Impact of organic agriculture on diversity and abundance of farmland birds in an arable landscape with hedges

H. Neumann, L. Bisschop-Larsen, R. Loges, and F. Taube

***Abstract* – A comparative study of breeding bird communities of organically and conventionally cultivated arable fields was carried out in northern Germany in 2005. The research was conducted on 40 pairs of fields (conventional/organic), which were selected with regard to similar field sizes and comparable boundary structures (particularly presence of hedges). Bird communities were solely dominated by the skylark *Alauda arvensis* L., which was the only frequent species on the tested pairs of fields. Diversity of farmland birds (number of species, Shannon-Index) was not affected by type of management. However, the abundance of skylarks (territories/10 ha) was significantly higher in organic than in conventional fields. As the study will be continued, the one-year findings will be verified with respect to changes of crops in rotations.[1]**

INTRODUCTION

Due to intensification of agriculture, populations of many farmland bird species have been declining in Northern and Western Europe during the last decades (Bauer & Berthold, 1996). Organic farming excludes some of the factors hold responsible for the loss of breeding and foraging habitats (see Bauer & Berthold, 1996), as the organic regime in comparison to conventional farming implicates a ban on synthetic fertilizers, herbicides and pesticides as well as a greater diversification of crops in rotations (European Union (EU) directive 2091/92). In Europe field studies about effects of organic agriculture on birdlife are almost lacking, especially outside of Great Britain (review Hole et al., 2005). This paper presents results of a comparative study of breeding birds on organic and conventional arable fields carried out in the federal state of Schleswig-Holstein in northern Germany in 2005. The research was carried out within the Interreg III a-Programme of the EU (German-Danish project “AVI-LAND”).

METHODS

Diversity and density of breeding birds on agricultural land is not only affected by intensity of management and specialisation in agriculture, but also by landscape characteristics (particularly presence and density of tall boundary structures such as hedges) and field and farm size, respectively (e. g. Whittingham et al., 2003). This study follows the hypothesis, that organic agriculture as defined in the directives (e.g. EU directive 2091/92) *per se* is not related to special field sizes and/or a defined presence and management of non-crop habitats. Therefore, we selected a paired field design consisting of conventionally and organically cultivated arable fields. Each pair featured similar area sizes and comparable boundary structures. Fields were selected from eight conventional and nine long-time organic farms (organic farming since at least ten years). Due to different crop rotations on conventional and organic farms, it was not possible to choose pairs of identical crops. Organic farms were specialized like conventional farms in cash crop production on fertile soils and in forage production on poorer soils, respectively. Therefore, field pairs were generated for both cash crops and forage crops. Permanent grassland was excluded from analysis, because grassland areas of the selected farms were too small in view of minimal territories of recorded bird species (see below). Field sizes and crop types of the tested pairs (n=40) are presented in table 1 and fig. 1. Crop rotations, cultivation practices and yield levels of fields can be considered as representative for the region. The boundaries of the selected fields were occupied by hedges, shrubs or tree rows on average by 50 % to 75 % (boundary structures mapped by means of four classes: 0-25, 26-50, 51-75, 76-100 % of boundaries occupied by vertical structures).

Bird survey was restricted to species known to breed and forage directly on agricultural land („true field species“). Birds were recorded by territory mapping, which especially accounts for behaviour pattern that indicate breeding (e.g. singing males).

Statistical analysis was carried out for abundance of skylark and total abundance of remaining species (see results) as well as for species diversity (number of species per field, Shannon-Index). Tests verified whether the difference of variables between conventional and organic agriculture differs from zero (t-test, probability of error 5 %; SAS, 2001). If variables were not distributed normally, data was transformed prior to analysis (table 2).

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Table 1. Arable crops on conventional and organic fields in 2005 (wcs: whole crop silage, n: number of fields, ha: total area in ha).

Crops		Conventional		Organic	
		n	ha	n	ha
Forage crops	Maize (wcs)	12	80.4	1	11.0
	Ley	3	9.7		
	Clover/grass			9	52.8
	Peas/barley (wcs)			5	22.8
Cash crops	Winter cereals	15	92.2	10	53.8
	Winter rape	8	94.8	1	8.6
	Spring cereals	1	4.0	7	80.9
	Sugar beet	1	27.0		
	Seed production*			2	13.0
	Grain legumes			2	12.9
	Clover/grass**			3	39.8
Total	All crops	40	308.1	40	296.1
	Spring sown crops	14	111.4	18	161.5

*oil seed radish, red clover; **green manure crops

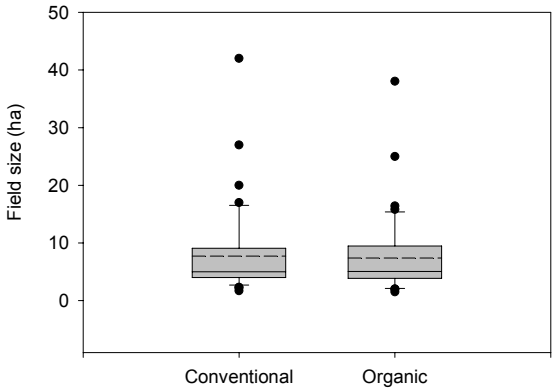

Figure 1. Size (ha) of conventional and organic arable fields in 2005 (box-and-whisker plots, dashed line: arithmetic mean; n=40 pairs of fields).

Table 2. Transformations of variables

Variable	Transformation
Number of species	log(x+1)
Shannon-Index	x^3
Abundance skylark (territories/10 ha)	log(x+1)
Total abundance species without skylark (territories/10 ha)	none

Results and Discussion

Bird communities were solely dominated by the skylark, which was the only frequent species on the tested pairs of fields in 2005 (table 3). Number of species and Shannon-Index were not affected by type of farming (table 4). Species richness with in average 1.2 (conventional) and 1.4 (organic) bird species per field, respectively, was very low (data not presented; compare Bezzel, 1982).

Due to the low presence of most species, the variable abundance was only tested for the skylark as well as for the sum of species without skylark. In agreement with studies from Great Britain (review Hole et al., 2005), frequency of larks was significantly higher in organic than in conventional fields. Total abundance of remaining species was not affected by type of cultivation.

In addition to the more diverse crop rotations on organic farms (compare table 1), further reasons for the difference in abundance of skylarks between regimes may be i. a more comfortable light vegetation structure and ii. a richer food supply in organic fields (Hole et al. 2005). As the "AVI-LAND"-project will be continued in 2006 and 2007, the one-year findings will be verified with respect to changes of crops in rotations.

Table 3. Mean presence (P) (%), dominance (D) (%) and abundance (A) (territories/10 ha) of farmland birds in organic and conventional arable fields in 2005 (n=40 pairs of fields, see fig. 1 and table 1).

Species	Conventional			Organic		
	P	D	A	P	D	A
Skylark *Alauda arvensis*	57.5	43.9	0.78	72.5	58.5	1.85
C. Pheasant *P. colchicus*	10.0	6.3	0.08	22.5	8.3	0.23
Yellow Wagtail *Motacilla flava*	17.5	7.0	0.16	12.5	1.9	0.07
Lapwing *Vanellus vanellus*	15.0	11.6	0.28	12.5	5.4	0.17
C. Quail *Perdix perdix*	2.5	2.0	0.13	7.5	2.0	0.12
Reed Bunting *E. schoeniclus*	5.0	1.0	0.02	2.5	0.6	0.01
Marsh Warbler *A. palustris*				2.5	1.3	0.09
Whinchat *Saxicola rubetra*				2.5	1.9	0.04
Corncrake *Crex crex*				2.5	0.1	0.01
C. Whitethroat *Sylvia communis*	7.5	2.6	0.04			
Ringed Plover *C. hiaticula*	2.5	0.5	0.03			

Table 4. Levels of significance (Pr > |t|) of tests, whether the difference (Diff.) of parameters between conventional and organic agriculture differs from Zero (n=40 pairs of fields, see fig. 1 and table 1).

Parameter	Diff.*	Pr > |t|
Number of species	-0.051	0.2515
Shannon-Index	-0.004	0.5776
Abundance skylark (territories/10 ha)	-0.179	0.0008
Total abundance species without skylark (territories/10 ha)	-0.021	0.9279

*arithmetic means (transformations see table 2)

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