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Presence of the great grey shrike *Lanius excubitor* affects breeding passerine assemblage

Martin Hromada[1], Piotr Tryjanowski[2]* & Marcin Antczak[1]

[1)] *Department of Zoology, Faculty of Biological Sciences, University of South Bohemia, Branišovská 31, CZ-370-05 České Budějovice, Czech Republic (e-mail: martinhromada@hotmail.com)*
[2)] *Department of Avian Biology and Ecology, Adam Mickiewicz University, Fredry 10, PL-61-701 Poznań, Poland (*e-mail: ptasiek@main.amu.edu.pl)*

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The great grey shrike, *Lanius excubitor*, is known to be a raptor-like passerine. In addition to invertebrate prey, its diet also consists of vertebrates, including small birds. We examined the effect of presence of the great grey shrike on the breeding assemblages of small passerine birds in an intensively farmed landscape in western Poland. Line transects were used for bird censuses. Birds were counted at 29 treatment transects (length 500 m, width 100 m), located within shrike territory, as well as 29 control transects, situated > 800 m from the nearest shrike nest. Treatment and control transects did not differ with respect to the habitat composition. We did not detect any difference between territories and controls regarding either numbers of recorded bird species, or pairs. However, the vicinity of shrike nests negatively affected the total density of the skylark *Alauda arvensis*, the most abundant bird species and important item of shrike bird prey, and the whinchat *Saxicola rubetra*. The results indicate that the presence of the great grey shrike selectively affects species of breeding bird communities.

Introduction

For a long time interspecific competition, though disputed, was regarded as a crucial force in organising bird communities (Schoener 1982). The potential role of predation as an important factor in community formation in birds has gained attention only recently, in contrast to other animal groups (Suhonen *et al*. 1994). The risk of predation affects all aspects of bird

* Corresponding author

behaviour, including foraging behaviour, sociality, nest site selection, and antipredatory vigilance (Lima & Dill 1990). So far, two hypotheses have been advanced to explain the observation that bird abundance is lower in the vicinity of predator nests than farther away (Suhonen *et al*. 1994, Norrdahl & Korpimäki 1998): (1) such a pattern may be a direct result of predation on birds breeding near a raptor nest, and (2) potential prey species avoid breeding near a raptor. Birds usually avoid the areas surrounding raptor nests (Geer 1978, Meese & Fuller 1987, Suhonen *et al*. 1994, Norrdahl & Korpimäki 1998).

To date, all studies that examined the effect of a bird predator on bird communities dealt, for obvious reasons, mostly with birds of prey. However, raptors *sensu stricto* are not the only birds which hunt birds. What influence do shrikes have on passerine bird assemblages when such species are known to have similarities to raptors in both morphology and habits?

Shrikes are small to medium-sized passerine birds. Their food consists mainly of invertebrate prey, and some of the smaller species feed almost exclusively on insects and other small invertebrates. However, their key trophic specializations, such as the presence of a tomial tooth on the beak and tearing of prey by impaling and wedging, were suggested to be mainly adaptive for catching and feeding on the large prey, and are important in the handling of vertebrates (Cade 1995, Schön 1996). Birds, reported as a diet component of many shrike species, probably are an important food source during migration, in wintering grounds, and in seasons with few active insects of adequate size (Moreau 1972, Lefranc & Worfolk 1997).

Birds identify shrikes as predators — Curio (1975) confirmed that the flycatchers of genus *Ficedula* recognize and attack the red-backed shrike *Lanius collurio*. Moreover, shrikes are able to mimic the song of other birds. Atkinson (1997) in experiments with song records showed that it attracts passerines.

The great grey shrike is one of the largest and most raptor-like shrikes. Despite this, predation on birds has been considered rather exceptional in this species and, with its low hunting success, the possibility of capturing a healthy adult was regarded as problematical. The high portion of juveniles between birds captured was recorded (Cramp & Perrins 1993).

Olsson (1986) and Hromada & Krištín (1996) supposed that this shrike fed on birds mainly when voles, the most important vertebrate prey, are inaccesible. However, extensive analysis of shrike's bird prey in Poland (n = 659) showed that the great grey shrike can be a serious predator of small passerines also during a breeding season. This is most likely caused by increased nutritional needs during nestling feeding (Lorek *et al*. 2000). The main part of caught birds consisted of adults, but later in the breeding season fledged birds were also included.

Thus, the hypothesis that small passerines, potential prey of the great grey shrike, should avoid the vicinity of breeding shrike, and/or their abundance should be decreased directly by shrike predation is reasonable.

We suggest that the number of breeding pairs of small birds in the presence of great grey shrike, a passerine with habits of a raptor, is decreased.

Materials and methods

The study was conducted during the breeding seasons of 1999 and 2000 in the Wielkopolska province, western Poland (52°N, 16°E). Composition of the main habitats was as follows: arable fields — 31.6%, forest and woodlots — 38.3%, meadows — 18.4%, and other habitats — 11.7% (for further details on shrike habitats, *see* Tryjanowski *et al*. 1999).

Meadows and spring crops predominate in the great grey shrike breeding territories. Thus, differences in bird communities within and outside of territories could be caused simply by different habitat composition. To avoid this bias, we selected the control and treatment transects in pairs for each territory. We employed field maps and aerial photos to assess the percentage of meadows, fields, shrub and tree cover, length of ecotones and woodlots. The control transects were therefore as similar as possible to those in the territories.

We used line transects as a census method.

The treatment transects started from trees with the great grey shrike nests, whereas the corresponding control lines led off trees in similar woodlots. Observations of the hunting behaviour of breeding great grey shrikes showed that the birds foraged mainly within 500 m of their nest (Tryjanowski *et al*. 1999). Hence, we drew transects, each 500 m long and 100 m wide (50 m to both sides of the transect). Because all nests were located at forest patch edges (up to 7 m from the edge), in very small woodlots (below 0.4 ha) or in rows of trees, both treatment and control transects were arranged perpendicularly to such edges of trees. Control transects were situated outside the hunting area of nesting great grey shrikes, at least 800 m from the closest great grey shrike nest. Twenty-nine treatment transects were walked to estimate species-specific numbers of breeding birds within the great grey shrike territories, as well as an equivalent number of control transects.

We walked lines directly from nests or selected control points and recorded all birds seen or heard within the transect. We followed recommendations for the standard line transect method by Järvinen and Väisänen (1976), similarly to that of Norrdahl and Korpimäki (1998) and Tryjanowski (2001). Each line was counted once in the breeding season, in the period of 10–20 May. The period of transect counts was chosen regarding the growth stage of the nestlings, several days before fledgling. It is the period with the highest food requirements of breeding shrikes (Degen *et al*. 1992). In the last days of May, Lorek *et al*. (2000) observed maximal bird hunting activity for the great grey shrike in Poland. All counts were made during the first 5 hours after sunrise (before 9 a.m.) in fair weather. We censused treatment and control transects in pairs on the same morning, varying the order of censusing at random. The same person always made a pair of transects (treatment and control).

We excluded migratory or non-breeding flocks ($n > 2$) of passerines from the analysis (flocks including starlings *Sturnus vulgaris*, swallows *Hirundo rustica*, house martins *Delichon urbica*, house sparrows *Passer domesticus*, tree sparrows *P. montanus*). Only those species potentially caught by the shrike (Lorek *et al*. 2000, Tryjanowski & Hromada, unpubl.) were regarded. Because of the constraints of statistics, only those species with more than 20 pairs counted were analysed for treatment *vs*. control differences.

All basic statistics were performed according to Sokal and Rohlf (1995). We analysed pairs of transects together. The Wilcoxon matched-pairs test was employed to check for the effect of the presence of the great grey shrike on the density and number of breeding bird species. Statistical significance of tests was set at $\alpha = 0.05$. All *P*-values in significance tests are one-tailed. We use sequential Bonferroni correction to adjust experimentwise level of significance.

Results

Comparisons of bird assemblages at the treatment and control transects

A total of 34 small passerine species were recorded. Among them 24 species were recorded on both treatment and control transects (Table 1). The presence of the great grey shrike did not affect the mean number of species counted per transect (Table 2, $P = 0.243$).

In total, 453 breeding pairs of birds were recorded during the censuses (Table 1). The number of pairs did not decrease in the presence of great grey shrike (Table 2, $P = 0.072$). The most abundant bird species were: skylark *Alauda arvensis*, yellow wagtail *Motacilla flava*, yellowhammer *Emberiza citrinella*, corn bunting *Miliaria calandra*, reed bunting *Emberiza schoeniclus* and whinchat *Saxicola rubetra*. They constituted 68.21% of the whole bird assemblage.

The presence of great grey shrikes negatively affected the number of skylarks ($P = 0.005$) and whinchat ($P = 0.020$) but did not affect negatively the number of the four other most abundant species (in all cases after sequential Bonferroni adjustment, Table 2).

Discussion

The bird assemblages in both treatment and control transects were generally species-rich com-

pared with other farmland bird communities in western Poland (Tryjanowski 1999, 2000). It is probably connected with the fact that the great grey shrike is most abundant in farmlands with varied patchy habitats (Schön 1994, Tryjanowski *et al*. 1999), thereby, at least potentially, in areas with higher density and/or diversity of passerine birds (Wiens 1989).

The presence of great grey shrikes does not negatively affect the total number of the species of breeding small passerines, or the total number of pairs.

However, shrike presence has a negative impact on the density of two species: the skylark and the whinchat. The skylark was one of the most frequent prey birds of breeding great grey shrikes in Poland (13.4%), and so were yellowhammer (18.5%) and tree sparrow *Passer montanus* (14.3%) (Lorek *et al*. 2000). The only species of them with a decreased number of pairs in the vicinity of shrikes was the skylark, the most abundant species of farmland habitats examined in this study. The yellowhammer was four times less abundant there, and the tree sparrow was present in only one pair.

Skylarks nest in open habitats, and never use the protection of shrub or tree vegetation. It is possible that these facts force the species to adopt the tactic of shrike avoidance. Of course, it is not possible to say, following our data, whether the skylark really avoids the vicinity of the great grey shrike, or that the lower number of pairs within shrike territories is caused directly by predation by the shrike.

Table 1. The number of pairs of small passerines within (treatment) and outside (control) of the great grey shrike territories.

Species	No. of pairs		
	Treatment	Control	Total
Alauda arvensis	57	84	141
Motacilla flava	31	29	60
Emberiza citrinella	14	16	30
Miliaria calandra	15	13	28
Emberiza schoeniclus	13	13	26
Saxicola rubetra	7	17	24
Sylvia communis	11	6	17
Turdus pilaris	13	2	15
Anthus pratensis	4	11	15
Sturnus vulgaris	7	7	14
Acrocephalus palustris	2	8	10
Hippolais icterina	7	2	9
Fringilla coelebs	5	4	9
Acrocephalus scirpaceus	4	3	7
Acrocephalus schoenobaenus	2	4	6
Sylvia atricapilla	3	2	5
Oriolus oriolus	2	3	5
Lanius collurio	2	3	5
Sylvia borin	3	1	4
Acanthis cannabina	0	3	3
Turdus merula	0	2	2
Parus major	1	1	2
Motacilla alba	1	1	2
Locustella naevia	1	1	2
Emberiza hortulana	1	1	2
Carduelis carduelis	1	1	2
Sylvia curruca	0	1	1
Phoenicurus ochruros	1	0	1
Passer montanus	0	1	1
Parus caeruleus	0	1	1
Muscapa striata	1	0	1
Luscinia megarhynchos	1	0	1
Locustella luscinioides	0	1	1
Coccothraustes coccothraustes	1	0	1
No. of pairs	211	242	453
No. of species	28	30	34

Table 2. The results of pairwise comparisons for the effect of presence of the great grey shrike on the total number of pairs of the bird assemblage, the number of bird species, and most abundant passerines (only those species with more than 20 pairs were analysed). Cases significant after sequential Bonferroni correction marked by asterisks.

	Z	*P*
No. of species	–1.45	0.243
Total number of pairs	–0.69	0.072
Alauda arvensis	–2.57	0.005*
Motacilla flava	–0.09	0.464
Emberiza citrinella	–1.02	0.153
Miliaria calandra	–0.56	0.287
Emberiza schoeniclus	–0.51	0.305
Saxicola rubetra	–2.04	0.020*

The second affected passerine, the whinchat, which we found to be the sixth most abundant species, was not an important prey in shrike diet (0.5%) (Lorek *et al*. 2000). Though, Bastian (1993) observed during the study of one great grey shrike pair that the whinchat evaded the closeness of the shrike nest when establishing nesting place.

The great grey shrike is one of the first passerines that occupies its territories in spring. In fact, we observed the first courtship behaviour in future breeding places by the end of February and beginning of March. Besides, a portion of the shrike population stays at the breeding grounds throughout winter (Schön 1994). Other passerines, including the skylark, begin to establish nesting territories later, or at the same time. Thus, the presence of the great grey shrike can be one of the most important factors that influences the decisions of the skylark and maybe other passerines in the choice of a nesting place.

The interactions between the great grey shrike and other passerines are not always antagonistic. For example, the cornbunting *Miliaria calandra*, common in shrike habitats, did not show a visible reaction to physical closeness of shrike — males often sang at the top of the same bush, sometimes 1 m from a sitting shrike. Their singing bouts were frequently longer than 10 min, without any response to each other (Hromada unpubl.).

In conclusion, we found that the presence of great grey shrike is one of the important factors organising the breeding bird assemblage in the intensively farmed landscape of western Poland. Densities of the great grey shrike which were found in the study plots, reached 11.3 pairs/100 km^2 (Tryjanowski *et al*. 1999), Lorek (1995) locally found up to 22.9–33.3 pairs/100 km^2. These values are the highest ones reported in Europe so far — the shrike belongs to an important species of the local bird assemblages. Our data does not support the hypothesis that the species affects a density of the breeding passerine assemblage as a whole. However, the presence of the great grey shrike may selectively affect those species, which are an important part of its diet.

Our results support a growing body of evidence that one of many factors organising the bird assemblages is the presence of a predator. Moreover, even the species which is not predominately specialised for hunting birds, the raptor-like passerine great grey shrike, can nevertheless play an important role in the passerine community.

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