Changes in breeding bird populations in farmland of south-western Poland between 1977-1979 and 2001

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Abstract. The paper deals with the population changes of birds inhabiting an extensive area (15.8 km^2) dominated by arable land, situated on the Silesian Lowland in south-western Poland. The number of territories was established with the use of the mapping method in the years 1977-1979 and 2001. Some changes in habitat and indices of agricultural production occurred between the two study periods. The 2001 study revealed a clear rise of the species diversity and the area was colonised with 18 new bird species. In the group of agricultural birds the only visible decrease was recorded for the species nesting in or using open cultivated areas, where the total abundance dropped. Within this group the most affected were: *Perdix perdix*, *Vanellus vanellus* and *Alauda arvensis*. The abundance of species inhabiting non-cropped, treeless habitats within open farmland went up. The total abundance of twelve species nesting in hedgerows and woodlots also rose. The severe reduction of the bird populations inhabiting open farmland is most probably associated with much larger environmental changes linked with intensification of agriculture, compared to the small transformations of the non-cropped or marginal habitats (sometimes becoming even larger and more diverse), where bird abundance went up.

Key words: farmland birds, farmland biodiversity, population change, bird habitat, land abandonment, marginal habitats, agricultural intensification

Introduction

The intensification of research on the changing natural resources of the European farmland over the last few decades was triggered by the urgent need to assess the directions and threats posed by the ever more intensive farming methods (Henle et al. 2008). Birds inhabiting farmland have been singled out as indicators of the environmental changes (Gregory et al. 2005), and according to the latest modeling the abundance of the world's farmland birds may be reduced by 8 to 26% by 2050, as a result of the agricultural land conversion (Teyssedre & Couvet 2007). The disappearance of the farmland avifauna is well documented with the majority of relevant studies having been made in western and northern Europe (Robinson & Sutherland 2002). In the central and eastern Europe after the fall of communism, i.e. from 1990s, the agricultural production started to grow from relatively low levels. In Poland, like in other countries of the region, the main indices of agricultural production have gone up sharply over the last 20 years, although they still have not matched the level observed in the old EU member states (FAOSTAT 2007).

There is a shortage of studies describing the transformations of breeding bird assemblages in various farmland habitats all over Europe. The knowledge of long term trends of central European bird communities is also insufficient. Moreover, while the population trends both for farmland and woodland birds are well known (Gregory et al. 2005, Donald et al.

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2006, Voříšek et al. 2007), quantitative data on avifauna over large agricultural landscapes are scarce, especially in the new accession countries (Herzon & O'Hara 2007).

The results of the latest research from the central European countries point at the woodland and urban species being among those with positive abundance trends (Reif et al. 2007). Analogous tendencies have also been proved for farmland woodlots in Poland (Kujawa 2002, Orłowski 2004). However, the most recently compiled data from the whole continent highlight the reduction of the forest bird abundance. It seems probable that the existing discrepancies in the population trends result from the different levels of intensity of the forest management in various parts of Europe (Reif et al. 2007, Voříšek et al. 2007). Contrary to the contradictory data for forest bird populations, the decline of agricultural birds is reported consistently, both from old and new EU countries (Chylarecki & Jawińska 2007, Voříšek et al. 2007). It must be emphasized though, that due to certain changes in land use in central Europe (mainly land abandonment), some species inhabiting early succession stages of crop fields may benefit locally, e.g. *Saxicola rubetra*, *Miliaria calandra*, *Acrocephalus palustris*, *Lanius collurio*, *Serinus serinus* (Dombrowski & Goławski 2002, Orłowski 2005).

The aim of the current study is to assess the quantitative changes in breeding bird populations inhabiting largely agricultural area situated in south-western Poland between two distant periods, 1977-1979 and 2001.

Material and Methods

Characteristics of the studied area

The surveyed plot present an area of 15.8 km^2 situated south of the Wrocław city, Silesian Lowland, south-western Poland (approximate location: 51°02´N, 17°03´E). The dominant form of land use was arable, covering in both study periods >90% of the area. There were 22 small farm woods located within the area, with the total surface of 24.98 ha (average ± SD = 1.13 ± 2.11 ha; min-max = 0.025 – 8.9 ha). The study plot comprised also linear woody features growing alongside drainage ditches (hereafter defined as riparian strips or water-edge hedgerows) and roads (defined as roadside hedgerows and tree lines). The whole study area contained 22 780 m drainage ditches, 9 950 m (48.4%) of them overgrown with riparian strips. The total length of roadside hedgerows and tree lines was 2 755 m. All these woody landscape elements were dominated by deciduous trees and bushes, mainly *Fraxinus excelsior*, with fairly abundant addition of *Ulmus laevis*, *Quercus robur*, *Alnus glutinosa* and poplar hybrids *Populus* sp. The undergrowth consisted mainly of *Prunus spinosa*, *Sambucus nigra*, *Crataegus monogyna* and *Prunus padus* and in riparian strips also *Salix cinerea* (detailed information on woody vegetaion growing in non-cropped habitas of this area in Orłowski & Nowak 2005). The farm woods area has not changed between 1977–1979 and 2001. The cessation of vegetation clearance along some ditches and roadside verges and tree lines allowed the regeneration of shrub communities (mainly *S. cinerea*, *P. spinosa* and *C. monogyna*). The study area included two villages, covering 80 and 125 ha, the size of which has not changed substantially between the both study periods.

Based on the data gathered in the Statistical Office in Wrocław (compiled by K. Kowal) it was possible to demonstrate the increase of the main agricultural production indices on the study area between 1977-1979 and 2001, i.e. the wheat yield by 14% (from

3.79 to 4.33 tonnes ha^{-1}; data for Dolnośląskie/Lower Silesia voivodship) and the number of tractors per 100 ha by 69% (from 3.5 to 5.9), although the use of mineral fertilizers has decreased by 55% (from 203.1 to 91.2 kg NPK ha^{-1}). The general crop composition has also changed over that time, with the expansion of winter cereals (by 67%, from 960 ha in 1978 to 1604 ha in 2001; data for 9 857 ha area of the local administration unit), oil-seed rape (by 458%; from 36 ha to 201 ha) and maize (by 382%; from 90 ha to 434 ha). Still, the total share of oil-seed rape and maize in 2001 did not exceed 8% of the whole cropped area. The same period saw the decline of spring cereals (by 46%; from 1076 ha to 576 ha), root crops (by 54%; from 858 ha to 397 ha) and meadows and pastures (by 31%; from 1299 ha to 892 ha). In 1990s some land was taken out of production leading to the appearance of abandoned fields, unknown in the 1970s. In 2001, the detailed inventory revealed 10 abandoned fields (with permanent wasteland flora; mainly *Tanacetum vulgare*) with the total size of 16.75 ha.

Bird data and analysis

The bird counts were conducted in four breeding seasons 1977-1979 and 2001 with the use of the mapping method. The fieldwork was carried out between the middle of April and the beginning of July and consisted of nine censuses in 1977 and 1978, five in 1979 and eight in 2001. Additionally in the each year conducted 1–2 censuses in the evening. The singing posts and other territorial behaviour (nest building, feeding of the offspring, aggression) were marked on 1:5 000 and 1:1 000 maps. Territories of bird located on the border of surveyed plot were recognized as half-pair. All species were covered in the censuses, except for the very abundant house sparrow *Passer domesticus*, swallow *Hirundo rustica* and house martin *Delichon urbica*. In the each year the censuses was made by one observer. Due to the large study area the actual number of field visits was much higher, resulting in each fragment being controlled at least 5 to 9 times. The censuses were carried out along the wooded field margins, ditches, roads, and on the extensive crop fields along the paralel lines every 250 m to ensure the coverage of the whole field area. Due to the high bird density in large farm woods, abandoned fields and villages, the visits to these habitats were much longer (up to 2.5 hours in the villages and in the largest woodlot), and birds were recorded here on cadastral maps in smaller scale (1:500). The censuses were conducted between the dawn and ca 11 a.m. and the evening ones from *ca* 2 hours before to 1 hour after the sunset.

The abundance of the breeding population of mallard *Anas platyrhynchos*, coot *Fulica atra* and moorhen *Galinula chloropus* was based on the number of females leading chicks. The particular attention was paid to the rising and landing places of singing skylarks *Alauda arvensis*. The starling *Sturnus vulgaris* abundance was based on the number of occupied nest holes, and all occupied nests of white stork *Ciconia ciconia*, buzzard *Buteo buteo*, goshawk *Accipiter gentilis*, magpie *Pica pica*, hooded crow *Corvus cornix* and rook *C. frugilegus* were also counted. Evening censuses provided data for the abundance estimate of grey partridge *Perdix perdix*, quail *Coturnix coturnix*, corncrake *Crex crex*, owls and song thrush *Turdus philomelos*.

Based on the nest site location the species were divided into four groups: 1) nesting on the ground and in small shrubs (≤1.5 m); 2) nesting on taller shrubs and trees (>1.5 m above ground); 3) hole-nesters; 4) nesting on buildings (Cramp 1998). Habitat preferences served for another breakdown into: 1) agricultural birds (farmland specialists); 2) woodland birds; 3) species nesting in built-up areas and other habitats; 4) species nesting in wetlands and marshland habitats. It is almost identical with the division into agricultural and woodland birds presented by G r e g o r y et al. (2005) and S i r i w a r d e n a et al. (1998), with the only exception of *B. buteo* (in our study classified as farmland specialist; in central Europe this species breeds in small farm woods and isolated trees and feeds in open farmland). One more species, the *Acrocephalus palustris*, due to its association with the open agricultural landscape in central Europe, was also included in this group.

An additional subdivision in the group of 31 agricultural birds was made in relation to the used habitat during breeding season: 1) species nesting or feeding only in open cultivated cropland; 2) species nesting in non-cropped, treeless habitat within open farmland (abandoned cropland, ruderal biotopes); 3) species nesting in woody field margins (riparian strips, woodlot edges). This last breakdown is the reflection of habitat preferences of these birds in Poland and central Europe (C r a m p 1998, K u j a w a 2002, O r ł o w s k i 2005).

In the paper presented also; the changes of abundance of species selected by G r e g o r y et al. (2005) were used to calculation of Farmland Bird Index 23 (FBI 23) (19 of these 23 species occurred in the study area; see Table 1).

After B ö h n i n g - G a e s e & B a u e r (1996) the change in abundance of the most numerous species and ecological groups of birds between two periods – 1977–1979 and 2001 was defined as change = (2001 number – average 1977–1979 number) / [(2001 number + average 1977–1979 number)/2]. The calculated values of these changes ranged between –2 (extintion) and +2 (new breeder). For the first study period (1977–1979) the average value from three consecutive years was used. The birds which abundance in at least one year of study was ten pairs were recognized as the most numerous species. The quantitative change in the three specified groups of agricultural birds was tested with the use of Wilcoxon test for matched pairs. The changes in the whole bird assemblage and particular ecological groups were tested with the use of chi-square (χ^2) test. Due to the strong dependence of the results on the abundance changes of *A. arvensis* the number of whole community of 19 species, which are the base of the calculation of the FBI 23 (Table 1), was tested with and without *A. arvenis*. Results with probability $p \leq 0.05$ were treated as significant.

Results

In the years 1977–1979 there were 53, 49 and 45 breeding species recorded respectively. In 2001 their number increased to 65, and the area was colonized by 18 new bird species (Table 1). In comparison to the first study period, nine species disappeared from the plot in 2001 (Table 1).

In the group of 15 most numerous farmland specialists the population changes of particular species were very diverse, with 10 increases (maximal change = +1.700 in *C. carduelis*), and 5 decreases (Fig. 1). The steepest declines were recorded for the three species nesting in open cultivated cropland (change = -1. 774, *V. vanellus*; change = -1.694, *P. perdix*; change = -0.791, *A. arvensis*).

The changes among the most numerous woodland birds were positive, ranging from, change = +1.600 (*T. philomelos*) to +0.543 (*H. icterina*) (Fig. 1).

The adopted division of the agricultural birds, based on habitat preferences, allowed the comparison of the quantitative changes in the three specified groups. The evident decrease was noted only in nine species nesting in open cultivated areas (among 10 species in this group), whose populations dropped, with the exception of *M. flava* (Wilcoxon test, $Z = 2.52$, $p = 0.01$) (Table 2). However, the abundance of the two other groups of agricultural birds

Table 1. Number of breeding pairs of birds in the agricultural area of Wrocław Plain (15.8 km^2) in 1977–1979 and 2001. [A] Species selected by G r e g o r y et al. (2005) to calculation of Farmland Bird Index 23 (FBI 23). [B] (G) species nesting on the ground and small shrubs (≤1.5 m), (T) nest located on shrubs and trees (>1.5 m above ground), (H) hole-nesters, (B) nest located on buildings. [C] (F) farmland specialists, (W) woodland birds, (U) species nesting in built-up areas and other habitats, (M) species nesting in wetlands and marshland habitats. [D] applied only to farmland specialists: (OPEN) species nesting or feeding only in open cultivated cropland; (NON) species nesting in non-cropped, treeless habitat within open farmland (abandoned cropland, ruderal biotopes); (HEDG) species nesting in woody field margins (hedgerows, woodlot edges). [E] Population trend in Europe: (↑) moderate increase, (–) stable, (↓) moderate decline, (↓↓) step decline, (?) uncertain (after V o ř í š e k et al. 2007); population trends for *C. coturnix*, *C. crex* and *C. ciconia* concerns only the area of Poland (after C h y l a r e c k i & J a w i ń s k a 2007).

Species [A]	Nesting group [B]	Habitat preferences [C]	Nesting habitat within agricultural areas [D]	Number of pairs				Long-term population trend in Europe [E]
				1977	1978	1979	2001	
Alauda arvensis	G	F	OPEN	276	313	304	129	↓
Acrocephalus palustris	G	F	NON	121.5	129.5	116.5	132	–
Sylvia communis	G	F	HEDG	62.5	23.5	37	30	↑
Perdix perdix	G	F	OPEN	54	50	23	3.5	↓↓
Miliaria calandra	G	F	NON	33.5	33.5	13.5	52.5	↓
Fringilla coelebs	T	W		30	22	25	62.5	–
Hippolais icterina	T	W		27	15	13	32	↓
Motacilla flava	G	F	OPEN	23	41	9	34.5	↓
Sylvia atricapilla	G	W		19	15	13	71	↑
Vanellus vanellus	G	F	OPEN	18	41	41	2	↓
Coturnix coturnix	G	F	OPEN	18	18	4.5	7.5	↓↓
Pica pica	T	U		17.5	10	14.5	7	↓
Emberiza hortulana	T	F	HEDG	16	17.5	11.5	17.5	–
Luscinia megarhynchos	G	W		14	12	15	50.5	↓
Turdus merula	T	W		14	14	8	45	↓
Emberiza citrinella	G	F	HEDG	11	4	6	26	↓
Sylvia curruca	G	W		11	4	3.5	13.5	–
Sylvia borin	G	W		11	5	4	2	↓
Carduelis chloris	T	F	HEDG	11	5	3	23	–
Passer montanus	H	F	HEDG	10	9	12	12	↓
Phylloscopus collybita	G	W		9	5	5	14	↑
Sturnus vulgaris	H	F	HEDG	9	8	9	23	↓
Oriolus oriolus	T	W		8.5	7	8	6	↑
Columba palumbus	T	W		8	8	5	0	↑
Carduelis carduelis	T	F	HEDG	8	6	8	28	↑
Corvus cornix	T	W		6.5	3	4	0	↑
Serinus serinus	T	F	HEDG	6.5	7	6.5	8	↓
Lanius collurio	T	F	HEDG	6	3	3	13	↓
Streptopelia turtur	T	F	HEDG	5	3	5	0	↓
Parus caeruleus	H	W		5	5	1	16	↑
Crex crex	G	F	OPEN	4	0	0	0	↓↓
Turdus philomelos	T	W		4	1	1	18	↓
Parus major	H	W		4	2	5	17.5	↑
Cuculus canorus	T	W		4	4	4	5	↓
Buteo buteo	T	F	HEDG	3.5	2	4	5.5	↑

Table 1. continued

Anas platyrhynchos	G	M		3	6	3	5	lack of data
Phylloscopus trochilus	G	W		3	1	1	0	↓
Muscicapa striata	H	W		3	1	0	4	↓
<u>*Corvus frugilegus*</u>	T	F	OPEN	3	3	2	0	↑
Erithacus rubecula	G	W		3	1	4	1	↑
Oenanthe oenanthe	G	F	NON	2	0	0	6	↓
Emberiza schoeniclus	G	F	NON	2	0	0	8	–
<u>*Falco tinnunculus*</u>	T	F	OPEN	1	1	3	0.5	↓
Anthus trivialis	G	W		1	1	1	0	↓
<u>*Anthus pratensis*</u>	G	F	OPEN	1	0	0	0	↓
<u>*Carduelis cannabina*</u>	T	F	HEDG	1	0	1	7	↓
Streptopelia decaocto	T	U		1	1	0	18.5	↑
Locustella naevia	G	M		1	0	0	1	↓
Motacilla alba	B	U		1	1	0	4	↓
<u>*Ciconia ciconia*</u>	B	F	OPEN	1	1	1	1	↓
Sitta europaea	H	W		0	1	0	0	↑
<u>*Saxicola rubetra*</u>	G	F	NON	0	2	0	9	↓
Lanius excubitor	T	F	HEDG	0	0	0	2.5	?
Accipiter gentilis	T	W		0	0	0	1	lack of data
Acrocephalus scirpaceus	G	M		0	0	0	4	↓
Acroc. arundinaceus	G	M		0	0	0	2	?
<u>*Saxicola torquata*</u>	G	F	NON	0	0	0	5.5	?
Aegithalos caudatus	T	W		0	0	0	3	–
Coccothraustes coccothraustes	T	W		0	0	0	3	↑
Phoenicurus ochruros	B	U		0	0	0	18	–
Certhia brachydactyla	H	W		0	0	0	2	–
Sylvia nisoria	G	F	HEDG	0	0	0	4	lack of data
Prunella modularis	G	W		0	0	0	2	↓
Galinula chloropus	G	M		0	0	0	3	lack of data
Strix aluco	H	W		0	0	0	1	lack of data
Turdus pilaris	T	W		0	0	0	4	↑
Dendrocopos major	H	W		0	0	0	1	↑
Fulica atra	G	M		0	0	0	3	lack of data
Circus aeruginosus	G	M		0	0	0	1	lack of data
Circus pygargus	G	M		0	0	0	0.5	lack of data
Phasianus colchicus	G	F	HEDG	?	?	?	19	lack of data

went up. The total change of six species nesting in the non-cropped, treeless habitat within open farmland amounted to +0.341, and the difference in the number of breeding pairs between two periods was significant (Wilcoxon test, $Z = 2.02$, $p = 0.04$). Similarly, the total change of 14 species nesting in hedgerows and woodlot edges was +0.545 (increase from 114 to 199.5 pairs), and the difference in the number of breeding pairs between two periods was significant (Wilcoxon test, $Z = 2.80$, $p = 0.005$). In this group of agricultural birds the biggest changes over +1 were recorded in four species (*C. carduelis*, *E. citrinella*, *C. chloris* and *L. collurio*; Fig. 1).

The changes of abundance in these three groups brought on essential alterations in the composition of the whole group of agricultural birds. The share of species nesting in open cultivated areas dwindled in favour of the two remaining groups (chi-square test, $\chi^2 = 45.9$, df = 2, $p < 0.0001$). Birds showing clear positive abundance trends included also species nesting on buildings, hole-nesters and birds associated with wetlands (Table 2).

The proportions of particular ecological groups also suffered serious transformations (Table 2). Within the nesting groups the share of birds nesting on ground and in low shrubs decreased, while the other species benefited, especially in birds nesting on taller shrubs and trees (chi-square test, $\chi^2 = 15.1$, df = 3, $p < 0.002$). Similar trends were visible among groups with different habitat preferences, where the share of agricultural birds dropped, whereas the abundance of other birds increased (chi-square test, $\chi^2 = 22.6$, df = 3, $p < 0.0001$).

The abundance of 19 bird species used for the calculation of FBI 23 decreased between 1977–1979 and 2001, change = -0.270 (Table 3). This result is, however, caused to a large extent by the fall of *A. arvensis*, and after its exclusion from the analysis, the overall population growth of the remaining species is apparent, change = +0.247 (Table 3).

Table 2. Characteristics of the breeding bird community in the agricultural area (15.8 km^2) of Wrocław Plain in two study periods. Total number of bird pairs is given according to their ecological requirements and used habitat. Division of particular groups and species classification as in Table 1. [A] In brackets is given the percentages calculated for one group of birds. [B] Average value from three consecutive years. [C] details in chapter Material and Methods.

Group of birds	Years [A]		Change in abundance [C]
	1977–1979 [B]	2001	
NESTING GROUP			
species nesting on the ground and small shrubs (≤1.5 m)	670 *(79.0%)*	623 *(60.3%)*	-0.073
nest located on shrubs and trees (>1.5 m above ground)	148 *(17.4%)*	310 *(30.0%)*	+0.707
hole-nesters	28 *(3.3%)*	76.5 *(7.4%)*	+1.151
nest located on buildings	1.7 *(0.3%)*	23 *(2.3%)*	+1.725
HABITAT PREFERENCES			
agricultural birds	684 *(80.7%)*	590.5 *(57.2%)*	-0.147
woodland birds	144 *(17.0%)*	375 *(36.3%)*	+0.890
species nesting in built-up areas	15 *(1.8%)*	47.5 *(4.6%)*	+1.040
species nesting in wetlands and marshland habitats	4.3 *(0.5%)*	19.5 *(1.9%)*	+1.277
NESTING HABITAT OF AGRICULTURAL BIRDS			
species nesting or feeding only in open cropland	418 *(61.1%)*	178 *(30.1)*	-0.805
species nesting in non-cropped, treeless habitat	151 *(22.1%)*	213 *(36.1)*	+0.341
species nesting in woody field margins	115 *(16.8%)*	199.5 *(33.8)*	+0.537

Table 3. Total number of pairs of species (*n* = 19) used in calculation of Farmland Bird Index 23 in years 1977–1979 and 2001 in the rural area (15.8 km^2) of Wrocław Plain.

Group of species	Year				
	1977	1978	1979	Average 1977–1979	2001
All 19 species	483.5	510.5	464.5	486.2	370.5
Without *Alauda arvensis*	207.5	197.5	160.5	188.5	241.5

Discussion

The results of the present study demonstrate that the changes in the bird populations inhabiting the largely agricultural area of south-western Poland between 1977–1979 and

2001 varied enormously among different groups of species, as well as within the agricultural birds themselves. The last 30 years saw an evident increase of avian species diversity of this farmland region. However, a simultaneous dramatic drop of abundance of the most numerous species nesting in the crop fields – *A. arvensis*, *P. perdix*, *V. vannellus*, *C. coturnix* – was also recorded (change = -0.926), causing important alterations in the proportions of the whole bird assemblage (Table 2). The severe reduction of the bird populations inhabiting open farmland is most probably associated with much larger environmental changes affecting crop fields linked with intensification of agriculture, compared to the small transformations of the non-cropped or marginal habitats (sometimes becoming even larger and more diverse), where bird abundance went up. A sign of the intensification of agricultural production in the studied area was the expansion of autumn-sown and the reduction of spring-sown cereals. Data on habitat preferences of birds nesting on crop fields collected so far, point to the rapidly growing autumn-sown cereals as not providing favourable nesting conditions for ground-nesters, especially *A. arvensis* (Chamberlain et al. 1999, Wilson et al. 2005). In the case of *P. perdix*, sedentary species, another essential factor must have been the reduction of food resources (Panek 1992, review in Wilson et al. 2005). It refers both to the breeding season – 6-fold increase of pesticide use between 1978 and 2001 (based on data for Poland; Central Statistical Office 1980 and 2003) as well as winter – disappearance of stubbles on set-aside fields. The results from northern France point to the stubble fields presence in winter as a factor encouraging *P. perdix* to remain for the breeding season near winter foraging grounds (Bro et al. 2004), with analogous relationship detected also for the British population of *E. citrinella* (Whittinghan et al. 2005). In the present study though, the lack of stubble fields in winter caused by the restriction of spring-sown cereals area did not affect the abundance of two other sedentary seed-eating species (*E. citrinella* and *M. calandra*).

The abundance of some species inhabiting the study area was conditioned by the increased predator pressure. The collapse of bird populations nesting in cropfields could have been triggered – apart from environmental changes – by the growing predation by red fox *Vulpes vulpes* – fast increasing in Poland, able to restrict the abundance of *P. perdix* and *A. arvensis* (Tryjanowski 2000, Panek 2005). The disappearance of three species – *C. palumbus*, *C. cornix* and *S. turtur* – may be linked to the colonisation of the area by *A. gentilis*. The *C. palumbus* and *C. cornix* populations are now growing rapidly all over Europe, especially in urban areas, whereas *S. turtur* is in serious decline (Tomiałojć & Stawarczyk 2003, Chylarecki & Jawińska 2007, Voříšek et al. 2007).

An apparent decrease of *S. communis* registered in 2001 can be explained by the large fluctuations observed in 1977–1979. However, after exclusion of the unusually high result from 1977, the mean abundance from the two other years, 1978 and 1979, is consistent with that recorded in 2001. Similarly, it seems hard to explain the increase of the *E. citrinella* population. It may be however all down to the large yearly fluctuations of this species in 1977–1979 (see Table 1) and the lack of additional census years in the second study period. Strong oscillations of *E. citrinella* in the 1970s could be also a result of more severe winters at that time, reducing the survival rates of this sedentary species. The growth of *M. flava* population is most likely connected with the expansion of oil-seed rape (according to published data on habitat preferences of this species; Stiebel 1997). The abundance of *S. communis* has gone up in Europe over the last two decades, while *M. flava* belongs to the group of species with marked downward population trend (Donald et al. 2006, Voříšek et al. 2007).

In spite of the alarming data on the decline of some species from the other two groups of farmland specialists – species nesting in non-cropped, treeless habitat within open farmland

and species nesting in woody field margins (Gillings & Fuller 1998, Donald et al. 2006, Voříšek et al. 2007), and the decreasing FBI 23 (Gregory et al. 2005), the abundance of these birds on the studied part of Lower Silesia increased visibly. These contradictions are most likely explained by the augmented habitat diversity within the present study area. The rising abundance of species nesting in non-cropped, treeless habitat within open farmland should be linked to i) colonisation and utilization by some species (*C. carduelis*, *S. rubetra*, *M. calandra*) of the abandoned fields, absent in 1970s; ii) expansion of the scrub habitat, mainly with *Prunus spinosa* and *Crataegus monogyna*, largely due to a spontaneous regeneration of vegetation on abandoned farmland and field margins, along ditches and small roads (*Lanius collurio*, *C. chloris*, *C. cannabina*) (Dombrowski & Goławski 2002, Orłowski 2005).

Contrary to the inconsistent population trends among farmland specialists, most woodland species showed evident increases (Table 2). This is likely to be explained by the farm woods remaining in a good state (i.e. lack of tree removal) since 1970s, as well as by the changes

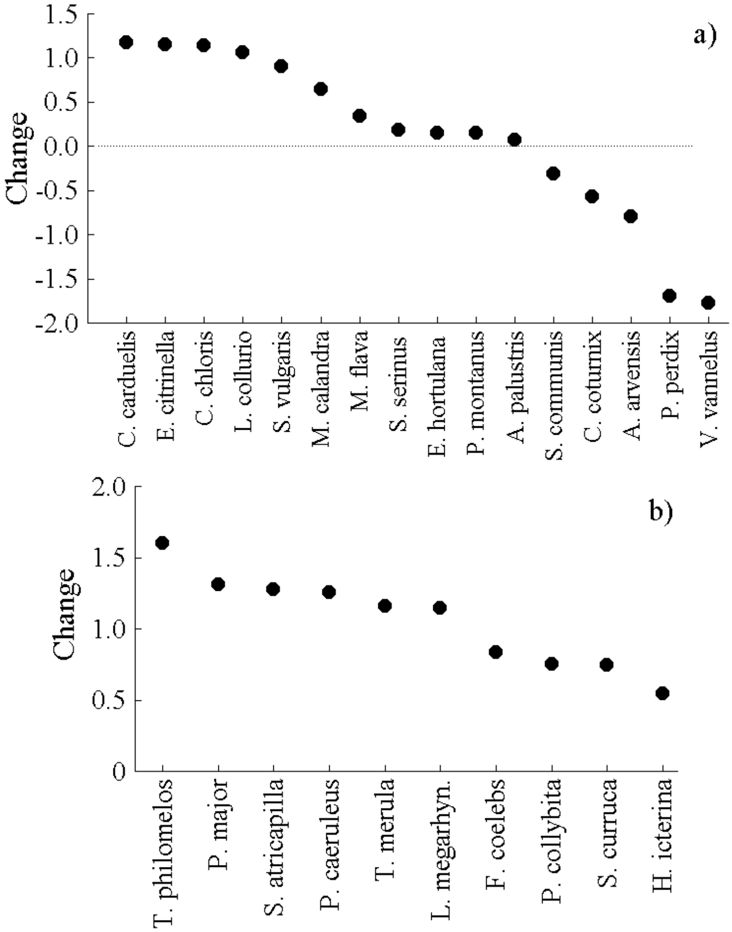

Fig. 1. Population changes of the most numerous species within two ecological groups of birds in the agricultural area of Wrocław Plain between 1977-1979 and 2001; a) agricultural birds; b) woodland species. Changes calculated on the base of diferences in the number of pairs between the two analysed periods (for details see Material and Methods).

occurring in the very structure of woodlots, i.e. trees decaying and appearance of holes attracting hole-nesters, mainly *S. vulgaris* and two species of tits (*Parus major* and *P. caeruleus*), but also *Passer montanus* – a farmland specialist (see Fig. 1). Another factor encouraging the population growth of woodland birds is undoubtedly the adaptation to and colonisation by some species (*T. merula*, *F. coelebs, H. icterina*) of the linear woody habitats, i.e. hedgerows containing trees. For example in 1977–1979 *T. philomelos* bred only in two largest farm woods (8.9 and 5.1 ha), while in 2001 it inhabited smaller woods (<1 ha), with 3 pairs nesting even in hedgerows. The increase of *S. atricapilla*, *L. megarhynchos*, *P. collybita*, *T. merula* (see Fig. 1), as well as of two species inhabiting villages – *P. ochruros* and *S. decaocto*, is generally in line with their population trends known from central Europe (V o ř í š e k et al. 2007).

In the light of the recently published data on the abundance changes of birds inhabiting European farmland (D o n a l d et al. 2006, V o ř í š e k et al. 2007) the results presented here are consistent only for the group of species nesting in the cropfields (fall) and built-up areas (rise). The data obtained for the remaining majority of farmland specialists contradict the earlier findings of the negative trends reported from elsewhere in Europe, as their abundance in Lower Silesia actually went up. The increase of the main indices of agricultural production reported for central Europe (new EU member states) in recent years (FAOSTAT 2007), may herald the progressing impoverishment of natural resources within farmland in this part of the continent, one of its first symptoms being the decline of the species nesting in cropfields. At the same time, it can be assumed that the habitat loss and reduction of landscape diversity, i.e. removal of hedgerows, small farm woods and other non-cropped biotopes will be only the next stage of agricultural intensification. However, as described in the present study, the area of non-farmed habitats actually increased here over the last 30 years, contributing to the rise of bird abundance. Therefore, the present paper, like many other earlier publications (G i l l i n g s & F u l l e r 1998, e.g. F u l l e r et al. 2004), highlights the enormous role of the non-cropped areas within arable landscapes as bird refuges and calls for the preservation of these landscape elements as biodiversity hotspots. The enhancement of non-cropped habitats requires however the ecological education and the introduction of some financial incentives for farmers, for example within the agri-environmental schemes. It must be noticed though, that the study results from other parts of Poland carried out after 2000, point to the progressing decline of farmland birds, with only slight or absent changes of habitat structure (G o ł a w s k i 2006, C h y l a r e c k i & J a w i ń s k a 2007, K u j a w a 2008), what may indicate that not only intensively land use is responsible for decline of birds associated with farmed landscapes.

A c k n o w l e d g e m e n t s

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