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EVALUATING PREY PREFERENCES OF AN INSECTIVOROUS BIRD SPECIES BASED ON DIFFERENT SAMPLING METHODS

ORSOLYA KISS

University of Szeged, Faculty of Agriculture
H-6800 Hódmezővásárhely, Andrássy út 15.
kiss.orsolya@mgk.u-szeged.hu

ABSTRACT
Decline in populations of farmland and grassland birds has been attributed to the recent changes of agricultural practice in Europe. These changes may affect the food resources, so the studies in prey preference may have an importance when try to protect these species. We studied prey preference in the European Roller (*Coracias garrulous*) in natural grassland and farmland mosaics by two different sampling methods. (i) Pitfall traps were used to determine prey availability in Rollers' territories and (ii) nestbox content, supplemented with video recordings, were used to estimate the contribution of main prey taxa to nestling diet. We found that Rollers did not select their prey items in proportion to their availability. We also found significant differences between Savage selectivity indices obtained by the different sampling methods. Nestbox content indicated high preference of coleopterans and avoidance of orthopterans, but video recording showed significant preference of both taxa. None of our sampling methods indicated difference in prey preference during the nestling period between the two study sites.

Keywords: nestbox content, nestling diet, *Coracias garrulus*, video records, Savage selectivity index

INTRODUCTION

Knowledge of prey preference may play an important role in the conservation of threatened species. Recent changes in populations of grassland birds have been attributed to the changes in food supply due to agricultural intensification, such as increased pesticide use or reduction of suitable feeding areas (DONALD ET AL., 2006; NEWTON, 2004; MORRIS ET AL., 2005). Identification of main prey types and preservation of their populations are important to maintain the suitable food supply for threatened bird species. Usually, several methods are used to identify prey composition of the species. Analysis of pellets or nestbox content is most frequently used in raptor species (STENFOFF ET AL., 1988; BAKALOUDIS ET AL., 2012). Direct observation can be performed where prey items are large enough to detect (MARGALIDA ET AL., 2009).Video recordings of feeding birds (BRITSCHGI ET AL., 2006) and collar samples (TRYJANOWSKI ET AL., 2003) are useful methods to identify smaller prey items and allow us to detect changes in prey composition during the nestling period. Our study species, the European Roller (*Coracias garrulus*) is a threatened bird species in Europe. It suffered from serious population decline during the 1970's and disappeared as a breeding species from Finland, Denmark, Germany and the Czech Republic (CRAMP ET AL., 1993). The reasons for the severe decline in Roller populations are still not correctly revealed. The main causes of recent widespread decline are considered the loss of suitable habitats due to changing agricultural practices and loss of nesting sites. KOVÁCS ET AL. (2008) mentioned that the critical threats for Rollers is the conversion of natural grasslands to any other land use, management of meadows and pastures, destruction of microhabitats of large insects serving for basic food supply. The European Roller typically feeds on terrestrial invertebrates and slowly flying arthropods (CRAMP ET AL., 1993; AVILÉS AND PAREJO, 2002). However, this species is also known as a polyphagous bird species, also foraging on vertebrates (CRAMP ET AL., 1993). In this study we aimed to investigate prey preference of Rollers during the nestling period based

on two sampling methods, in two study site. We predict that food samples collected in nestboxes may indicate the higher use of certain taxa, such as coleopterans and vertebrates, because the remains of these taxa are most durable. We predict that both sampling methods differ in diet composition between the two studied habitats.

MATERIAL AND METHOD

Study site

The study was conducted in southern Hungary, in two sites: (i) "Grassland" habitat at the village Baks (46°32'N; 20°03'E). It was an alcalic natural grassland, which was characterized by the mosaic of salt and dry grasslands; (ii) "Farmland mosaics" at the village Szatymaz (46°24'N; 19°57'E). The second site was an agricultural area, which is composed of the mosaics of salt grassland patches (23% of the whole area) and extensive cereal cultures (3%), arable fields (53%) and artificial forest monocultures (e.g. black locusts, Robinia pseudoacacia; 4 % of the whole area). The size of the grassland patches within this habitat was about 14 ha. Due to the lack of natural holes available for breeding, nestboxes were installed in the area in the previous years (MOLNÁR, 1998). The study was conducted in 2009 during the breeding season of Rollers (from late April to early August).

Nestling diet

We studied the availability of prey in 10 plots at each sites. In these sites each plots were established within the breeding territories of Rollers. We used pitfall traps to estimate arthropod abundance. In each study plots we randomly placed 5 pitfall traps of plastic bowls with the diameter of 65 mm in a line, 1 m apart from each other. Ethylene glycol (30-50%) was used as killing-preservative solution. Pitfall-traps were active for two weeks between 16 June and 20 July, which overlapped the feeding period of nestlings. This resulted in two samples from pitfall traps. Rollers usually feed on arthropods larger than 1 cm (CRAMP ET AL., 1993), hence we selected the food items larger than 1 cm from the collected samples for further analyses. We used video recording and nestboxes content to determine the diet of Roller nestlings. We documented prey composition delivered by Rollers with the help of video recordings (Sony DCR-HC53E camera with Sony Premium mini DV cassettes). We recorded Rollers between 6 and 12 hours (C.E.T. summer time) in the morning, because POOL (2006) reported that frequency of Roller's feeding activity did not change in this period. We recorded each nests twice, first during the first week of the nestling period and the second recordings during the third week, as Rollers nestling period is at least 3 weeks long (CRAMP ET AL., 1993). Previous studies on Rollers reported that prey remains in the nestbox were useful indicators of nestlings' diet in Rollers (AVILÉS ET AL., 2002; TIDMARSH, 2003; MOLNÁR, 1998; CRAMP ET AL., 1993). For this reason we collected the content of 10-10 nestboxes in each study sites. The number of individuals of taxa was calculated based on TIDMARSH (2003).

Statistical analysis

We used Savage electivity index to determined Roller prey preferences in insects groups. Savage selectivity index $w_i = Ui / D_i$, where U_i is the proportion of units used in one territory and D_i is the proportion of units available (SAVAGE, 1931). This index varies from 0 (maximum negative selection) to infinity (maximum positive selection), with 1 indicating no selection. The statistical significance of the selection for each of the taxonomic groups considered is obtained by comparing the statistic $(w_i - 1)^2 / se(w_i)^2$ with theoretical value of a χ^2 distribution with one degree of freedom, with w_i being the Savage index for the

taxonomic group and se(wi), the standard error of the index. [es(W_i)] is the standard error of the index approximately given by $\sqrt{[(1 - D_i) / (u + D_i)]}$. Non-parametric tests were used testing potential differences in prey composition collected by the different methods.

RESULTS

From video records we identified 245 prey items delivered to 20 Roller nests, but 63 additional items (20.5 %) remained unidentified. From nestbox contents we identified 2141 prey items. Both methods revealed similar prey types, although their frequencies in nestling diet were different (*Table 1*). These results suggested that orthopterans and coleopterans were the most important taxa in nestlings' diet, however, nestbox content indicated higher consumption of coleopteras, whereas video recordings showed the higher consumption of orthopteras.

Table 1. Percentage of prey types in Roller nestlings' diet obtained by different sampling methods

Sampling method	Orthoptera (except mole crickets)	Coleoptera	*Gyrllotalpa gyrllotalpa*	Amphibians and reptiles	Mammals
nestbox contents	8.2%	77.2%	13.4%	0.1%	1.3%
video recordings	40.75%	25 %	0.32 %	9.4 %	3.76%

The European mole cricket (*Gyrllotalpa gyrllotalpa*) was highly overrepresented in nestbox contents; however, we found higher frequency of vertebrates in video recordings than in nestbox samples. We analysed prey-selection in respect to availability by the Savage electivity index (*Figure 1*). We did not calculate Savage index for Mole Cricket in case of video recordings, because we only detected once this taxon with this sampling method.

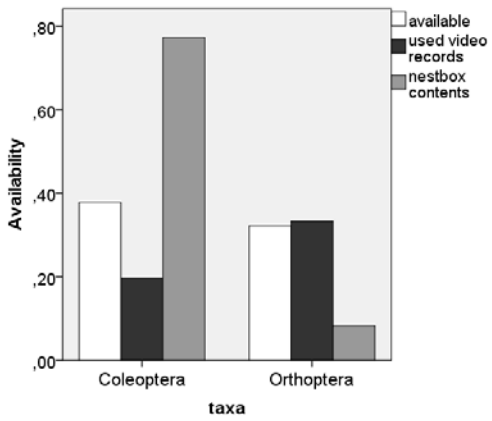

Figure 1. Relative frequency of Rollers' main prey types obtained by two sampling methods (video records and nestbox contents), and their availabilityin the territories during the breeding season. Availability was estimated by pitfall trap method.

Prey items were not selected in proportion to their availability both in case of nestbox content (orthopterans: $w_i = 0.34$, se = 0.19, p =0.001; coleopterans: $w_i = 4.8$, se. = 0.08, p

= 0.001; *Gyrllotalpa gyrllotalpa*: w_i = 2.8,se. = 0.1, p < 0.001); and video records (orthopterans: w_i = 1.9, se. 0.8, p = 0.03, coleopterans: w_i = 1.14, se. = 0.29, p = 0.001). We found differences in preference caused by the sampling methods. Preferences for main prey types differed significantly when we compared data obtained by the different sampling methods. The nextbox content indicated high preference of coleopterans (Mann-Whitney U = 5500, n_1 = 20, n_2 = 20, p = 0.001) and lower preference (avoidance) the orthopterans (Mann-Whitney U = 66000, n_1 = 20, n_2 = 18, p = 0.001) than video records.
We also investigated the differences of prey selection in different habitats. We found that the Savage index did not differ significantly between study sites neither in the case of nestbox contents (orthopterans: Mann-Whitney U = 32500, n_1 = 10, n_2 = 9, p = 0.315; coleopterans: Mann-Whitney U = 47000, n_1 = 10, n_2 = 10, p = 0.821; *Figure 2/a*) nor in video records (orthopterans: Mann-Whitney U = 26000, n_1 = 10, n_2 = 9, p = 0.133; coleopterans: Mann-Whitney U = 50000, n_1 = 10, n_2 = 10, p =0.1; *Figure 2/b*). The preference for mole cricket (*Gryllotalpa gryllotalpa*) was did not differ in the two habitats (Mann-Whitney U = 12000, n = 8, p = 0.23).

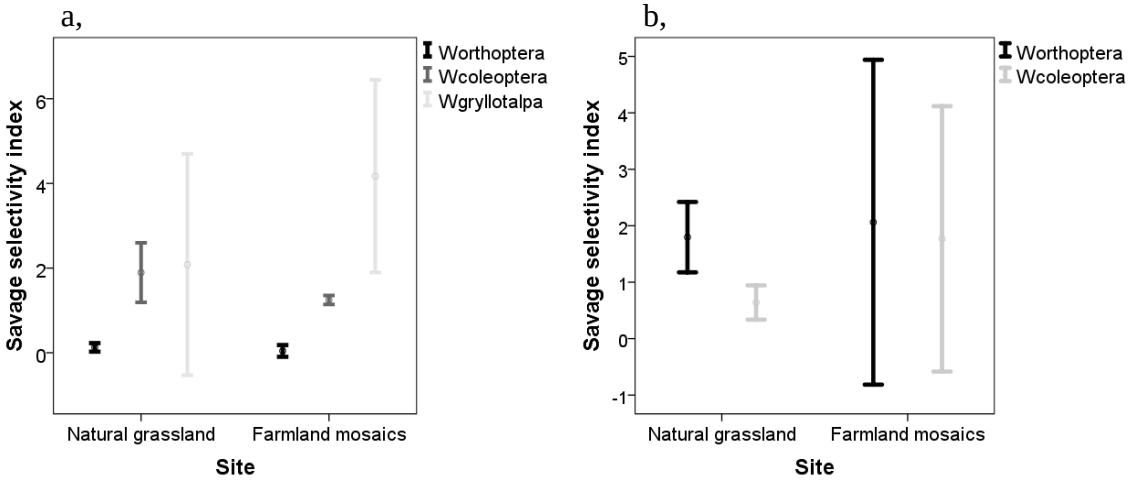

Figure 2. Savage electivity index in two different habitats by using nestbox contents (a) and video records (b) sampling methods.

CONCLUSIONS

According to the literature, Rollers' nestling diet was evaluated by a variety of methods, but none of them compared the results of the different techniques in the same territories. Most of the studies indicates polyphagia in this species (CRAMP ET AL., 1993) and highlighted the importance of vertebrates (AVILÉS ET AL., 2002). TIDMARSH (2003) found high frequencies of orthopterans by analysing nestbox content in France and AVILÉS ET AL. (2002) also found orthopterans as the most frequently consumed prey type. Our results, however, indicate much higher importance of coleopterans by using nestbox contents, but not in video records. We found that the sampling methods may indicate different preferences in same territories. Nestbox contents presumably overestimates the importance of coleopterans in nestlings' diet, although the analysis of pellets collected under perch sites and from nest-hole contents in East Germany found high frequency of coleopterans (77.6%) and less frequency of orthopterans (16.4%) (CRAMP ET AL., 1993). The analysis of nestbox contents proved to be useful to identify the important prey species, which was almost undetectable by video records. The latter method seems to be providing detailed informations about Rollers' diet. The results obtained by this method were similar to the

results of former studies (CRAMP ET AL., 1993). Biases in the methods of diet analysis were also found in other species. TRYJANOWSKI ET AL. (2003) found differences in orthopterans collected by different methods and TORBERG ET AL. (2007) reported that small prey items were underestimated in remains. In video records orthopterans were delivered to the nests the most frequently, this taxon consisted of 40% of nestling diet. According to the video records this taxon was probably the main prey type for Rollers during the nestling period in both habitats. Our results suggest that analyses of prey remains in nestbox contents should be used to find large preys, such as beetles, and data obtained by different methods is useful to perform an analysis of Rollers' diet.

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