Avocetta 33: 93-98 (2009)

Recent changes in agricultural landscape and bird populations in Latvia: impacts and prospects of EU agricultural policy

Ainars Aunins[1,2], Janis Priednieks[2]

[1] Latvian Fund for Nature - Dzirnavu iela 73-2, Riga, LV-1011, Latvia (dubults@lanet.lv)
[2] Department of Zoology and Animal Ecology, University of Latvia - Kronvalda bulv. 4, Riga, LV-1586, Latvia

Abstract – Since Latvia joined the EU in 2004, the amount of funds allocated to the agricultural sector has increased substantially. The different measures included in the national Rural Development Plan serve as driving forces causing a rapid change in agricultural land use and farming practices. We used data from the Latvian Farmland bird monitoring scheme to describe the ongoing changes on Latvian farmland. We compared population trends of 54 individual species and species groups as well as species richness, diversity and total bird abundance between the periods 1995-2003 (period 1) and 2003-2006 (period 2). Pairwise comparisons of the trends of all the analysed species between the two periods showed that trends in period 2 were lower than in period 1 and this difference was significant. Splitting the species into six ecological groups, the pattern was consistent in all groups. However the differences were significant only in the "ShrubEdge" and "Forest" groups and near significant in the "Open" group. The trend comparisons grouping species by their wintering areas and main food sources also showed a similar pattern, however, the differences were significant only in the species wintering in Sub-Saharan Africa and insectivore group. Overall bird abundance as well as farmland bird abundance declined in period 2 and so did farmland bird species richness and diversity. Eleven species declined and only five species increased statistically significantly in the period 2 contrasting with four and 26 species in the period 1, respectively. The observed changes can be linked to ongoing changes on Latvian farmland: intensification, restoration of the overgrown areas as well as removal of various landscape elements to increase the "eligible" area for EU subsidies. Although these changes do not cause immediate threat to farmland birds, future development is very important.

INTRODUCTION

The Latvian farmland bird monitoring scheme was introduced in 1995. At that time the state's agricultural sector was undergoing a deep crisis due to changes in the political and economic system: agricultural production decreased by more than 50% and use of agrochemicals by more than 90% while over 40% of the arable land was abandoned (Anon 2000). Many bird species profited from this situation and their populations as well as species richness in farmland increased substantially during the 1990s (Aunins and Priednieks 2003, Keišs 2005, Aunins and Priednieks 2008).

After 2001 and especially since Latvia joined the EU in 2004, the amount of funds allocated to the agricultural sector increased substantially. The different measures included in the national Rural Development Plan served as driving forces causing a rapid change in land use patterns and farming practices. Thus, cereal yields experienced a growth since 2003 (Anon 2006), as did the area of arable land, while the area of abandoned land and grassland declined (Table 1, Aunins 2006). The aim of this study is to test whether any changes in farmland bird communities and population trends have occurred since the country joined the EU. The results could serve as a basis for more specialised studies in future on the causes of the changes.

METHODS

We used data on 54 of the most commonly recorded species in the Latvian farmland bird monitoring scheme to calculate population trends for the periods 1995-2003 (period 1) and 2003-2006 (period 2). The details of the monitoring scheme can be found in Aunins *et al.* (2001), Aunins and Priednieks (2003), and Aunins and Priednieks (2008). The year 2003, the last one before Latvia accessed to the EU and the massive funding for the agricultural development became available, was chosen as a break year.

Following the idea of Tiainen and Pakkala (2001, see also Herzon *et al.* 2006) the species were divided into six ecological groups for separate analysis according to their

Table 1. Areas occupied by main farmland habitat categories within the 200m zones around bird count points and cereal yields in Latvia.

	1995	2000	2003	2005
Arable lands (ha)	645	794	750	882
Abandoned fields (ha)	201	314	343	242
Grasslands (ha)	878	616	604	576
Cereal yields (ha)	17.1	22.7	21.8	28.0

preferred habitat structures (Table 2) and these were analysed separately:

1) "Open" - typical farmland species requiring open areas (fields or grasslands) for both breeding and feeding
2) "ShrubEdge" - typical farmland species requiring high herbaceous or shrubby edges or patches. Some species using such structures in farmyards were also included here
3) "TreeEdge - typical farmland species utilising forest-farmland edges. Most are the species breeding in forest or tree stands and feeding in fields. Some species using such structures in farmyards were also included here
4) "Swallows and martins" - the Swallow, House Martin and Sand Martin were grouped as aerial feeders that can feed far from their breeding places
5) "Wetland" - species dependent on presence of wetland elements for breeding and feeding, however also may feed on fields
6) "Forest" - species majority of whose populations breed in forests and where the presence of farmland is not mandatory.

The species grouping was based on an earlier study on birds - habitats associations in Latvian farmland (Aunins *et al.* 2001), as additional information sources were used other studies from the Baltic countries or Finland (e.g. Tiainen and Pakkala 2001, Herzon *et al.* 2006). We made separate groupings also according to wintering areas and feeding preferences (Table 2). For wintering, species were classified as those spending the winter in or near breeding areas (including partial migrants), in W or S Europe or N Africa, in Sub-saharan Africa, and in southern Asia. For feeding, groups were granivores, insectivores and other according to the primary food source. Information on species wintering areas and feeding habits was collected from relevant literature sources (cf. Snow and Perrins 1998) and adjusted by ringing recovery records in the database of the Latvian Ringing centre. A species could be assigned only to one group in each of the three main grouping categories.

For the bird abundance (total number of all individuals counted, all species combined) and species diversity analyses we used three species sets:

1) all species: all breeding species recorded during the counts
2) rural species: species successfully utilising farmland and its typical elements for breeding or feeding or both
3) farmland specialists: species primarily dependent on farmland.

PC-ORD 5.0 software (McCune and Mefford 2006) was used for calculating the community parameters (abundance, Shannon-Wiener index and species richness). SPSS 15.0 software package (SPSS Inc. 2006) was used for the statistical tests. TRIM 3.5 software was used for trend calculation (Pannekoek and van Strien 2005). The trends were classified according to the classification system suggested by Pannekoek and van Strien (2005).

RESULTS

There was no correlation between population trends (estimated using a Time-effects model in TRIM) between the two periods (fig. 1; Spearman rank correlation: $r_s = 0.031$, $n = 54$, $p > 0.8$) thus generally the new trends were inconsistent with the previous ones. The largest proportion of species belonged to the group with increasing trends in period 1 and declining in period 2.

Pairwise comparisons of the trends of all 54 analysed species between the two periods showed that trends in period 2 were lower than in period 1 (Wilcoxon signed ranks test, $Z = -4.034$, $n = 54$, $p < 0.001$). Trend differences were significant also in "ShrubEdge" and "Forest" groups ($Z = -2.578$, $n = 11$, $p = 0.01$ and $Z = -2.040$, $n = 14$, $p = 0.041$) and near significant in "Open" group ($Z = -1.690$, $n = 7$, $p = 0.091$). Although the pattern for trends in period 2 to be lower than in period 1 was similar, the differences in other groups were not significant (Fig. 2). "Open", "Wetland" and "Swallows and Martins" groups have small sample sizes (number of species per group) and when these groups were pooled the difference was statistically significant ($Z = -2,556$, $n = 15$, $p = 0.011$).

The trend comparisons grouping species by their wintering areas and main food sources also showed a similar pattern, however, the differences were significant only in the Sub-Saharan Africa wintering ($Z = -3.857$, $n = 24$, $p < 0.001$) and insectivore groups ($Z = -3.669$, $n = 35$, $P < 0.001$), respectively. There was a strong mutual relationship between these two species groups as only 2 of 24 species wintering south of the Sahara were not classified as in-

Table 2. Species trend estimates for the time periods 1995-2003 and 2003-2006 and species grouping according to their preferred habitat structures (see details in text), migrant status (**sed**: sedentary and partial migrants. **Eur**: wintering in southern or western Europe or North Africa. **Afr**: wintering in sub-Saharan Africa. **Asia**: wintering in southern Asia) and dominant food sources (**Ins**: Insectivores. **Gran**: granivores. **O**: other). * refers to significance of change at p < 0.05 and ** to p < 0.01.

SPECIES	Trend estimates				Ecological group	Wintering	Feeding
	1995-2003		2003-2006				
	Slope	SE	Slope	SE			
Ciconia ciconia	0.9952	0.0121	0.9841	0.0349	Tree Edge	Afr	O
Anas platyrhynchos	0.9860	0.0681	0.9960	0.1251	Wetland	Sed	O
Buteo buteo	0.8767**	0.0195	1.0468	0.0754	Tree Edge	Eur	O
Tetrao tetrix	0.9700	0.0710	0.7233*	0.1213	Open	Sed	Gran
Coturnix coturnix	1.2029*	0.0663	0.8766	0.1553	Open	Afr	O
Crex crex	1.0224	0.0200	0.9370	0.0462	Open	Afr	Ins
Grus grus	1.4315**	0.0952	1.1752*	0.0694	Wetland	Eur	O
Vanellus vanellus	1.0733**	0.0212	1.1176*	0.0478	Open	Eur	O
Columba palumbus	1.0867**	0.0191	1.0322	0.0384	Tree Edge	Eur	Gran
Cuculus canorus	1.1647**	0.0152	1.0242	0.0217	Forest	Afr	Ins
Jynx torquilla	1.3227**	0.0775	1.1451	0.1065	Tree Edge	Afr	Ins
Dendrocopos major	1.0595	0.0462	1.3356*	0.1549	Forest	Sed	Ins
Alauda arvensis	1.0075**	0.0027	0.9726**	0.0080	Open	Eur	Ins
Riparia riparia	1.1162	0.1749	0.7238	0.2986	Swallows & Martins	Afr	Ins
Hirundo rustica	1.1260**	0.0181	1.0805	0.0584	Swallows & Martins	Afr	Ins
Delichon urbica	1.2311**	0.0357	0.8802	0.0793	Swallows & Martins	Afr	Ins
Anthus trivialis	1.0845**	0.0132	0.9221**	0.0264	Tree Edge	Afr	Ins
Anthus pratensis	0.9191**	0.0108	0.9398	0.0389	Open	Eur	Ins
Motacilla alba	0.9212**	0.0165	0.9812	0.0542	Tree Edge	Eur	Ins
Luscinia luscinia	1.0918**	0.0093	0.9212**	0.0162	Shrub Edge	Afr	Ins
Saxicola rubetra	1.0444**	0.0095	0.9741	0.0199	Open	Afr	Ins
Turdus merula	1.0140	0.0113	0.8939*	0.0278	Forest	Eur	Ins
Turdus pilaris	1.0546*	0.0271	0.9882	0.0707	Tree Edge	Eur	Ins
Turdus philomelos	1.0910**	0.0143	0.9096**	0.0346	Forest	Eur	Ins
Turdus iliacus	1.1174**	0.0418	0.8121**	0.0894	Forest	Eur	Ins
Locustella naevia	1.1465**	0.0294	0.9535	0.0433	Shrub Edge	Afr	Ins
Locustella fluviatilis	0.9901	0.0256	0.8776	0.0757	Shrub Edge	Afr	Ins
Acrocephalus schoenobaenus	0.9797	0.0207	0.9777	0.0507	Wetland	Afr	Ins
Acrocephalus palustris	1.0495**	0.0095	0.8763**	0.0250	Shrub Edge	Afr	Ins
Acrocephalus arundinaceus	1.0718	0.0493	0.9730	0.0931	Wetland	Afr	Ins
Hippolais icterina	1.0240	0.0279	0.8379*	0.0668	Forest	Afr	Ins
Sylvia curruca	0.9222	0.0488	1.0582	0.1238	Tree Edge	Eur	Ins
Sylvia communis	1.0970**	0.0072	0.9453**	0.0161	Shrub Edge	Afr	Ins
Sylvia borin	1.0552**	0.0152	0.9678	0.0391	Shrub Edge	Afr	Ins
Sylvia atricapilla	1.1455**	0.0287	0.9916	0.0539	Forest	Eur	Ins
Phylloscopus sibilatrix	0.9173**	0.0319	0.9419	0.0783	Forest	Afr	Ins
Phylloscopus collybita	1.1466**	0.0273	1.0694	0.0457	Forest	Afr	Ins
Phylloscopus trochilus	0.9845	0.0145	1.1225**	0.0458	Forest	Afr	Ins
Parus caeruleus	1.0575	0.0642	0.8804	0.0987	Forest	Sed	Ins
Parus major	1.0964**	0.0266	0.9769	0.0507	Forest	Sed	Ins
Oriolus oriolus	1.1603**	0.0163	0.9949	0.0281	Forest	Afr	Ins
Lanius collurio	1.0184	0.0273	0.9687	0.0778	Shrub Edge	Afr	Ins
Pica pica	1.1758**	0.0385	1.0613	0.0627	Shrub Edge	Sed	O

→

SPECIES	Trend estimates				Ecological group	Wintering	Feeding
	1995-2003		2003-2006				
	Slope	SE	Slope	SE			
Corvus corone cornix	1.0186	0.0100	1.0188	0.0461	Tree Edge	Sed	O
Corvus corax	1.1233**	0.0238	0.8704	0.0923	Tree Edge	Sed	O
Sturnus vulgaris	0.9916	0.0139	1.0652	0.0434	Tree Edge	Eur	Ins
Passer montanus	0.9546	0.0359	1.0573	0.0879	Tree Edge	Sed	Gran
Fringilla coelebs	1.0321**	0.0086	0.9627	0.0195	Forest	Eur	Gran
Carduelis chloris	1.0441	0.0352	1.0262	0.0925	Tree Edge	Sed	Gran
Carduelis carduelis	1.0089	0.0255	0.6324**	0.0646	Tree Edge	Sed	Gran
Carduelis cannabina	0.9830	0.0268	0.9482	0.0871	Shrub Edge	Eur	Gran
Carpodacus erythrinus	0.9794	0.0131	0.9634	0.0424	Shrub Edge	Asia	Gran
Emberiza citrinella	0.9925	0.0072	1.0704**	0.0221	Shrub Edge	Sed	Gran
Emberiza schoeniclus	0.9571	0.0230	0.9763	0.0712	Wetland	Eur	Gran

sectivores. To test whether wintering areas or food sources were responsible for the significant differences in trends between the two periods in the "ShrubEdge" and "Forest" groups, the pairwise comparisons were repeated with only these two categories (pooled) included in the analysis. There were more negative than positive ranks in all the categories tested, and differences in the Sub-Saharan group and the group wintering in West or South Europe and North Africa as well as the insectivore group were statistically significant ($Z = -2.691$, $n = 13$, $p = 0.007$, $Z = -2.201$, $n = 6$, $p = 0.028$ and $Z = -2.875$, $n = 20$, $p = 0.004$ respectively).

Trend in bird abundance, species richness and diversity changed from "moderate increase" in period 1 to "stable" or "moderate decline" in period 2 in all three species community categories analysed (Table 3).

There were 11 species showing statistically significant declines and only 5 showing significant increases in period 2 while in period 1 these figures were 4 and 26 respectively (Table 2).

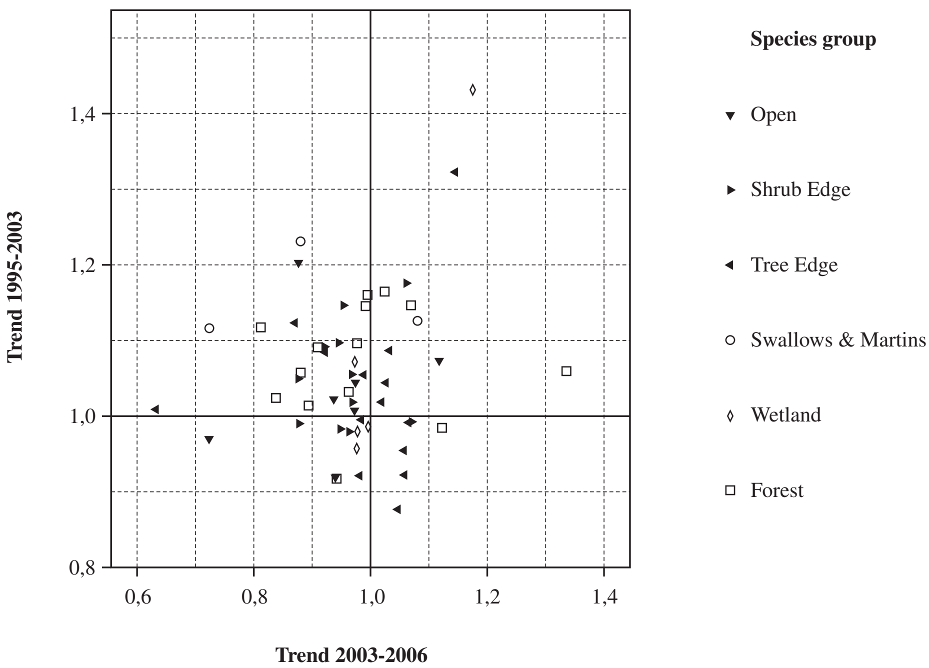

Figure 1. Scatterplot of trends in periods 1995-2003 and 2003-2006.

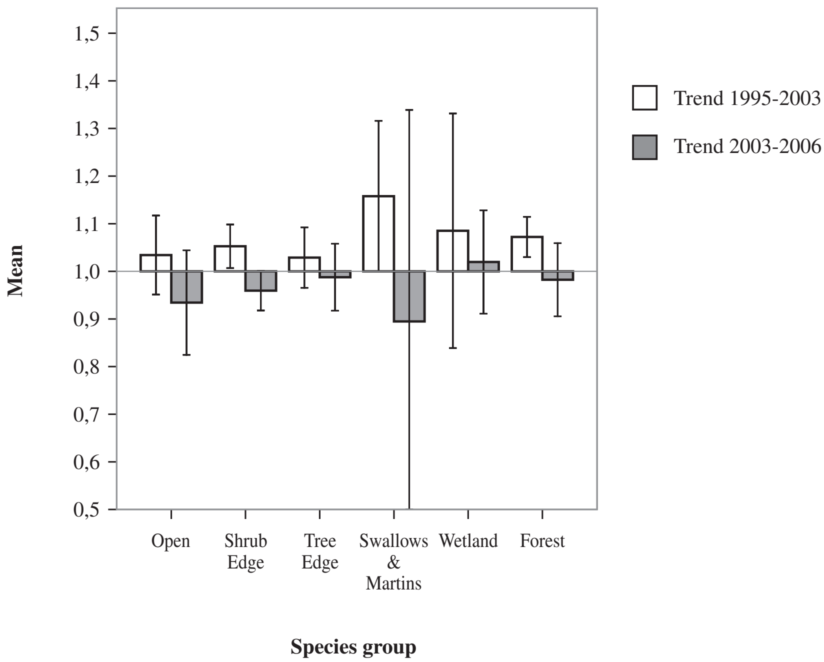

Figure 2. Comparison of the mean trends between the periods 1995-2003 and 2003-2006 in different ecological species groups. Open (n = 7), Shrub Edge (n = 11), Tree Edge (n = 14), Swallows & Martins (n = 3), wetland (n = 5) and forest (n = 14).

DISCUSSION

It may be argued that the three year period we used to assess the post-accession effects is not long enough for detection of trends as these may be strongly affected by the yearly population fluctuations caused by various biotic and abiotic factors and thus having large confidence intervals. However, as we are deliberately focusing on short-time effects that might be caused by the recent agricultural policy changes in Latvia and we look at patterns common in larger groups of species instead of individual species performance, we consider the chosen approach appropriate for the given task.

It was expected that the increase in species diversity and abundance that Latvian farmland experienced during the 1990s had to stop and stabilise at some point as the carrying capacity of the environment could not grow endlessly. However, in this study we found reversal rather than the stabilisation of the trends, as the trajectories of many bird populations as well as total bird abundance changed to negative in period 2. Although not always statistically significant, this pattern was consistent in almost all the species groups analysed. Statistically significant differences were found in the "ShrubEdge" and "Forest" groups whose habitats in farmland have been most affected by the recent changes: cutting bushes and trees in the overgrown areas as well as along the roads and ditches both to comply with the "good agricultural condition" requirements and to increase the "eligible" area for the "single area payment".

It has been reported earlier that the trends of African wintering species are worse than those wintering in Europe (Sanderson *et al.* 2006). In this study the trends of the species wintering south of Sahara became significantly worse in period 2, however, this wintering area factor does not account for all of the differences in trends, as the SW Europe and N Africa wintering group also had significantly worse trends in the "ShrubEdge" and "Forest" groups. The significantly more negative trends found in the insectivore group suggests that the abundance of insects might have decreased as a result of the ongoing changes.

The observed changes cannot be attributed only to the increased and still growing area of the active farmland due to restoration carried out in the previously overgrown areas as the declines in "ShrubEdge" and "Forest" groups might suggest - the reversal of trends has been observed in abundances, species richness and diversity of the farmland specialists too (Table 3). Thus we argue that the reason for the observed declines is in the lower carrying capacity of the environment caused by the changes in agricultural practices and intensity due to increased funding allocated to this sector that are promoting this change. Further research is needed to assess the role of political and

Table 3. Trends in species richness, diversity and abundance. **MI**: refers to "moderate increase". **MD**: "moderate decline". **S**: "stable" according to classification system suggested by Pannekoek and van Strien (2005). * refers to significance of change at $p < 0.05$ and ** to $p < 0.01$.

Measure	Group	1995 - 2003		2003 - 2006	
Species richness	All species	1.0234 ± 0.0017	MI**	0.9805 ± 0.0053	MD**
	Rural species	1.0188 ± 0.0023	MI**	0.9917 ± 0.0068	S
	Farmland species	1.0134 ± 0.0023	MI**	0.9818 ± 0.0068	MD**
Shannon-Wiener diversity index	All species	1.0120 ± 0.0012	MI**	1.0006 ± 0.0033	S
	Rural species	1.0099 ± 0.0015	MI**	0.9965 ± 0.0044	S
	Farmland species	1.0075 ± 0.0016	MI**	0.9902 ± 0.0047	MD*
Abundance	All species	1.0357 ± 0.0019	MI**	0.9810 ± 0.0043	MD**
	Rural species	1.0240 ± 0.0023	MI**	0.9780 ± 0.0052	MD**
	Farmland species	1.0221 ± 0.0022	MI**	0.9767 ± 0.0052	MD**

economic changes in the agricultural sector in changes in farmland bird diversity (but see Herzon and O'Hara 2007 for analysis on conservation policy implications to structural diversity of farmland and farmland birds in the Baltic countries).

Nevertheless, despite current developments, the agricultural intensity level in Latvia still does not reach the level characteristic for Western Europe (faostat.fao.org). It is unrealistic to expect that it would be possible to maintain agricultural intensity as low as it was during the 1990s. Economically driven low intensity in most cases is co-occurring with land abandonment that is also causing serious problems to biological diversity of farmland birds, especially the farmland specialists, dependant on open areas. Although the current increase in intensity might have been responsible for the observed slight reduction of the biodiversity level reached during the 1990s, it should not be regarded as a major threat that calls for immediate solutions yet. It is important at what level the agricultural intensity will stabilise and whether or not sufficient areas of low intensity farmland supported by agri-environmental schemes will be available. The Latvian Rural Development Plan 2007-2013 provides only one agri-environmental measure directly targeted at the management of diversity of wild species ("Maintenance of biological diversity in grasslands"). This is eligible in less than 2% and currently being implemented in less than 1% of the Latvian farmland. The current situation should be regarded as unsatisfactory as the scheme has negligible effect on countrywide biological diversity. The agri-environmental schemes aimed at maintaining biologically diverse species communities in a wider range of agricultural habitats, and applied on a significant proportion of farmland, are urgently needed.

REFERENCES

Anonymous 2000. Statistical yearbook of Latvia 2000. Central Statistical Bureau of Latvia, Riga, 230 pp.

Anonymous 2006. Agricultural farms in Latvia 2005. Collection of statistical data. Central Statistical Bureau of Latvia, Riga, 36 pp.

Aunins A 2006. [Ensuring continuity and compatibility of bird monitoring data regarding changes in the Biological diversity monitoring section of the National Monitoring programme. Report to Latvian Environmental Protection Fund] (in Latvian). Riga, Latvian Fund for Nature, 92 pp.

Aunins A, Petersen, BS, Priednieks J, Prins E 2001. Species - habitats relationships in Latvian farmland. Acta Ornithologica 36 vol. 1: 55-64.

Aunins A, Priednieks J 2003. Bird population changes in Latvian farmland 1995-2000: responses to different scenarios of rural development. Ornis Hung. 12-13: 41-50.

Aunins A, Priednieks J 2008. Ten years of farmland bird monitoring in Latvia: population changes 1995-2004. Revista Catalana d'Ornitologia 24: 53-64.

Herzon I, Aunins A, Elts J, Preikša Ž 2006. Habitat associations of farmland birds across the East Baltic region. Acta Zoologica Lituanica Vol. 16, No. 4: 249-260.

Herzon I, O'Hara RB 2007. Effects of landscape complexity on farmland birds in the Baltic States. Agriculture, Ecosystems & Environment 118: 297-306.

Keišs O 2005. Impact of changes in agricultural land use on the Corncrake Crex crex population in Latvia. Acta Univ. Latviensis Vol. 691, Biology: 93-109.

McCune B, Mefford MJ 2006. PC-ORD. Multivariate Analysis of Ecological Data. Version 5. MjM Software, Gleneden Beach, Oregon, U.S.A

Pannekoek J, van Strien A 2005. TRIM 3 Manual (TRends and Indices for Monitoring data). Statistics Netherlands, Voorburg, 60 p.

SPSS Inc. 2006. SPSS Base 15.0 User's Guide. Chicago, USA, 591 pp.

Sanderson FJ, Donald PF, Pain DJ, Burfield IJ, van Bommel, FPJ 2006. Long term population declines in Afro-Palearctic migrant birds. Biol. Conserv. 131: 93-105.

Tiainen J, Pakkala T 2001. Birds. In: Pitkanen M, Tiainen J (eds.). Biodiversity of Agricultural Landscapes in Finland. Birdlife Finland, Helsinki, 33-50.