

# A comparative study of breeding bird communities in representative habitats of the Sárosfő Nature Reserve area

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WINKLER, D. & ERDŐ, Á.: *A comparative study of breeding bird communities in representative habitats of the Sárosfő Nature Reserve area.*

**Abstract:** This paper presents the results of breeding bird community surveys conducted in 2010 in the Sárosfő Nature Reserve area. The main goal was to determine species richness, diversity, density- and dominance structures in the bird communities of different forest, meadow and reed habitats. Bird community composition data were obtained by conducting standard transect counts carried out twice during the breeding season. The method used was suitable for recording pigeon- (*Columbiformes*), woodpecker- (*Piciformes*) and passerine bird (*Passeriformes*) species. A total of 44 bird species were encountered. Diversity was the highest in the riverine ash-alder woodland habitat and the lowest in the reedbed habitat. Breeding bird community structure comparison between the different habitats was estimated using single linkage cluster analysis based on the Morisita-Horn similarity index that well emphasized the separation of three habitat groups (reed bed, open and forest habitats). The results showed that the rich mosaic habitat structure of the relatively small area provides optimal nesting and feeding grounds not only for waterfowl related to the fishponds but also for passerine bird communities.

**Keywords:** breeding bird communities, bird diversity, mosaic habitat structure

## Introduction

Ornithological studies related to fishponds in Hungary mostly focus on waterbird species (e.g. KOVÁCS 1984, MUSICZ 1988, KOVÁCS et al. 2011) while there are only very few reports on breeding bird communities in the oftentime diverse surrounding habitats (SCHMIDT 1963, STERBETZ 2002). Several researches have shown that vegetation structure, its complexity and spatial dispersion are the primary determining factors in bird community composition (MACARTHUR & MACARTHUR 1961, WILSON 1974, BLICKE 1982), while other authors have pointed out that floristic composition can also play an important role (WIENS & ROTENBERRY 1981, MOSKÁT 1988, WHELAN 2000). The vicinity of water bodies has always a considerable impact on animal communities, including the avifauna. The aim of our study was to survey and describe species composition of breeding bird communities of different habitats surrounding the Sárosfő fishponds and to determine their species diversity, density- and dominance structures.

## Material and Methods

### *Study area*

The Sárosfő Nature Reserve area is situated in the valley of the Kígyós Stream ( $47^{\circ}3'18''\text{N}$ ,  $17^{\circ}23'42''\text{E}$ ; 165m above sea level), 6 km from the city Devecser, Veszprém county, Hungary. Its total area is 261.4 ha, while the fishpond system covers 32 ha. The fishponds are surrounded with reedbeds, different aged and types of forests and meadows. Bird surveys were conducted in 6 different habitat types including both open and forest habitats (Fig.1). The main characteristics of the surveyed habitats are given below.

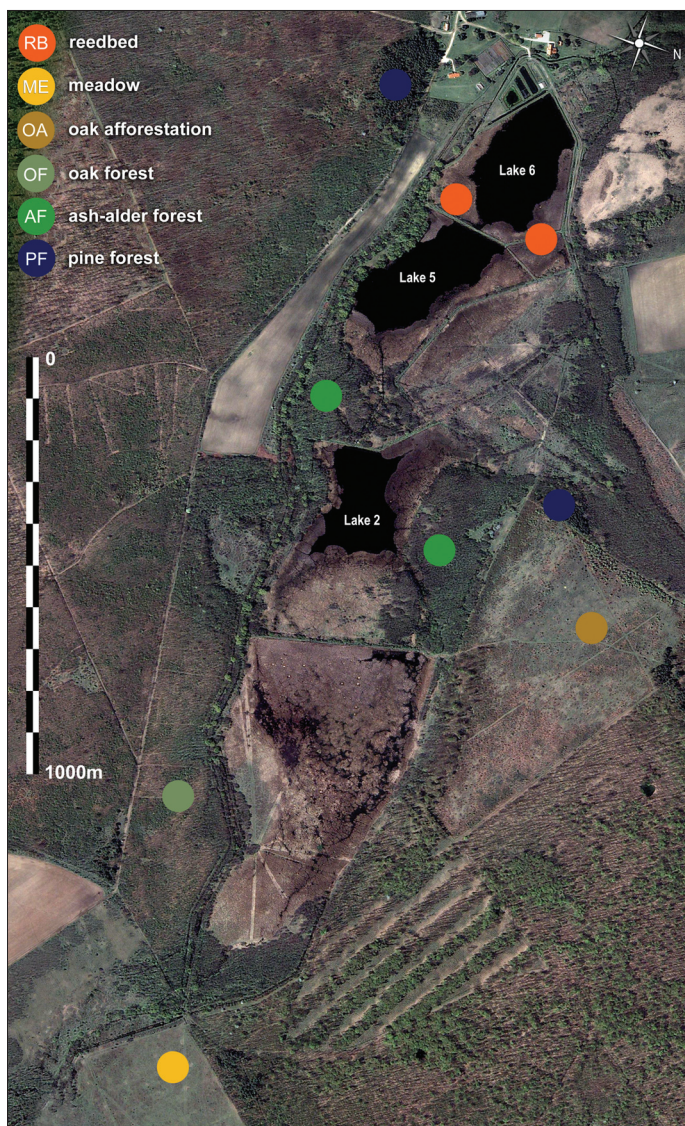


Fig. 1: Survey sites around the Sárosfő fishpond system (Google Earth)

*reedbeds* (RB): reedbeds around the lakes composed dominantly by Common Reed (*Phragmites australis*) and dispersedly also by Narrow-leaf Cattail (*Typha angustifolia*) and Broadleaf Cattail (*Typha latifolia*).

*meadow* (ME): Pastinaco-Arrhenatheretum, a layered meadow association with an average height of 120 cm. Apart from the dominant Tall Oatgrass (*Arrhenatherum elatius*) further characteristic species are the Wild Carrot (*Daucus carota*), the Cocksfoot (*Dactylis glomerata*), the Field Wood-rush (*Luzula campestris*), the Tall Buttercup (*Ranunculus acris*) and the German Catchfly (*Viscaria vulgaris*).

*young pedunculate oak afforestation* (OA): afforestation in an early successional stage. Average tree height is about 1.7 m. The cover of young trees is 30–35%. The main tree species is the Pedunculate Oak (*Quercus robur*), scattered trees of European Hornbeam (*Carpinus betulus*) and Small-leaved Lime (*Tilia cordata*) can be found too. Additional species in this 'shrub layer' include the Hawthorn (*Crataegus monogyna*), the European Privet (*Ligustrum vulgare*) and the Blackberry (*Rubus fruticosus*). The cover of herb layer is high (80–85%) with typical species like the Giant Goldenrod (*Solidago gigantea*), the Chee Reed Grass (*Calamagrostis epigeios*) and the Cocksfoot (*Dactylis glomerata*).

*low-pole turkey oak–pedunculate oak stands* (OF): height of the trees 10–14 m. The coverage of the tree layer is rather high (~80%). Apart from the main tree species, the Turkey Oak (*Quercus cerris*) and the Pedunculate Oak (*Quercus robur*), scattered trees of European Ash (*Fraxinus excelsior*), Silver Birch (*Betula pendula*) and European Alder (*Alnus glutinosa*) are also present. The shrub layer is developed moderately with a coverage of about 20–25%. Common species in this layer are the Common Dogwood (*Cornus sanguinea*), the Hawthorn (*Crataegus monogyna*) and the European Spindle (*Euonymus europaeus*). The cover of the herbaceous layer is considerably high (~60%) including species like the Wood Bluegrass (*Poa nemoralis*), the Wood Melick (*Melica uniflora*) and the Sweet Woodruff (*Galium odoratum*).

*riverine ash-alder forest* (AF): stands along the Kigyós stream and northwards from Lake 2. Average tree height is 20 m, the cover of the tree layer is 85–90%. Apart from the main tree, the European Alder (*Alnus glutinosa*), the European Ash (*Fraxinus excelsior*) and the (*Salix alba*) is also present with proportion of 5% each. The shrub layer has moderate cover (30–35%) and includes species like the Common Dogwood (*Cornus sanguinea*), the Alder Buckthorn (*Frangula alnus*) and the Old Man's Beard (*Clematis vitalba*). Typical species in the moderately developed herb layer are the Stinging Nettle (*Urtica dioica*), the Goutweed (*Aegopodium podagraria*), the Hollowroot (*Corydalis cava*) and the Spinulose Woodfern (*Dryopteris carthusiana*).

*allochthonous Scots pine forest* (PF): almost pure Scots Pine (*Pinus sylvestris*) stands with scattered trees of Pedunculate Oak (*Quercus robur*). In the moderately developed shrub layer we can find the Elder (*Sambucus nigra*), the Hawthorn (*Crataegus monogyna*) and the Blackberry (*Rubus fruticosus*). The herbaceous layer is poor, mostly composed by Cocksfoot (*Dactylis glomerata*) and Greater Celandine (*Chelidonium majus*).

### Survey methods

Bird community composition data were obtained by conducting standard transect counts using the data of the belts of 25 m on both sides of the observer (BÁLDI et al. 1997). For the bird survey nearly same-sized sample areas (~6 ha) were selected from each habitat type. Bird censi were carried out twice during the breeding season (once in April and once in late May 2010). Observations took place in early mornings (about 5.00–9.00 am). The method used was suitable for recording pigeon- (*Columbiformes*), woodpecker- (*Piciformes*) and passerine bird (*Passeriformes*) species only.

### Data analysis

Relative density values for all species per habitat type are given. Out of the results of two bird censi (carried out in April and May) the higher density values were chosen for each species. Habitat-amplitude (HA) for each bird species was measured by calculating 'niche-breadth' from the Simpson index (CHESSEL et al. 1982). Bird community structural characteristics were calculated for each habitat. Apart from the actual species richness, bird communities were evaluated by comparing total density, dominance structure (community dominance index - CDI), Shannon diversity index ( $H' = -\sum p_i \ln p_i$ ) and equitability ( $J = H' / \ln S$  - where  $S$  is species richness). To compare diversity values of two assemblages a t-test was used to determine whether they are significantly different (HUTCHESON 1970). Rényi diversity profiles (TÓTMÉRÉSZ 1997) were used for partial ranking of the recorded bird communities based on diversity. A community of higher diversity has a diversity profile consistently above the profile of a less diverse community. In case the diversity profiles cross each other, the communities are not comparable, and thus the diversity comparison carried out by using t-test gets overruled.

Community structure comparison between the different habitat types was estimated using single linkage cluster analysis based on the Morosita-Horn index of similarity (MAGURRAN 2004). This index is nearly independent of sample size and it is recommended as one of the best overall measures of similarity for ecological use (WOLDA 1981, KREBS 1999).

Breeding bird communities were also analyzed in relation to the species' migratory habits (BLICKE 1984).

Statistical analyses were carried out using the software Past ver. 2.15 (HAMMER et al. 2001).

## Results and Discussion

During the survey days a total of 44 bird species were encountered. Table 1 shows the pair density and habitat amplitude of each bird species occurred. About 57% of the observed species appeared in more than one habitat. Species with the highest habitat-amplitude, like the Common Chiffchaff (*Phylloscopus collybita*), the Chaffinch (*Fringilla coelebs*), the Common Blackbird (*Turdus merula*) and the European Robin (*Erithacus rubecula*), can be regarded as habitat generalists, appearing with high densities in four or at least in three habitats. Species having relatively small habitat amplitude can be considered as habitat specialists. Some of this species are connected to certain vegetation type, such as the reed warblers (*Acrocephalus* spp.) to the reedbeds or the Coal Tit (*Parus ater*) to the pine plantation, while others are characteristic for open habitats as manifested by the appearance of the Skylark (*Alauda arvensis*), Corn Bunting (*Emberiza calandra*) in the surveyed meadow. The occurrence of the Grasshopper Warbler (*Locustella naevia*) in the oak afforestation is an interesting yet not unusual phenomenon anymore. This species was very rare until the 1980's and appeared only in wet meadow habitats. It was first reported by KÁRPÁTI (1982) that this species might appear as breeding species in completely new habitats, such as clear-cut areas and young afforestations. In the bird community of the ash-alder forest we recorded two species that can be considered as habitat specialists. Both the Eurasian Wren (*Troglodytes troglodytes*) and the Icterine Warbler (*Hippolais icterina*) are typical species that prefer riverine forests for nesting.

**Table 1: Density values (pairs/10 ha) of bird species in the studied habitat and bird species habitat amplitude by calculating 'niche-breadth' from the Simpson index**

(RB – reedbed, ME – meadow, OA – oak afforestation, OF – oak forest, AF – ash-alder forest, PF – Scots pine forest; HA – habitat amplitude)

Species	RB	ME	OA	OF	AF	PF	HA
<i>Columba palumbus</i>	-	-	-	-	2.13	3.23	1.92
<i>Streptopelia turtur</i>	-	-	1.79	-	2.13	-	1.98
<i>Dryocopus martius</i>	-	-	-	-	0.71	-	1.00
<i>Dendrocopos major</i>	-	-	-	-	3.55	3.23	1.99
<i>Alauda arvensis</i>	-	0.99	-	-	-	-	1.00
<i>Anthus trivialis</i>	-	-	2.68	-	-	-	1.00
<i>Troglodytes troglodytes</i>	-	-	-	-	2.84	-	1.00
<i>Prunella modularis</i>	-	-	0.89	-	-	-	1.00
<i>Erithacus rubecula</i>	-	-	-	5.32	3.55	3.23	2.85
<i>Luscinia megarhynchos</i>	-	-	-	-	0.71	-	1.00
<i>Saxicola torquatus</i>	-	1.98	4.46	-	-	-	1.74
<i>Turdus merula</i>	-	-	2.68	3.19	4.26	-	2.89
<i>Turdus philomelos</i>	-	-	-	-	2.84	3.23	1.99
<i>Turdus viscivorus</i>	-	-	-	-	0.71	-	1.00
<i>Locustella naevia</i>	-	-	0.89	-	-	-	1.00
<i>Locustella luscinioides</i>	0.95	-	-	-	-	-	1.00
<i>Acrocephalus scirpaceus</i>	1.90	-	-	-	-	-	1.00
<i>Acrocephalus palustris</i>	0.48	-	-	-	-	-	1.02
<i>Acrocephalus arundinaceus</i>	2.86	-	-	-	-	-	1.00
<i>Hyppolais icterina</i>	-	-	-	-	0.71	-	1.00
<i>Sylvia atricapilla</i>	-	-	3.57	-	4.96	-	1.95
<i>Sylvia nisoria</i>	-	-	0.89	-	-	-	1.00
<i>Sylvia curruca</i>	-	-	0.89	-	-	-	1.00
<i>Phylloscopus collybita</i>	-	-	4.46	5.32	4.26	3.23	3.88
<i>Muscicapa striata</i>	-	-	-	2.13	0.71	-	1.60
<i>Ficedula albicollis</i>	-	-	-	-	2.13	-	1.00
<i>Aegithalos caudatus</i>	-	-	-	1.06	0.71	-	1.92
<i>Parus palustris</i>	-	-	-	3.19	3.55	-	2.00
<i>Parus cristatus</i>	-	-	-	-	2.13	3.23	1.92
<i>Parus ater</i>	-	-	-	-	-	3.23	1.00
<i>Parus caeruleus</i>	-	-	-	3.19	3.55	-	2.00
<i>Parus major</i>	-	-	0.89	5.32	4.96	-	2.33
<i>Sitta europaea</i>	-	-	-	2.13	2.13	-	2.00
<i>Certhia brachydactyla</i>	-	-	-	2.13	1.42	-	1.93
<i>Oriolus oriolus</i>	-	-	-	-	0.71	-	1.00
<i>Lanius collurio</i>	-	-	2.68	-	-	-	1.00
<i>Garrulus glandarius</i>	-	-	-	1.06	0.71	-	1.92
<i>Sturnus vulgaris</i>	-	-	-	-	0.71	-	1.00
<i>Fringilla coelebs</i>	-	-	-	8.51	7.80	6.45	2.96
<i>Carduelis chloris</i>	-	-	1.79	-	-	-	1.00
<i>Carduelis cannabina</i>	-	-	2.68	-	-	-	1.00
<i>Coccothraustes coccothraustes</i>	-	-	-	1.06	-	-	1.00
<i>Emberiza citrinella</i>	-	1.98	6.25	-	-	-	1.58
<i>Emberiza calandra</i>	-	0.99	-	-	-	-	1.00
Sum	6.19	5.94	37.50	43.62	64.54	29.03	

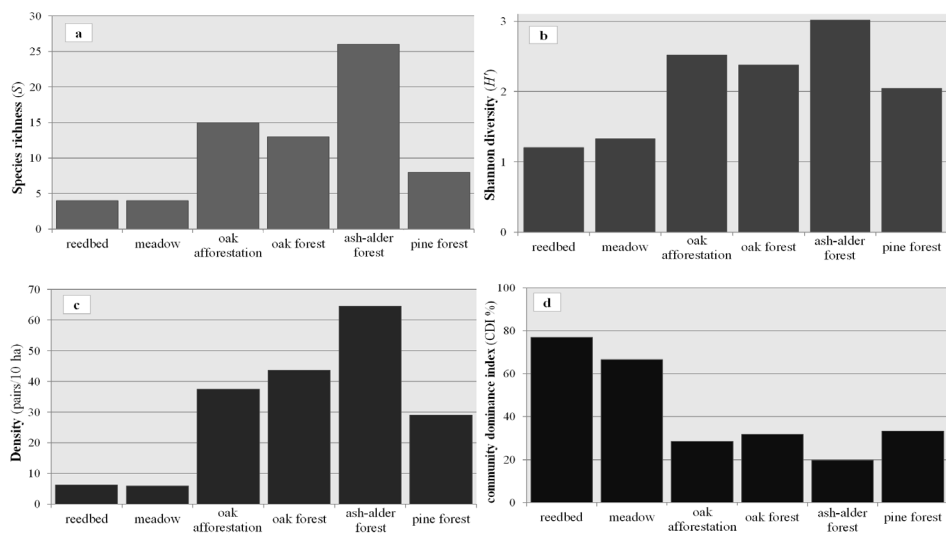
**Table 2: Ecological structural characteristics of bird communities in the different habitats**

S – species richness, De – total bird density (pairs/10 ha), H' – Shannon's diversity index, J – Pielou's equitability index, CDI – community dominance index (%)

	<i>S</i>	<i>De</i>	<i>H'</i>	<i>J</i>	<i>CDI</i>
reedbed	4	6.19	1.205	0.8691	76.92
meadow	4	5.94	1.330	0.9591	66.67
oak afforestation	15	37.50	2.518	0.9299	28.57
oak forest	13	43.62	2.376	0.9265	31.71
ash-alder forest	26	64.54	3.013	0.9249	19.78
pine forest	8	29.03	2.043	0.9826	33.33

The most important structural characteristics of breeding bird communities are presented in Table 2.

Species richness ranged between 4 and 26 in the habitats surveyed (Fig. 2a). Only 4–4 species have been recorded in the reedbeds and meadow, while the habitat with the highest number of species (26) appeared to be the riverine ash-alder woodland. Species richness was relatively high (15) also in the young pedunculate oak afforestation. Bird communities in this shrub stage of secondary forest succession often include species characteristic for open habitats, like the Grasshopper Warbler (*Locustella naevia*), the Common Stonechat (*Saxicola torquata*) and the Yellowhammer (*Emberiza citrinella*) while typical shrubland birds like the Blackcap (*Sylvia atricapilla*), the Common Blackbird (*Turdus merula*) are also present, often in high densities (WINKLER 2005). We encountered only 13 species in the turkey oak–pedunculate oak forest. This low value of species richness can presumably be explained by the age of the surveyed forest stand (WALICZKY 1991). Generally, habitats like these low pole stands are no longer appropriate for species nesting in shrubs such as warblers (*Sylviidae*) and not yet suitable for the hole-nesting ones like woodpeckers (*Piciformes*), flycatchers (*Muscicapidae*) or tits (*Paridae*). From the forest habitats sampled, species richness was the lowest (8) in the

**Fig. 2a-d: Species richness, Shannon diversity, density and community dominance index**

**Table 3: Comparison of Shannon diversities using Hutcheson's t-test**  
(t-values, \*\*\*P=0.01; \*\*P=0.05; \*P=0.1; ns – not significant)

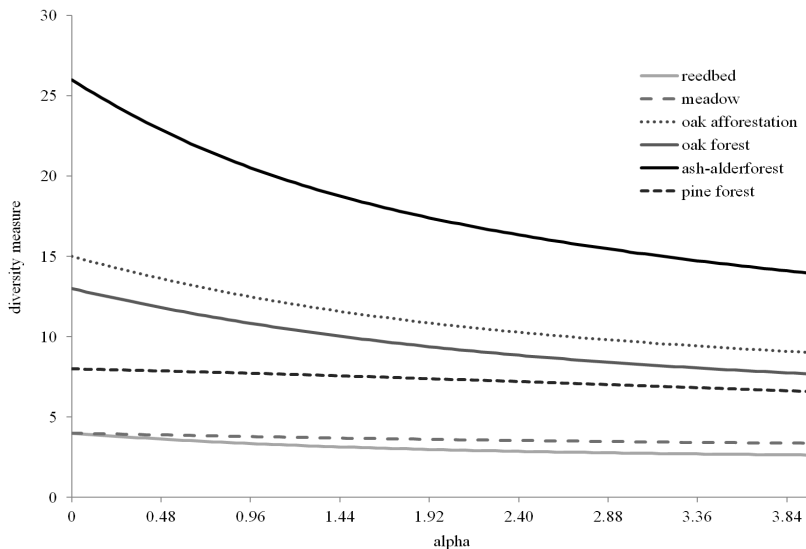
	reedbed	meadow	oak afforestation	oak forest	ash-alder forest
meadow	0.0323 ns				
oak afforestation	6.0413**	4.7602**			
oak forest	5.4661**	4.3086**	0.7881 ns		
ash-alder forest	9.2026***	7.0226***	3.9198***	4.8414***	
pine forest	1.9473 ns	1.7179 ns	2.7483*	2.2712*	5.0552***

allochthonous Scots pine forest. Nevertheless, this habitat was responsible for the occurrence and nesting of species connected to coniferous forest, such as the Coal Tit (*Parus ater*) or the Crested Tit (*Parus cristatus*), thus increasing the summarized species richness of the whole study area.

Shannon diversity showed a similar trend (Fig. 2b) expressed in species richness. Its numerical value was the highest (3.013) in the riverine ash-alder woodland area while the lowest (1.205) in the reed habitat.

Breeding pair density was the highest (64.54 pairs/10 ha) in the riverine ash-alder forest, but it was also considerable (~44 pairs/10 ha) in the low pole oak stand (Fig. 2c). Total density of bird community was fairly low (~6 pairs/10 ha) in the reed and meadow habitats.

The community dominance index is a simple characteristic calculated as the percentage of the total abundance of all species in the community that is contributed by the two most abundant species (Fig. 2d). It can therefore be an appropriate characteristic for evaluating the dominance structure of bird communities. Its value was considerably high in the reedbed and meadow habitats that can be explained with the low number of spe-



**Fig. 3: Diversity profiles of breeding bird communities in the different habitats**

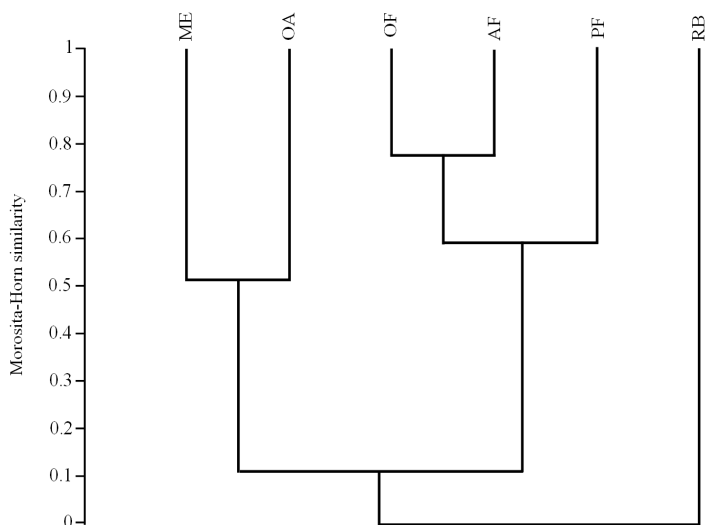
cies. The community dominance index was the lowest in the riverine ash-alder forest, thus also indicating an optimal bird community structure consisting of species with no extreme dominance.

The comparison of bird community diversities of the different habitats using Hutcheson's method yielded significant differences in 11 cases (Table 3).

To rank the bird communities of the studied habitats the Rényi's diversity profiles were used (Fig. 3).

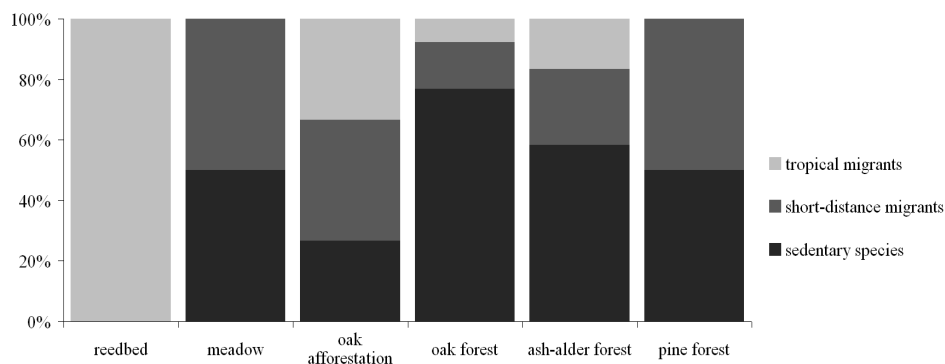
The result shows that there was no single case of diversity profiles crossing each other, thus the bird communities can be ranked also confirming the results of the Hutcheson's modified t-test indicating significant differences between diversities of certain communities. The diversity profile of the bird community found in the ash-alder forest runs above the curves of other habitat's communities. It can also be observed that two pairs of diversity profiles, namely the curves of bird communities in the two oak forests (both of the afforestation and of the low pole stand) and also the curves of the two open habitats (reedbed and meadow) run very close to each other.

Results of comparison of breeding bird communities in different habitats carried out using cluster analysis based on the Morisita-Horn similarity index is shown on Fig. 4. The dendrogram well emphasises the differences and similarities between bird communities in different habitat types. The reedbed shows a total separation, which means that no common species occurred between this edge habitat and the other studied habitats. The second main group is further subdivided into two subgroups, where a complete separation can be observed between the 'open' habitats (meadow and young pedunculate oak afforestation) and the 'forest' habitats. Inside the 'forest' subgroup, communities of the ash-alder forest and the low pole oak forest were grouped under the same cluster showing at the same time the highest similarity between paired communities, while the bird community of the only coniferous forest habitat, the Scots pine plantation, discretely separated from the two mentioned deciduous forest's communities.



**Fig. 4: Dendrogram based on cluster analysis using Morosita-Horn index of similarity on the breeding bird communities of different habitats**

(RB – reedbed, ME – meadow, OA – oak afforestation, OF – oak forest, AF – ash-alder forest, PF – pine forest)



**Fig. 5: Classification of bird communities according to the species' migratory habits**

The analysis of bird communities according to the migratory habits of the species showed interesting results (Fig. 5). The observed trend is true for both the species richness and density.

The proportion of sedentary species is higher primarily in the forest habitats (reaching its peak in the turkey oak–pedunculate oak forest) while, similarly to other studies (HERRERA 1978, HELLE & FULLER 1978), the cumulated proportion of migrant species (both short-distant and tropical migrants) was higher rather in the open habitats. A probable explanation of this phenomenon might be that the surveyed open habitats (e.g. young afforestations) are showing certain similarities with the wintering areas of the actual species: the open savannas and semi-deserts (BLICKE 1984).

Taking into account the results of the breeding bird survey, the following remark can be drawn as a conclusion. This relatively small area around the artificial lakes has a rich mosaic habitat structure which is optimal not only for waterfowl linked to the fishponds but also for passerine bird communities.

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