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Seasonal and annual changes in the diet of the Red-backed Shrike *Lanius collurio* in farmland of Eastern Poland

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ABSTRACT. The aim of the study was to identify differences in diet composition of the Red-backed Shrike during the breeding period and between years related to habitat diversity of territories. The study was conducted in 1999-2003 in extensive farmland of Eastern Poland. The diet composition the Red-backed Shrike was analysed based on examination of animal remains in pellets found under nests and places where the birds often stayed. The material was divided into two groups: pellets collected in territories with predominantly arable land and others with predominantly grasslands (meadows and pastures). In territories with the prevalence of arable land the proportion of Hymenoptera in the Red-backed Shrike diet increased, and of Coleoptera decreased, with the progress of the season. A corresponding pattern was not observed in territories comprising grasslands. Territories of the Red-backed Shrike located in the same places in two years did not differ in the proportions of Coleoptera and Hymenoptera in a birds' diet. This can be an evidence of a food stability of Red-backed Shrike's territories in consecutive years and of dietary preferences of this species. Grasslands supported a greater abundance and variety of invertebrates in comparison with arable land. Thus, actual food preferences of Red-backed Shrikes in grassland territories could be causing the lack of a relation between season and the proportion of a given taxon in the diet. Thus, the occurrence of feeding preferences in sites of restricted feeding conditions may not entirely reflect actual food selectivity of the species.

KEY WORDS : Red-backed Shrike, *Lanius collurio*, food, extensive farmland

INTRODUCTION

The diet composition of the Red-backed Shrike *Lanius collurio* (Linnaeus, 1758) has been extensively described in literature (summaries in: CRAMP & PERRINS, 1993; LEFRANC & WORFOLK, 1997; HARRIS & FRANKLIN, 2000). The diet composition of the Red-backed Shrike can vary depending on many factors including geographical location or weather conditions that may in turn influence the activity of potential prey (CRAMP & PERRINS, 1993; TRYJANOWSKI et al., 2003a). Methods used for the analysis of diet (TRYJANOWSKI et al., 2003b), as well as the timing of collecting the material within a season (KARLSSON, 2004) may also affect the results of dietary studies.

The Red-backed Shrike is an endangered species with a decreasing trend in numbers in Europe, especially in its western part (FORNASARI et al., 1997). Thus, the knowledge of the diet and food preferences of this species is very important for its active protection (KUPER et al., 2000; TRYJANOWSKI et al., 2003a).

The aim of the present study was to characterise differences in the diet composition in the Red-backed Shrike during the breeding season and between years, with respect to habitat diversity in birds' territories. Observations were conducted in agricultural landscape of Eastern Poland, which is characterised by extensive farming practice. Such areas, because of the type of land use, are rare in Europe and differ even from the farmland of Western Poland. These differences are reflected in a trend of increasing numbers of birds observed in recent years in many species that inhabit this type of landscape, including the Red-backed Shrike (DOMBROWSKI et al., 2000; DOMBROWSKI & GOŁAWSKI, 2002).

MATERIALS AND METHODS

The study was conducted 10-15km NE from Siedlce (52º12'N, 22º17'E). The study area consisted of 855ha of farmland with low intensity of farming practice (little mineral fertilisers, herbicides) and considerable fragmentation of fields. Arable land predominated (53.5%), with mainly crops of rye and potatoes. Meadows and pastures covered 21.1%, and the proportion of fallows was 2.2%. Besides these open habitats, there were woodlands and orchards. The structure of land use did not change during the study.

The material was collected in June and July 1999-2003. The diet composition of the Red-backed Shrike was analysed based on examination of animal remains in pellets found under nests and places where the birds often stayed. In this paper, four orders of invertebrates were analysed - only these which were abundantly represented in birds' food (GOŁAWSKI, 2006a). Prey was classified by an entomologist into the lowest possible taxon. Numbers of invertebrates were determined according to the number of remains characteristic for a taxon, i.e. heads, legs, parts or whole coverts.

The material was divided into two groups: collected in territories with predominantly (over 70%) arable land and those with predominantly grasslands (meadows and pastures). The first group consisted of 18, and the second – 14 territories of the Red-backed Shrike. A circle of 70m radius with the centre in the nest location was assumed as

a Red-backed Shrike territory. The accepted territory size (1.5ha) is the average territory size in this species in Europe (CRAMP & PERRINS, 1993). To assess shrikes' diet, the numbers of territories was used as a sampling unit (KATZNER et al., 2005) to avoid pseudoreplication which occurs when the number of pellets is used. To minimize the impact of unequal sampling in different territories, I analysed only data from territories where more than 25 prey items were collected. These pellets were analysed at four half-month stages in June and July, similar to other studies (e.g. KARRLSON, 2004). In addition, the proportions of two most abundant orders of insects: Coleoptera and Hymenoptera (other orders of insects represented in lower numbers) in birds' food was analysed in the same territories in different seasons. In this case, pairs of data collected in corresponding half-month periods were compared.

In statistical tests Gamma correlation coefficient and Wilcoxon matched pairs test were used. These calculations were done with Statistica 6.0 (STATSOFT, 2003).

RESULTS

Coleoptera predominated in the diet of Red-backed Shrikes which inhabited territories comprising arable land (n=18 territories; Coleoptera 81.4%±17.59; mean±SD), followed by Hymenoptera (9.0%±7.18), Heteroptera (8.2%±16.43) and Orthoptera (2.2%±1.11). The dominance structure of prey was similar in the diet of birds from territories including meadows and pastures (n=14 territories), and the dominants were Coleoptera (77.3%±22.60), followed by Hymenoptera (13.8%±10.20), Heteroptera (2.6%±1.32) and Orthoptera (2.6%±1.85). The representation and rank of importance of these invertebrates in birds' food was similar in all analysed periods (Tables 1 & 2).

In territories with arable land an increase of proportion of Hymenoptera (r Gamma=0.34, p=0.025) and a decrease of the proportion of Coleoptera (r Gamma=-0.29, p=0.012) with the progress of the season was observed. For the two remaining orders of invertebrates, no significant trends were observed (Table 1). In territories which included grasslands, tendencies in changes of proportions of Coleoptera and Hymenoptera in birds' food were similar (Table 2), but not statistically significant (p>0.103 in both cases). For Heteroptera and Orthoptera, similar to the situation in territories with arable fields, no seasonal changes in their proportions in the diet could be detected (Table 2).

The analysis of the composition of the Red-backed Shrike diet in the same territories occupied in two seasons did not reveal any differences in the percentage of both Coleoptera (Wilcoxon matched pairs test, z=0.36, p=0.722, n=11) and Hymenoptera (Wilcoxon matched pairs test z=0.65, p=0.515, n=9). Thus I assume that these two orders of invertebrates had similar proportions in the diet in the same territories during consecutive seasons (Fig. 1).

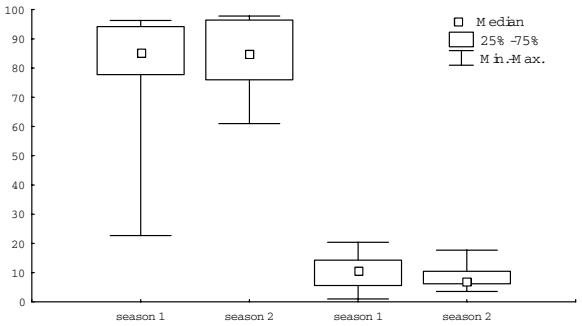

Fig. 1. – Proportions of Coleoptera (left bars, n=11 territories) and Hymenoptera (right bars, n=9 territories) in the diet of the Red-backed Shrike during two seasons.

TABLE 1

Proportions ± SD (n territories) of four of the most abundant taxa in the diet of the Red-backed Shrike in territories comprising arable land in farmland of Eastern Poland

Taxa	1-15 June	16-30 June	1-15 July	16-31 July
Coleoptera	85.0±12.62 (7)	85.6±8.31 (10)	80.8±11.79 (9)	68.1±26.64 (5)
Hymenoptera	10.2±11.27 (6)	7.7±5.26 (8)	9.3±5.35 (8)	15.3±6.42 (4)
Heteroptera	1.5±0.99 (2)	5.3±2.34 (6)	5.2±0.28 (2)	27.6±38.11 (2)
Orthoptera	1.5±0.99 (2)	3.7±2.27 (5)	5.2±0.28 (2)	2.3 (1)

TABLE 2

Proportions ± SD (n territories) of four of the most abundant taxa in the diet of the Red-Backed Shrike in territories comprising grasslands in farmland of Eastern Poland

Taxa	1-15 June	16-30 June	1-15 July	16-31 July
Coleoptera	86.8±8.32 (6)	77.6±9.25 (3)	80.5±14.12 (7)	69.7±4.24 (2)
Hymenoptera	12.3±8.28 (4)	15.7±7.50 (3)	14.3±13.58 (7)	21.7±0.71 (2)
Heteroptera	3.1±1.56 (2)	3.7±1.86 (3)	2.6±2.02 (6)	3.7 (1)
Orthoptera	10.1±11.46 (2)	3.4±0.92 (2)	1.2±0.10 (3)	4.9±1.70 (2)

DISCUSSION

The dominance structure of insect orders in the Red-backed Shrike diet, based on analysis of pellets, did not depart from proportions of these orders in the diet of these birds observed in other places in Europe (MANN, 1983; HERNÁNDEZ et al., 1993; WAGNER, 1993; OLSSON, 1995; KUPER et al., 2000; TRYJANOWSKI et al., 2003b; KARLSSON, 2004; GOŁAWSKI, 2006a). Proportions of two dominant orders of insects did not differ between territories located in the same places in consecutive years. This may be evidence of food preferences of the Red-backed Shrike, as it was demonstrated previously that this species prefers insects from these two orders (HERNÁNDEZ et al., 1993; GOŁAWSKI, 2006b). Moreover, this fact may prove food stability of these territories between years. This is probably an effect of the extensive use of farmland in this part of Poland (low use of mineral fertilisers and herbicides, mosaics of habitats, USW, 2005), and a lack of major changes in the structure of land use.

In territories comprising arable land, changes in food composition during the season were found. The proportion of Coleoptera in Red-back Shrike diet decreased, while the proportion of Hymenoptera increased during the breeding season. This pattern corresponded with results obtained in Finland (KARLSSON, 2004). However, a distinct increase in the proportion of Orthoptera in the diet with the progress of the season was observed in Finnish birds (KARLSSON, 2004). In the present study, although similar tendencies of seasonal changes in diet were observed in territories located on grasslands, these were statistically not significant. This difference could potentially be due to low food abundance in arable land in comparison with grassland (GOŁAWSKI, 2005 msc). Thus, in arable land Red-backed Shrikes have limited possibilities of catching suitable prey and depend upon food available in this habitat. In contrast, grasslands, which support greater abundance and diversity of animals, offer a richer food base allowing shrikes to actively select suitable prey (in the described area this is Coleoptera and Hymenoptera), and avoid other insects (e.g. Orthoptera; GOŁAWSKI, 2006b). Thus, in grassland selection of prey is less dependent on changes in numbers of insects (species) during the season. The different height of herbaceous vegetation in territories comprising arable land and grasslands can have some influence on the diet composition of the Red-backed Shrike, by affecting the way birds hunt. With the progress of the season crops grow taller, making potential prey less visible and forcing Red-backed Shrikes to catch most of their prey in flight. Territories in grasslands have lower vegetation (because of hay mowing, cattle grazing) and in such conditions Red-backed Shrikes can hunt on the ground. Indeed, in Hungary, Red-backed Shrikes more often catch prey in flight in territories with tall herbs in comparison with territories of low vegetation (MOSKÁT, 2001).

The obtained results indicate the importance of grassland for the ability of the Red-backed Shrike to collect suitable food. The importance of grasslands was confirmed by the studies on the breeding performance of the Red-backed Shrike in the studied region; the number of fledglings in clutches of these shrikes was positively correlated with the area of meadows and pastures in their territories (GOŁAWSKI & MEISSNER, 2007). Changes in land use in Europe lead to the decrease of grassland and the increase of arable land coverage (FULLER et al., 1991). The same trend of change occurred also in the studied area after the accession of Poland to the European Union (subsidies for farmers for land cultivation). Besides the decrease of grassland area, the coverage of fallows also decreased, which has a positive effect on the number of fledglings in the Red-backed Shrike (GOŁAWSKI & MEISSNER, 2007). However, to protect this, as well as several other species (as e.g. Hoopoe *Upupa epops*, Great Grey Shrike *Lanius excubitor*), grassland areas as large as possible should be retained, especially pastures with low vegetation where collecting suitable food is easier for birds. Turning grassland into arable fields, often associated with cutting clumps of trees and bushes (simplification of the landscape) would undoubtedly lead to the decrease in numbers of the Red-backed Shrike in Poland, where one of its greatest populations in Europe still breeds (BIRDLIFE INTERNATIONAL, 2004).

The structure of vegetation in a territory and its food abundance can influence the diet composition, and thus the interpretation of results pertaining to food preferences. The present results confirm that it is possible to find a relation between the available prey and prey used by shrikes in sites with relatively low abundance and diversity of animals (KUPER et al., 2000). This may be so because such relation is easier to detect in places poorer in food. However, dietary preferences found in such conditions may not completely reflect the actual food selectivity of a species.

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