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The composition and dynamics of a wintering bird community in an agricultural area of western Poland

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Abstract. The avifauna of an agricultural area near Wolsztyn (W Poland) was studied in winters 1987/8 to 1992/3, by way of 8–11 visits made each season between November 27th and March 1st. 39 bird species (15–22 per season) were noted within the 56.2 ha study plot, and a total of 57 in the whole area of 315 ha. Dominants were *Emberiza citrinella*, *Miliaria calandra*, *Passer montanus*, *Alauda arvensis* and *Carduelis cannabina*, which together accounted for 64% of the community on average. Species recorded most frequently were *E. citrinella* and *Parus major*, noted on respectively 53% and 57% of the visits made. There was a significant correlation between the frequency with which a species was recorded and its abundance (r = +0.67), while the densities of birds in different 5-day periods ranged from 1.6/10 ha at the end of February to 15.7/10 ha in late November/early December. The mean density was 7.2/10 ha. Habitats preferred by birds were mid-field tree cover and fallow land, while arable fields were avoided.

Key words: agriculture, farmland, wintering birds, western Poland

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INTRODUCTION

The birds wintering in the agricultural landscape of the western Poland have been studied by Górski (1976) and Wiatr (1975), as well as more recently by Kujawa (1995), albeit in this case with the focus on forests and mid-field woods. However, these studies resembled others done in Poland (Jabłoński 1972, Jermaczek 1980, Witkowski 1964) in continuing for only 1–3 winters, and in thus providing little information on the dynamics of bird communities through a season or on structural changes in successive years.

The aim of the 6-year study described here was thus to investigate the compositional and structural dynamics of a wintering bird community, and to determine the factors conditioning species composition and abundance where such communities occur in agrocoenoses.

STUDY PLOT AND METHODS

The research involved an agricultural area near Wolsztyn in the Wielkopolska region, western Poland (52°07′ N; 16°04′ E). 95.3% of the area is cultivated fields, with the remaining 4.7% made up of mid-field tree cover, ponds, roads and fallow land. The 56.2 ha study plot was typical in that 96% was under cultivation with a range of crops in the different seasons (Tab. 1). The plot featured 0.9 ha of mid-field tree cover (alder-ash carr), along with single trees by one of the roads and in several other areas. The areas occupied by these habitats varied with the agricultural work carried out in successive years, as did the area of fallow land (Tab. 1). The site is crossed by one made-up road, one field track and 5 power lines.

Fieldwork was done in the winters 1987/8 to 1992/3 inclusive, between 27 XI and 1 III each year. The total of 52 census visits included 8–11 annually

(mean 8.7 ±1.2) (Fig. 1), with birds counted between 07.30 and 11.30 and with the count-days chosen having few people in the fields and favourable atmospheric conditions. Counts basically involved a permanent route of broken lines covering the whole study area evenly. 1:5000 scale plans were used to note all observations, but subsequent analysis was confined to birds feeding or resting in the study plot, or else flying low over it. Birds in surrounding fields were also noted if within several hundred metres, with the result that c. 315 ha were actually censused. Data for each winter were assigned to 5-day periods in accordance with the numbering adopted by Berthold (1973).

Table 1. Characteristics of study plot. [1]roads, haystacks, fallow land, manure heaps; [2]shrubs and trees along ditches and roads, areas under trees.
[Tabela 1. Charakterystyka badanej powierzchni. [1]drogi, stogi, ugory, pryzmy obornika; [2]krzewy i drzewa wzdłuż rowów i dróg, zadrzewienie.]

Biotope	Area in ha and as percentage of total					
	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93
Cultivated fields:	54.87 (97.6)	53.86 (95.8)	53.97 (96.0)	53.85 (95.8)	53.99 (96.1)	53.97 (96.0)
winter crops	(65.2)	(27.6)	(24.4)	(27.9)	(27.9)	(44.1)
rape	–	–	(27.6)	(16.1)	(28.5)	(27.6)
alfalfa	(16.3)	(27.9)	(27.9)	–	–	–
unsown	(16.1)	(40.3)	(16.1)	(51.8)	(39.7)	(24.3)
fallow land[1]	1.18 (2.1)	1.19 (2.1)	1.17 (2.1)	1.28(2.3)	1.15 (2.0)	1.17 (2.1)
under trees[2]	1.15 (2.0)	1.15 (2.0)	1.06 (1.9)	1.06 (1.9)	1.06 (1.9)	1.06 (1.9)
drainage ditches [m]	1450	1450	650	650	650	650

RESULTS

Species composition

Winter records for the 56.2 ha plot involved 39 species, with totals for particular seasons of 15–22 (mean 19.0 ± 2.7 (Tab. 2). The total for the wider (315 ha) area was taken to 57 by a further 18 species: *Anser fabalis, A. albifrons, A. anser, Circus cyaneus, Falco cherrug* (accepted by Faunistic Commision; KF 3465/92), *Larus canus, Strix aluco, Eremophila alpestris, Anthus pratensis, Phylloscopus collybita, Aegithalos caudatus, Parus montanus, P. ater., Garrulus glandarius, Passer domesticus, Fringilla montifringilla, Carduelis flavirostris* and *Coccothraustes coccothraustes.*

3–7.5 species (mean 5.13 ±1.36) were actually noted in particular five-day periods of the winter. The maximum numbers for 5-day periods in the 6 seasons combined were 6–18 (mean 10.16 ± 4.04), with two peaks noted in the second and last 5-day periods of winter (Fig. 2), along with a further high at the end of an old year and beginning of a new one. No significant trends were noted for the numbers of species observed in successive seasons.

Dominance structure

Dominant species (accounting for >5% of total numbers) were *Emberiza citrinella, Miliaria calandra, Passer montanus, Alauda arvensis* and *Carduelis cannabina* (Tab. 2). Together, these accounted for 64% of the community. However, only *E. citrinella* was a dominant in each of the study years, with a further 9 species being dominant in some but not all.

Abundance

A total of 2090 individual birds were observed in the course of the research, with the range for a single winter being 230–430 and the mean density 7.2 individuals/10 ha.

Densities in the different five-day periods varied across an almost 10-fold range, from a maximum of 15.7 (in late November/early December) to a minimum of 1.6 (at the end of February). There was however no significant straight-line trend to the changes occurring in successive five-day periods (Fig. 3).

The courses of the non-linear changes describing the abundance and number of species in a 5-day period were similar, but the variables were not in fact correlated together (r = 0.03 and 0.08 for the mean and maximum number of species, p > 0.05). Similarly, densities and the number of bird species observed in a given season were not correlated either (r = 0.05, p > 0.05).

Finally, there was also no statistical significance to the trend observed for the mean abundance of birds in successive years.

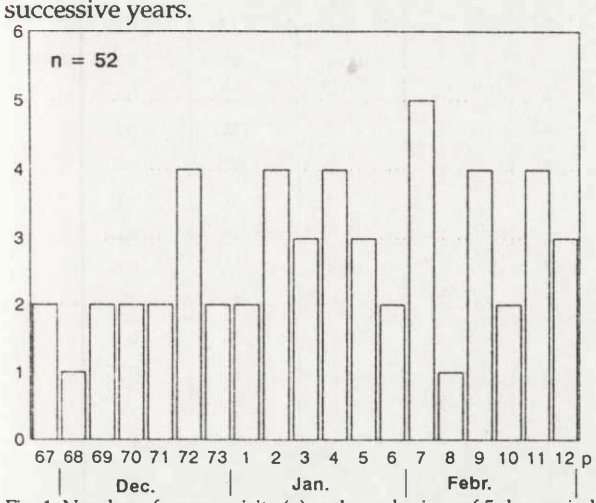

Fig. 1. Number of census visits (n) and numbering of 5-day periods (p) in all study seasons.

[Rys.1. Liczba kontroli (n) dokonanych w poszczególnych pentadach; p — numeracja pantad.]

Frequency of occurrence

For all seasons combined, the mean frequency of occurrence of a species (i.e. the % of counts during which it was observed) was 12.69 ±15.45. The maximum and minimum frequencies were 2 and 63%. The occurrence of different species in successive years was very variable with even the most abundant (*Emberiza citrinella*) being noted on no more than 2 out of every 3 counts. Values for this measure varied considerably in successive seasons (Tab. 3) and frequency of occurrence was significantly correlated with the population density of a species (r = 0.67, p < 0.001).

Habitat preferences

Birds were distributed unevenly across the different environments, and even in fields with different types of cultivation. The greatest number of species (22 or 56% of the community) were noted in areas with trees, and it was in these habitats that there occurred the most species (15) not observed in other environments (namely *Dendrocopos minor, Troglodytes troglodytes, Turdus merula, T. pilaris, T. viscivorus, Parus palustris, P. montanus, P. caeruleus, Sitta europea, Certhia brachydactyla, Pica pica, Serinus serinus, Carduelis spinus,*

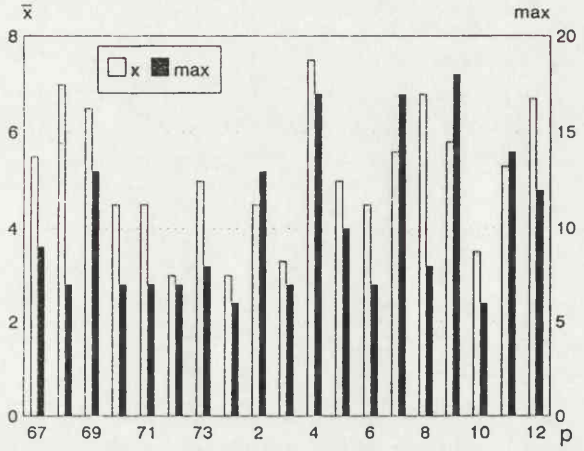

Fig.2. Mean (x̄) and maximal (max) number of species in particular 5-day periods (p).

[Rys.2. Średnia (x̄) i maksymalna (max) liczba gatunków stwierdzonych w poszczególnych pentadach.]

C. flammea and *Pyrrhula pyrrhula*). A total of 19 species (or 48.7% of the total) were recorded from open cultivated fields. Fields associated with particular crops had between 10 and 14 species (in the cases of alfalfa and winter crops respectively). 8 species were exclusive to field habitats, but only one — *Plectro-*

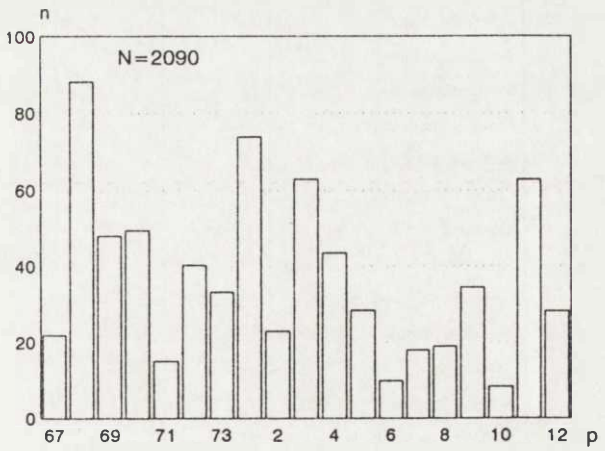

Fig. 3. Mean number of individuals (n) in particular 5-day periods (p).

[Rys.3. Średnia liczba osobników (n) notowana w poszczególnych pentadach (p).]

Table 2. Wintering avifauna of agriculture area near Wolsztyn. P — birds observed near the study plot.
[Tabela 2. Awifauna zimowa terenu rolniczego koło Wolsztyna. P — ptaki obserwowane w pobliżu powierzchni.]

Species	Individuals						Σn	ind/10ha
	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93		
Emberiza citrinella	79	48	90	52	136	165	570	2.0
Miliaria calandra	5	23	24	116	6	110	284	1.0
Passer montanus	P	P	107	8	P	77	192	0.7
Alauda arvensis		34	58	1	62	1	156	0.5
Carduelis cannabina	2	121	12				135	0.5
Parus major	5	31	25	19	18	2	100	0.3
Carduelis spinus	64		6	P	24	4	98	0.3
Corvus frugilegus	5	59	1		1	14	80	0.3
Carduelis chloris	P	12	1	12	53	P	78	0.3
Parus caeruleus	2	13	11	8	14	7	55	0.2
Fringilla coelebs	P	6	31	1	3	9	50	0.2
Corvus monedula	14	20				8	42	0.1
Buteo buteo	6	6	7	7	5	7	38	0.1
Perdix perdix	P	P	6	19		10	35	0.1
Carduelis carduelis	P			P	35	P	35	0.1
Turdus pilaris	33				1	P	34	0.1
Corvus corax	3	3			7	3	16	0.1
Lanius excubitor	P	1	1	4	2	5	13	+
Turdus merula	2		2	4	4		12	+
Vanellus vanellus		P	10				10	+
Corvus corone	P	P		1	2	4	7	+
Fringilla montifringilla			6	P			6	+
Pica pica	1			2	1	1	5	+
Sturnus vulgaris	2		3		P	P	5	+
Buteo lagopus	2	P	1	P		1	4	+
Serinus serinus					4		4	+
Falco columbarius		P	3				3	+
Falco tinnunculus	2		1				3	+
Parus palustris		2			1		3	+
Pyrrhula pyrrhula				3			3	+
Accipiter gentilis		1		1			2	+
Certhia brahydactyla			1			1	2	+
Dendrocopos minor				2			2	+
Parus montanus	P				2		2	+
Troglodytes troglodytes	2						2	+
Turdus viscivorus	1						1	+
Sitta europea					1		1	+
Acanthis flammea				1			1	+
Plectrophenax nivalis						1	1	+
Total ind.	230	380	480	261	382	430	2090	
Species	18	15	22	18	22	19	39	
ind./census	28.8	47.5	37	29	47.8	53.8	40.2	7.15

phenax nivalis — was confined to just one type of cultivation (winter crops). The remaining species only observed in fields were *Accipiter gentilis*, *Perdix perdix*, *Vanellus vanellus*, *Alauda arvensis*, *Corvus corax*, *C. monedula* and *Lanius excubitor*. Appearing on fallow land were 11 species, including 2 (*Passer montanus* and *Carduelis carduelis*) found nowhere else.

Table 3. Frequency of occurrence (% of census visits on which recorded) for 10 most numerous species in successive study seasons.

[Tabela 3. Frekwencja (% kontroli podczas których obserwowano gatunek) 10 najliczniejszych gatunków w kolejnych sezonach badań.]

Species	1987/88	1988/89	1989/90	1990/91	1991/92	1992/93	$\bar{x}$
Emberiza citrinella	62	62	72	33	87	62	63
Miliaria calandra	12	37	27	22	25	50	28
Passer montanus	0	0	27	11	0	25	11
Alauda arvensis	0	25	27	11	62	12	23
Carduelis cannabina	12	25	27	0	0	0	11
Parus major	37	87	54	55	87	25	57
Carduelis spinus	25	0	9	0	25	12	11
Corvus frugilegus	25	50	9	0	12	25	19
Carduelis chloris	0	25	11	11	37	0	13
Parus caeruleus	25	25	63	55	75	50	50

The highest bird densities, reported from fallow land and areas with trees, were more than 25 times greater than those noted for fields (Tab. 4). The observed distribution of birds between habitats differed significantly from that expected (chi-square = 16671, $p < 0.001$), allowing fallow land and areas with trees to be considered preferred habitats for birds.

DISCUSSION

Broad differences in study techniques make it difficult to compare results obtained for the wintering of birds in Europe's agricultural areas. Methods applied include atlas methodology (Moller 1984), point counts (Telleria & Santos 1985, Fedrigo *et al.* 1989), transect counts (Pavelka 1990, Kujawa 1995) and methods based on mapping (Busche 1983). Furthermore, it is not only the methods which differ, since the intensity of surveying through the winter also varies, in this case from a single count in late December/early January (Moller 1984, Tucker 1990) to the 3–5 counts per month made between late November and the beginning of March by Górski (1976), Tucker (1990, 1992) and the author of the present paper.

The study plot may be considered species-rich when compared with other study areas in Central Europe (Tab. 5). This fact is presumably linked to the intensive mapping methods employed, as well as to the duration of the present study (6 seasons as opposed to 1–3 in the cases of other authors). The number of species recorded did rise as the years passed, with a mean of 4.2 ±2.2 species being added each year as part of a trend ($p < 0.001$; $r = 0.98$, $y = 4.4x + 14.9$). There was a decline in the number of new species added to the overall list in successive winters, but the downward trend did not achieve statistical significance ($r = -0.80$, $y = -1.1x + 7.5$; $n = 5$; $p > 0.05$). Part of the reason for this lay in the changes in meteorological conditions in successive winters. Warm winters saw species like *Vanellus vanellus*, *Fringilla montifringilla* and *Serinus serinus* stay on, while cold ones saw their places taken by visitors from north-eastern Europe (e.g. *Buteo lagopus*, *Falco columbarius* and *Pyrrhula pyrrhula*). Such conditions also increased the chances of encounters with rare species (e.g. *Acanthis flammea* and *Plectrophenax nivalis*), especially since many show 5-year cyclicity in their appearances (Mason 1989).

Use of data from successive pairs of years only would have limited the number of species to around 27, a figure similar to that noted in other areas of

Central Europe. However, the 57 species recorded for the whole 315 ha area makes it Europe's richest. Data from Table 5 show no correlation between the number of species and the size of an area (r = –0.08; NS), and the correlation between sample size (number of individuals in a community) and number of species is also non-significant (r = –0.24; NS), attesting to the lack of any link of the kind emphasized in American studies on the birds wintering in forests (Engstrom & James 1981).

Table 4. Habitat preferences of wintering bird community on study plot. PT — total fields, O — winter crops, R — rape, L — alfalfa, B — unsown, N — fallow lands, Z — mid-field tree cower; Preference (p) or lack of preference for distinguished habitat ("+" or "–") determined using chi-square test: *** p<0.001, ** p<0.01, * p<0.05.

[Tabela 4. Wybiórczość siedliskowa zimującego zgrupowania ptaków na badanej powierzchni. S — łączna liczba gatunków, S/season — średnia liczba gatunków w ciągu 1 zimy, (S) — liczba gatunków wyłącznych. PT — pola łącznie, O — ozimina, R — rzepak, L — lucerna, B — bez zasiewu, N — nieużytki, Z — zadrzewienia. Preferencję (P) bądź jej brak względem wyróżnionego siedliska („+" lub „–") ustalono przy użyciu testu chi-kwadrat i jej istotność oznaczono gwiazdkami: *** p<0.001, ** p<0.01, * p<0.05.]

	Species			Individuals		
	S	S/season	(S)	n	n/10ha	P
PT	19	9.2±1.9	8	795	0.5	–***
O	14	3.4±2.6	1	253	0.4	–***
R	11	4.3±1.7	0	140	0.5	–***
L	10	5.7±3.5	0	192	0.9	–**
B	13	5.8±1.9	0	210	0.4	–***
N	11	4.2±0.8	2	722	19.4	+***
Z	22	9.5±2.9	15	426	12.5	+***

Areas in Germany and the Czech Republic are seen to have respectively 4–5 and 2.5 times the number of individual birds recorded in the fields of western Poland (Tab. 5). However, the great differences between the areas in a country (6.7–37.0 individuals/ha in Germany and 7.2–195.6/ha in Poland) suggest that geographical location does not have a decisive influence on the sizes of bird populations wintering in Central Europe.

Many authors (like Farina 1989, Górski 1976, Tucker 1992, Wiatr 1975) have considered the occurrence and availability of food to be the main factor influencing the populations of birds in field environments in winter. The low densities of birds reported in this study may be accounted for by the small size of the areas having most influence on populations, namely the mid-field tree cover most important for insect-eating birds (Kujawa 1995) and the weed-covered fallow land determining the numbers of seed-eaters (Górski 1976, Wiatr 1975, Witkowski 1964). The influence of the structural diversity of the area was also clear, with most species and individuals gathering on fallow land and in tree

Table 5. Data on wintering bird communities in study plots in Central Europe; *) excluding species noted only in woodland interior; density concerns mid-field tree cover only.

[Tabela 5. Dane o zimowych zgrupowaniach ptaków na badanych powierzchniach w Europie Środkowej; *) wyłączono gatunki odnotowane tylko wewnątrz kompleksów leśnych; zagęszczenie dotyczy tylko zadrzewień śródpolnych.]

Locality (country)	Area (ha)	Species	ind./ 10ha	Author
Wrocław (PL)	2000	25	5.6	Witkowski (1964)
Kraghede (DK)	1701	34	no data	Moller(1984)
Stęszew (PL)	1000	29	8.3	Górski (1976)
Wolsztyn (PL)	315	57	no data	niniejsza praca
Swarzędz (PL)	280	29	14.3	Górski (1976)
Kosieczyn (PL)	200	24	7.8	Jermaczek(1982)
Mannheim (D)	140	42	22.3	Handke & Handke(1982)
Heide (D)	96.1	36	36.6	Busche(1983)
Alsdorf (D)	95.3	55	27.8	Hennes(1984)
Klembów (PL)	95	24	7.6	Jabłoński(1972)
Hanan (D)	72.5	37	37.0	Klein(1979)
Luneburger (D)	71.4	15	6.7	Pailer & Schnebel(1971)
Wolsztyn (PL)	56.2	39	7.2	niniejsza praca
Rostock (D)	50	27	34.2	Plath(1978)
Turew (PL)	50	36	73	Kujawa(1995)*
Luboń (PL)	25	16	195.6	Górski(1976)
Westerwald (D)	14.9	29	20.3	Kunz(1986)
Leskowe (CZ)	10.8	20	18.3	Pavelka(1990)

cover. Taken together, the two habitats accounted for only 4% of the study area, but supported 79.5% of the wintering species and 59.1% of the individuals (Tab. 4). Similarly, the alfalfa fields supported proportionally the most individuals and the winter crops proportionally the fewest (Tab. 4).

Just as the overall density is lower in the present study plot than in others, so the density of particular

species is also lower, albeit with the fundamental composition of the groupings being similar in all the Central European areas considered. The core species are *Emberiza citrinella, Passer montanus, Alauda arvensis* and *Carduelis cannabina*, as well as *Carduelis chloris* and *Corvus frugilegus* locally. Noteworthy on the study plot was the significant role of *Miliaria calandra*. Putting this observation together with data from Górski (1976), it may be suggested that this species is characteristic of the cultivated fields of Wielkopolska in winter. Subject to greater variation is the group of supplementary species whose representation fails to reach 0.5%.

The three peaks noted in the course of the winter for the size of the bird community in the Wolsztyn area are reminiscent of the trends indicated by Górski (1976) and Jermaczek (1982). The similarity reflects the proximity of the areas studied.

Significant directional changes in the number of species or mean population sizes were not observed in the 6 years of the study.

CONCLUSIONS

1. Studies of the winter avifauna of 56.2 ha of field habitat revealed a total of 39 species, with a further 18 noted in surrounding fields (total area 315 ha). This is a high figure when compared with data from other field areas of Central Europe and is to a great extent a reflection of the intensity and duration of the study (8–11 counts/season over 6 years).

2. The core community of *Emberiza citrinella, Miliaria calandra, Passer montanus, Alauda arvensis* and *Carduelis cannabina* accounted for 64% of the total number of individuals recorded.

3. At 7.2/10 ha, the overall density of birds was similar to those reported for western Poland, and amongst Central Europe's lowest.

4. The factors considered to have most influence on the distribution and numbers of birds are feeding conditions, as well as the structure of the land surface — where this afforded birds protection from predators and hostile atmospheric conditions. The result was the preference shown by birds for fallow land and mid-field tree cover, as well as their general avoidance of open cultivated fields.

5. The species richness and population size of the bird community followed similar trends in the course of the winter, but the number of species in a 5-day period was not correlated with the mean number of birds.

6. Significant trends were not noted across the 6-year study period for either the number of species or the mean density of birds.

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STRESZCZENIE

[Skład i dynamika zgrupowania ptaków zimujących na terenie rolniczym w zachodniej Polsce]

Praca przedstawia wyniki liczeń awifauny zimowej w ciągu 6 sezonów (1987/88–1992/93) na powierzchni (56.2 ha) położonej w środowisku polnym koło Wolsztyna (zachodnia Wielkopolska). Prawie 96% powierzchni stanowiły otwarte pola uprawne, natomiast pozostałą część stanowiły drzewa (zadrzewienie śródpolne, aleja i nieużytki (tab. 1).

Liczenia w każdym sezonie (8–11) wykonano przy użyciu metody kartograficznej, w terminach od 27 listopada do 1 marca (ryc. 1).

Stwierdzono łącznie 39 gatunków (tab. 2), a na polach otaczających powierzchnią (razem 315ha) dalszych 18. W poszczególnych sezonach notowano 15–22 (śr. 19.0) gatunki. Dominantami były: *Emberiza citrinella*, *Miliaria calandra*, *Passer montanus*, *Alauda arvensis* i *Carduelis cannabina*, stanowiące łącznie 64% zgrupowania.

Stwierdzono zagęszczenie średnio 7.15 osobn./10ha/1 liczenie. Skład gatunkowy i liczebność zgrupowania charakteryzowały się podobnymi krzywymi dynamiki w ciągu zimy (ryc. 2 i 3). Mimo to liczby gatunków nie były istotnie skorelowane ze średnimi liczebnościami ptaków w poszczególnych pentadach.

Liczba stwierdzonych na powierzchni gatunków należy do najwyższych w Europie Środkowej. Jest to w dużej mierze wynik intensywności i długotrwałości badań. Różnice w składzie gatunkowym porównywanych powierzchni dotyczą przede wszystkim gatunków dodatkowych (poniżej 0.5% udziału). Natomiast trzon awifauny stanowią zasadniczo te same gatunki, choć na badanej powierzchni zwraca duży udział *Miliaria calandra*. Gatunek ten uznano za charakterystyczny dla pól Wielkopolski w okresie zimowym, uwzględniając również dane Górskiego (1976).

Zagęszczenie ptaków stwierdzone na badanej powierzchni należy do najniższych w Europie Środkowej, jest natomiast podobne do innych notowanych w Polsce (tab. 5). Czynnikiem decydującym o liczebności ptaków była obfitość dostępnego pokarmu, a także sama struktura terenu, zapewniająca możliwość ochrony przed drapieżnikami i niekorzystnymi czynnikami atmosferycznymi. Większość ptaków odnotowano na nieużytkach i w zadrzewieniach śródpolnych. Mimo, że łącznie stanowiły one ok.4% powierzchni to stwierdzono tu 79.5% stwierdzonych gatunków i 59.1% osobników (tab. 4). Ptaki unikały otwartych pól, jednak w nierównym stopniu — najwięcej osobników względem liczby spodziewanej zanotowano na uprawie lucerny, a najmniej na oziminie (tab. 4).

W ciągu 6 lat badań nie odnotowano kierunkowych zmian liczby gatunków i średniej liczebności ptaków.

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