Farmland bird communities in the Baltic region: impact of agricultural intensification and farmers' attitudes

Peltolinnusto Baltian maissa: tuotannon tehokastumisen vaikutukset ja viljelijöiden näkemykset

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Abstract

Intensification of agricultural land-use was shown to be the key reason behind declines in wildlife species associated with farmland. I looked at scenarios of agricultural development across the Baltic states of Estonia, Latvia and Lithuania, and the ways they are seen to affect farmed environments as a habitat of farmland bird species. Community richness and abundance of many farmland bird species were positively related to the number of non-cropped elements within farmland, the local mixture of annual crop and grass fields, and the variety of field types. The above positive associations were strongest in open landscapes. There was a clear indication that the more intensively farmed areas across the region provided habitat for fewer bird species and individuals. The difference could partly be explained by the more heterogeneous landscape and field areas in the latter. Within homogenous arable fields intensification of field management was reflected in a tangible decrease in farmland bird abundance, especially in species in need of edge structures.

Based on the interviews in Estonia and Finland I explored farmers' interest in and knowledge of farmland wildlife, their understanding of the concept of biodiversity, and awareness of the potential causes behind declines of farmland birds. Many farmers viewed biodiversity from a narrow perspective often excluding species directly related to farming. In Finland farmers expressed concern about the decline in common farmland species, but Estonian farmers did not, which might be related to the fact that these species are still very common. In both countries farmers rated intensification of agriculture as the major driving force behind farmland bird declines. The expressed interest in wildlife positively correlated with willingness to undertake wildlife-friendly measures. Only farmers with agri-environment contracts targeted specifically at biodiversity enhancement were more knowledgeable about practical on-farm activities favouring wildlife, and were more willing to employ them that the rest.

The results suggest that, by contributing to simplification of the farmland structure, homogenisation of crops, and increase in intensity of field use EU agricultural policies will have a detrimental effect on farmland bird populations in Eastern Europe. Farmers are on the whole positive to the idea of supporting wildlife in the fields, and are concerned about its decline, but they require payments to offset their income loss and extra work. Biodiversity conservation should be better integrated into the agri-environment programmes if it to serve as awareness tool for farmers. I argue that with a foreseen tripling of cereal yields across the region, the EU Council's Göteborg target of slowing biodiversity decline by 2010 may not be realistic unless considerable improvements are made into the EU agricultural policy for the region.

Keywords: agri-environmental policy, bird abundance, farmers' knowledge, habitat heterogeneity, landscape type, species richness

Introduction

Ten countries joined the EU in 2004, eight of which are Central and East European Countries (CEECs). The conservation importance of the CEECs for farmland biodiversity in Europe is well documented (EEA 2004). The region retained a high proportion of extensively managed farmed habitats (EEA 2003). Populations of a number of farmland birds currently have their strongholds in the region (BirdLife International 2004), being both commoner and attaining densities several-fold higher than those in western Europe (Sanderson et al. 2006). The issue of reconciling production and other functions of agroecosystems is therefore critical for these countries. Accession to the European Union (EU) is regarded as a potential threat to the CEE region's farmland biota (Donald et al. 2002; EEA 2004) but it also brings new opportunities to support farmland wildlife through agri-environment programmes. Correct identification of on-farm measures within agri-environment programmes, their efficient targeting at both the national and regional levels, and sound monitoring are all crucial (Vickery et al. 2004). Data on the ecology, abundance and distribution of farmland organisms are therefore urgently needed from various landscape and farmland types across the whole accession region.

Intensification is a complex phenomenon with several concurrent processes potentially affecting wildlife and farmed habitats (Sanderson et al. 2006). Intensification can generally be grouped into two main forces affecting associated biological diversity. One influences the farmed habitat structure and leads towards its simplification at all spatial scales, from within-field to the farm and landscape levels (review in Benton et al. 2003). It manifests itself in removal of non-productive biotopes (such as hedges and ditches), segregation of arable and grassland production, expansion of monoculture fields, simplified rotations, and improvement of less productive parts of fields. The other force operates through intensified management of crop fields and grasslands themselves and manifests itself in a considerable increase in chemical inputs of fertilisers and pesticides, and more frequent disturbance (tillage or mowing).

Farmers' values and attitudes towards the environment have been shown to influence the way they manage their farms and participate in environmental support schemes (Willock et al. 1999; Wilson & Hart 2000; Schmitzberger 2005). Farmers' understanding of biodiversity as a target for management is likely to also have an effect. There are very few studies of farmers' knowledge and attitudes towards the biodiversity of their land, specifically related to nature-friendly management, and none comes from the CEECs.

The main research aim was to evaluate the current state of farmland bird communities across the Baltic region against expected changing patterns of land-use in the region, as well as the socio-political context of farmers' attitudes to biodiversity and its conservation.

Material and methods

Bird counts in farmland across performed in three Baltic countries of Estonia, Latvia, and Lithuania. The survey areas represented three landscape types and two land-use intensity levels. The proportion of farmland in each county characterised the landscape type of a study area, and the average cereal yield from commercial enterprises in each county for the five years preceding the field survey was used as an indication of farming intensity. Within each country it positively related to the inputs of fertilisers and the number of tractors per agricultural area. Within each area survey squares were selected at random. Additionally, birds were counted within open fields being under an annual crop the most farmland-dominated and agriculturally productive part of the Baltic region in order to look at the effect of actual field management of arable fields in homogeneous landscape.

Generalised linear modelling with Poisson error structure and logarithmic link function was used in S-Plus 6.1. Variables were selected in a stepwise selection algorithm based on Akaike's information criteria corrected, wherever appropriate, for small sample sizes. In exploring the pattern of species distribution within the region's farmland canonical correspondence analysis (CCA) in CANOCO was employed.

The sociological part comprised semi-open interviews with farmers in one Baltic country (Estonia, 27 farmers) and a neighbouring EU-15 country (Finland, 24 farmers). The interview included questions pertaining to farmers' interest in and knowledge of major animal groups, plants and nature as a whole, awareness of the impact of farming activities on farmland wildlife, and willingness to undertake measures favouring farmland biodiversity. In addition to presenting data in the form of a frequency distribution, some quantitative (non-parameteric) analysis were used to detect associations between variables.

Results and discussion

Contribution of habitat types to the community characteristics and abundance of a number of farmland species varied across the region reflecting the geographical position and differences in the level of fragmentation, soil types and vegetation development pattern. All the community metrics strongly related to one or several aspects of the spatial organisation of local habitat (Table 1), and the relationship in most cases was strongest in open landscape. A simple index of the number of non-cropped habitat elements was the most significant positive predictor for the richness and abundance of farmland specialist birds, as well as for many individual species. In real terms, reduction of non-cropped habitat elements by half translated into a 25% decrease in the number of farmland species, and removal of all non-cropped elements led to a decrease of 60%.

Table 1. Estimates for the final generalised linear models relating farmland bird community attributes with habitat spatial organisation in three agricultural landscape types in the Baltic States. Coefficients and standard errors (in parenthesis) standardised by SD of a respective covariate are given. Whenever significant interactions of variable with the landscape type were found or estimates differed among landscape types, the differences for the semi-open (S) and enclosed (E) landscapes were compared to the open (O) landscape type. Abbreviations: DE – distance to the edge, RH – residual (non-cropped) habitat, VAR - variety of fields, MIX – mixed crop and grass, CO – coordinates.

Community metrics	Intercept for the landscapes	Retained structural indices					ps r^2
		DE	RH	VAR	MIX	CO	
Farmland species richness	O 6.24 (1.117) S 0.50 (0.126) E -0.03 (0.187)		O 0.43 (0.085) S -0.31 (0.325) E -0.08 (0.124)		0.074 (0.027)	-0.12(0.03)	0.61
Farmland species abundance	6.93 (0.678)	0.08 (0.019)	O 0.23 (0.05) S -0.08 (0.056) E -0.24 (0.08)	0.09 (0.018)		-0.1 (0.02)	0.45
Farmland species diversity	O 6.48 (1.403) S 0.67 (0.15) E 0.17 (0.23)	O 0.44 (0.105) S 0.36 (0.124) E 0.099 (0.16)			0.108 (0.037)	0.15 (0.03)	0.40

[a] Pseudo r^2 (ps r^2) provides a ratio of the explained deviance to the total deviance in Poisson models.

In the more intensively managed areas we observed only half the species and individuals of non-farmland birds, and nearly 20% fewer species and individuals of farmland specialists, as compared to less intensively farmed areas. When the difference in species richness or abundance between two areas pared by intensity of land-use within each country existed, its direction was always consistently in favour of the less intensive area (Fig. 1). Intensity level remained a highly significant predictor in most of the models after habitat differences between the areas were controlled for by inclusion of habitat covariates.

On arable fields within a structurally simple landscape, a tangible negative effect of intensity of field management on community characteristics, especially the abundance of birds, was detected (Fig. 2). In fields under more intensive management (with dense even crops, tramlines, and without weeds) we registered about 50% less individuals of farmland birds as compared to fields characterised by lack of regular management.

Farmers' awareness and attitudes

Over 20% of Estonian and Finnish farmers viewed biodiversity from a narrow perspective, limiting it to only the variety of crops and wild species outside the crops. The perception of wild species diversity was most relevant to the farmers, while diversity of ecosystems and genes was less so. Nearly 70% of the farmers avoided explicit inclusion of pests and weeds into the "biodiversity" concept. This may impair acceptance of the agri-environment schemes having "biodiversity enhancement" as their main target.

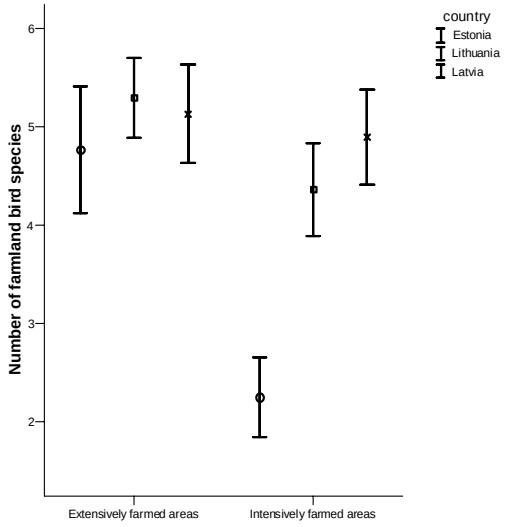

Figure 1. Abundance of farmland specialist birds (mean and SE) agricultural areas under extensive and intensive farming in the Baltic states of Estonia, Lithuania and Latvia.

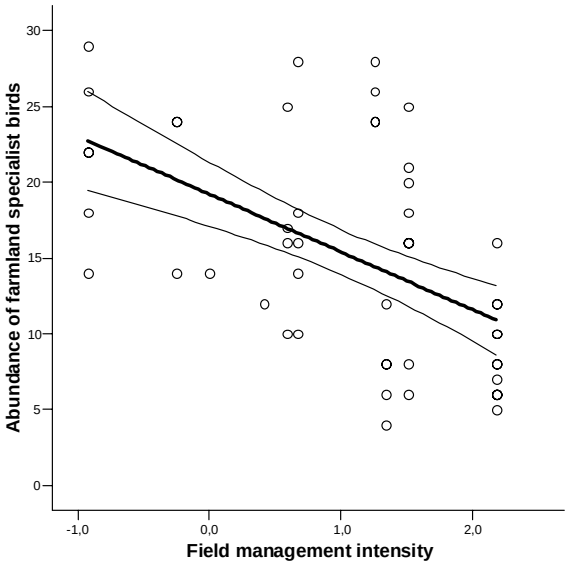

Figure 2. Relationship between abundance of farmland specialist birds (mean and CI of 95%) and the gradient of management intensity of arable fields based on field assessment of weed abundance, crop structure, and presence of tramlines.

When asked to name wild species whose disappearance from their farm they would feel as a "personal loss", Finnish farmers expressed a higher level of concern about the decline in common farmland species than did Estonian ones. For Estonian farmers the question appeared difficult to answer and about 40% did not answer it at all.

In both countries farmers rated intensification of agriculture as the major driving force behind farmland bird declines (Table 2). However, nearly 40% of farmers also looked for reasons elsewhere.

Table 4. Percent of farmers who regarded the suggested factors as having moderate or strong negative effect on the populations of farmland birds.

	All, n = 51	Estonia, n = 27	Finland, n = 24
Wide use of pesticides, %	65	67	63
Farming intensification and specialization, % *	63	52	75
Loss of crop diversity, % **	59	41	80
Increase of predators, % **	53	37	71
Land abandonment, % *	43	33	54
Climate change, %	39	44	33
Afforestation, % *	26	19	34
Hunting, %	24	19	29

* = P < 0.05, ** P < 0.01, Mann-Whitney test for the difference between the countries.

Almost all farmers (over 90%) from both countries showed considerable interest in the wildlife on their farms, which positively correlated with their willingness to undertake wildlife-friendly measures. Though about 80% of the interviewed farmers in both countries regarded conservation work as important on their farm, only 30% of them could clearly name some biodiversity-benign on-farm practices. They quoted almost exclusively management options supported under the countries' respective agri-environment programmes as ways to enhance biodiversity.

Discussion

Our results corroborate a number of avian studies on the positive relation between habitat heterogeneity and the species richness at the scales of landscapes (cf. Böhning-Gaese 1997; Atauri and de Lucio 2001) and fields (Tryjanowski 1999). The landscape type on a scale of 100 km^2 explained little of the variation in the number of species and individuals of farmland birds. Farmland structural characteristics on a local scale seem to be more important in shaping the farmland bird community. The suitability of open field area can be improved with sufficient variation of its inner structure (Wilson et al. 2005). Out of all non-cropped elements the extent of ditches and small rivers was the strongest positive predictor of the bird community, and the only one with an exclusively positive effect on individual species. A number of studies from North-Eastern Europe (Priednieks et al. 1999; Piha et al. 2003; Vepsäläinen et al. 2005) showed their prominent role in otherwise homogenous fields.

In this study the differences in crop yields between areas paired by land-use intensity were about 30%. In 2002, when the study was carried out, yields even in the most productive cereal zone were still one third of those possible by the standards of western European agriculture. The available statistical data show a further average increase for the Baltic countries of about half a tonne per hectare (or 25%) over the period 2003-2005. Further tripling of cereal yields across the region is possible if the respective yields for the EU-15 countries are to be reached: up to five tonnes on average in Estonia, and up to eight for Southern Latvia and Lithuania. Though high average yield levels are unlikely to be achieved over the whole region, this rate of increase is plausible for the most productive cereal growing areas, with which many typical true field species associate. Intensification of agricultural land-use in the Baltic region is likely to result in massive declines in farmland birds. This will undoubtedly impair the achievement of the Göteborg target of halting biodiversity decline in the EU by 2010.

Our results confirmed that the farmers' comprehension of "biodiversity" concept was largely restricted to the realm of wild nature, with weeds and pests often not accepted into the concept. Some other studies similarly showed that farmers' notion of "biodiversity" differs from academic definitions and may be very narrow (Beedell & Rehman 1999; Moore & Renton 2002; Jurt 2003). This may impair the acceptance of schemes targeted at biodiversity conservation. There did not appear to be a link between knowledge of wildlife and any form of contingent or actual action, which is in agreement with Jacobson et al. (2003). It was instead the expressed interest in wildlife and nature which throughout the analysis positively correlated with willingness to act. Thus it is of utmost importance to promote and support the interest of rural populations in the "living creatures out there".

The farmers were predominantly aware of (potential) adverse impact of their farming enterprises on farmland wildlife. Estonian farmers were less critical about some of the intensification-related factors and were less clear about potential losses in farmland wildlife, than the farmers in Finland. Better strategies to raise awareness about this undesirable by-product of intensifying production are needed before it actually happens. The understanding of the consequences, as well as acceptance that solutions by large also rest with them, might promote farmers' interest in agri-environment schemes aimed at conservation.

All the bird species mentioned by Finnish farmers as having personla value are common farmland birds which have been strongly declining or have already disappeared from some of the Finnish countryside. Finnish farmers, being witnesses of current declines in formerly common birds, expressed personal attachment to many such species. The situation is quite different in Estonia, where most farmland birds are still common and abundant. The passive response of Estonian farmers does not necessarily indicate lack of interest (as results below demonstrate), but rather difficulty in apprehending the scale of potential losses driven by modern farming.

Estonian farmers showed greater enthusiasm in adopting some wildlife-friendly management options and preserving diversity of non-cropped patches within their farms, which is known to be important for supporting farmland species diversity (Benton et al. 2003). Nearly total enrolment into the Finnish agri-environment programme can not be regarded as an indicator of the programme's efficiency in addressing conservation needs. We could not find indications that the programme, though in use since 1995, have added to farmers' understanding of the farmland biodiversity or practical measures to enhance it. A better incorporation of conservation-oriented options into the basic level schemes is clearly needed as suggested also by the programme evaluation (Kuussaari et al. 2004).

Conclusions

Agricultural intensification affects bird communities by changing habitat composition and structure, both leading to habitat simplification from landscape to in-crop levels, and by increasing intensity of crop management. An adverse impact of intensive management of crops is unlikely to be entirely mitigated by farmland complexity for all bird ecological groups, unless it is supported at all levels, from landscape to in-crop. Maximising heterogeneity of farmland at the landscape level with other habitats, such as forest, or high vertical elements such as hedges, will adversely affect specialised and often endangered field species, especially in already fragmented landscapes. At the same time, higher heterogeneity within farmland (low vertical structures such as grassy margins and ditches, variety of crops) and within crops (their patchiness, presence of weeds) will benefit all species. If similar factors operate in the Baltics as they do in western European countries, both retention of farmland heterogeneity at all scales and maintenance of a network of extensively managed areas will be crucial aspects of farmland biodiversity preservation in the long run.

Farmers are on the whole positive to the idea of supporting wildlife in the fields, and are concerned about its decline, but they require payments to offset their income loss and extra work. Biodiversity conservation should be better integrated into the agri-environment programmes if it to serve as awareness tool for farmers. The results indicate that (a) biodiversity related measures of the national agri-environment scheme in Estonia should be reinstated and they should be better incorporated into the basic level schemes in Finland; (b) farmers' interest in wildlife should be encouraged, and their understanding of different aspects of biotic diversity should be increased in order to enhance their acceptance of biodiversity conservation within farmland; (c) awareness work about possible severe declines in farmland wildlife in connection with agricultural intensification is important, especially in the CEE region; (d) sufficient demonstration and advisory work is invaluable in putting conservation in practice; (e) and, finally, positive feedback from society, not only in financial terms, to farmers' work for biodiversity is needed.

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