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BIOTOPE DISTRIBUTION AND HABITAT PREFERENCE OF BREEDING BIRD COMMUNITIES IN ALPINE AND SUBALPINE BELTS IN THE TATRA AND BABIA GORA Mts. (SOUTHERN POLAND)

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Abstract. During the breeding period 1998, bird communities of alpine and subalpine levels (hetero- and homogenous dwarf pine zone, alpine meadows with klatch of pine, alpine meadows with rocks, and rocks), their biotopic distribution in the Tatra and the Babia Gora National Parks (southern Poland) were investigated. Species richness and diversity of bird communities change along of altitude and vegetation structure. The correlation between altitude and diversity is not linear. On the sample plots from 15–17 (heterogeneous dwarf pine zone) to 7 (rocks) bird species have been registered. The density decreased from 16,6–19,6 to 4,3 pairs/10 ha with increasing of altitude. SQ distribution is 0,7–1,0 between compared pairs of habitats. The highest α-diversity was recorded in the heterogeneous elfin woodland in both massifs. Two groups, which are connected by the similarity index sizes, are noted by the similarity analyses of bird communities (cluster-analysis): (I) alpine meadows with stones and rocks, (II) hetero- and homogenous dwarf pine zone and alpine meadows with klatch of pine. In the Tatra *Tichodroma muraria*, *Falco peregrinus,* in the Babia Gora *Aquila chrysaetos, Monticola saxatilis* have been registered.

Key words: Poland, bird community, species composition, habitat preference, rare species.

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Біотопічний розподіл і вибір місцеперебувань птахів в орнітоугрупованнях альпійського та субальпійського поясів у Татрах і на Бабій Гурі (Південна Польща). - А.-Т. Башта. - Беркут. 14 (2). 2005. - Протягом гніздового періоду 1998 р. досліджували орнітоугруповання альпійського та субальпійського поясів (мішане криволісся, зарості гірської сосни, луки з куртинами гірської сосни, альпійські луки з камінням, скелі), їх біотопічний розподіл в Татранському та Бабйогурському національних парках. Видове багатство та різноманітність орнітоугруповань змінюється вздовж висотного градієнту та структури рослинності. Кореляція між висотою над рівнем моря і різноманітністю не лінійна. На пробних площах виявлено від 15–17 (мішане криволісся) до 7 (скелі) видів птахів. Щільність особин знижується від 16,6–19,6 до 4,3 пар/10 га зі зростанням гіпсометричних висот. Коефіцієнт Соренсона (SQ) досягає 0,7–1,0 між порівнюваними парами біотопів. Найвищий показник α-різноманіття виявлений у мішаному криволіссі обох масивів. Дві групи, пов'язані близькими індексами подібності, виявлені з допомогою кластерного аналізу: (I) альпійські луки зі камінням і скелі, (II) мішане криволісся, зарості гірської сосни і альпійські луки з куртинами гірської сосни.

Introduction

Carpathians range (as well Tatra Mts. and Babia Gora Mts.) belongs to the tertiary mountains of alpine system. Tatras (2663 m a. s. l.), as well as Babia Gora Mts. (to a certain degree) are the peculiar miniature examples of high-mountains, taking into account their small surface and insignificant per cent of high mountains area of their territories. They are clearly attributed plant belts – the result of climatic changes on the altitude gradient (Mirek, 1996). Both massifs are the most northern centres of high-mountain flora and fauna of Europe.

Birds are most dynamic and susceptible for the mountain landscape structure; they are also more observable of animals in the mountains. Information about the distribution of bird species and the faunistic aspects of their bird fauna of Tatra Mountains are known from the works of Wodzicki (1850), Schauer (1862), Karliński (1882), Kocyan (1884), Ferens (1962), Kania, Wasilewski (1969), Głowaciński, Profus (1992), Wozniak (1992), Cichocki (1991, 1996), Wasilewski (1996) et al. The Babia Gora massif is investigated not so detailed and precised (Ferens, 1963; Bocheński, 1970). Great quantity of data about the bird fauna of these regions is collected in the Polish Red Data Book (Głowaciński, 2001). But it is lacking elaborated investigations based on quantitative bird censuses and which give the possibility to watch the change in the quantities of some species as well as bird community structure. This article gives the results of investigations of breeding bird communities of the belts above the high-mountain forest border on the territories of Tatra and Babia Gora National Parks.

Material and Methods

Description of the studied area

Only Tatra Mts. are in the Carpathians mountain massif with typical alpine character of relief. Their climate changes considerably from the foot to the peaks. Average year temperatures fluctuate on vertical profile of Tatras from +6 to –4°C (gradient 0,5°C on 100 m). Upper border of alpine meadows connected with isotherm 0°C, upper border of upper forest belt connected with isotherm +2°C. Snow cover lies 6–8 months a year (Hess, 1996).

Babia Gora Mts. is the second mountain massif after the Tatras, where exists a remarkable alpine belt. Babia Gora is built from complex of magura's sandstones (Alexandrowicz et al., 1989). The boulders and stone plates occur on the highest peak of massif (Diablak – 1725 m. a. s. l.). Climate of region is typically mountainous. Middle-annual temperature averages 0,5°C (middle January: –9,3°C, middle of July: +8,7°C) in the top parts of massif (Denysiuk, Mielnicka, 1990).

The initial soils with an undeveloped profile dominate above the upper forest border in the Tatras, they hold stone gutter slopes as well as musk-humic soils, created by the dwarf cover grass vegetation (Komornicki, Skiba, 1996).

In the Babia Gora NP podzolic rankers prevail in the belt of dwarf pine forest. The peak parts hold the initial soil stages (Adamczyk, 1983).

The subalpine belt holds in the Tatras from 1550 to 1800 m a. s. l., alpine belt – 1800–2150 m a. s. l. on the carboneous bedrock and to the 2300 m a. s. l. on the granitic one. In the Tatra Mts. the rock or subnival belt is situated above the alpine one (Alexandrowicz et al., 1989).

The distribution of the plant belts on the Babia Gora has a different appearance. Subalpine belt is situated on the height of 1400–1650 m. a. s. l., and alpine meadows belt is placed higher (Denysiuk, Mielnicka, 1990).

Isolated clamps of dwarf pine occur regularly at the lower part of alpine belt in the Tatras also – up to 1960, in the Babia Gora -–up to 1650 m. a. s. l. Depending on bedrock, the dwarf pine communities are divided in two subcommunities: on the carbonaceous bedrock – *Pinetum mughi carpaticum calcicolum* with the rich floristic composition, and on the crystalline bedrock – *Pinetum mughi carpaticum silicolum* – with the poor floristic composition (Denysiuk, Mielnicka, 1990; Piękoś-Mirkowa, Mirek, 1996).

The growths of dwarf pine (*Pinetum mughi carpaticum*), which occupy spacious areas in the lower parts the belt above the upper border of forest, break with the increasing of height by the clamps of *Vaccinium mirtillus* and grass communities. Dwarf pine (*Pinus mugo*) is their dominant component in the Tatras, which is accompanied by *Salix silesiaca* and *Sorbus aucuparia var. glabrata* in the Babia Gora – *Ribes petraeum* also. The isolated exemplars of dwarfish spruce have been noted above the upper border of forests. Deep

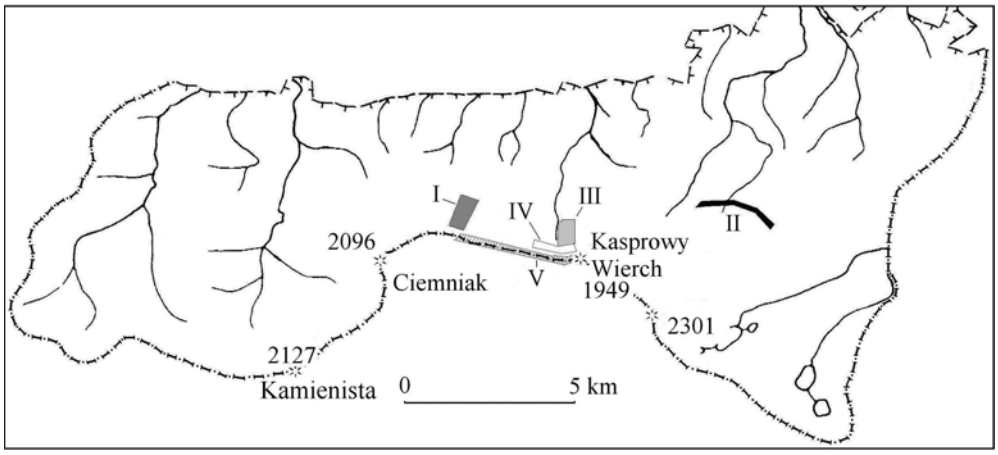

Fig. 1.Sample plots in the Tatra National Park.
Рис. 1. Пробні площі у Татранському національному парку.

thickets of pure dwarf pine develop in the higher parts.

Above the belt of dwarf pine on the uncarbonaceous bedrock the high-mountain grasses occupied great places forming plant community *Oreochloo distichae – Juncetum trifidi* (*Trifido-Distichetum*). Two types of vegetation occur on the carbonaceous bedrock. One of them has been created by the low grass (*Firmetum* or *Caricetum firmae*) in the rock places, which are scarcely covered with the thin soil layer (Piękoś-Mirkowa, Mirek, 1996).

Trifido-Supinetum or *Junco trifidi-Festucetum supinae* is the most characteristic plant community of alpine belt in the Babia Gora (Celiński, Denysiuk, 1987).

Landslides and granite fixed gravel in the dwarf pine, meadow and rock zones have been choked by plant community *Oxyrio-Saxifragetum carpaticae* (Piękoś-Mirkowa, Mirek, 1996).

The grasses *Trifido-Supinetum* dominate in the alpine belt on the territory of Babia Gora NP; small fragments of *Vaccinium mirtillus* L. appear also (Alexandrowicz et al., 1989).

Study areas in the Tatra NP (Fig. 1).

T-1. Elfin woodland (heterogeneous dwarf pine forest) on the slopes of Kondratowa valley. Study area (18 ha) is situated on the height 1420–1580 m. a. s. l. It has been covered by dwarf pine (*Pinetum mughi carpaticum*) with the admixture of the Mountain-ash (*Sorbus aucuparia*). Spruce (*Picea abies*) occurs often in the lower part of investigation plot. Soils are podzolic rankers and common rankers, rarely rendzinas (inf. A. Miechówka). Censuses were carried out on the following days: 2,10,11 June, 6 and 9 July.

T-2. Homogenous dwarf pine. Study area (23 ha) situated in thicket of dwarf pine (*Pinethum mughi subalpinum*) on the height 1500–1720 m. a. s. l. in the Dubrawiska area along the yellow way to the Kszyżne. Mountain-ash grows only in a few places. Soils are the lithic leptosols, podzolic rankers (inf. A. Miechówka). The investigations were curried out on the following days: 31 May, 1,7 June, 5 and 8 July.

T-3. Alpine meadow with clumps of dwarf pine. Simple plot (31 ha) is situated on the slopes of Kasprowy Wierch Mt. (Kotliny area, Zakosy valley) on the height 1560–1840 m. a. s. l. Dominant formation is high-mountain grasses (*Trifido-Distichetum*). The clumps of dwarf pine held about 30 % of place. Podzolic soils are formed on the granite (inf. A. Miechówka). Censuses were carried out on the following days 4 and 10 June, 6, 9 and 13 July.

T-4. Alpine meadow and talus cones. The plot (38 ha) is situated on the slopes of Kas-

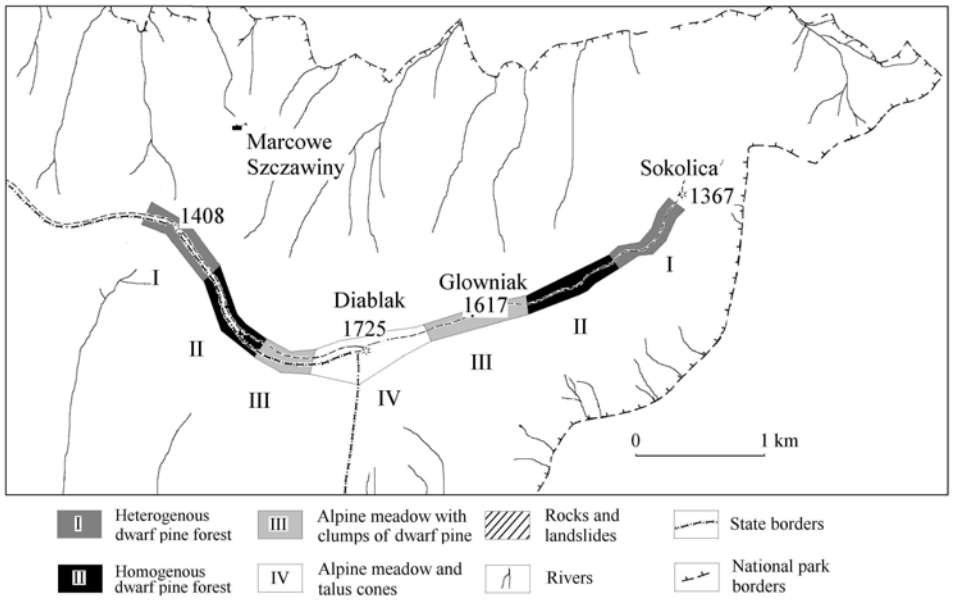

Fig. 2. Sample plots in the Babia Gora National Park.
Рис. 2. Пробні площі у Бабйогурському національному парку.

prowy Wierch Mt. (Zakosy area) on the height 1660–1940 m. a. s. l. Plant communities are represented by *Trifido-Distichetum* and *Oxyrio-Saxifragetum*. Soils are initial, poorly developed (Komornicki, Skiba, 1996). The investigations were carried out in the same days as on the plot T-3.

T-5. The rocks and landslides in subnival belt. Simple plot (21 ha) is situated on the range Korzysta on the height 2050–2193 m. a. s. l. Vegetation is represented here by communities of lichens, high-mountain grasses (mainly *Juncetum trifidie*) on the poor carbonaceous bedrock. Censuses were carried out on the following days: 7 June, 5, 8, 11 and 15 July.

Study areas in the Babia Gora NP (Fig. 2).

B-1. Elfin woodland (heterogeneous dwarf pine forest) on the eastern and western slopes of the Babia Gora range. The plot (11 ha) is situated on the height 1374–1525 m. a. s. l. It is covered by dwarf pine with the bushes of the Mountain-ash *Ribes* sp. and sometimes with spruce. Soils are podzolic rankers (Adamczyk, 1983). Censuses are curried out on the following days: 29, 30 May, 12, 13 and 14 June.

B-2. Homogenous thickets of dwarf pine. Simple plot (12 ha) is situated in the thickets of dwarf pine on the height 1525–1610 m. a. s. l. on the Babia Gora-range. Soils are podzolic rankers. Investigations are carried out in the same days as on the plot B-1.

B-3. Alpine meadow with clumps of dwarf pine. The plot (12 ha) is situated on the height 1610–1650 m. a. s. l. The high-mountain grasses are the dominant formation here represented mainly by the community *Trifido-Supinetum*. Clumps of dwarf pine held about 40 % of plot place. Soils are podzolic rankers. Bird censuses are carried out in the same days as on the plot B-1.

B-4. Alpine meadow and talus cones. The plot (13 ha) is situated on the height 1650–1725 m. a. s. l. Community *Trifido-Supinetum* represents vegetation. Soils are initial and poorly developed (Adamczyk, 1983). Investigations were carried out in the same days as on the plot B-1.

Methods

The main methods of bird estimations were the mapping method (Ehemar, 1959), with the modifications increasing its efficiency suggested by Tomiałojć (1980). The width of sample plot did not exceeded 100 m in the deep thicket of dwarf pine and it was connected to tourist ways. The censuses were taken mainly in the hours 5 to 10 in the morning and 2–3 hours before the sunset.

The single occurrences of birds were excluded during the summing of census results, excepting occurrence of birds or pairs, which revealed sings of nesting (birds with nest materials, food or excrements, nesting behaviour). The birds which were found in a given biotope only in tiny numbers (N < 0,1 pairs/10 ha) and which probably nested close to the sample plot, were included in the breeding community as complementary ones and marked with "+". The species is dominant when their part in the community is not less than 10 % (Kuziakin, 1962).

Similarity of bird communities is calculated on the base of Sorenson's formula (SQ) (Magurran, 1988). Some informational indexes were used for the valuations of structure complicity of bird communities (Shannon, Weaver, 1949; Hutcheson, 1970; Odum, 1983):

a) Shannon species diversity index (H')

$H' = -S\ p_i \ln p_i$, where p_i, the proportion abundance of the i-th species = (n_i/N);

b) Margalef's species richness index (D)

$D = (S - 1)/\ln N$, where S, the number of species in the community, N, the number of individuals in the sample plot;

c) Simpson domination index (c)

$c = S (n_i /N)^2$, where n_i, the number of individuals in the i-th species; N, the total number of individuals.

α-diversity proposed to mean the species richness of a particular habitat that is considered to be homogeneous; β-diversity, the degree of replacement of species among different habitats in a landscape. The two components of diversity were originally proposed for studies of changes along continuous environmental gradients (Whittaker, 1972, 1977; Routledge, 1977; Cody, 1975, 1993; Halffter, 1998).

α-diversity was analyzed using two expressions of species richness: 1) the cumulative α-diversity, which is the total number of species recorded in the total number of sampling nights per habitat; and 2) the average α-diversity, which is the summation of the number of species recorded each night, from night 1 to total number of nights, divided by the total number of nights per habitat.

We used a modified version of spatial index β diversity (Whittaker, 1972), which is obtained by dividing the total number of species in a set of species lists by the mean a diversity of the lists (and x 100). This index has a minimum value of 0 when the two habitats being compared are identical and a maximum value of 100.

Cluster-analysis was carried out using Ward's method. The material was elaborated statistically using the programme "Statistica" licensed in the Institute of Nature Protection Polish Academy of Science in Krakow (Poland).

Results

27 bird species were noted in general on the simple plots in the Tatras and the Babia Gora during our investigations.

15 bird species were noted on the simple plot T-1 in the Tatra NP. 12 species belonged to the breeding species with the density 16,6 pairs/10 ha (Table 1). Breeding community of the elfin woodland in the Babia Gora NP (sample plot B-1) was consisted from 10 species (in general – 17) with the density 19,6 pairs/10 ha (Table 2). The Dunnock (*Prunella modularis*) was the most numerous bird on the both massifs in this habitat (30,1 % and 32,5 % accordingly). Also the Redpoll (*Carduelis flammea*) and the Chiffchaff (*Phylloscopus collybita*) belonged to the dominant species of this community in the Western Tatras; the Willow Warbler (*Phylloscopus trochilus*) and the Chiffchaff – in the Babia Gora.

The Dunnock was the superdominant in the zone of homogenous dwarf pine (plots T-2 and B-2), forming about 50 % of bird number in

Table 1

Species composition and density of breeding bird community in the Tatras elfin woodlands in the subalpine belt (T-1)
Видовий склад і чисельність гніздового орнітоугруповання мішаного криволісся в субальпійському поясі Татр (T-1)

Species	Number of pairs		
	18 ha	10 ha	%
Prunella modularis	9,0	5,0	30,1
Carduelis flammea	3,0	1,7	10,9
Phylloscopus collybita	3,0	1,7	10,9
Sylvia atricapilla	2,5	1,4	8,1
Erithacus rubecula	2,0	1,1	6,7
Phylloscopus trochilus	2,0	1,1	6,7
Parus ater	2,0	1,1	6,7
Fringilla coelebs	2,0	1,1	6,7
Anthus spinoletta	1,0	0,6	3,3
A. trivialis	1,0	0,6	3,3
Pyrrhula pyrrhula	1,0	0,6	3,3
Turdus torquatus	1,0	0,6	3,3
Nucifraga caryocatactes	+	+	+
Anthus pratensis	+	+	+
Phoenicurus ochruros	+	+	+
Total:	29,5	16,6	100,0

Table 2

Species composition and density of breeding bird community in the Babia Gora elfin woodland in the subalpine belt (B-1)
Видовий склад і чисельність гніздового орнітоугруповання мішаного криволісся в субальпійському поясі Бабйої Гури (B-1)

Species	Number of pairs		
	11 ha	10 ha	%
Prunella modularis	7,0	6,4	32,5
Phylloscopus trochilus	6,0	5,5	27,9
Ph. collybita	2,0	1,8	9,4
Anthus spinoletta	1,0	0,9	4,6
Sylvia atricapilla	1,0	0,9	4,6
Carduelis cannabina	1,0	0,9	4,6
Turdus torquatus	1,0	0,9	4,6
Fringilla coelebs	1,0	0,9	4,6
Carduelis spinus	1,0	0,9	4,6
Erithacus rubecula	0,5	0,5	2,6
Anthus trivialis	+	+	+
Carduelis flammea	+	+	+
Turdus merula	+	+	+
Corvus corax	+	+	+
Cuculus canorus	+	+	+
Pyrrhula pyrrhula	+	+	+
Turdus philomelos	+	+	+
Total:	21,5	19,6	100,0

each community. This habitat in the Tatra NP was populated by 5 bird species (in general 10); their general density consisted 10,4 pairs/10 ha (Table 3). The Black Redstart (*Phoenicurus ochruros*) was observed among other species, which prefer mainly the rock places in this environment. Such forest bird species as the Chiffchaff, the Robin (*Erithacus rubecula*), the Coal Tit (*Parus ater*) were not numerous on the plot T-2 (< 0,1 pairs/10 ha). A little another species composition in community was noted in the similar habitat in the Babia Gora (Table 4). Here were observed 13 species from which 5 species with density 12,9 pairs/10 ha belong to the breeding species.

8 species were noted in the zone of high-mountain meadow with the clamps of dwarf pine (plot T-3) on the territory of the Tatra NP (5 breeding species with the density 7,5 pairs/10 ha; Table 5). Superdominant was the Water Pipit (*Anthus spinoletta*) with 58,1% specimens number in the community. The Dunnock was numerous also (24,5 %). In the same environment of the Babia Gora massif (plot B-3) 9 species were noted (10,8 pairs/10 ha; Table 6). Thought 4 species belonged to the breeding bird community on meadows of the Babia Gora, their quantity was more almost by one third. The Northern Wheatear (*Oenanthe oenanthe*) was noted here, which is not observed in this biotope in the Western Tatras.

7 species were noted on the plot of meadow with the landslides in the alpine belt (plot T-4), but the quantity of breeding bird community consist of 5,4 pairs/10 ha (Table 7). This habitat (plot B-4) on the Babia Gora counted 7 bird species also (Table 8), instead of their quantity was almost more twice (8,5 pairs/10

Table 3

Species composition and density of breeding bird community in the Tatras homogenous dwarf pine forests in the subalpine belt (T-2)
Видовий склад і чисельність гніздового орнітоугруповання гірської сосни в субальпійському поясі Татр (T-2)

Species	Number of pairs 23 ha	10 ha	%
Prunella modularis	12,0	5,2	50,2
Anthus spinoletta	8,0	3,5	33,3
Carduelis flammea	2,0	0,4	8,3
C. spinus	1,0	0,4	4,1
Phoenicurus ochruros	1,0	0,4	4,1
Phylloscopus trochilus	+	+	+
Erithacus rubecula	+	+	+
Phylloscopus collybita	+	+	+
Parus ater	+	+	+
Turdus torquatus	+	+	+
Total:	24,0	9,9	100,0

Table 4

Species composition and density of breeding bird community in the Babia Gora homogenous dwarf pine forest in the subalpine belt (B-2)
Видовий склад і чисельність гніздового орнітоугруповання гірської сосни в субальпійському поясі Бабйої Гори (B-2)

Species	Number of pairs 12 ha	10 ha	%
Prunella modularis	7,5	6,3	48,4
Anthus spinoletta	4,0	3,3	25,7
Phylloscopus trochilus	2,0	1,7	12,9
Carduelis spinus	1,0	0,8	6,5
Carduelis flammea	1,0	0,8	6,5
Phoenicurus ochruros	+	+	+
Oenanthe oenanthe	+	+	+
Erithacus rubecula	+	+	+
Sylvia atricapilla	+	+	+
Turdus torquatus	+	+	+
Cuculus canorus	+	+	+
Fringilla coelebs	+	+	+
Total:	15,5	12,9	100,0

ha). The Water Pipit has a quantitative maximum, consisting in the both habitats 60,9 and 56,0 % of specimens' quantity. The Black Redstart was another numerous species. The observations of the Alpine Accentor (*Prunella collaris*) began in this belt.

The least numerous bird community on the simple plots was characteristic for the rocks and regoliths (plot T-5), which occurred only in the Tatras. 7 bird species were noted here (4,3 pairs/10 ha; Table 9). The Alpine Accentor was a most typical bird species in this belt. The Water Pipit and the Black Redstart were numerous also. The Common Kestrel (*Falco tinnunculus*) was observed regularly, as well as the Peregrine (*F. peregrinus*), – the species rare in the Tatras.

Differences in the avifauna of the mountain belts above forest zone between sites in areas of differing biotopes were assessed using the mapping census data. The state of biotopical characteristics especially a species number (S), breeding bird density (N), biomass (B), indexes of species diversity (H'), species richness (D) and domination (c) are given in the table 10 for investigated bird communities. On the sites sampled on Tatra Mts., the

Table 5

Species composition and density of breeding bird community in the Tatras meadows with clumps of dwarf pine in the alpine belt (T-3)
Видовий склад і чисельність гніздового орнітоугруповання лук з куртинами гірської сосни в субальпійському поясі Татр (T-3)

Species	Number of pairs 31 ha	10 ha	%
Anthus spinoletta	13,5	4,4	58,1
Prunella modularis	6,0	1,9	24,5
Phoenicurus ochruros	2,0	0,6	8,6
Carduelis flammea	1,0	0,3	4,3
C. cannabina	1,0	0,3	4,3
Phylloscopus trochilus	+	+	+
Motacilla cinerea	+	+	+
Corvus corax	+	+	+
Total:	23,5	7,5	100,0

Table 6

Species composition and density of breeding bird community in the Babia Gora meadows with the clumps of dwarf pine in the alpine belt (B-3)
Видовий склад і чисельність гніздового орнітоугруповання лук з куртинами гірської сосни в субальпійському поясі Бабйої Гори (B-3)

Species	Number of pairs 12 ha	10 ha	%
Anthus spinoletta	6,5	5,4	50,1
Prunella modularis	4,0	3,3	30,8
Phoenicurus ochruros	1,5	1,3	11,5
Carduelis flammea	1,0	0,8	7,6
Oenanthe oenanthe	+	+	+
Turdus torquatus	+	+	+
Phylloscopus trochilus	+	+	+
Corvus corax	+	+	+
Anthus pratensis	+	+	+
Total:	13,0	10,8	100,0

richest were heterogeneous dwarf pine forest as well on Babia Gora.

The diversities based on pair numbers seem to be essentially of the same order of magnitude in all the communities studied. Diversities are, however, affected by spatial heterogeneity, i.e. the sizes of census areas in the size range of areas used in this study.

Table 7

Species composition and density of breeding bird community in the Tatras alpine meadows and talus cones in the alpine belt (T-4)
Видовий склад і чисельність гніздового орнітоугруповання лук з осипищами в альпійському поясі Татр (T-4)

Species	Number of pairs 38 ha	10 ha	%
Anthus spinoletta	12,5	3,3	60,9
Phoenicurus ochruros	5,0	1,3	24,4
Prunella collaris	2,0	0,5	9,8
Oenanthe oenanthe	1,0	0,3	4,9
Falco tinnunculus	+	+	+
Motacilla cinerea	+	+	+
Corvus corax	+	+	+
Total:	20,5	5,4	100,0

Table 8

Species composition and density of breeding bird community in the Babia Gora alpine meadows and talus cones in the alpine belt (B-4)
Видовий склад і чисельність гніздового орнітоугруповання лук з осипищами в альпійському поясі Бабйої Гури (B-4)

Species	Number of pairs 38 ha	10 ha	%
Anthus spinoletta	6,5	5,0	58,1
Phoenicurus ochruros	2,0	1,5	17,7
Oenanthe oenanthe	1,5	1,5	15,2
Prunella collaris	1,0	0,8	9,1
Monticola saxatilis	+	+	+
Falco tinnunculus	+	+	+
Corvus corax	+	+	+
Total:	11,0	8,8	100,0

Table 9

Species composition and density of breeding birds in the Tatras rocks and landslides in the subnivale belt (T-5)
Видовий склад і чисельність гніздового орнітоугруповання скель в субнівальному поясі Татр (T-5)

Species	Number of pairs 18 ha	10 ha	%
Prunella collaris	4,0	1,9	44,3
Anthus spinoletta	2,5	1,2	27,8
Phoenicurus ochruros	1,5	0,7	16,7
Oenanthe oenanthe	+	0,5	11,2
Falco peregrinus	+	+	+
Corvus corax	+	+	+
Falco tinnunculus	+	+	+
*Tichodroma muraria**	–	(+)	(+)
Total:	8,0	4,3	100,0

* – the species was observed very close to the border of sample plot.

Table 10

Some basic parameters and biodiversity indexes of investigated bird communities on the Tatras (simple plots T-1 – T-5) and the Babia Gora (simple plots B-1 – B-4)
Деякі основні параметри та індекси біорізноманітності досліджуваних орнітоугруповань у Татрах (ділянки T-1 – T-5) і Бабій Гурі (ділянки B-1 – B-4)

	Tatra NP					Babia Gora NP			
	T-1	T-2	T-3	T-4	T-5	B-1	B-2	B-3	B-4
S	15	10	8	7	7	17	13	9	7
S (N > 0,1)	12	5	5	4	4	10	5	5	4
N (pairs/10 ha)	16,6	10,4	7,5	5,4	4,3	19,6	12,9	10,8	8,5
B (kg/10 ha)	0,318	0,202	0,161	0,129	0,120	0,381	0,232	0,212	0,105
H’	2,209	1,185	1,147	1,020	1,258	1,884	1,319	1,331	1,019
c	0,140	0,374	0,415	0,442	0,313	0,205	0,327	0,309	0,430
D	4,983	3,843	3,474	3,558	4,113	5,337	4,693	3,374	2,804

α-diversity for each habitat type differed according to whether we considered the cumulative number of species, or the average number of species (Table 11). In both cases, however, the highest α-diversity was recorded in the heterogeneous elfin woodland.

Cumulative α-diversity during the whole sampling period varied from 7 in alpine meadows and talus cones to 15 species in the elfin woodlands in the subalpine belt, with a mean of 9,4 species in the Tatra Mts. and from 7 to 17 ones, with a mean of 11,7 in the Babia Gora. It is not surprisingly, lowest cumulative α did correspond to relatively the highest, homogeneous habitats such as meadows and talus cones as well rocks and landslides.

Spatial β-diversity was very different (Table 12), which means that species turnover between habitats.

Number of Sorenson index for analogous habitats both massifs varied between 73 and 100 %. The smallest similarity is noted between the bird communities of heterogeneous elfin woodlands – 73 %. This parameter is the largest between the bird communities of meadows with landslides – 100 %, i.e. the species composition of bird fauna of those habitats is identical. Their significance varied between 80–89 % for the bird communities on the analogous plots of dwarf pine forest and meadow with clumps of dwarf pine.

The peculiarity of some bird species occurrence on the investigated plots are given below.

Aquila chrysaetos. One subadult individual (what demonstrate the white tail with the black edge) was noted 12 June on the Diablak-mountain (Babia Gora NP). After half hour soaring over the massif the bird flayed away in the northern-eastern direction.

Falco tinnunculus. Two individuals (both males) were observed above the Mala Babia

Table 11

α-diversity of birds in nine habitats, N is total number of sampling days
α-різноманіття птахів у дев’яти біотопах, N – загальна кількість днів досліджень

Habitat type	N	Cumulative α-diversity	Average α-diversity
T-1	5	15	11,5
T-2	5	10	7,9
T-3	5	8	6,9
T-4	5	7	6,0
T-5	5	7	5,7
B-1	5	17	15,1
B-2	5	13	10,8
B-3	5	9	6,8
B-4	5	7	6,2

Table 12

Whittaker measures of spatial β-diversity between pairs of habitats in the landscape
Величина просторової β-різноманітності Віттекера між досліджуваними парами біотопів

	T-1	T-2	T-3	T-4	T-5	B-1	B-2	B-3	B-4
T-1	*	20,0	56,5	81,8	82,6	35,3	33,3	21,4	42,9
T-2		*	44,4	76,5	77,8	40,7	27,3	36,8	76,5
T-3			*	46,7	62,5	60,0	50,0	15,8	60,0
T-4				*	20,0	83,3	68,4	41,2	28,6
T-5					*	84,0	70,0	52,9	20,0
B-1						*	26,7	53,9	83,3
B-2							*	27,3	60,0
B-3								*	50
B-4									*

Gora-mountain (30 May) and on the northern side of Głowniak mountain (13 June). This species was noted sporadically over the Koszysta-range as well as in the Kondratowa-valley region.

Falco peregrinus. Single birds and pairs probably breeding were observed regularly in the Koszysta range region (plot T-5).

Apus apus. Up to 30 individuals were observed almost every count over the Babia Gora range. The largest their quantity appears after the midday, as a rule. Before the sunset the birds dart in the air with the characteristic shrill, catching the insect. Isolated specimens or their group were observed in the Koszysta and Kasprowy Wierch regions.

Hirundo rustica, *Delichon urbica*. They were observed rather often over the Babia Gora and more rarely – over the ranges of the Tatras.

Motacilla cinerea. Species was noted on the plots T-3 and T-4 owing to available streams.

Monticola saxatilis. One individual was noted 12 June on the top of Diablak-Mt.

Tichodroma muraria. One bird was noted 11 July in the Koszysta range area, near the investigation plot T-5. The species breeds mainly in the mountains with the necked and almost vertical rocks and make the nests in the rock crevices. It is very rare species on the Tatras (Cichocki, 1986).

Carduelis flammea. The species is wholly numerous on the territory of Tatras. It occurs mainly in the heterogeneous elfin woodlands. 11.06. 1998 on the plot T-1 was noted the pair bringing a food for the nestlings.

Discussion

Bird communities are influenced by first of all time (succession), temperature (altitude), moisture (annual rainfall or soil moisture) or by the combinations of these and other (latitude) factors, which often produce gradient of vegetation (Karr, 1990)

The structure and trophic condition of the heterogeneous habitats are much more favourable for birds that the homogenous ones. Biotical conditions are supplemented there with physical factors (air temperature, insolation, snow cower persistence, etc.), which become important in the mountains and considerably shape the faunal relationships.

The homo- and heterogeneous dwarf pine forest habitats offer milder whether conditions and a little earlier breeding season than open habitats (Bollmann, Reyer, 2001). Those factors are not uniforms over all areas. Particularly, the persistence of the snow might significantly influence the presence of birds nesting on the ground. It comes out, that in terms of the number of bird species, the homogenous habitats are poorly as their heterogeneous twilling.

Dependence of bird species diversity and species richness on habitat diversity has been clarified for breeding bird communities in many studies (e.g. Keast, 1990; Landmann, 1990, etc.). The altitude change of vegetation has slightly jumping character in the investigated mountain massifs (Piękoś-Mirkowa, Mirek, 1996). In these plant communities the

vegetation period continues 2–3 months and such short warm season intensify the competitive relation and cause to the strain biotic relations between the living organisms.

Differences on the species packing were minimized in the choice of study areas with highly similar vegetation physiognomy, of foliage profile. The bird species diversity has been shown to be in good correlation with the foliage height diversity in many areas (MacArthur et al., 1962; Cody, 1974) though it is still to be shown within climate zones considered in this study. There is a wealth of studies from different part of Europe (Haapanen, 1965; Głowaciński, 1975, etc.), which account great changes in the bird species diversity of vegetation layers. The similarity of diversity of the same biotopes in Tatra and Babia Gora supports the theory that foliage profile diversity determines the bird species diversity.

The significant decreasing of species number and density of breeding pairs were observed with the rise of altitude above sea level on both investigated massifs. The results clearly show that there is a significant difference in the altitudinal distribution of breeding birds on Tatra and Babia Gora. The significant differences were found between different biotopes of one altitudinal level on both massifs ($P < 0,05$, G_1-test).

The change of bird communities along the altitude gradient is caused first of all by the change of environment structure (Winding et al., 1993). Relatively high homogeneity of alpine meadow habitat caused noticeably smaller species diversity of bird communities. However, general trends of disappearing of bird species richness, species diversity with the altitude increasing may be also broken in some cases depending to structural features of habitat that is noted also by Brunner (1998).

General biomass of specimens in bird community decreased almost twice with altitude on the simple plots of the Tatras and by a third on the Babia Gora. The index of domination of bird communities increased as well.

Primary conditions for the diversity H' lie this in the structure of the habitats (Recher, 1971) and concern all factors shaping the values S and N. Changes of bird community parameters H' don't have a linear character. The coefficient H' of birds attains no so very high value (twice lower) in the heterogenous dwarf pine forest (1,884–2,209 bits per indiv.) (Table 10) as rich forest habitats in the European temperate zone (Głowaciński, 1981; Tomialojc et al., 1984).

From the total bird community diversity, Cody (1975) among others separates the α-diversity or species packing level of a habitat, the β-diversity or turn over between habitats. The latitudinal component is consequences of differences in the productivity of ecosystems owing to the altitudinal gradient, and the strength and length of winter season.

Comparison of bird communities of these territories with the analogous plots in the Western Tatras (Głowaciński, Profus, 1992) shows that the least similarity is between these communities in the homogenous dwarf pine forest (Table 13). The similarities (SQ) between bird communities consist 46–80 % in the alpine and subalpine belts in the High Tatra and Babia Gora Mts. and 62–89 % between the bird communities in the Western and High Tatras. In those regions the bird communities of meadows with the landslides and rocks and regolits are almost identical. The bird communities of meadow with the landslides detect the great-

Table 13

Indices of similarity of the bird communities found in the simple plots of the alpine and subalpine belts on the High Tatras, Babia Gora and Western Tatras

Індекси подібності орнітоугруповань пробних площ альпійського та субальпійського поясів у Високих Татрах, Бабій Гурі та Західних Татрах

	High Tatras				
	I	II	III	IV	V
Western Tatras	0,82	0,62	0,73	0,75	0,89
Babia Gora	0,64	0,46	0,80	0,75	–

Table 14

Biotopical distribution of birds in habitats of the alpine and subalpine belts in the Tatras (sample plots T-1 – T-5)
Біотопічний розподіл птахів у альпійському та субальпійському поясах Татр (ділянки T-1 – T-5)

Species	Investigated plots				
	T-1	T-2	T-3	T-4	T-5
Nucifraga caryocatactes	(+)				
Anthus pratensis	(+)				
Sylvia atricapilla	+				
Fringilla coelebs	+				
Pyrrhula pyrrhula	+				
Anthus trivialis	+				
Phylloscopus collybita	+	(+)			
Parus ater	+	(+)			
Erithacus rubecula	+	(+)			
Turdus torquatus	+	+			
Carduelis spinus	–	+			
Phylloscopus trochilus	+	(+)	(+)		
Prunella modularis	+	+	+		
Carduelis flammea	+	+	+		
Phoenicurus ochruros	(+)	+	+	+	+
Anthus spinoletta	+	+	+	+	+
Carduelis cannabina			+		
Motacilla cinerea			(+)	(+)	
Corvus corax			(+)	(+)	(+)
Falco tinnunculus				(+)	(+)
Oenanthe oenanthe				+	+
Prunella collaris				+	+
Falco peregrinus					(+)
Tichodroma muraria					(+)

+ – breeding bird species; (+) – birds which were found only in tiny numbers (N < 0,1 pairs/10 ha) and probably nested close to the sample plot.

est similarity between analogous habitats also. Similarity between bird communities in the same habitat types is larger in the Tatras than between such communities in the High Tatras and in the Babia Gora.

Biotopical species distribution for the investigated birds of mountains is shown in Tables 14 and 15. There is no striking difference between altitudinal-biotopical distributions of breeding bird species on the two massifs. The number of species decreases with increasing altitude. Main strictly mountain bird species occur in the highland. This pattern is repeated for birds of main conservation concern (threatened, endemic and restricted-range species).

High species diversity of vegetation is characteristic for the belt of elfin woodland that caused relatively numerous bird communities in comparison with other investigated biotopes. In terms of density index, the communities constitute a clear gradation from the community of heterogeneous dwarf pine forest (T-1, B-1) to the poorer habitat of the alpine meadows and rocks on the subnival belt. The quantitative state of breeding bird communities in the heterogeneous dwarf pine forests both Tatra and Babia Gora presents the same patterns that of the number of species. This is most probably caused by the spatial development modes and the trophic abundance of the habitats. Index of bird density is particularly sensitive to structural changes and volume of habitats. There were note for the investigated biotopes in the Tatras as well as in the Babia Gora. Elfin woodland is the upper border of distribution of many forest birds (e.g. *Pyrrhula pyrrhula*, *Phylloscopus collybita*, *Parus ater*, *Erithacus rubecula*, *Carduelis spinus*, etc.) and the bottom distribution border of some high-mountain bird species (*Anthus spinoletta*).

Analysis of the species composition and biotopical distribution of bird species showed in alpine and subalpine belts on the Babia Gora and the Western Tatras that the bird communities are rather similar in these massifs.

Only for some species it is possible to distinguish strictly the species that show a strong

habitat preference (that is indicator) for each of the investigated biotopes (Tables 14, 15). The zones of bird occurrence are usually broader than it would follow from the distribution of the sample plots. In mountain zones it is possible to identify only the characteristic species, which prefer some biotopes.

Homogenous structure of biocoenosis and strong climate condition, especially in alpine belt caused small species and numerous representations of birds. The Water Pipit was the most numerous species in the alpine belt. Single pairs of this species disappeared already in the belt of elfin woodland. Our results indicate that the Water Pipit's bred in all high-mountain biotopes but they prefer to use the habitats of alpine meadow with the occasional clamps of dwarf pine, where it was the most numerous species. At the mesohabitat scale, territory locations coincide with areas, where dwarf pine was presented not continuous cover and not open meadows but the meadows with the clumps of dwarf pine. Probably the clumps give better protection for the nests of the Water Pipit. Salzmann (1982), Murphy (1983), Bollmann, Reyer (2001) showed that in ground-nesting birds, heat stress is a cause of nestling mortality. Parameters of Water Pipit's density are rather similar on the territory of the Western Tatras (our investigations) as well as High Tatras which given Głowaciński and Profus (1992).

The Redpoll was noted in the elfin woodland and represented the subspecies *Carduelis flammea cabaret* on this territory (Hanzák, 1953; Wasilewski, 1996). From the middle of XX cent. a noticeable increasing of quantity of this boreal-alpine species is noted in many regions of Europe. The active territorial expansion of this species is observing to unoccupied high-mountain regions of continent.

Not numerous occurrences of the Redpoll's breeding were known in the Tatras from the middle of XIX cent. (Tomiałojć, Stawarczyk, 2003). However the absence of observations from the latest periods could suppose that the species has disappeared from this region. Ferens (1962) indicated that the Redpoll was not found in the Polish part of Tatras. New observations of the Redpoll were known in XX cent. on this territory owing to investigations of Kania and Wasilewski (1969) and Cichocki

Table 15

Biotopical distributions of birds in habitats of the alpine and subalpine belts in the Babia Gora (sample plots B-1 – B-4)
Біотопічний розподіл птахів у альпійському та субальпійському поясах Бабйої Гури (ділянки B-1 – B-4)

Species	Investigated plots			
	B-1	B-2	B-3	B-4
Pyrrhula pyrrhula	(+)			
Turdus philomelos	(+)			
T. merula	(+)			
Anthus trivialis	(+)			
Phylloscopus collybita	+			
Carduelis cannabina	+			
Cuculus canorus	(+)	(+)		
Fringilla coelebs	+	(+)		
Sylvia atricapilla	+	(+)		
Erithacus rubecula	+	(+)		
Carduelis spinus	+	+		
Turdus torquatus	+	(+)	(+)	
Phylloscopus trochilus	+	+	(+)	
Prunella modularis	+	+	+	
Carduelis flammea	(+)	+	+	
Corvus corax	(+)	(+)	(+)	(+)
Anthus spinoletta	+	+	+	+
Oenanthe oenanthe		(+)	(+)	+
Phoenicurus ochruros		(+)	+	+
Anthus pratensis			(+)	
Prunella collaris				+
Monticola saxatilis				(+)
Falco tinnunculus				(+)

+ – breeding bird species; (+) – birds which were found only in tiny numbers (N<0,1p/10 ha) and probably nested close to the sample plot

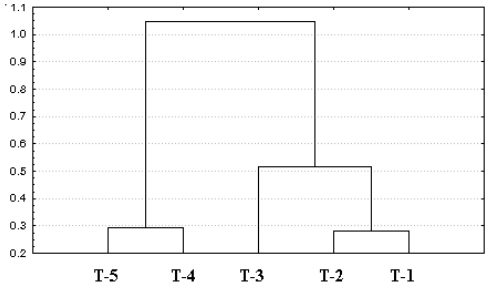

Fig. 3. Similarity analysis of the breeding bird communities of alpine and subalpine belts in the Tatra Mts., according to hierarchical cluster analysis (correlation matrix: Sorenson's; dendrogram: Ward's method), T-1 – elfin woodlands; T-2 – homogenous dwarf pine forest; T-3 – meadows with the clumps of dwarf pine; T-4 – alpine meadows and talus cones; T-5 – rocks and landslides

Рис. 3. Подібність гніздових орнітоугруповань альпійського та субальпійського поясів у Татрах згідно з результатами ієрархічного кластерного аналізу (кореляційна матриця Соренсона; дендрограма: метод Варда), Т-1 – мішане криволісся; Т-2 – зарості гірської сосни; Т-3 – луки з куртинами гірської сосни; Т-4 – альпійські луки з осипищами; Т-5 – скелі.

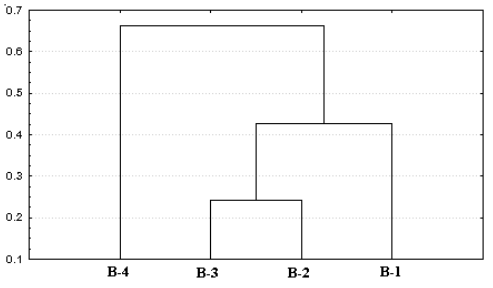

Fig. 4. Similarity analysis of the breeding bird communities of alpine and subalpine belts in the Babia Gora Mts., according to hierarchical cluster analysis (correlation matrix: Sorenson's; dendrogram: Ward's method), B-1 – elfin woodlands; B-2 – homogenous dwarf pine forest; B-3 – meadows with the clumps of dwarf pine; B-4 – alpine meadows and talus cones,

Рис. 4. Подібність гніздових орнітоугруповань альпійського та субальпійського поясів у Бабій Гурі згідно з результатами ієрархічного кластерного аналізу (кореляційна матриця Соренсона; дендрограма: метод Варда), В-1 – мішане криволісся; В-2 – зарості гірської сосни; В-3 – луки з куртинами гірської сосни; В-4 – альпійські луки.

(1986). Karaska (1989) recalled also about the breeding one on the upper forest border and in the elfin woodland in the Slovak part of Tatras. Mošansky (1974) noted that the Redpoll occurred not often or singly on the altitudes from 1500 to 2000 m a. s. l. in the Slovak Tatras. In the polish Tatras (our simple plots) breeding pairs have been noted on the altitudes from 1400 m a. s. l. in hetero- and homogenous dwarf pine forests as well as on meadows with clump of dwarf pine. In the area of Morskie Oko (Western Tatras) the Redpoll was noted from homogenous dwarf pine (Głowaciński, Profus, 1992).

The data about the distribution of the Redpoll in the Babia Gora are insufficient. In 1970s the species has not been noted on this territory (Bocheński, 1970). Ferens (1963) wrote also about the necessity of confirmation of its occurrence in the elfin woodland belt. Karaska and Kocyan (1991) observed 1–2 specimens of this species during the breeding period on the slovak part of Babia Gora. Notice about the Redpoll's breeding in this massif is given also in the Polish Red Data Book (Jakubiec, 2001). It was noted during our investigations that this species prefer the zones of homogenous dwarf pine forest and meadow with the clumps of pine forest.

According to the results of investigations and extrapolation of Głowaciński and Profus (1992) estimated population of the Redpoll in the polish Tatras is 20-40 pairs. In our opinion, Redpoll's population on the territory of Babia Gora is 6–10 pairs.

The Bluethroat (*Luscinia svecica*) was one of the most numerous species in zone of homogenous dwarf pine in the High Tatras (Głowaciński, Profus, 1992). These authors have

detected the tundra subspecies *Luscinia s. svecica* in the Tatras. Cichocki (1996) realised the special investigations in 1992–1994 and discovered 4–5 breeding plots of this species in the Gasiennicowa-valley and 11–16 pairs in the Polish Carpathians in total. We haven't noted this species on the simple plots in the Western Carpathians. Also Mošansky (1974) did not put it in the list of species from territory of the Slovak Tatras.

The Black Redstart was among the species observed in all investigated massifs. It was rare in the dwarf pine forest. A few pairs nested on the top of Babia Gora, which was accorded with the data of Bocheński (1970). Increasing of this species quantity is improbably on this territory from the cause of limited square of potential breeding and foraging biotopes. In the Tatras it was one of the numerous species on the places distinguishing by plumb walls, stone and meadows with landslides. Głowaciński and Profus (1992) marked out it as azonal species with distribution depending on biotope structure more as on high above sea level. Indices their territory Black Redstart was significantly more likely to use the heap of stones and rocks.

The Dunnock belongs also to the breeding species with great amplitude of vertical distribution and it occurred from the arable fields to the dwarf pine forest (Bocheński, 1970). It was the dominant species in the heterogeneous and homogenous dwarf pine forest forming up to the half of bird specimens' number of those areas on the territories of both Parks.

The Willow Warbler was the second species for a quantity after the Dunnock in heterogeneous elfin woodland on the territory of Babia Gora NP and it was observed usually in higher distribution places of the previous species. This species occurred also in the homogenous dwarf pine zone. In the Western Tatras it was less numerous in the heterogeneous elfin woodland and the rare – in the homogenous one.

The Chiffchaff occurred in the lower zones of elfin woodland and it is connected closely with the presence of spruce in the dwarf pine thicket.

The Northern Wheatear prefers the alpine meadows with the dwarf pine clumps, meadows with the landslides as well as among the rocks and regolithes and it is not numerous species on the both investigated regions. According to Głowaciński and Profus (1992), their density consist to 0,4 pairs/10 ha in the High Tatras.

The Alpine Accentor is a dominant species in biotopes of rocks and rockslides on the territory of Tatras. It is a species of the open high-mountain biotopes and it was noted in the habitat of mountain meadow and rock biotopes. It is the typical mountain bird species with the Palaearctic distribution and well adapted to existing in extreme high-mountain conditions. It is displayed in bionomy and morphology of this bird. Density of this species is detected also almost the same in rocks of the Western and High Tatras (Głowaciński, Profus, 1992). This species was rare on the territory of Babia Gora and was observed only on the top of Diablak-mountain.

Some species (the Common Kestrel, the Peregrine) hold strictly on high-mountain rock biotopes as the breeding habitats. However, they hunt on the whole surface of mountains. From another site the Raven (*Corvus corax*) and the Common Buzzard (*Buteo buteo*) are breeding species of the forest belt and the facultative species of high-mountain areas.

Probably a great quantity of birds in the investigated biotopes on the territory of Babia Gora is caused by the lesser structural homogeneity of the plots as well as ecotone phenomenon from the reason for small spatial representation of alpine and subalpine belts. Biotopes in the Babia Gora massive are more attractive in the topical and trophic aspects owing to greater square of ecotones.

α-diversity, the species richness within habitats, is based on the species that self-maintain viable populations within the habitat that come from the surroundings by mass effect. In our bird study, transitory species are very important in increasing the α-diversity of some habitats, because they can forage in more than one habitat, although they probably are not able

to reproduce successfully in some of these habitats. The presence of transitory species may depend on the mobility of the group, spatial heterogeneity (Stevens, 1989), or the size and topological relations of habitats.

The β-diversity is very different in the bird communities of those area (see Table 12) and can be resulting from at least three main factors: the part of generalist species; high vagility of some species; the spatial structure of the landscape.

Connection distance of some groups of bird communities, which are noted by cluster-analysis, illustrated obviously the similarities and difference of biocoenosis structure (Fig. 3, 4). Similarity analysis of bird communities showed two groups of clusters connected by high similarity indexes. One group is formed by bird communities of meadows with landslides and rocks-regoliths, and second – by homogenous and heterogeneous elfin woodlands and meadows with clumps of dwarf pine. It is marked also, that similarities between the bird communities of the alpine and subalpine belts on the territory of Babia Gora are considerably greater as one the territory of Tatras. Bocheński (1970) did not separate hetero- and homogenous elfin woodlands and give that on the Babia Gora the dwarf pine forest and the spots of grasses in it form for birds the habitats more approximate to the growth and forests than to the open areas of alpine meadow zone.

Species composition and quantitative parameters of breeding communities are similar in a considerable degree in the analogous biotopes of both investigated areas. However, widely distributed species can also display low plasticity in the using of substrate in the local scale. Comparative studies of this type have great potential in helping to understand the evolutionary and ecological factors that mould bird community structure.

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REFERENCES

Adamczyk B. (1983): Charakterystyka gleb Babiogórskiego Parku Narodowego. - Park Narodowy na Babiej Górze. Przyroda i człowiek. Warszawa-Kraków. 95-120.

Alexandrowicz Z., Denysiuk Z., Michalik S., Bolland A., Czemerda A., Jozefko U., Zabierowska D. (1989): Ochrona przyrody i krajobrazu Karpat Polskich. Warszawa-Kraków: PWN. 1-265.

Bocheński Z. (1970): Ptaki Babiej Góry. - Acta zool. Cracov. 15(1): 1-60.

Bollmann K., Reyer H.-U. (2001): Reproductive success of Water Pipits in an alpine environment. - Condor. 103: 510-520.

Brunner H. (1998): Ökologisch-faunistische Untersuchungen der Vogelwelt (Aves) in Gebirgslebensräumen der Seckauer Alpen (Niedere Tauern, Österreich). - Mitt. naturwiss. Ver. Steiermark. 128: 227-243.

Celiński F. Denysiuk Z. (1987): Importance of phitosociological investigations for the formation and renaturalization of protected areas in the Polish Carpathians. - Colloq. phytos. 15: 157-192.

Cichocki W. (1986): Niektóre gatunki lęgowych ptaków w Tatrzańskim Parku Narodowym. - Parki nar. i rez. przyr. 7: 57-62.

Cichocki W. (1991): Ptaki wędrowne w Tatrach. - Tatry. 1: 19-21.

Cichocki W. (1996): Rozmieszczenie i liczebność wybranych gatunków ptaków w Tatrzańskim Parku Narodowym w latach 1992-1995. - Przyroda Tatrzańskiego Parku Narodowego a Człowiek. Tom 2. Biologia. Kraków-Zakopane. 108-112.

Cody M. L. (1974): Competition and the structure of bird communities. Princeton: Princeton Univ. Press. 1-318.

Cody M. L. (1975): Towards a theory of of continental species diversities over Mediterranean habitat gradients. - Ecology and evolution of communities. Cambridge: Belknap Press. 214-257.

Cody M. L. (1993): Bird diversity components within and between habitats in Australia. - Species diversity in ecological communities: historical and geographical perspectives. Chicago: Univ. of Chicago Press. 147-158.

Denysiuk Z., Mielnicka B. (1990): Babiogórski Park Narodowy. Wrocław-Warszawa-Kraków. 1-216.

Ehemar A. (1959): On the determination of the size and composition of a passerine bird population during the breeding season. A methodological study. - Vår fågelwärld. Suppl. 2: 1-114.

Ferens B. (1962): Ptaki. - Tatrzański Park Narodowy. Kraków. 389-426.

Ferens B. (1963): Ptaki. - Babiogórski Park Narodowy. Kraków. 185-195.

Głowaciński Z. (1975): Ptaki Puszczy Niepolomickiej. Badania fauno-ekologiczne. - Acta zool. Cracov. 20: 1-87.

Głowaciński Z. (1981): Lęgowa avifauna lasów podlegających sukcesji allogenicznejw Puszczy Niepołomickiej. - Studia Ośr. Dokument. Fizjogr. PAN. 9: 229-253.

Głowaciński Z. (ed.) (2001): Polska czerwona księga zwierząt. Kręgowce. Warszawa: PWRL. 1-452.

Głowaciński Z., Profus P. (1992): Structure and vertical distribution on the breeding communities in the Polish Tatra National park. - Ochrona Przyrody. 50 (1): 65-94.

Haapanen A. (1965): Bird fauna of the Finnish forests in relation to forest succession. - Ann. Zool. Fennici. 2: 153-196.

Halffter G. (1998): A strategy for measuring landscape biodiversity. - Biology International. 36: 3-17.

Hanzák J. (1953): Hnízdéni a systematycké postavení cecetek, *Carduelis flammea* L. v Československu. - Sylvia. 14: 75-76.

Hess M. (1996): Klimat. - Przyroda Tatrzańskiego Parku Narodowego. Kraków-Zakopane. 53-68.

Hutcheson K. (1970): A test for comparing based on the Shannon Formula. - J. theor. Biol. 29: 151-154.

Jakubiec Z. (2001): Czeczotka *Carduelis flammea* (Linne, 1758). - Polska czerwona księga zwierząt. Kręgowce. Warszawa: PWRL. 271-272.

Kania W., Wasilewski J. (1969): Obserwacje czeczotki, *Carduelis flammea*, w okresie lęgowym w Polskich Tatrach. - Not. orn. 10 (4): 75-76.

Karaska D. (1989): Vtáctvo Statnej Prirodnej Rezervacie Babia Hora. - Stredne Slovensko 6. Prirodne vedy. 301-319.

Karaska D., Kocyan L. (1991): Vtáctvo Slovenskej časti Babej Hory. - Vlas. Zbornik. 16: 239-254.

Karliński J. (1982): Wykaz ptaków tatrzańskich na podstawie własnych i obcych spostrzeżeń. - Spraw. Komisji Fiziogr. 16: 141-169.

Karr J. R. (1990): Interactions between forest birds and their habitats: A comparative synthesis. - Biogeography and ecology of forest bird communities. Hague: SPB Academic Publishing. 379-386.

Keast A. (1990): Australian eucalypt forest bird communities, features and adaptations. - Biogeography and ecology of forest bird communities. Hague: SPB Academic Publishing. 285-296.

Kocyan A. (1884): Ptaki spostrzegane po północnej stronie Tatr. - Pam. Tow. Tatrzańskiego. 9: 50-70.

Komornicki T., Skiba S. (1996): Gleby. - Przyroda Tatrzańskiego Parku Narodowego. Kraków-Zakopane. 215-226.

Kuziakin A. P. (1962): [Zoogeografia SSSR]. - Uchonye zapiski MOPI im.Krupskoy. 109 (1): 3-182.

Landmann A. (1990): Space utilization and habitat preferences of synanthropic birds in the post-breeding season: results of a combined version of mapping and point counting. - Bird Census and Atlas Studies. Proc. XIth Int. Conf. on Bird Census and Atlas Work. Prague. 35-43.

MacArthur R. A., MacArthur J. W., Preer J. (1962): On bird species diversity: II. Prediction of bird census from habitat measurements. - Am. Nat. 96: 167-174.

Magurran A. (1988): Ecological diversity and its measurement. London: Croom Helm. 1-179.

Mirek Z. (1996): Tatry i Tatrzański Park Narodowy – wiadomości ogólne. Zbiorowiska roślinne. - Przyroda Tatrzańskiego Parku Narodowego. Kraków-Zakopane. 235-274.

Mošansky A. (1974): Aves. - Zborník prác o Tatranskom Národnom Parku. Osveta. 223-308.

Murphy M. T. (1983): Nest success and nesting habits of Eastern Kingbirds and other flycatchers. - Condor. 85: 208-219.

Odum E. P. (1983): Basic Ecology. Philadelphia: CBS College Publ. 1-613.

Piękoś-Mirkowa H., Mirek Z. (1996): Zbiorowiska roślinne. - Przyroda Tatrzańskiego Parku Narodowego. Kraków-Zakopane. 235-274.

Recher H. (1971): Bird species diversity: a review of the relation between species number and environment. - Proc. Ecol. Soz. Australia. 6: 135-152.

Routledge R. D. (1977): On Whittaker's component of diversity. - Ecology. 58: 1120-1127.

Salzmann A.G. (1982): The selective importance of heat stress in gull nest location. - Ecology. 63: 742-751.

Schauer E. (1862): Tagesbuchnotizen während eines ornithologischen Ausfluges auf den hohen Tatra in den Monaten Juli und August 1861. - J. Orn. 10 (3): 224-240.

Shannon C.E., Weaver W. (1949): The mathematical theory of communication. Illinois: Univ. Illinois Press. Urbana. 1-117.

Stevens G.C. (1989): The latitudinal gradient in geographic range: how so many species coexist in the tropix. - Am. Nat. 113: 240-256.

Tomiałojć L. (1980): Kombinowana odmiana metody kartograficznej do liczenia ptaków lęgowych. - Not. Orn. 21: 33-54.

Tomiałojć L., Stawarchyk T. (2003): Avifauna Polski. Rozmieszczenie, liczebność i zmiany. Wrocław: "pro Natura". 1, 2: 1-870.

Tomiałojć L., Wesołowski T., Walankiewicz W. (1984): Breeding bird community of a primeval temperate forest (Białowieża National Park, Poland). - Acta Orn. 20 (3): 241-310.

Wasilewski J. (1996): Ptaki. - Przyroda Tatrzańskiego Parku Narodowego. Kraków-Zakopane. 455-472.
Whittaker R. H. (1972): Evolution and measurement of species diversuty. - Taxon. 21: 213-251.
Whittaker R. H. (1977): Evolution od species diversity in land communities. - Evolutionary Biology. New York: Plenum Press. 10: 1-67.
Winding N., Werner S., Stadler S., Slotta-Bachmayr L. (1993): Die Struktur von Vogelgemeinschaften am alpinen Hohengradienten: Quantitative Brutvogel-Bestandsaufnahmen in der Hohen Tauern (Österreichische Zentralalpen). - Wiss. Mitt. Nationalpark Hohe Tauern. 1: 106-124.
Wodzicki K. (1850): Wycieczka ornitologiczna w Tatry i Karpaty Galicyjskie na początku czerwca 1850 roku. Lesz. 1-100.
Wozniak I. (1992): Stwierdzenie lęgu mornela (*Charadrius morinellus*) w Tatrzańskim Parku Narodowym. - Not. Orn. 33 (1-2): 107-108.

Замітки	Беркут	14	Вип. 2	2005	162

НАХОДКИ ОКОЛЬЦОВАННЫХ ПТИЦ В СОВЕТСКОМ РАЙОНЕ ТЮМЕНСКОЙ ОБЛАСТИ

Recoveries of ringed birds in Sovetsky district of Tyumen Region. - V.V. Syzhko. - Berkut. 14 (2). 2005. - Data about findings of Wigeon and Tufted Duck are presented. (Russian).

Свиязь *(Anas penelope).* В сентябре 1996 г. в окрестностях пос. Пионерский на озере был застрелен самец с кольцом BRIT. MUSEUM LONDON SW7 AT 71365. Птица окольцована 15.02.1962 г. в Великобритании (Great Britain, Essex Abberton reservoir, near Colchester) в годовалом возрасте. Координаты места находки – 61.18 N, 62.48 E, места кольцевания – 51.49 N, 0.50 E. Дистанция – 3805 км, азимут – 74º, время – 12617 дней.

Хохлатая чернеть *(Aythya fuligula).* Самец, окольцованный 7.03.1996 г. в возрасте более 2 лет в Швейцарии, застрелен 5.05.2001 г. охотниками в окрестностях г. Советский. На нем было кольцо Vogelwarte Sempach Helvetia Z 72746. Координаты места кольцевания – 46.20 N, 6.10 E, места находки – 61.38 N, 63.40 E. Дистанция – 3963 км, азимут – 36º, время – 1886 дней.

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О ДОБЫЧЕ БЕЛОГО ГУСЯ В СУМСКОМ РАЙОНЕ СУМСКОЙ ОБЛАСТИ

About shooting of Snow Goose in Sumy district of Sumy region. - I.R. Merzlikin. - Berkut. 14 (2). 2005. - 3 birds were observed on a pond on 17.09.2005. A goose was shooted.

В Украине известно несколько залетов белых гусей (*Chen caerulescens*) в различные регионы в период с 1905 по 1938 гг. и залеты гусей асканийской популяции после их акклиматизации в Аскании-Нова в 1961 г. (Лысенко, 1991).

Нам стало известно о встрече белых гусей на территории Сумской обл. На р. Олешня (правый приток р. Псел) располагается каскад прудов. Вечером во время охоты 17.09 2005 г. на одном из этих прудов, в окрестностях с. Рудневка Сумского р-на наблюдалась стайка белых гусей из трех особей. Один из них был застрелен.

ЛИТЕРАТУРА

Лысенко В.И. (1991): Фауна Украины. Т. 5. Птицы. Вып. 3. Гусеобразные. К.: Наукова думка. 1-208.

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