The birds of Rotes Luch fen (E Brandenburg, Germany): the effect of mowing frequency on bird species composition and density

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Abstract

This study aimed to determine the relationship between land-use and species richness and population density of birds on a fenland 50 km east of Berlin. Bird density was determined by mapping in the area of 52 ha divided into four plots with differentiated intensity of mowing and, as a result, with different structure of vegetation cover. The total density of breeding birds was determined to be 1.7 - 6.6 pairs/ha and species number from 5 to 31. The lowest density was recorded on plot B, mowed every three to four years, and highest on plot D, which had not been mowed for the last several years. The most intensively mowed plot (two times per year) was characterized by the highest density (two pairs/ha) and number of species (four) typical of grasslands. The density and species number of grassland birds was positively correlated with the intensity of mowing. On plots C and D (not mowed during the last several years, and partially covered by trees and shrubs) the density of grassland birds was very low and accounted for only several per cent of the whole community. Grassland plant species diversity did not reflect grassland bird diversity. From our observations, we conclude that conservation measures should be carefully designed to fit local demands.

Key words: breeding bird community, land-use, grassland, habitat structure, agricultural practices.

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INTRODUCTION

Grassland birds belong to a group of organisms which are strongly affected by farming intensification. Most grasslands in Europe exist under strong farming pressure. During the last 30 years, large areas of grasslands in many countries have been changed to arable land (e.g. Pain et al. 1997). In addition, remaining natural grasslands are being replaced by pastures or mowed meadows. Both crop fields and agriculturally used grasslands have been recognized as habitats inhabited by several species which have strongly declined during the last 30 to 40 years. However, knowledge about mechanisms involved in these changes differs markedly between these two habitats. The relationships between bird ecology and management of crop fields seem to be better recognized than linkage between bird ecology and grassland management (Atkinson et al. 2005). There is more and more evidence to link agricultural intensification to the decline of many species living on farmland (Fuller et al. 1995, Siriwardena et al. 1998) but the relevant studies deal mainly with arable land (Aebischer et al. 2000, Fox 2004). However, Atkinson et al. (2005) indicate that different studies show that intensification of grassland management has a negative impact on birds (Chamberlain & Fuller 2000, Siriwardena et al. 2000). There are several ways in which modern intensive agricultural practices influence grassland birds. Earlier mowing than in the past can destroy nests or render them more available to predators; earlier or more intensive mowing decreases the amount of prey for young bird feeding; and denser grass cover and reduced plant species diversity negatively affect the arthropod community (Sotherton & Self 2000, Di Giulio et al. 2001, Vickery et al. 2001). As a result, there has been a significant decrease in bird density, leading even to the disappearance of some species (Pain et al. 1997, Moller 1983, Lewartowski & Piotrowska 1987, Winiecki 1992). The survival of many of these species, e.g. Quail *Coturnix coturnix,* Corncrake *Crex crex,* and some Charadriiformes and Meadow Pipit *Anthus pratensis,* depends on the persistence of extensively used grasslands.

For the protection of animal and plant species whose survival depends on high quality grassland ecosystems, some of these areas are protected by law. However, grasslands are in an early stage of natural development and their vegetation structure changes relatively quickly. Natural development of grasslands leads to changes in fauna and flora up to the disappearance of typical grassland species. Therefore, effective protection of avifauna on grasslands needs careful determination of the proper ways of managing the habitats in these areas. Relationships between plant species, composition of grasslands, and bird species richness and abundance seem to be unclear. For example, coincidence between high plant diversity and high bird species richness was not proved by research in Sweden (Pärt & Söderström 1999).

Our study aimed to determine the influence of intensity of farming on bird communities on grasslands. The main goal of the study was to recognize the relationships between mowing frequency - the main driving force influencing the vegetation structure of grassland - and bird species richness and density, with special attention given to grasslands species.

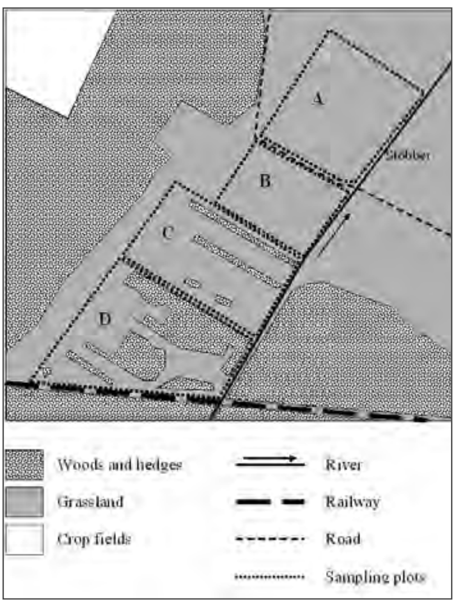
STUDY AREA

The study was carried out in 1994 in a complex of fresh grasslands named "Rotes Luch" located along the small regulated river Stöbber, five km east of Müncheberg (in the eastern part of Germany). The width of the complex is about 1 km, and the total area approximately 800 ha. The study covered an area of 52 ha, which was divided into four plots, A, B, C, and D (Figure 1), with different intensities of habitat use and, as a result, with different structures of vegetation. All the plots have rich flora. As many as 68-92 species of vascular plant per plot were recorded.

Plot A (12 ha) was mowed twice per year during the several previous years. The plant species occurring here are dispersed and do not create any clusters, with the exceptions of a few poorly developed patches of Lesser Pond-sedge *Carex acutiformis* and Slender Tussock-sedge *C. gracilis,* as well as Common Nettle *Urtica dioica*, with a total share of several per cent. Only the meliorating rows are composed of tall unmowed perennials dominated by Cabbage Thistle *Cirsium oleraceum*, Hemp-agrimony *Eupatorium cannabinum,* and Purple Loosestrife *Lythrum salicaria*.

Plot B (9 ha) was less intensively used than plot A. It was mowed every three to four years. Its vegetation is characterised by the occurrence of tall, compact patches of expansive perennial species: *Urtica dioica*, Cow Parsley *Anthriscus silvestris* and Creeping Thistle *Cirsium arvense*. These patches cover 50% of the plot. Other species (with species composition very similar to that observed on plot A) grow dispersed without any distinguished patches.

Figure 1. Study area



On plot C (13.2 ha) the composition and structure of vegetation cover are almost the same as on the previously described plot B, but some trees and bushes grow here in small strips and clumps. These tree and bush communities cover 10 per cent of the plot. They are composed of Elder *Sambucus nigra*, Grey Willow *Salix cinerea*, Bird Cherry *Padus avium,* Downy Birch *Betula pubescens*, Silver Birch *B. pendula*, oaks *Quercus* sp., Aspen *Populus tremula* and Hawthorn *Crategus* sp.

Plot D (18.5), in general similar to plot C, is characterized by the biggest share of tree and/or bush community covering 25% of the plot.

METHODS

Bird density was estimated with the aid of a combined version of mapping methods (Tomiałojć 1980). Good orientation in the field was possible thanks to a regular system of meliorating rows on plots A and B and the presence of tree and bush communities on plots C and D. On each plot six early morning counts were performed. A relatively low number of counts was compensated for by slow speed of censusing amounting to 8 ha/h, i.e. 2.5 times slower than recommended for farmland by Bibby et al. (1993). An area was regarded as breeding territory if birds with breeding or territorial behaviour were recorded at least three times. In the case of lately arriving *Acrocephalus palustris,* 50% of the territory was appointed on the basis of three records, and others, four records. For other species, most of the territory (84%) was appointed on the basis of at least four records.

Similarity of species composition between plots was determined by Sörensen's index: J = 2c x 100/(a+b) , where a and b represent the number of species in compared communities, and c the number of species common to both communities. Dominance similarity (*Re*) was estimated with the aid of Renkonen's formula: Σw, where *w* is the common or lower value of dominance (in %) for the species occurring in both communities.

RESULTS AND DISCUSSION

On the most intensively used plot A, six breeding species were recorded with a total density of 2.8 p/ha (Table 1). Among them, four species (*A. arvensis*, *A. pratensis*, *S. rubetra* and *C. crex*) can be regarded as species typical of grasslands. Total density of these species amounted to two p/ha. Species not linked with grasslands - *A. palustris* and *E. schoeniclus* - occurred relatively often (0.8 p/ha) due to the presence of meliorating rows of dense, tall perennials.

Plot B, less intensively used, was characterised by similar species composition to that described in plot A (J=90%), but significantly lower density (Table 2). Comparison of two open habitat plots (A and B) without trees and shrubs shows the significant effect of mowing frequency on dominance structure (Figure 2). Plots C and D were excluded from this analysis because of the presence of numerous trees and shrubs, which usually negatively influence grassland species independently of the structure of herb and grass layers. Dominance similarity index Re amounted to 46%. This value seems to be very low if we take into account the high similarity of species composition. Low density was recorded within the group of grassland species: the density of *A. arvensis* and *A. trivialis* was markedly lower (12 and 4 times respectively) than on plot A. Total density of grassland species amounted to 0.6 p/ha. On the other hand, the density of species not linked with grassland was higher (1.1 p/ha) than on plot B. For instance, the density of *A. palustris* was two times higher.

These differences are presumably related to different intensity of farming on the described plots and to the differences in the structure of plant cover mentioned above. Plot A, regularly mowed each year, was characterised by homogenous distribution of plant species and by the lack of patches of particular species. It seems that it is this kind of vegetation structure which is preferred by the most common grassland species - *A. arvensis* and *A. pratensis*. On the other hand, on plot B numerous tall (1.5 m) and compact patches of several perennial species were developing and these created very convenient nesting places for some species such as *A. palustris* and *S. rubetra*. These two species constituted over 80% of all pairs on that plot. Other species typical of grasslands bred sparsely on that plot, around 0.1 p/ha.

As far as plot C is concerned, a significantly larger number of species was recorded in comparison to A and B (Table 3). 22 species were found to nest there with a density of 3.7 p/ha. Among them there were only four grassland species (*C. crex*, *A. arvensis*, *A. pratensis*, *S. rubetra*) with very low density as well as low dominance (total - 10.5%). Therefore, even with less then 10% of hedges, the community of birds in a grassland habitat rapidly changed. Though grasses constitute 90% of the area, the dominance of birds typical of that habitat is low and the share of species linked with tree or shrub layer is significant (e.g. *C. chloris* - 12.2%, *S. borin* - 7.2%).

Plot D, with the highest share of hedges, was characterized by the largest number of species (32) as well as density (6.6 p/ha). Grassland species were absent (Table 4) though their habitat covered 75% of the plot. Thus, occurrence of hedges covering 25% of the area plays a most important role for the bird community and as a result, 75% of the area covered by grasses is invisible in the bird species list. Among the dominant species are typical forest species such as *Sylvia atricapilla*, *Turdus merula*, *Phylloscopus trochilus*, *Phylloscopus collybita*, *Parus major* and *Parus caeruleus*.

Table 1. Breeding bird community on plot A.

Species	N	Density (pairs/ha)	Dominance (%)
Alauda arvensis	15	1.2	42.9
Acrocephalus palustris	6.5	0.5	17.9
Anthus pratensis	5.5	0.4	14.3
Emberiza schoeniclus	4	0.3	10.7
Saxicola rubetra	4	0.3	10.7
Crex crex	1	0.1	3.4
Total	36	2.8	99.9

Table 2. Breeding bird community on plot B.

Species	N	Density (pairs/ha)	Dominance (%)
Acrocephalus palustris	8.5	1.0	60.7
Saxicola rubetra	3	0.4	21.4
Emberiza schoeniclus	1	0.1	7.1
Alauda arvensis	1	0.1	7.1
Anthus pratensis	0.5	0.1	3.6
Total	14	1.7	99.9

Table 3. Breeding bird community on plot C.

Species	N	Density (pairs/ha)	Dominance (%)
Acrocephalus palustris	16	1.2	33.0
Carduelis chloris	6	0.4	12.2
Sylvia borin	3.5	0.3	7.2
Emberiza schoeniclus	3.5	0.3	7.2
Crex crex	2	0.1	4.1
Cuculus canorus	2	0.1	4.1
Turdus merula	1.5	0.1	3.1
Sylvia atricapilla	1.5	0.1	3.1
Turus philomelos	1	0.1	2.1
Prunella modularis	1	0.1	2.1
Fringilla coelebs	1	0.1	2.1
Parus caeruleus	1	0.1	2.1
Alauda arvensis	1	0.1	2.1
Locustella naevia	1	0.1	2.1
Anthus pratensis	1	0.1	2.1
Hippolais icterina	1	0.1	2.1
Saxicola rubetra	1	0.1	2.1
Carduelis carduelis	1	0.1	2.1
Lanius collurio	1	0.1	2.1
Emberiza citrinella	1	0.1	2.1
Sylvia communis	0.5	+	1.0
Motacilla alba	+	+	
Total	48.5	3.7	100.2

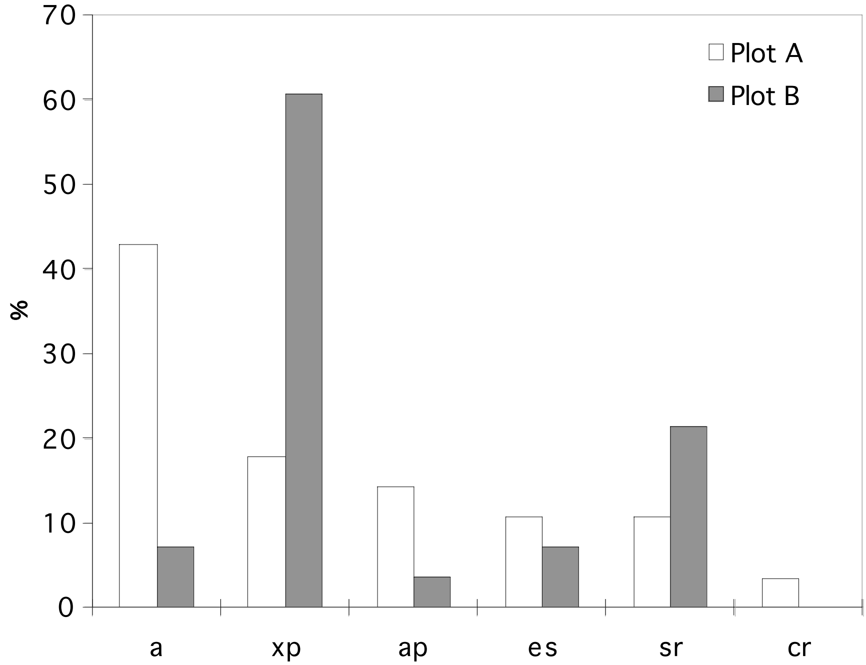
Table 4. Breeding bird community on plot D.

Species	N	Density (pairs/ha)	Dominance (%)
Acrocephalus palustris	15	0.81	12.8
Sylvia borin	11	0.59	9.4
Sylvia atricapilla	9	0.49	7.7
Turdus merula	8	0.43	6.8
Phylloscopus trochilus	7	0.38	6.0
Phylloscopus collybita	7	0.38	6.0
Parus major	7	0.38	6.0
Fringilla coelebs	6	0.32	5.1
Parus caeruleus	6	0.32	5.1
Sylvia communis	6	0.32	5.1
Turus philomelos	4	0.22	3.4
Carduelis chloris	3	0.16	2.5
Prunella modularis	3	0.16	2.5
Emberiza schoeniclus	2.5	0.14	2.1
Emberiza citrinella	2.5	0.14	2.1
Cuculus canorus	2	0.11	1.7
Streptopelia turtur	2	0.11	1.7
Luscinia megarhynchos	2	0.11	1.7
Erithacus rubecula	2	0.11	1.7
Parus montanus	2	0.11	1.7
Coccothraustes coccothraustes	2	0.11	1.7
Locustella fluviatilis	2	0.11	1.7
Dendrocopos major	1	0.05	0.8
Columba palumbus	1	0.05	0.8
Garrulus glandarius	1	0.05	0.8
Oriolus oriolus	1	0.05	0.8
Sylvia nisoria	1	0.05	0.8
Sitta europaea	0.5	0.03	0.4
Hippolais icterina	0.5	0.03	0.4
Muscicapa striata	0.5	0.03	0.4
Parus palustris	+		
Total	117.5	6.6	99.7

It should be taken into account that larger plot size can have also a positive influence for the number of breeding species. However, the most important factor enhancing bird species richness was the relatively high proportion of tree and shrub community on the plot, which was not related to plot size.

Although plot size does not fit recommendations for mapping methods applied to farmland (Bibby et al. 1993), pronounced differences in bird species composition and density observed between plots strongly suggest that the frequency of mowing strongly influences the bird community. The best environment for grassland species was found on plot A, the one with the most intensive mowing. With more extensive management on plot B, a significant decrease in grassland species density was recorded. Similar results have been reported from Japan, where *Alauda arvensis* increased slightly when grassland started to be used as pasture (Fujimaki & Takami 1986), and in Poland where the density of the species was much higher on mowed grasslands when compared to non-utilised areas (Lewartowski & Piotrowska 1987). The structure of plant cover on plot B has changed so much (as patches of perennials developed), that it did not match the habitat requirements of most grassland

Figure 2. Dominance (%) of species in plots A and B. Abbreviations: a - *Alauda arvensis*, xp – *Acrocephalus palustris*, ap – *Anthus pratensis*, es – *Emberiza schoeniclus*, sr – *Saxicola rubetra*, cr – *Crex crex*.



species. On the other hand, natural succession lasted for too short a time for the development of hedges, shrubs etc.; thus the density of species linked with that type of vegetation was very low. If natural growth lasts a sufficient time, and tree and/or bush communities start to develop (plot C and D), the bird community will begin to change rapidly until there is a total loss of grassland species (at 25% of tree/bush community). At the same time the proportion of common species increases, which leads to "homogenization" of the community as described by Devictors et al. (in press) with respect to the urbanization effect on bird communities. As a result of such "homogenization," the bird community tends to consist of more species, but most of the species are common to many habitats, and the conservation value of the grasslands becomes lower than in the past when plants were regularly mowed.

Our study confirms that using vascular plants as indicators of overall biodiversity is unreliable (Pärt & Söderström 1999). Conservation measures should be precisely fitted to recognized local conservation demands.

Conclusions

The protection of breeding avifauna on grasslands needs special and careful management of the habitats. Conservation of the chosen area (in terms of the termination of farming) is surely insufficient. Only several years after mowing ends can a significant decrease of density of grassland species be expected. Reasonable protection of grassland bird communities should include mowing grasses, fitting their terms to breeding phenology to minimize brood losses.

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