

Zenon LEWARTOWSKI and Krzysztof WOŁK

**Breeding avifauna of a moss-spruce forest and related habitats in the Białowieża  
Primeval Forest**

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Results of one-year studies by the mapping method of breeding communities of birds in a boreal forest association *Sphagno Girgensohnii-Piceetum*, and in adjacent associations: *Carici elongatae-Alnetum* and managed 7–15 year old alder forests in spruce forest habitat, are presented. Total density of birds in the complex of habitats surveyed amounted to 60 pairs/10 ha. The following species were dominant: *Fringilla coelebs*, *Erithacus rubecula*, *Phylloscopus collybita*, *Sylvia atricapilla* and *Regulus regulus*. Of rare breeding species the following were found: *Accipiter nisus*, *Dendrocopos leucotos*, *Picoides tridactylus*, *Carduelis spinus* and *Loxia curvirostra*. The natural bird community of the moss-spruce forest was found to have changed as a result of the small area of the plot and the neighbourhood of managed forests.

Z. Lewartowski, K. Wolk, Department of Nature Protection, Institute of Forestry Studies, 17–230 Białowieża, Poland.

Гнездовая авифауна сфагнового ельника и родственных типов леса в Беловежской пуще.

Представлены результаты одногодичных подсчетов по картографическому методу гнездовых комплексов птиц бореального лесного сообщества *Sphagno Girgensohnii-Piceetum* и соседних с ним сообществ *Carici elongatae-Alnetum* и *Circaeo-Alnetum*, а также эксплуатируемых 7-15-летних зарослей черной ольхи, произрастающих на биотопе ельника после его вырубki. Плотность птиц в комплексе исследованных биотопов составляла в общем 60 пар/10 га. Доминировали виды: *Fringilla coelebs*, *Erithacus rubecula*, *Phylloscopus collybita*, *Sylvia atricapilla* и *Regulus regulus*. Из редких гнездящихся видов констатированы: *Accipiter nisus*, *Dendrocopos leucotos*, *Picoides tridactylus*, *Carduelis spinus* и *Loxia curvirostra*. Констатировано, что в результате малой площади и соседства с эксплуатируемыми лесами, комплекс авифауны бора подвергся частичному отклонению от естественного состояния.



Relatively numerous boreal elements are one of characteristic features of the Białowieża Primeval Forest. Especially interesting is the association of *Sphagno Girgensohnii-Piceetum*, similar to boreal spruce forests, occupying analogous habitats in northern and eastern Europe. This association, as distinguished by POLAKOWSKI (1962), occurs in Poland within boundaries of the lowland range of *Picea abies* (POLAKOWSKI 1962, CZERWIŃSKI 1968, SOKOŁOWSKI 1966, 1979, 1980). For the protection of this forest association in the managed part of the Białowieża Primeval Forest a number of reserves have been established (SOKOŁOWSKI 1966).

The present paper is a part of a research programme on the avifauna of the Białowieża Primeval Forest — which has been carried out in the managed forest and in the Białowieża National Park (TOMIAŁOJĆ *et al.* 1977). It concerns the avifauna of a complex of habitats found in a peat depression *Sphagno Girgensohnii-Piceetum*, *Carici elongatae-Alnetum* and *Circaeo-Alnetum*, as well as young alder forests growing in the habitat of spruce forest. A stress has been laid upon the form and completeness of data presentation, restricting comparisons and conclusions to results connected only with the studies presented.

#### METHODS

The census plot was censused by a combined modification of the mapping method (TOMIAŁOJĆ 1980a, 1980b). The data were collected during 8 censuses between 19 April and 21 June 1977. Average duration of the census was 126 min per 10 ha, thus during the whole season each 10 ha of forest was observed for 17 hours.

Possibilities of various interpretations of species maps were reflected in the accuracy of bird pairs estimation (Table 1). For a number of species, according to the data, only classes of numbers could be given. For the calculation of the density and dominance the medium numbers of a class have been taken into account. However, by constructing the territory distribution maps (Figs. 2–4) doubts concerning the occurrence of some pairs were ignored, and the upper level of estimates was accepted. One should emphasize that the idea of “pairs per 10 ha” and other use of the word “pairs” in reality signifies the number of territories of males or pairs. If a territory was occupied by birds on at least two or three dates, it was considered as an occupied territory. This rule was not observed rigorously, and in the case of one of the territories occupied by *Locustella fluviatilis* an assumption has been made of its existence from one record at the beginning of June, which can be supported by MACKOWICZ's data (1977).

For comparisons of the degree of similarities of bird communities, the species composition similarity index (QS) (TOMIAŁOJĆ 1970) and index of



similarity of densities (PZ), as proposed by WESOŁOWSKI (1975), were used. As dominant species are considered those species which are represented by over 5% of pairs in the community.

In Figures 2 and 3 the distribution of dominant species territories is presented. These are only approximates, most probable on the basis of the gathered data. Figure 4 presents, in a more simplified way, the distribution of pairs of other species, ignoring only several species with very big territories.

#### DESCRIPTION OF STUDY AREA\*

The Głębokki Kąt reserve, where the research was carried out, has been established to protect the *Sphagno Girgensohnii-Piceetum* association together with other associations similar to the natural ones, providing a kind of protective zone. The reserve is located in the Hajnówka forest administrative unit, district Leśna; it covers compartments 414 C, and 439 A a–g. The sampling plot covered 36.3 ha — almost 70% of the reserve area and adjacent managed forests (fragments of compartments 414 C g, h, i; 439 B c, f, g). Its detailed localisation is presented in Figure 1. This area is situated within the forest complex at a distance of about 3 km from the western edge of the Białowieża Forest. Its terrain is even, and consists of peat soils. The ground water level is usually not deep (10–20 cm). Within the boundaries of the sampling plot there are main forest associations, typical of such set of habitat conditions. On account of the diversity of the avifauna, the area in question has been divided into three habitat types (Fig. 1):

A — Bog moss-spruce forest — area of 19 ha. It is similar to the natural association *Sphagno Girgensohnii-Piceetum*, subassociation *dryopteridetosum*, showing a certain similarity to *Alnetum*. The stand consists mostly of *Picea abies* which represents 80–90% of the stand and only in a few spots does its proportion decrease to 50%. Other components area: *Pinus silvestris* 10–20%; *Alnus glutinosa* usually occurs sporadically, and only in some parts of the plot edge does it represent up to 50%; *Betula pubescens* — occurs singly; *Fraxinus excelsior* is sporadic only. The under storey is developed only in a section north of a road that runs across this area. The age of the stand is 110–120 years, that of *Pinus silvestris* — even 200 years. The stand height is 23–28 m; its density is moderate, interrupted or loose. The coniferous forest interior is more shady than the adjacent *Alnetum* forests. In the coniferous forest the shrub layer covers about 30–40% of the area. It is 1–5 m high, and consists of *Picea abies*, *Corylus avellana*, and more sparse *Quercus robur*, *Carpinus betulus*, *Betula pubescens*, *Alnus glutinosa*, *Fraxinus excelsior* and *Sorbus aucuparia*. This layer is best developed along the edges of the stand and near the road, in zones 50–150 m wide, but it is poorly developed inside the forest. The forest floor is covered mainly by mosses, the hummock-hollow structure of the forest floor being responsible for the distribution of the moss

\* Descriptions of habitats are based on papers by SOKOŁOWSKI (1966, 1976, 1979), unpublished data by Aleksander W. SOKOŁOWSKI and on "Plan of Forestry Management for the period of 1 October 1968 – 30 September 1978 for forests of the Białowieża Primeval Forest" (1976).



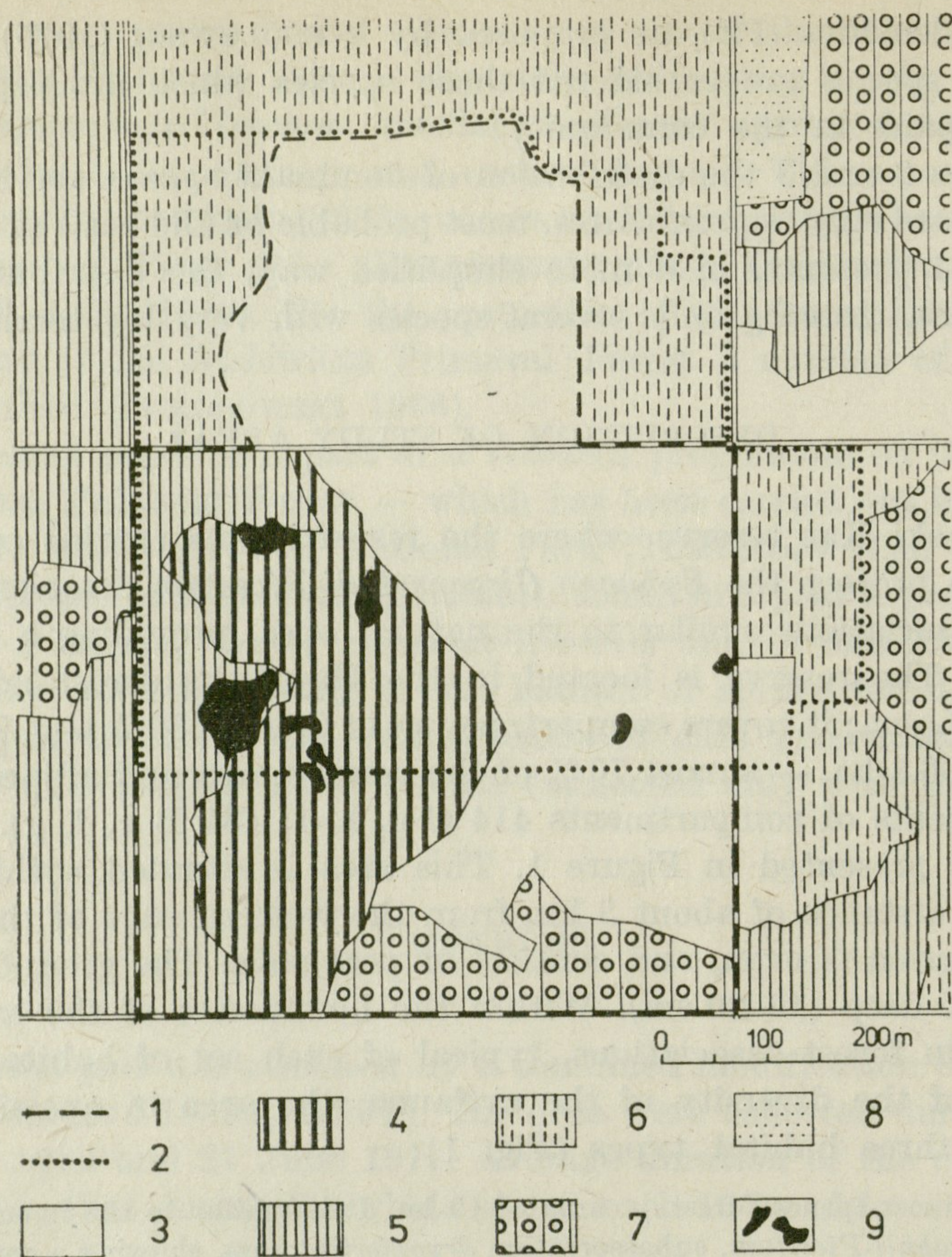


Fig. 1. Location of the census plot and diversity of habitats in the Głęboki Kąt reserve and its vicinity.

1 — reserve boundary; 2 — census plot boundary; 3 — *Sphagno Girgensohnii-Piceetum*; 4 — *Carici elongatae-Alnetum*; 5 — *Circaeo-Alnetum*; 6 — young alderwoods in the habitat of moss spruce forest; 7 — a mosaic of *Carici elongatae-Alnetum* and *Circaeo-Alnetum*; 8 — hunting plot; 9 — larger gaps in the stand.

layer components. The herb layer is rather poorly developed: the vegetation of this layer occurs sparsely and in small patches. There are numerous fallen trees in the forest. However, they are usually removed, as are dead standing trees. Numerous heaps of branches are left there.

Over considerable areas the bog moss-spruce coniferous forest has been changed as a result of forest management. The most evident changes are as follow: peat undergoes mineralisation, moss layer vanishes, herb and shrub layers begin to grow exuberantly. These changes have been much advanced on the eastern edges of the coniferous forest plot. Similar changes have occurred also along both sides of the road, framed by ditches that are about 80 cm deep. Here an additional reason for changes has been a lowering of the ground water level.

B — Alder carr and flood plain forest — area of 8.2 ha. Associations covering this



section of the study area are differentiated into a number of forms representing various stages of herb layer occupation by mosses. They form a successional series starting from typical *Carici elongatae-Alnetum* and *Circaeo-Alnetum* to *Sphagno Girgesohnii-Piceetum*. Due to a great structural similarity of these *Alnetum* associations and their intermingling in the area, they are discussed together in the analysis of the avifauna.

*Carici elongate-Alnetum* adjoins the coniferous plot, covering a surface of 5 ha; *Circaeo-Alnetum* covers a surface of 3.2 ha. Tree stand consists mainly of *Picea abies* and *Alnus glutinosa* (30, 60 % each). *Betula pubescens* only in some places represents up to 20 % of the stand and in the rest of the area it occurs singly, similarly to: *Fraxinus excelsior*, *Pinus silvestris*, *Carpinus betulus*, and several other species. The stand age is 80–120 years, and it is 20–29 m high. It has a multilayer structure and the structure of the lower layer is similar to that of the top layer. The *Alnetum* forests are more transparent than the coniferous forest, and the forest floor is more insolated. Several larger gaps (Fig. 1) add more light to the lower layers. The shrub layer, which consists mainly of *Picea abies* and *Alnus glutinosa*, covers about 20–40 % of the area. It forms a separated layer in *Circaeo-Alnetum* whereas in *Carici elongatae-Alnetum* it is highly dispersed. The forest floor is covered by rich vascular plant vegetation. *Urtica dioica* is especially abundant, forming here and there dense thickets. In forests described uprooted trees are encountered more often than in the coniferous forest.

C — Young alder forests — area of 9.07 ha. They are located in tree stand fragments adjacent to the area over-grown with coniferous forest. All fragments of alder forests are overgrown with young tree stands (age 7–15 years). The alder is predominant, and other species occur as single trees, or here and there in groups. These stands are 3–10 m high. Only in a fragment situated in the north-western part of the area among low alder trees, do 80-year old *Fraxinus excelsior* and *Alnus glutinosa* grow. The forest floor is covered by moss and herb layers with *Urtica dioica* covering 80–90 % of the area.

#### DESCRIPTION AND COMPARISON OF BIRD COMMUNITIES

Breeding community consisted of 47 bird species (Table 1); there were 36 species in the coniferous forest, 33 species in the *Alnetum* forests and 26 species in young alder forests. The higher number of species in the coniferous forest, as compared with *Alnetum* forests, results from the neighbouring of the fragment of forest with very different habitats. Along the boundary between the coniferous forest and the young alder-forest species characteristic of coniferous forest edges, shrubs and deciduous forests, are found. In fact, the avifauna of the pure coniferous forest is poorer (species number) than shown in Table 1 (cf. Figs. 2–4). The overall density of pairs for the set of habitats in question amounted almost to 60 pairs/10 ha. 5 dominant species represented almost 50 % of all pairs. They were: *Fringilla coelebs*, *Erithacus rubecula*, *Phylloscopus collybita*, *Sylvia atricapilla* and *Regulus regulus*. The density of bird community in the *Alnetum* forest was biggest (68 pairs/10 ha), exceeding the density of birds in the coniferous forest (57 pairs/10 ha) and young alder forests (55 pairs/10 ha). These differences resulted most probably from a better development of vertical stratification of the stands in the *Alnetum* forests, from numerous gaps and transparencies in the stands, as well as from a richer vegetation in the lower layers. This resulted in a relatively high density of a number



Table 1. Breeding avifauna communities in a census plot in the Głęboki Kąt reserve and its vicinity in 1977

Total plot area — 36.3 ha; Parts of the plot: A — *SphagnoGirgensohnii-Piceetum* (19.0 ha); B — *Carici elongatae Alnetum* and *Circaeo-Alnetum* (8.2 ha); C — young alder forests (9.1 ha); G — species that breed on the ground and up to a height of 1.5 m; T — species that build open nests above 1.5 m over the ground level; H — tree-hole nesting birds; + — occurrence lower than 0.5 pair; (+) — visits of species representatives without signs of territorial behaviour.

Species		Density (pairs/10 ha)				Number of pairs			
		A	B	C	A+B+C	A	B	C	A+B+C
<i>Fringilla coelebs</i>	T	11.8	14.0	1.7	9.8	22.5	11.5	1.5	35.5
<i>Erithacus rubecula</i>	G	8.4	5.5	6.1	7.2	16	4.5	5.5	26
<i>Phylloscopus collybita</i>	G	2.6	7.9	3.3	4.0	5	6.5	3	14.5
<i>Sylvia atricapilla</i>	G	2.1	7.3	4.4	3.9	4	6	4	14
<i>Regulus regulus</i>	T	5.0	4.3		3.6	9-10	3.5		12.5-13.5
<i>Prunella modularis</i>	G	3.4	3.1	1.7	2.9	6.5	2.5	1.5	10.5
<i>Troglodytes troglodytes</i>	G	3.2	3.1	1.1	2.6	6	2.5	1	9.5
<i>Sylvia borin</i>	G	0.3	1.8	8.3	2.6	0.5	1.5	7-8	9-10
<i>Turdus philomelos</i>	T	2.6	1.8	3.3	2.6	5	1.5	3	9.5
<i>Turdus merula</i>	T	1.8	2.4	1.9	2.0	3.5	2	1.5-2	7-7.5
<i>Phylloscopus sibilatrix</i>	G	3.2	1.2		1.9	6	1		7
<i>Locustella fluviatilis</i>	G		1.8	5.0	1.7		1-2	4.5	5.5-6.5
<i>Certhia familiaris</i>	H	1.6	2.4		1.4	2.5-3.5	2		4.5-5.5
<i>Carduelis spinus</i>	T	1.8	1.8	(+)	1.4	3-4	1-2	(+)	4-6
<i>Acrocephalus palustris</i>	G			5.0	1.2			4-5	4-5
<i>Hippolais icterina</i>	T			4.4	1.1			4	4
<i>Ficedula albicollis</i>	H	1.3	0.6		0.8	2-3	0.5		2.5-3.5
<i>Garrulus glandarius</i>	T	1.1	+	0.6	0.7	2	+	0.5	2.5
<i>Anthus trivialis</i>	G	0.3	1.2	0.6	0.6	0.5	1	0.5	2
<i>Oriolus oriolus</i>	T	0.3	0.6	1.1	0.6	0.5	0.5	1	2
<i>Muscicapa striata</i>	H	0.8	+	0.6	0.6	1-2	+	0.5	1.5-2.5
<i>Parus palustris</i>	H	0.3	1.8	(+)	0.6	0.5	1.5	(+)	2
<i>Parus cristatus</i>	H	1.1			0.6	2			2
<i>Pyrrhula pyrrhula</i>	T	1.1	(+)		0.6	2	(+)		2
<i>Columba palumbus</i>	T	0.5	0.9	(+)	0.5	1	0.5-1	(+)	1.5-2
<i>Anas platyrhynchos</i>	G			1.7	0.4			1-2	1-2
<i>Luscinia luscinia</i>	G			1.7	0.4			1.5	1.5
<i>Parus ater</i>	H	0.5	0.6		0.4	1	0.5		1.5
<i>Tringa ochropus</i>	G	+	+	+	0.3	+	+	+	1-1.5
<i>Streptopelia turtur</i>	T	0.3		0.6	0.3	0.5		0.5	1
<i>Lanius collurio</i>	G	(+)		1.1	0.3	(+)		1	1
<i>Sylvia curruca</i>	G			1.1	0.3			1?	1?
<i>Ficedula albicollis</i>	H	0.3	0.6		0.3	0.5	0.5		1
x <i>F. hypoleuca</i>									
<i>Aegithalos caudatus</i>	T		1.2	(+)	0.3		1	(+)	1
<i>Sitta europaea</i>	H	0.3	0.6	(+)	0.3	0.5	0.5	(+)	1
<i>Loxia curvirostra</i>	T	0.5	(+)		0.3	1	(+)		1
<i>Cuculus canorus</i>	T	+	+	+	0.2	+	+	+	0.5-1
<i>Dendrocopos major</i>	H	0.3	(+)	(+)	0.1	0.5	(+)	(+)	0.5
<i>Dendrocopos leucotos</i>	H		0.6	(+)	0.1		0.5	(+)	0.5
<i>Picoides tridactylus</i>	H	0.3			0.1	0.5			0.5



<i>Parus caeruleus</i>	H	(+)	0.6	(+)	0.1	(+)	0.5	(+)	0.5	
<i>Accipiter nisus</i>	T	+	+		+	+	+		+	
<i>Buteo buteo</i>	T	+	+	+	+	+	+	+	+	
<i>Tetrastes bonasia</i>	G	+		+	+	+		+	+	
<i>Scolopax rusticola</i>	G	+	+	+	+	+	+	+	+	
<i>Strix aluco</i>	H	+	+		+	+	+		+	
<i>Dryocopus martius</i>	H	+			+	+			+	
<i>Dendrocopos medius</i>	H		+		+		+		+	
Total			56.8	68.0	54.9	59.4	108	56	50	215.5
							(±2.5)	(±1)	(±2)	(±6)

of species breeding on the ground or low in shrubs in the *Alnetum* forests. It is well illustrated in Table 2: the density of birds of the "G" group was almost 10 pairs/10 ha higher in the *Alnetum* forests than in the coniferous forest. Analogously, the density differences between species breeding in open nests at a height over 1.5 m and those breeding in holes are very small. Because of the lack of a clearly differentiated layer of crowns in the young alder forests, there are no typically forest species and especially hole nesters; if they are present there, their densities are low. In the total density of bird community these deficiencies were considerably compensated by a high abundance of birds nesting on the ground and in low shrubs (41 pairs/10 ha; 74% of the community pairs).

The dominance structure of bird communities in the coniferous forest, and *Alnetum* forests is similar: in the coniferous forest 6 dominant species (*Fringilla coelebs*, *Erithacus rubecula*, *Regulus regulus*, *Prunella modularis*, *Troglodytes troglodytes*, *Phylloscopus sibilatrix*) jointly represented 62% of pairs; in the *Alnetum* forests — 5 species (*Fringilla coelebs*, *Phylloscopus collybita*, *Sylvia atricapilla*, *Erithacus rubecula* and *Regulus regulus*) represented 57% of pairs in the community. The differences observed in this respect between both communities are most probably connected with some "interchange" of species with well defined habitat requirements: in the coniferous forest the proportion of species associated with *Picea abies* and with a shady forest interior, whereas in *Alnetum* forests the proportion of the species associated with more transparent stands (e.g. *Phylloscopus collybita*, *Sylvia atricapilla*), is higher.

The bird community in young alder forests differed considerably from the above-described bird communities. Eight dominant species (*Sylvia borin*, *Erithacus rubecula*, *Locustella fluviatilis*, *Acrocephalus palustris*, *Hippolais icterina*, *Sylvia atricapilla*, *Phylloscopus collybita* and *Turdus philomelos*) jointly represented 72% of the community.

A comparison of bird communities in the study habitats with the similarity indices QS and PZ shows (Fig. 5) 1. the species compositions of bird communi-



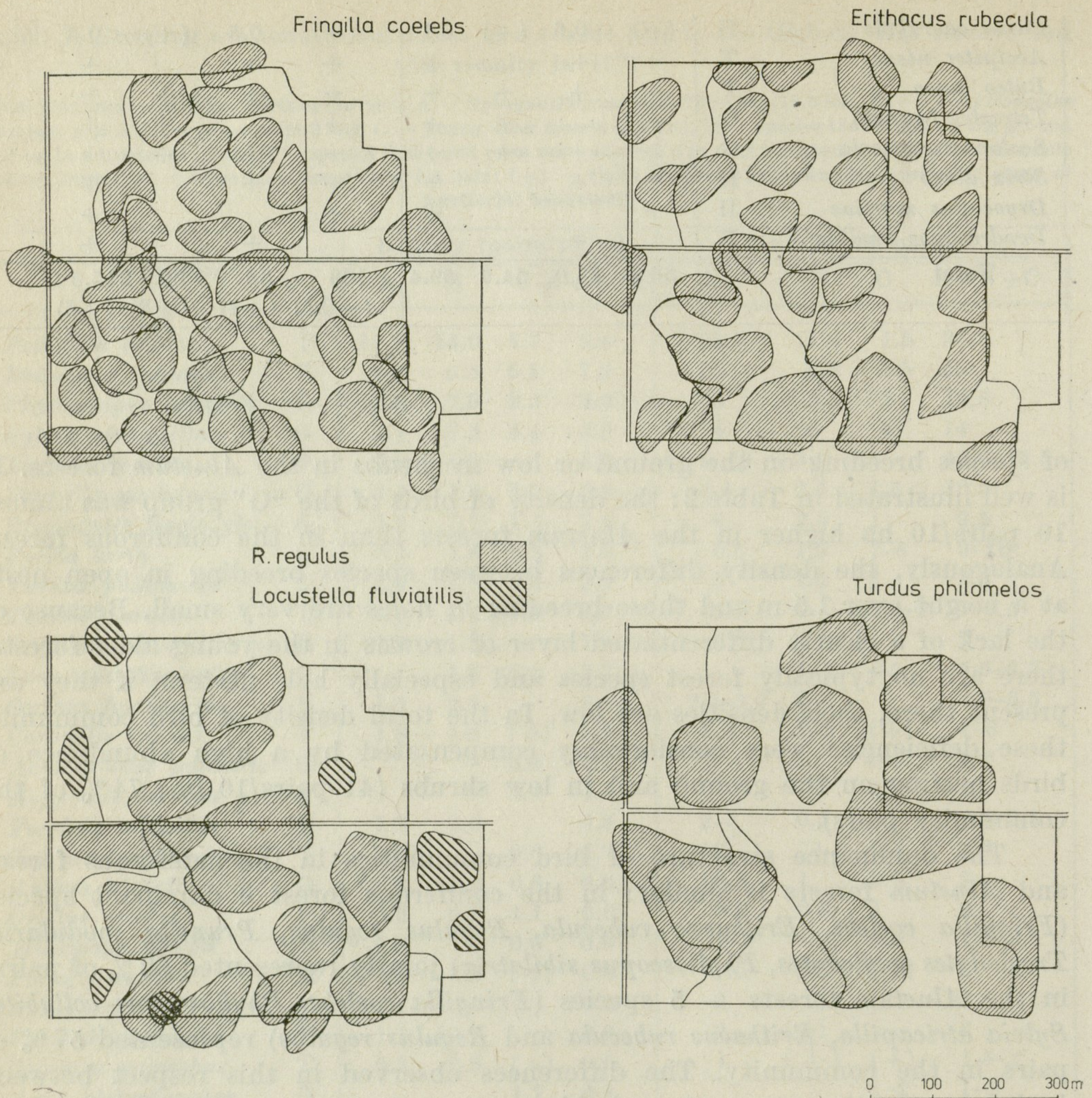


Fig. 2. Distribution of territories in the census plot in 1977: *Fringilla coelebs*, *Erithacus rubecula*, *Regulus regulus*, *Locustella fluviatilis* and *Turdus philomelos*.

ties in spruce forests and *Alnetum* forests are very similar, but they differ much from the species composition in young alder forests; 2. the quantitative structure of bird communities is different in each of the three habitats studied.

It should be added that the deviation of the bird community structure, typical of pure natural habitats, resulted from man-made changes in the habitats studied. This problem is explained in more detail in the next section of this paper.



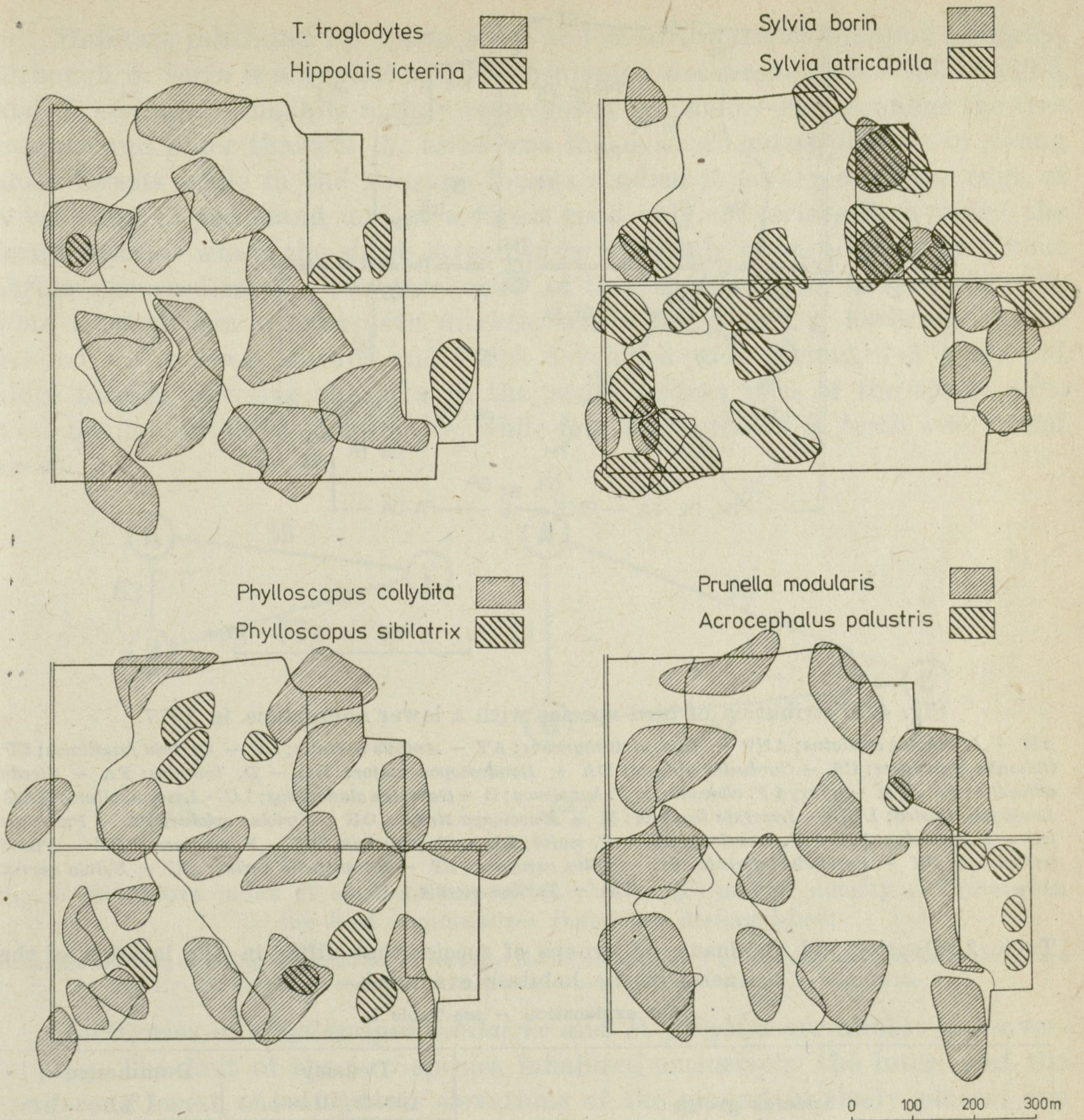


Fig. 3. Distribution of territories in the census plot in 1977: *Troglodytes troglodytes*, *Hippolais icterina*, *Sylvia borin*, *S. atricapilla*, *Phylloscopus collybita*, *P. sibilatrix*, *Prunella modularis* and *Acrocephalus palustris*.

### DISTRIBUTION OF BREEDING TERRITORIES

The distribution of territories of all species occurring as dominants at least in one of the habitats studied is shown in maps (Figs. 2 and 3). Attention is drawn to the fact that in the high coniferous forest stands and in the *Carici elongatae-Alnetum* and *Circaeo-Alnetum* the territories of *Fringilla coelebs*,



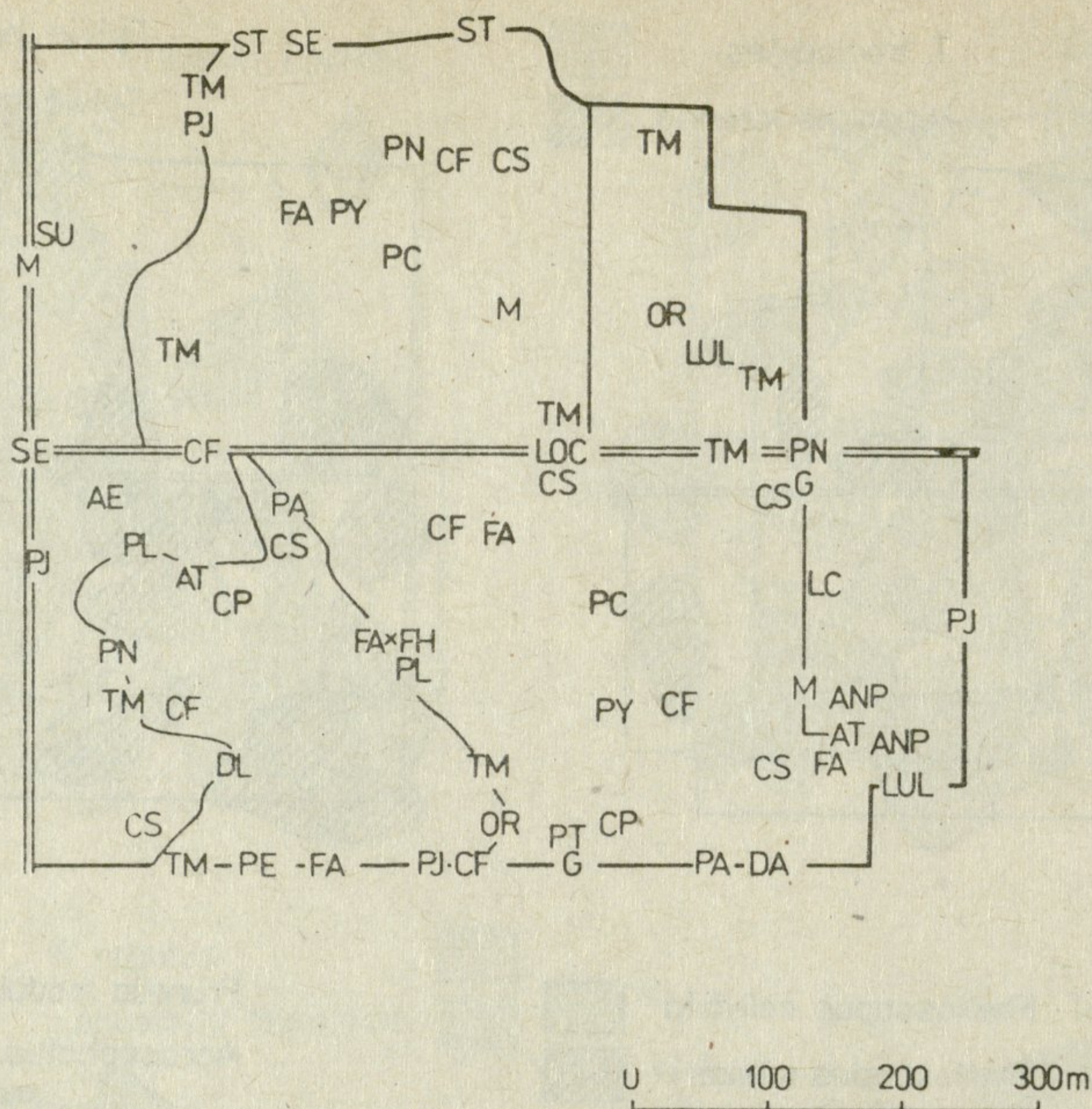


Fig. 4. Distribution of bird species with a lower abundance in 1977.

AE - *Aegithalos caudatus*; ANP - *Anas platyrhynchos*; AT - *Anthus trivialis*; CF - *Certhia familiaris*; CP - *Columba palumbus*; CS - *Carduelis spinus*; DA - *Dendrocopos major*; DL - *D. leucotos*; FA - *Ficedula albicollis*; FA × FH - hybrid *F. albicollis* × *F. hypoleuca*; G - *Garrulus glandarius*; LC - *Lanius collurio*; LOC - *Loxia curvirostra*; LUL - *Luscinia luscinia*; M - *Muscicapa striata*; OR - *Oriolus oriolus*; PA - *Parus ater*; PC - *P. cristatus*; PE - *P. caeruleus*; PJ - *P. major*; PL - *P. palustris*; PN - *P. montanus*; PT - *Picoides tridactylus*; PY - *Pyrrhula pyrrhula*; SE - *Sitta europaea*; ST - *Streptopelia turtur*; SU - *Sylvia curruca*; TM - *Turdus merula*.

Table 2. Density and dominance of groups of species that differ in the location of their nests in the habitats examined.

For explanation - see Table 1.

Species group	Density (pairs/10 ha)			Dominance (%)		
	A	B	C	A	B	C
G - Weaving open nests on the ground and up to 1.5 m of height	23.5	32.9	41.1	41.3	48.5	74.2
T - Weaving open nests at a height more than 1.5 m	26.8	27.0	13.6	47.1	39.9	24.5
H - tree-hole nesting birds	6.5	7.8	0.6	11.7	11.7	1.0

*Erithacus rubecula*, *Troglodytes troglodytes*, *Turdus philomelos* and *Regulus regulus* cover almost completely the area of the mature stands of all the habitats studied. All the species enumerated above occurred in young alder forests with the exception of *Regulus regulus* which is closely connected with high trees of *Picea abies*; *Erithacus rubecula* and *Turdus philomelos* show relatively high densities in the last mentioned habitat.



Habitats inhabited by *Sylvia borin* and *S. atricapilla* overlapped partially, although *S. borin* is a typical species of younger deciduous shrubs full of light, and *S. atricapilla* inhabits mainly more shady deciduous shrubs under the tree canopy and older thickets. *S. borin* was the most abundant species in young alder forests while in the *Alnetum* forests studied it occurred at the edge of a vast gap in the stand and at a forest road only. *S. atricapilla* avoided the forest interior where the shrub layer consisted mainly of spruce and deciduous shrubs occurred rarely. Two territories of this species found in spruce forests were located near a road with ditches, where because of a lowering of the ground water level, shrubs and herbs developed well. Young, 7–8 years old alder forests, covering the area in the south-eastern part of the study plot, were not inhabited by this species, while four territories of *S. borin* were found there.

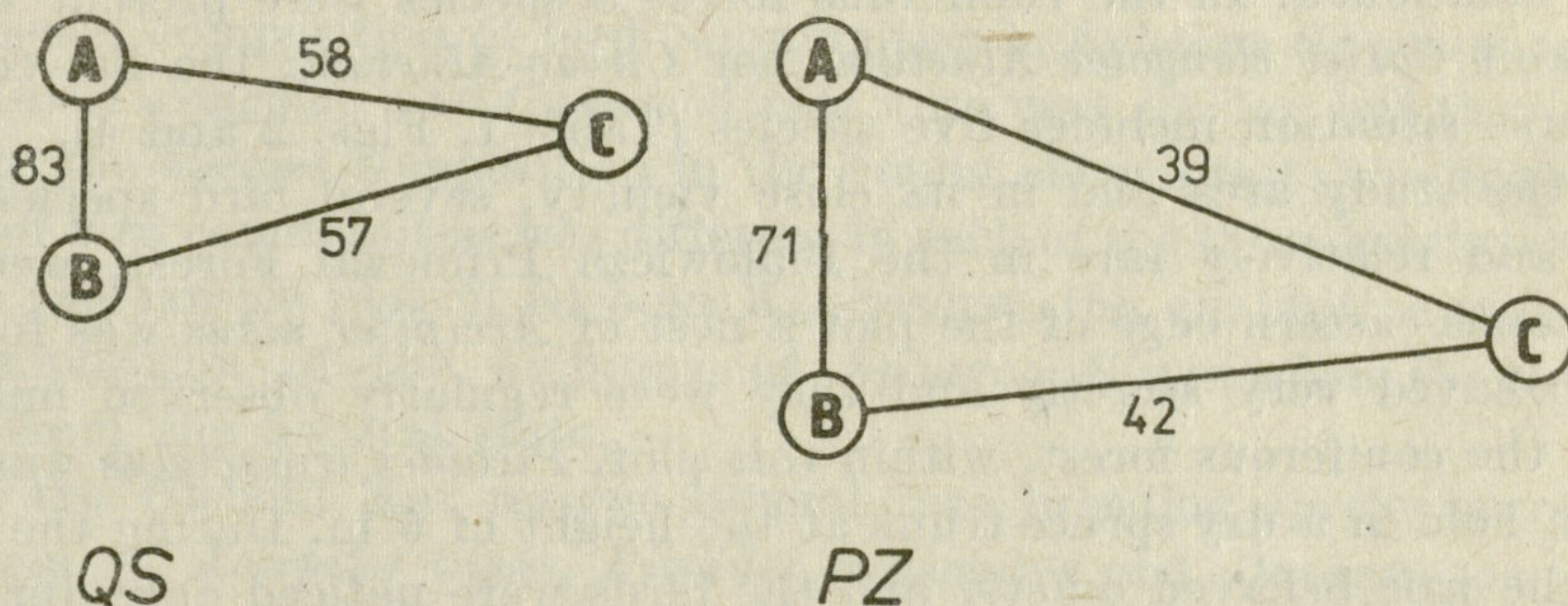


Fig. 5. Similarity index of species composition (index QS) and of density (PZ) between the bird communities that were distinguished.

In circles symbols denoting communities in separate habitats. Numbers (%) and distances between the circles specify the degree of community similarity. For alphabetic symbols — see Table 1.

Territories of *Phylloscopus sibilatrix* and *P. collybita* are almost non-overlapping. The first of the two species inhabited exclusively the interior of the coniferous forest, choosing local elevations of the ground in shady places: one pair that occurred in *Alnetum* forests possessed its territory in a region of coniferous forest appearance.

*Phylloscopus collybita*, commonly known as a species of transparent forests and their edges, in the study area was really associated with transparent stands. Territories of this species were found in both *Alnetum* forests, with the exception of parts of the forest with a high proportion of spruce; in the coniferous forest a regular distribution of territories was observed along the edge of mature stand bordering on a young alder forest, and at a broad road; two territories were found in looser parts of the stand, *i.e.*, in the transitional zone to *Circae-Alnetum*.

In the case of *Prunella modularis* a similar relationship in the distribution of territories was discovered though this species is considered as inhabiting



rather dark forests. There were no territories of this species in the coniferous forest interior in the northern and southern parts of the area (2.5 and 3 ha) where the conditions seemed to be optimal for *P. modularis*. Nor have territories of *P. modularis* been established in parts of the *Alnetum* forest with a high proportion of spruce.

All the territories of *Locustella fluviatilis*, *Acrocephalus palustris* and *Hippolais icterina* were found in a young alder forest with the exception of two *Locustella fluviatilis* territories, which occurred at the border of *Alnetum* forests in the area of luxuriant shrubs and large gaps in the stand.

In the young alder forest there occurred several species of birds which were not found in mature stands of coniferous type, nor in the *Alnetum* forests. These are: *Anas platyrhynchos*, *Luscinia luscinia*, *Lanius collurio* and probably breeding *Sylvia curruca*, as well as *Acrocephalus palustris* and *Hippolais icterina* already mentioned. In the coniferous forest 8 species were present which did not inhabit *Carici elongatae-Alnetum*, nor *Circao-Alnetum*; the list concerning the reverse situation includes five species (Table 1, Figs. 2 and 4).

In the study area and in its close vicinity, several bird species, rare in Poland and relatively rare in the Białowieża Primeval Forest, were found. At the south-eastern edge of the plot a nest of *Accipiter nisus* was found. The adults behaved very secretly and they were regularly observed only at the nest. In the coniferous forest, within this plot, *Picoides tridactylus* was nesting, having a hole in a dry spruce trunk at the height of 6 m. During the breeding season the pair behaved quietly and the birds were noticed only during three censuses out of eight. In the part of the area of the *Alnetum* forest *Dendrocopos leucotos* breeding was observed. Its nest was probably located near the southern boundary of the plot. *Dendrocopos leucotos* was visiting also the north-eastern part of the young alder forest. It was probably another pair. There was a territory of *Ficedula* sp. male, which was most probably a hybrid of *Ficedula albicollis* x *F. hypoleuca*. *Carduelis spinus* was rather numerous in the whole reserve and in its neighbourhood. Inaccuracy of the estimation of the number of pairs of this species on the sample plot (4–6 pairs) resulted from a specific behaviour of males and pairs, making simultaneous recognizing of neighbouring birds difficult. *Loxia curvirostra* was also found as breeding species (one pair occurred in the coniferous forest). The birds of this pair were probably observed in the February and March of 1977, then the birds were present in the same place in April showing anxiety (until 29 April). In May and June only nomadic birds were seen, e.g. on 26 of May a family feeding on *Pinus silvestris* was observed.

The list of birds in the reserve and its vicinity, given in Table 1, is supplemented by the list of bird visitors and migrants. During the breeding season the following species were observed: *Aquila pomarina*, *Columba oenas*, *Picus viridis*, *P. canus*, *Dendrocopos minor*, *Nucifraga caryocatactes*, *Corvus corax*, *Turdus iliacus*, *Carduelis carduelis* and *Coccothraustes coccothraustes*. During the



spring migration the following were observed: *Sylvia communis*, *Phylloscopus trochilus*, *Ficedula hypoleuca*, *F. parva* and *Turdus viscivorus*; *Sturnus vulgaris* was also observed during its postbreeding, nomadic behaviour in June.

#### SUMMARY

1. In 1977, 47 breeding species occurred in the habitats studied, 41 of which in natural habitats (*Sphagno Girgensohnii-Piceetum*, *Carici elongatae-Alnetum* and *Circae-Alnetum*) and 6 — in adjacent young managed forests.

2. Total density of the avifauna was almost 60 pairs/10 ha — the highest in *Carici elongatae-* and *Circae-Alneta* (68 pairs/10 ha), whereas in *Sphagno Girgensohnii-Piceetum* and in the young alder forest it attained a lower level (55–57 pairs/10 ha).

3. Species composition of bird communities in *Sphagno Girgensohnii-Piceetum* and *Carici elongatae-* and *Circae-Alneta* were very similar, but they differed much from the species composition in the young alder forest; the quantitative structure of bird communities was different in each of the three habitats studied.

4. In the sample plot in Głęboki Kąt reserve the qualitative and quantitative composition of the avifauna of *Sphagno Girgensohnii-Piceetum* was distorted from the natural state.

5. In the Głęboki Kąt reserve several rare breeding species were found among them — *Accipiter nisus*, *Picoides tridactylus* and *Dendrocopos leucotos*.

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## STRESZCZENIE

[Awifauna lęgowa boru świerkowego torfowcowego oraz zbiorowisk pokrewnych w Puszczy Białowieskiej]

Przedmiotem badań była awifauna lęgowa rezerwatu „Głęboki Kąt” i jego otoczenia. Rezerwat ten utworzono dla ochrony boru świerkowego torfowcowego (*Sphagno Girgensohnii-Piceetum*) i innych naturalnych zespołów leśnych zajmujących torfową nieckę w zachodniej części Puszczy Białowieskiej. Obserwacje przeprowadzono w 1977 r. z zastosowaniem metody kartograficznej. Niektóre wyniki:

1. W kompleksie badanych siedlisk (ryc. 1) występowało 47 gatunków ptaków lęgowych; w siedliskach naturalnych rezerwatu (bór świerkowy torfowcowy, ols — *Carici elongatae-Alnetum* i lęg — *Circaeo-Alnetum*) — 41 gatunków, a pozostałe zasiedlały wyłącznie przylegające zagospodarowane olszyny (tab. 1).

2. Ogólne zagęszczenie awifauny wyniosło blisko 60 par/10 ha — najwyższe było w olsie i lęgu (68 par/10 ha), natomiast w borze i olszynach kształtowało się na zbliżonym poziomie (55–57 par/10 ha) (tab. 1).

3. Wykazano stosunkowo nieduże różnice w składzie ilościowym awifauny boru w porównaniu z awifauną olsu i lęgu (PZ = 71%), natomiast porównania tych dwóch ugrupowań z awifauną olszyn wykazały jej dużą odmienność (PZ = 39–42%) (ryc. 5). Na różnice pomiędzy trzema wyróżnionymi ugrupowaniami ptaków złożyły się przede wszystkim odmienne udziały różnych grup ekologicznych (tab. 2).

4. Na badanej powierzchni próbnej w rezerwacie „Głęboki Kąt” skład jakościowy i ilościowy awifauny boru świerkowego torfowcowego w istotnym stopniu uległ odkształceniu od stanu naturalnego. Mianowicie na tzw. „efekt styku” złożyły się w tym przypadku specyficzne zależności rozmieszczenia terytoriów ptaków przy sztucznie odciętym skraju starodrzewia dostrzeżone m. in.



u takich gatunków jak: *Phylloscopus collybita*, *Phylloscopus sibilatrix*, *Sylvia atricapilla*, *S. borin*, *Prunella modularis*, *Anthus trivialis* (ryc. 2-4).

5. W rezerwacie „Głęboki Kąt” stwierdzono kilka rzadkich gatunków lęgowych, m. in. *Accipiter nisus*, *Picoides tridactylus*, *Dendrocopos leucotos*.

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Redaktor pracy — Maciej Gromadzki

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