total de proies obtenues (155) sur les 25 carrés de 25 x 25 cm pris au hasard, situés sur le sol; le total de la biomasse s'élève à 12,64 g. La valeur (Wi) et la signification de l'Index de SAVAGE sont montrées pour chaque catégorie de proie : $P < 0.05$: **; $P > 0.05$: ns.

more easily hunted than *Araneae* that can hide themselves into their holes, as could be deduced from the reported avoidance of this abundant and large prey type (FIG. 1).

The small mammals constituted the 54.58% of the whole consumed biomass by rollers though they were scarcely consumed (TAB. I). The occurrence of small vertebrates in the diet of the Roller has been previously shown (HAENSEL, 1966; CASSOLA & LOVARY, 1979; CRAMP & SIMMONS, 1988), although in none case biomass contribution was assessed. Within the arthropods, the Orthoptera, that were the more frequent consumed prey type, were too the taxa with a higher biomass contribution to the diet (31.10%), followed by Coleoptera (7.93%) and Araneae (6.32%).

In agreement with the pattern of prey type selection described above, rollers avoided the *Araneae* although they were the prey with the highest biomass contribution in the study area (FIG. 1), and preferred the Orthoptera that were not so important (FIG. 1). This pattern of prey selection could be explained as before by the higher difficulty to hunt *Araneae*. However, more exhaustive studies reporting foraging techniques of Rollers related to prey type are needed to accurately assess this point.

In the light of our results it would be expected that those agricultural practices that affect arthropods communities by means of pesticides or intensive management affect negatively Roller populations living there. So, the future Roller conservation measures and action plans should take into account the preference of the species by medium and large arthropods in its diet during the breeding period.

ACKNOWLEDGEMENTS

We are very grateful to C. SENDIN and J. M. SÁNCHEZ by their logistic support.

REFERENCES

• AVILÉS (J. M.) 1999.– Distribución de la población nidificante de la Carraca *Coracias garrulus* en España. *Ardeola,* 46: 223-226. • AVILÉS (J. M.) & PAREJO (D.) 1997.– Dieta de los pollos de Carraca (*Coracias garrulus*) en una zona mediterránea (Extremadura, suroeste de España). *Ardeola,* 44: 237-239. • AVILÉS (J. M.) & COSTILLO (E.) 1998.– Selection of the breeding habitats by the Roller (*Coracias garrulus*) in farming areas of the southwestern Iberian peninsula. *Die Vogelwarte,* 39: 242-247. • AVILÉS (J. M.) SÁNCHEZ, J. M. & PAREJO, D. 2000: Nest-site selec-

tion and breeding success in the Roller *Coracias garrulus* in the South-West of the Iberian peninsula. *Journal für Ornitol.*, 141: 1-6.

• BLANCO (J. C.) 1998.– *Mamíferos de España*. Geoplaneta Edition. Barcelona. Spain.

• CASSOLA (F.) & LOVARY (S.) 1979.– Food habits of Rollers during the nesting season. *Boll. Zool.*, 46: 87-90. • CHALINE (J.), BAUDUIN (H.), JAMMOT (D.) & SAINT-GIRONS (M. C.) 1974.– *Les proies des rapaces*. Doin Edition. Paris. France. • CRAMP (S.) (Eds.) 1988.– *The Birds of the Western Paleartic*, Vol V. Oxford University Press, Oxford.

• FOLCH (A.) 1996.– Distribución y status de la Carraca (*Coracias garrulus*) en Cataluña. *In*: J. FERNÁNDEZ GUTIÉRREZ & J. SANZ-ZUASTI (Eds.): *Conservación de las aves esteparias y sus hábitats*. Pp. 113-119, Junta de Castilla y León, Valladolid, Spain.

• GANGWERE (S. K.) & MORALES AGACINO (E.) 1970.– The biogeography of iberian orthopteroids. *Miscelania Zoologica*, 2: 9-75.

• HAENSEL (J.) 1966.– Zur Ernahrungsbiologie der Blauracke nach Analysen von Gewollen und Nisthohleninhalten im Bezirk Frankfurt. *O. Beitr.Vogelkde*, 12: 129-147. • HAGEMEIJER (W. J. M.) & BLAIR (M. J.) (EDS.) 1997.– *The EBCC Atlas of European Breeding Birds. Their distribution and abundance*. T & AD Poyser, London, U.K.

• LEPLEY (M.) 1994.– L'étude des pelotes de rejection d'oiseaux insectivores: méthode, limite, et atlas de restes de proies du Faucon crécerellette *Falco naumanni* en Plaine de Crau. *Faune de Provence*, 15: 5-15.

• MANLY (B.), MCDONALD (L.) & THOMAS (D.) 1993.– *Resource selection by animals. Statistical design and analysis for field studies*. Chapman and Hall. London. U. K. • MOREBY (S. J.) 1987.– An aid to the identification of arthropod fragments in the faeces of gamebird chicks (Galliformes). *Ibis*, 130: 519-526.

• RIVAS-MARTÍNEZ (S.) 1981.– *Memoria del mapa de series de vegetación de España*. Ministerio de Agricultura Pesca y Alimentación. ICONA, Madrid, Spain.

• SAVAGE (R. E.) 1931.– The relation between the feeding of the herring of the east coast of England and the plankton of the surrounding waters. Fishery Investigation, Ministry of Agriculture. *Food and Fisheries*, 12: 1-88. • SOSNOWSKI (J.) & CHMIELEWSKI (S.) 1996.– Breeding biology of the Roller *Coracias garrulus* in Puszcza Pilicka Forest (Central Poland). *Acta Ornithologica*, 31: 119-131.

• TUCKER (G. M.) & HEATH (H. F.) 1994.– *Birds in Europe: their conservation status*. Cambridge. U.K. Birdlife International.

Jesús M. AVILÉS & Deseada PAREJO
Laboratorie d'Ecologie, CNRS URA 258,
Université Pierre et Marie Curie, 7 Quai St Bernard,
Case 237, F-75252 Paris Cedex 05, France
(javiles@hall.snv.jussieu.fr)

3522 : LA BERGERONNETTE PRINTANIÈRE À TÊTE NOIRE *Motacilla flava feldegg* EN CORSE

Avec une extrême diversité phénotypique, la Bergeronnette printanière *Motacilla flava* apparaît comme une véritable mosaïque (SVENSSON, 1992 ; CRAMP, 1988 ; SNOW & PERRINS, 1998), dont plusieurs sous-espèces transitent et/ou nidifient en France (YEATMAN-BERTHELOT & JARRY, 1994 ; MAYAUD, 1952).

En Corse, cette espèce est régulière (THIBAULT & BONACCORSI, 1999 ; GOC), lors des mouvements prénuptiaux (4 mars-fin juin) et post-nuptiaux (12 juillet-1er novembre). À Capitello (1982-2000, GB), comme à Barcaggio (1992-1999, ORSONI, 1999), au printemps, il a été constaté que les mâles précédent les femelles.

Cette bergeronnette est source de problèmes d'identification qui ne sont pas toujours correctement résolus. Le motif et les couleurs de la tête sont essentiels pour une bonne reconnaissance, mais d'autres critères devront, parfois, être pris en considération. Ainsi, la voix est-elle aussi un élément discriminant dans certains cas (CRAMP, *op. cit.*). Le cri le plus distinctif, par rapport à la forme nominale, est celui de la race *feldegg (ibidem* ; VAN DEN BERG & OREEL, 1985), qui est originaire des Balkans (SNOW & PERRINS, *op. cit.*).

Cette dernière a été observée en Corse, notamment à la pointe du Cap, sur les sites de Barcaggio et de Macinaggio, où l'on remarque une forte concentration des migrateurs au printemps (FAGGIO & FRODELLO, *in prep.*). Au total y ont été relevées : 15 mentions représentant 19 spécimens, dont la première donnée insulaire en 1980. Il s'agit, presque toujours, d'individus isolés, mais, 4 avaient été vus ensemble le 22 avril 2000 (GOC, 1980-2001).

L'apparente irrégularité des observations tient à deux facteurs : d'une part, le petit nombre de spécimens et d'autre part, le fait que les races n'ont pas été répertoriées chaque année. Apparemment, le flux est nettement sous-estimé.

Dans les autres régions du littoral insulaire, on recense, pour la même période, au moins 15 mentions portant sur 17 individus (GOC).

On peut faire donc état d'un **minimum** de 30 observations pour 36 spécimens en Corse (GOC, 1980-2001 ; CANTERA, 1994-2000) notés entre le 4 avril et le 30 mai, puis le 25 juin (12 données en avril, 17 en mai et 1 en juin). Il n'existe, en revanche, aucune information relative à la migration post-nuptiale.