

## Avifauna of Bieszczady National Park (SE Poland) in 1987 and 1988 - quantitative and qualitative data

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Abstract. 107 bird species were recorded in 1987 and 1988 in Bieszczady National Park and its closest surroundings. Among others: *Aquila chrysaetos*, *Aquila pomarina*, *Circus caetus gallicus*, *Circus cyaneus*, *Ciconia nigra*, *Bubo bubo*, *Strix uralensis*, *Prunella collaris*. Quantitative data were collected by the method of stripe transect. The mean total density of birds from all recorded species in a mountain beech forest was 40.90 pairs/10 ha, in a dwarf beech forest 29.1 pairs/10 ha, on mountain meadows 7.35 pairs/10 ha. *Fringilla coelebs*, *Erithacus rubecula*, *Troglodytes troglodytes*, *Phylloscopus sibilatrix*, *P. collybita*, *Sylvia atricapilla* are the dominating species in forest communities. The greatest species diversity was recorded from the mountain beech forest ( $H' = -3.44$ ).

Key words: bird fauna, density, mountains, Carpathians.

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### I. INTRODUCTION

Except for the more extensive studies of BOROWSKI (1968), GŁOWACIŃSKI (1969) and JÓZEFIK (1969) on the birds of the Bieszczady Mts. only some sketches and notes on the occurrence of rare birds have been published (GRODZIŃSKI 1957, CAIS 1965, KULCZYCKI 1964, GOTZMAN 1969). This paper is the first quantitative elaboration of the avifauna of Bieszczady National Park (Bd.N.P.).

The main aim of this research was to collect detailed data on the breeding birds of Bd.N.P. We prepared both a qualitative and a quantitative description of the avifauna, found differences in bird species composition between the main plant communities, analyzed the diversity and the distribution of species.

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## II. STUDY AREA AND METHODS

The Bieszczady Mountains form the west part of the Eastern Carpathians. They are of medium height (the highest peak, Tarnica, 1 346 m a.s.l.), and their parallel ridges extend NW-SE. The dense net of rivers has a lattice configuration.

The arrangement of Bieszczady plant zones does not occur in the rest of the mountain area. According to ZARZYCKI (1963), three zones of vegetation can be distinguished here: 1 - a zone of Pogórze (up to 500 m a.s.l.), 2 - a lower mountain forest zone (500 to 1150 m a.s.l.), 3 - a zone of alpine meadows (over 1150 m a.s.l.). There is neither the zone of upper mountain forest nor that of dwarf pine. In the area of mountain meadows there are some scrubs of *Alnus viridis*.

Bieszczady National Park covers 5 725 ha\* overgrown mainly with forest (65 % of N.P. area) and alpine meadows. It lies in the west part of the Bieszczady Mountains (S-E corner of Poland). The main part of the National Park is covered by a lower mountain forest zone of Carpathian beech (MICHALIK 1987). Up to 1150 m a.s.l. the slopes of mountains are predominantly covered by compact, pure stand of beech with small glades. These forests belong to phytocenosis *Dentario glandulosae* - *Fagetum*. Beech *Fagus sylvatica* is a dominant species in woodlands of Bd.N.P. (82%). It forms a very compact pure stands, with almost no ground cover and without undergrowth. The other trees do not play an important role. The share of *Picea excelsa*, *Alnus incana*, *Abies alba* and *Acer pseudoplatanus* is very small. *Larix europea*, *Salix* sp., *Populus tremula* and *Betula verrucosa* occur rarely. Most of the main stand of Bd.N.P. belongs to the mean age group. There are many areas of young stands. The mature forest, over 100 years old, occupies about 20 % of the forest area. Streams in the area of the Carpathian beech forest are small brooks, completely hidden under the beech canopy. There are neither roads nor fairly big windfalls.

The timber line in Bd.N.P. is partly composed of the upper boundaries dwarf beech scrubs and beech-great maple stands with a high proportion of herbs in the ground cover. In this paper these communities are called dwarf beech forest.

The alpine meadows are composed of grassland associations and herbaceous vegetation. These are the associations: *Vaccinietum pocuticum*, flower grassland *Nardetum*

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\*The data actual for the years of study - since February 1991 the area of Bd. N. P. has been enlarged by 5 times.

*carpathicum-orientale* on dry slopes of alpine meadows and grassland *Trollio - centaure-etum* in more damp places. The scrubs of *Alnus viridis* and *Sorbus aucuparia* merge into an area of alpine meadows. The rocky crests and scree are visible in the top parts of the mountains.

Studies were conducted in the area of sub-alpine beech forest, dwarf beech forest and on alpine meadows, inside and outside Bd.N.P. (see footnote, p. 498). The qualitative data were also collected in the area of two peat-bog reserves: "Tarnawa" and "Litmirz" including the adjoining meadows, the whole valley of the Muczny stream from Stuposiany to Bukowiec (embracing forests between the state frontier and the Bd.N.P. borders) and the river Wołosaty valley from Stuposiany to Wołosate, the village of Ustrzyki Górne and the stream Terebowiec Valley (Fig. 1.). The "Tarnawa" reserve is composed of two peat-bogs separated from each other by the valley of a small brook. The peat-bog consists of mosses belonging to the associations *Sphagnetum medii et rubelli* and *Sphagnetum fuscii*. The middle and southern parts of the larger peat-bog are covered by marsh pine forest of the association *Vaccinio uliginosi - Pinetum*. The smaller peat-bog is unwooded, with sparsely occurring dwarf specimens of birch, spruce and rowan tree (KURZYŃSKI 1987). The "Litmirz" reserve is a similar peat-bog, situated on a bank of the river San not far from the "Tarnawa" reserve.

Studies were conducted from May 30 to June 30 1987 and from June 10 to July 10 1988 and during short, several days long periods of observation in April, May and July 1987 and 1988. Data concerning the species composition of the avifauna were collected in the whole area of Bd.N.P. and in adjacent areas, in diverse habitats. Observations were collected mainly in morning hours (5.00 - 11.00) or all day long including evening hours. Mist net trapping was also applied at Muczne.

Tables II, III, IV and V present the qualitative and quantitative composition of the Bd.N.P. bird fauna. The occurrence of breeding is given for each species according to the four-grade scale: A - observations do not imply breeding; B - breeding possible (an individual of given species recorded at least three times in the same place, a singing male, a pair in a habitat suitable for breeding, courtship); C - breeding very probable (copulation observed, nest building behaviour, clear anxiety or defense behaviour, nest not accessible, observations of fledglings); D - breeding recorded (a nest with eggs or nestlings, finding of egg shells, food collection). The birds were counted using the modified method of stripe transects (CICHON and ZAJAC, in prep.).

Five transects were assigned (Table I.): they were marked with successive numerals painted at eye-level on trees 25 meters apart on the main line of the transect. Birds were recorded from each 25-meter section, in a 100 meters wide stripe (50 m on the left and 50 m on the right of the main line of the transect). The positions of singing males and all the other observations which could imply breeding were recorded in the counting protocol. A set of observations implying breeding in the neighboring sections of the transect was accepted as a criterion of existence of a breeding territory (minimum: three recordings of a singing male in one section). Species density was calculated as a number of territories in the area of a transect stripe (a 100-meter section of transect is 1 ha in area) and standardized as a number of territories (pairs) per 10 ha. The mean density of birds in a



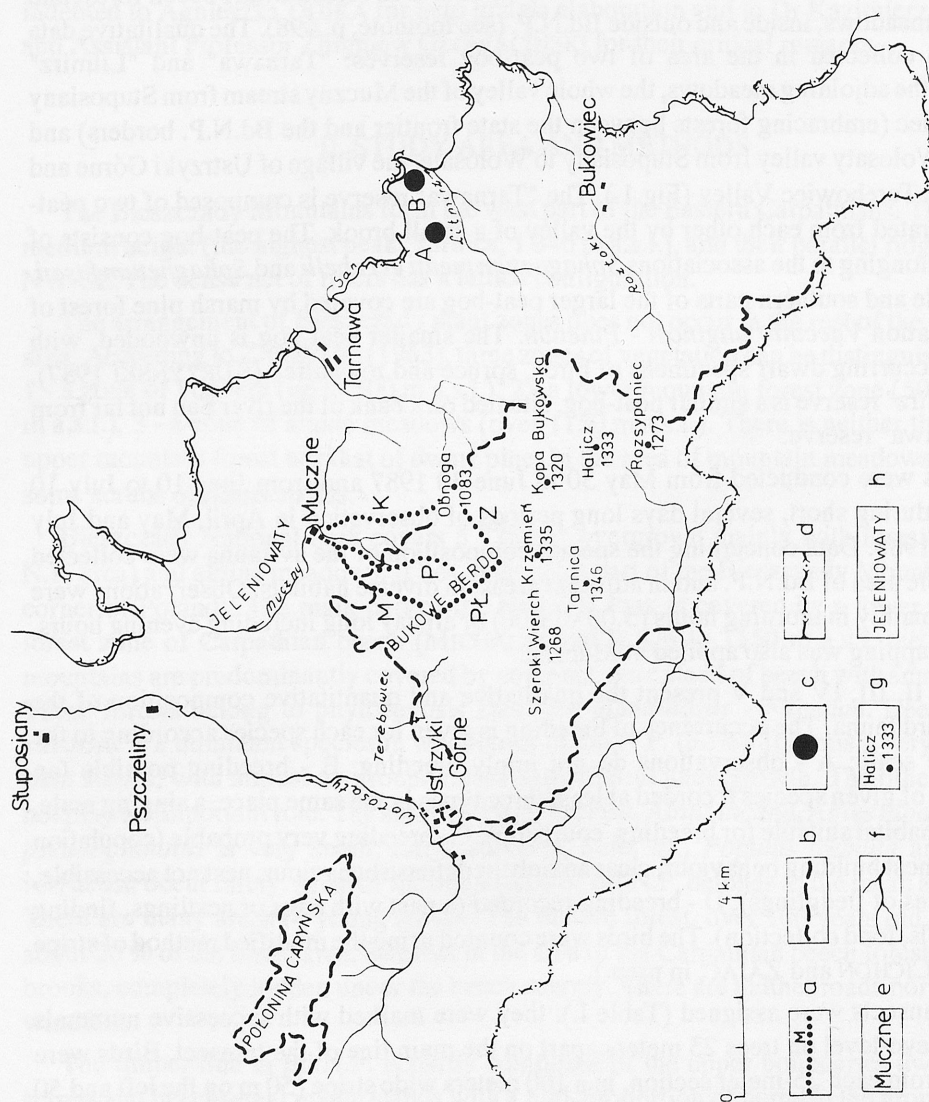


Fig. 1. Map of the study area. a - transect routes: K, M, P, PŁ and Z, b - boundary of Bieszczady National Park (see footnote, p. 498), c - peat-bog reserves: A - the "Tarnawa" reserve, B - the "Litmirz" reserve, d - state frontier, e - settlements, f - streams and rivers, g - mountains, h - mountain ranges.



Table I.

Characteristics of transects used for counts of birds.

Transect	Length (m)	Route	Altitude (m asl)	Description
K	2625	Muczne - Obnoga	725-1080	Very compact, mature stand of beech with patches of very old stand, 4 small glades, admixture of fir, great maple and spruce, small areas of low compactness.
M	2175	Muczne - Bukowe Berdo	725-1175	Very compact, mature stand of beech, small patches of pure spruce stand, 2 glades, near the edge of dwarf beech forest.
P	2500	E slope of Bukowe Berdo	725-1150	Like tr. "M"; lack of glades.
Z	1400	Obnoga - Bukowe Berdo	1080-1275	Dwarf beech forest, numerous big glades, low compactness, reach ground cover.
PŁ	2200	crest of Bukowe Berdo	1175-1310	Typical alpine meadow, many rocky crests, on east slope patches of rowan scrubs.

given habitat was calculated as a total number of pairs recorded from transects per total area of transects in the habitat.

Birds were counted almost every day (20 counts in June of each year) in transects which traversed all typical habitats, different slopes and valleys showing various physical conditions (Table I.).

The time taken to walk 1 km of transect averaged about 1.5 hour.

Dominance structure was calculated for quantitative data (percentage of a given species in the total number of species). The species diversity in bird communities was calculated using the SHANNON index

$$H' = - \sum_{i=1}^s p_i \log_2 p_i$$

where  $p$  is a fraction of individuals belonging to the species "i" and  $s$  is the number of species (MACARTHUR and MACARTHUR 1961, CODY 1970).

The index of equality of the proportion of a species in the total number was also calculated

$$J' = H'/H_{\max},$$

where  $H'$  is a value of the SHANNON function calculated for actual data,  $H_{\max}$  is a value of this function assuming that all species recorded occur in equal quantities.  $H_{\max}$  can be expressed by the equation

$$H_{\max} = -\log_2/s,$$

where  $s$  is the number of species observed. The index is equal to 1, when all the species occur in equal numbers. The less complicated is the community the smaller is the  $J'$  value (KOZŁOWSKI 1974).

### III. RESULTS

#### A. Qualitative data

The presence of 107 bird species was recorded in the study area during two consecutive years (Table II).

Table II

Bird species recorded from the study area in 1987 and 1988. The columns give categories of breeding (explained in "Study area and methods", p. 499).

Species	Bd. N. P.			Outside of Bd. N. P.				
	Carpathian beech f.	Dwarf beech forest	Alpine meadows	Peat-bogs	Carpathian beech f.	Fields & meadows	River valleys	Settlements
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
<i>Podiceps nigricollis</i> (BREHM, 1831)							A	
<i>Ciconia nigra</i> (LINNAEUS, 1758)	A			A	D			
<i>Anser fabalis</i> (LATHAM, 1787)	A							
<i>Anas platyrhynchos</i> (LINNAEUS, 1758)				A			A	
<i>Pernis apivorus</i> (LINNAEUS, 1758)	B			B	C			
<i>Accipiter gentilis</i> (LINNAEUS, 1758)	B				C			
<i>Accipiter nisus</i> (LINNAEUS, 1758)					C			
<i>Buteo lagopus</i> (PONTIPPIDAN, 1763)				A		A		
<i>Buteo buteo</i> (LINNAEUS, 1758)	C			B	D			
<i>Aquila pomarina</i> BREHM, 1831	B			D	D			

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
<i>Aquila chrysaetos</i> (LINNAEUS, 1758)					A			
<i>Circæetus gallicus</i> (GMELIN, 1788)					A			
<i>Circus cyaneus</i> (LINNAEUS, 1766)			A					
<i>Falco subbuteo</i> LINNAEUS, 1758	A		A	A	A			
<i>Falco tinnunculus</i> LINNAEUS, 1758	A				A	D		
<i>Bonasa bonasia</i> (LINNAEUS, 1758)	B				C			
<i>Coturnix coturnix</i> (LINNAEUS, 1758)						B		
<i>Perdix perdix</i> (LINNAEUS, 1758)				B		A		
<i>Rallus aquaticus</i> LINNAEUS, 1758				B				
<i>Crex crex</i> (LINNAEUS, 1758)			B	B		B		
<i>Vanellus vanellus</i> (LINNAEUS, 1758)						D		
<i>Charadrius dubius</i> SCOPOLI, 1786							A	
<i>Actitis hypoleucos</i> (LINNAEUS, 1758)							A	
<i>Scolopax rusticola</i> LINNAEUS, 1758	C				C			
<i>Columba palumbus</i> LINNAEUS, 1758	B			B	B			
<i>Columba oenas</i> LINNAEUS, 1758	B				B			
<i>Streptopelia turtur</i> (LINNAEUS, 1758)				B	B			
<i>Cuculus canorus</i> LINNAEUS, 1758	B	B		B	B			
<i>Bubo bubo</i> (LINNAEUS, 1758)					A			
<i>Asio otus</i> (LINNAEUS, 1758)					D			
<i>Strix aluco</i> LINNAEUS, 1758					C			
<i>Strix uralensis</i> PALLAS, 1771					D			
<i>Apus apus</i> (LINNAEUS, 1758)	A			A	A			
<i>Upupa epops</i> LINNAEUS, 1758	A							
<i>Dryocopus martius</i> (LINNAEUS, 1758)	B				C			
<i>Dendrocopos major</i> (LINNAEUS, 1758)					D			
<i>Dendrocopos medius</i> (LINNAEUS, 1758)							A	
<i>Dendrocopos leucotos</i> (BECHSTEIN, 1803)	B				B			
<i>Dendrocopos minor</i> (LINNAEUS, 1758)							A	
<i>Picoides tridactylus</i> (LINNAEUS, 1758)					D			
<i>Hirundo rustica</i> LINNAEUS, 1758								D
<i>Delichon urbica</i> (LINNAEUS, 1758)								D
<i>Alauda arvensis</i> LINNAEUS, 1758				B		B		
<i>Anthus trivialis</i> (LINNAEUS, 1758)	C	C	C	B	C	B		



(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
<i>Anthus pratensis</i> (LINNAEUS, 1758)				B		B		
<i>Anthus spinoletta</i> (LINNAEUS, 1758)			C					
<i>Motacilla alba</i> LINNAEUS, 1758				B		D		D
<i>Motacilla cinerea</i> TUNSTALL, 1771	B				D		D	
<i>Lanius collurio</i> LINNAEUS, 1758					B	C		D
<i>Lanius excubitor</i> LINNAEUS, 1758				C		B		
<i>Sturnus vulgaris</i> LINNAEUS, 1758								D
<i>Garrulus glandarius</i> (LINNAEUS, 1758)	A			A	A			
<i>Pica pica</i> (LINNAEUS, 1758)				A				D
<i>Nucifraga caryocatactes</i> (LINNAEUS, 1758)	B				A			A
<i>Corvus monedula</i> LINNAEUS, 1758								C
<i>Corvus corone</i> LINNAEUS, 1758				A				A
<i>Corvus corax</i> LINNAEUS, 1758	B		B	A	A	A		
<i>Cinclus cinclus</i> (LINNAEUS, 1758)	B				D		D	
<i>Troglodytes troglodytes</i> VIEILLOT 1807	D	B			D			
<i>Prunella collaris</i> (SCOPOLI, 1709)			D					
<i>Prunella modularis</i> (LINNAEUS, 1758)	D				D		D	
<i>Locustella fluviatilis</i> (WOLF, 1810)				B		B	B	
<i>Acrocephalus palustris</i> (BECHSTEIN, 1798)				B		B	B	
<i>Hippolais icterina</i> (VIEILLOT, 1817)							B	
<i>Sylvia borin</i> (BODDAERT, 1783)	D	B			D		B	
<i>Sylvia atricapilla</i> (LINNAEUS, 1758)	D	B			D		D	
<i>Sylvia communis</i> LATHAM, 1787	B		B	C	B		C	
<i>Sylvia curruca</i> (LINNAEUS, 1758)	B				B		B	
<i>Phylloscopus trochilus</i> (LINNAEUS, 1758)	B	B	B	D	B		B	
<i>Phylloscopus collybita</i> (VIEILLOT 1817)	B	B	B	B	D		B	
<i>Phylloscopus sibilatrix</i> (BECHSTEIN, 1793)	B	B		B	B			
<i>Regulus regulus</i> (LINNAEUS, 1758)	B	B			B			
<i>Regulus ignicapillus</i> (TEMMINCK, 1820)	B	B			B			
<i>Ficedula albicollis</i> (TEMMINCK, 1815)	D				D			
<i>Ficedula parva</i> (BECHSTEIN, 1794)	B				B			
<i>Muscicapa striata</i> (PALLAS, 1764)					C			
<i>Saxicola rubetra</i> (LINNAEUS, 1758)			C	C		C		
<i>Saxicola torquata</i> (LINNAEUS, 1766)				B				

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
<i>Phoenicurus ochruros</i> (GMELIN, 1774)			B					D
<i>Phoenicurus phoenicurus</i> LINNAEUS, 1758	B				B			
<i>Erithacus rubecula</i> (LINNAEUS, 1758)	B	B		B	D		B	
<i>Turdus torquatus</i> LINNAEUS, 1758	B	C			D			
<i>Turdus pilaris</i> LINNAEUS, 1758				A			D	
<i>Turdus merula</i> LINNAEUS, 1758	B	D		B	D			
<i>Turdus philomelos</i> BREHM, 1831	D				D			
<i>Turdus viscivorus</i> LINNAEUS, 1758	B	B			C			
<i>Aegithalos caudatus</i> (LINNAEUS, 1758)	D				C		D	
<i>Parus palustris</i> LINNAEUS, 1758	B				D			
<i>Parus montanus</i> C. VON BALDENSTEIN, 1827	B				D			
<i>Parus ater</i> LINNAEUS, 1758	B	B			C			
<i>Parus caeruleus</i> LINNAEUS, 1758					D			
<i>Parus major</i> LINNAEUS, 1758	B	B			D		B	D
<i>Sitta europea</i> LINNAEUS, 1758	B	B			D			
<i>Certhia familiaris</i> LINNAEUS, 1758	B				B			
<i>Passer domesticus</i> (LINNAEUS, 1758)								D
<i>Passer montanus</i> (LINNAEUS, 1758)							D	
<i>Fringilla coelebs</i> LINNAEUS, 1758	D	D		B	D		D	
<i>Serinus serinus</i> (LINNAEUS, 1766)								B
<i>Carduelis chloris</i> (LINNAEUS, 1758)								D
<i>Carduelis spinus</i> (LINNAEUS, 1758)					B			
<i>Carduelis carduelis</i> (LINNAEUS, 1758)				B		B		B
<i>Carduelis canabina</i> (LINNAEUS, 1758)				B		B		
<i>Carpodacus erythrinus</i> (PALLAS, 1770)			B	D			B	
<i>Loxia sp.</i> LINNAEUS, 1758	A							
<i>Pyrrhula pyrrhula</i> (LINNAEUS, 1758)	B				D			
<i>Coccothraustes coccothraustes</i> (LINNAEUS, 1758)			A		A			
<i>Emberiza citrinella</i> LINNAEUS, 1758				B		B		
Category A:	8	0	3	10	10	3	6	2
Category B:	33	14	7	23	16	11	10	2
Category C:	3	2	3	3	12	2	1	1
Category D:	8	2	1	3	26	3	8	10
Total of species 107	52	18	14	39	64	19	25	15

Observations of rare species or those not typical of the region and interesting from the ecological point of view are more extensively described below.

*Podiceps nigricollis* - one individual observed on March 21, 1987 at Ustrzyki Górne, at the mouth of the Terebowiec into the Wołosaty river.

*Ciconia nigra* - one individual observed on June 10, 1987 near Muczne; on June 29, 1987 two individuals observed near the "Tarnawa" reserve. During the whole June and in the first decade of July 1988 the Black Stork was observed about 2 km N-W of Muczne; a nest with four nestlings was found near Stuposiany. Young fledged in the first decade of August. Adults fed their young in the presence of people, who stood at a distance of 20 m from the nest.

*Anser fabalis* - one individual shot down by a hunter on March 21, 1987 in the Muczny river valley.

*Anas platyrhynchos* - one individual observed on June 29, 1987 and on June 17, 1988 on the San river near Tarnawa.

*Pernis apivorus* - one pair observed at Tarnawa. At the beginning of May 1987 courtship behaviour and birds carrying nest material were observed near Muczne; a pair of birds was frequently seen there. One pair of birds was observed several times in June 1988 in the neighborhood of Obnoga hill.

*Buteo lagopus* - four individuals foraging in fields of Bukowiec, Litmirz and Tarnawa, were observed on March 19, 1988; one individual was seen on June 23, 1988 in fields of Tarnawa.

*Aquila pomarina* - observed very frequently in Tarnawa region from June 26 to June 29, 1987 - along a section of the road between settlement Tarnawa and "Tarnawa" reserve at least 3 hunting individuals were frequently observed; there were two breeding pairs on a slope near the reserve - on June 26, 1987 one nest was found there, containing one downy nestling (the brood was destroyed at the end of July, probably by poachers); another pair was seen carrying food but the nest was not found. In June and July 1988 two pairs of *Aquila pomarina* were observed at Tarnawa, one pair in the area of Obnoga, one pair in the area between Muczne and Pszczeliny, one pair near Stuposiany and one in a forest south of Pszczeliny.

*Aquila chrysaetos* - one adult and one juvenile observed at the same time by DERWICH (pers. comm.) in May 1988 on the east slope of Mt. Halicz.

*Circaetus gallicus* - one individual observed on June 11, 1987 and on June 19, 1988 on the east slope of Mt. Bukowe Berdo.

*Circus cyaneus* - encountered twice: on June 16, 1987 one individual on Bukowe Berdo, and on June 5, 1988 one individual on the east slope of Halicz. According to foresters information before 1987 it was seen throughout the breeding season on meadows near Stuposiany.

*Falco tinnunculus* - one individual observed on June 6, 1987 on Bukowe Berdo. The birds hunting and carrying food were seen a few times in June and July 1988 in the area of Bukowiec.



*Falco subbuteo* - two individuals on June 24, 1987 and another one on June 28, 1988 were observed over the San river near Tarnawa. In the breeding season of 1988 it was also observed almost every day near Mt. Krzemień.

*Perdix perdix* - only one pair of birds observed on June 16, 1987 near Stuposiany.

*Coturnix coturnix* - on June 14, 1987 calling male was recognized on meadows near Stuposiany, from June 26 to 29, 1987 two calling males were recorded on meadows of the "Tarnawa" reserve and in its neighborhood.

*Rallus aquaticus* - on June 25, 1987 one calling male was recorded in the sedges at the west boundary of the "Tarnawa" reserve.

*Crex crex* - during whole June 1987 and 1988 one calling male was recorded on meadows near Stuposiany, and at least four calling males at Tarnawa and Litmirz; another calling male was heard on June 28, 1988 on the slopes of Halicz.

*Columba oenas* - a singing male frequently observed in both years in transect "K" and in 1988 near Muczne.

*Bubo bubo* - on July 2, 1988 one primary feather was found in a forest in the area of Mt. Rozsypaniec. Observed at carcasses by the forest service in winter. On Oct. 6, 1987 a dead bird was found under overhead high voltage line, in fields of Tarnawa; its measurements: wing span 168 cm, body length 67 cm, body weight 3.3 kG (KOŁOMYJA pers.comm.).

*Strix uralensis* - in both years of study three calling males were recorded near Muczne; one pair was observed on May 16, 1987 and many times in June in transect "M" and one pair in transect "K", where 3 fledglings were seen on June 28, 1987. In 1988 it was observed in the area of Bukowiec and regularly in transects "K", "P" (June 17, one fledgling observed) and "Z". On June 12, 1988 the woodcutters brought to the camp two dependent fledglings, which had been found in a nest placed in a tree cutdown by the woodcutters near Bukowiec. At the beginning of July in the evening hours fledglings were seen flying on their own to the forest. Probably the same individuals were observed once more in the vicinity of the camp in the last days of July.

*Dryocopus martius* - in both years observed during whole June near Muczne (also birds carrying food), on the east slopes of Bukowe Berdo and on Jeleniowaty Hill.

*Dendrocopos medius* - one individual observed on July 6, 1988 in Pszczeliny.

*Dendrocopos leucotos* - in 1987 single individuals on the slopes of Bukowe Berdo and a pair of birds in transect "K". On June 14, 1988 a female was caught in mistet at the Muczny river.

*Picoides tridactylus* - in 1987 a nest with two young was found in transect "K" (fledged on June 20). One individual was seen in transect "P" on June 16, 1988.

*Anthus pratensis* - in June 1988 two pairs were recorded from the "Tarnawa" reserve and one pair at Bukowiec.

*Anthus spinoletta* - occurs only on alpine meadows (look at quantitative data), most frequently observed in the area of rocky crests, which it uses as a perch.

*Motacilla cinerea* - on June 15, 1987 a nest with 5 young (14 days old) was found at the Muczny river; 4 other individuals were caught in mist nets near the village of Muczne. In 1988 it was observed almost every day on the Muczny river (in June 21 individuals were caught in mist nets) and in Stuposiany on the Wołosaty river.

*Cinclus cinclus* - in 1987 two pairs observed on the Muczny river, in June 1988 five pairs were recorded all along the Muczny and one nest with 7 eggs was found (4 young fledged on July 15).

*Prunella collaris* - on July 13, 1987 one juvenile was seen on Krzemień Mt. Despite of the fact that it was a single observation, it may be accepted that this bird represented local breeding population. The time of the year and a patchy distribution of this species justify this conclusion.

*Phoenicurus ochruros* - recorded from human settlements in both years. During whole June 1987 single singing males were seen on Krzemień Mt. and Tarnica Mt. One singing male was seen on the rock crests of Bukowe Berdo throughout June 1988.

*Saxicola torquata* - on June 25, 1987 one singing male was observed in the "Tarnawa" reserve.

*Turdus torquatus* - four breeding pairs were observed in a small group of firs near Muczne in June 1987. In other areas - not numerous and sparse. In 1988 during whole June it was present in transects: "Z" (one pair) and "M" (two pairs). On June 23, 1988 a nest with two young and an unhatched egg was found near Muczne.

*Turdus pilaris* - in 1987 and 1988 breeding colonies of few pairs each were found at Stuposiany and Tarnawa.

*Turdus viscivorus* - a nest with two young (about 8 days old) and an unhatched egg was found on June 6, 1987, in fir forest near Muczne. In 1988 it was observed on the east slopes of Bukowe Berdo and Jeleniowaty Hill.

*Locustella fluviatilis* - during the whole of June 1987 and 1988 a singing male was recorded from river valley scrubs near Stuposiany.

*Regulus ignicapillus* - one male was caught in mist nets in 1987 and a male and a female near Muczne in 1988.

*Ficedula albicollis* - in the middle of June a nest was found and two other pairs were observed, on the east slope of Obnoga Mt. A male was also observed in the Terebowiec valley, on June 2, 1987. In 1988 in transect "P" a nest was found (young fledged on June 18) and a few pairs were observed on the slopes of Bukowe Berdo.

*Aegithalos caudatus* - both subspecies were encountered in the study area: *A. c. caudatus* and *A. c. europaeus* and on June 3, 1987 a hybrid brood between the two subspecies was found in the Terebowiec valley. On April 2, 1988 a pair of *A. c. caudatus* was observed building a nest in the Wołosaty valley near Stuposiany.

*Lanius excubitor* - on June 26 and 29, 1987 one individual with food was observed in the "Tarnawa" reserve. During whole June one pair was seen at Bukowiec, a pair at "Litmirz" reserve, a pair in the "Tarnawa" reserve, a pair near the "Tarnawa" reserve and a pair on meadows near Stuposiany.

*Corvus corax* - in 1987 one pair permanently observed on Krzemień Mt., probably it did not breed there; throughout the breeding season one pair was observed to the south of Stuposiany. All through the winter of 1988 flocks of several dozen individuals were seen feeding on carcasses. At the end of February and at the beginning of March courtship behaviour of a pair was observed on Jeleniowaty Hill and some anxious individuals were noted several times in transect "K" at the beginning of April. On June 1, 1988 a flock of about 40 individuals aggregating on the top of Kopa Bukowska Mt. was recorded (no carcasses were found there). In June 1988 pairs were frequently observed near the "Tarnawa" reserve and in the Roztoki valley.

*Carpodacus erythrinus* - in 1987 two pairs were met with along a half a kilometer long section of the Muczny valley; at Ustrzyki Górne three pairs were seen in the Terebowiec valley, from the mouth of the Terebowiec to the gate of the National Park. On June 7, 1987 a singing male was heard on Obnoga; on June 24, 1987 a nest with five young was found in the "Tarnawa" reserve. In 1988 one pair was frequently observed in the Muczne valley and one pair in Stuposiany.

#### B. Quantitative data

The densities of bird species recorded in transects are presented in Tables III, IV and V. In 1987 the density of all species in mountain beech forest was 40.9 pairs/10 ha ( $S_{sp.} = 23$ ), in dwarf beech forest: 29.1 pairs/10 ha ( $S_{sp.} = 9$ ) and in alpine meadows of Bukowe Berdo: 7.1 pairs/10 ha ( $S_{sp.} = 6$ ). In 1988 the density of all species was 40.9 pairs/10 ha ( $S_{sp.} = 24$ ) for beech forest, 29.1 pairs/10 ha ( $S_{sp.} = 16$ ) for dwarf beech forest and 7.6 pairs/10 ha ( $S_{sp.} = 9$ ) for alpine meadows of Bukowe Berdo.

At least a 5% share in the total number of all species was established as a criterion of dominance (PALMGREN 1930).

A comparison of the SHANNON indices of diversity, shows that the highest diversity of species was occurred in Carpathian beech forest (in 1987  $H' = 3.43$ ; in 1988  $H' = 3.45$ ), lower in dwarf beech forest and on alpine meadows ( $H'$  was 2.21 in 1987 and 3.03 in 1988 in the former habitat and 2.05 in 1987 and 2.29 in 1988 in the latter).

In 1987 the index of equality of the proportion of species in the total number was the highest for alpine meadows ( $J'_m = 0.79$ ), a little lower for Carpathian beech forest ( $J'_c = 0.76$ ) and the lowest for dwarf beech forest ( $J'_d = 0.70$ ). In 1988 this index was the highest for dwarf beech forest ( $J'_d = 0.78$ ), a little lower for Carpathian beech forest ( $J'_c = 0.75$ ), and the lowest for alpine meadows ( $J'_m = 0.72$ ).

The highest number of dominant species occurred in dwarf beech forest (six species in either year); in Carpathian beech forest and on alpine meadows - five species were dominant in either habitat in 1987 and four species in 1988. The same species were dominant in both Carpathian beech forest and dwarf beech forest. *Fringilla coelebs* was the most numerous species in both kinds of beech forest: in dwarf beech forest more than a half of all birds belonged to this species, whereas in 1988 its share decreased by 17.2%. The Chaffinch was the common dominant species in both beech forest and alpine meadows. On alpine meadows it occurred in mountain ash and dwarf beech scrubs. Birds



Table III.

Birds of Carpathian beech forest. Columns 2, 3, 4, 5 and 6 present numbers of pairs recorded from each transect in 1987 and 1988. Total density for the whole area of counts in 1987 and 1988, calculated as the number of all pairs in the total area of transects is given in columns 7,8. Columns 9 and 10 give the domination and columns 11 and 12 the categories of breeding (see "Study area and methods", p. 499) for species listed in column 1. Data were obtained in transects "M" (11 ha in area) and "K" (18 ha) - total area: ca 29 ha - in 1987 and in transects "M" (13 ha), "K" (13 ha) and "P" (14 ha) - total area: ca 40 ha - in 1988.

Species	Transect					Total for whole transect area					
	K		M		P	density		domination		br. cat.	
	'87	'88	'87	'88	'88	'87	'88	'87	'88	'87	'88
<i>Fringilla coelebs</i>	30	22	14	20	16	15.2	14.6	37.2	35.5	D	C
<i>Erithacus rubecula</i>	8	8	5	6	7	4.4	5.3	10.8	12.9	B	B
<i>Phylloscopus sibilatrix</i>	7	6	2	3	6	3.1	3.5	7.7	8.5	B	B
<i>Phyll. collybita</i>	7	1	3	4	2	3.4	1.8	8.4	4.4	D	B
<i>Sylvia atricapilla</i>	4	2	3	5	1	2.4	2.0	5.9	4.8	B	D
<i>Troglodytes troglodytes</i>	3	3	0	2	4	1.0	2.3	2.4	5.6	D	D
<i>Parus major</i>	4	0	1	2	1	1.7	0.8	4.2	1.9	D	B
<i>Parus montanus</i>	3	1	0	2	3	0.7	1.5	1.7	3.6	D	B
<i>Anthus trivialis</i>	4	3	0	1	0	1.4	1.0	3.4	2.4	C	C
<i>Regulus sp.</i>	2	-	2	-	-	1.4	-	3.4	-	B	-
<i>Regulus regulus</i>	-	1	-	2	2	-	1.3	-	3.1	-	B
<i>R. ignicapillus</i>	-	0	-	1	2	-	0.8	-	1.9	-	B
<i>Sitta europea</i>	2	3	0	0	2	0.7	1.3	1.7	3.1	D	D
<i>Turdus merula</i>	2	2	1	1	1	0.7	1.0	1.7	2.4	D	B
<i>Parus ater</i>	2	1	1	0	2	1.0	0.8	2.4	1.9	C	C
<i>Sylvia borin</i>	1	0	1	1	0	0.7	0.3	1.7	0.7	D	B
<i>Pyrrhula pyrrhula</i>	1	0	1	0	0	0.7	0	1.7	-	B	-
<i>Turdus philomelos</i>	0	1	1	0	1	0.3	0.5	0.7	1.2	D	B
<i>Garrulus glandarius</i>	0	1	0	0	0	0	0.3	-	0.7	-	B
<i>Picoides tridactylus</i>	1	0	0	0	0	0.3	0	0.7	-	D	-
<i>Dendrocopos leucotos</i>	1	0	0	0	0	0.3	0	0.7	-	B	-
<i>Prunella modularis</i>	1	0	0	1	1	0.3	0	0.7	-	D	-
<i>Sylvia curruca</i>	1	0	1	0	0	0.3	0	0.7	-	B	-
<i>Phylloscopus trochilus</i>	0	0	1	0	0	0.3	0	0.7	-	B	-
<i>Ficedula albicollis</i>	1	1	0	0	0	0.3	0.3	0.7	0.7	D	B
<i>Ficedula parva</i>	1	0	0	0	1	0.3	0.3	0.7	0.7	B	B
<i>Muscicapa striata</i>	0	1	0	0	0	0	0.3	-	0.7	-	B
<i>Turdus torquatus</i>	0	0	0	1	0	0	0.3	-	0.7	-	B
<i>Phoenicurus phoenicurus</i>	0	1	0	0	0	0	0.3	-	0.7	-	B
<i>Parus caeruleus</i>	0	1	0	0	0	0	0.3	-	0.7	-	D
Total (29 species):	47.5	46.3	33.4	40.9	35.7	40.9	40.9	100	100	23	23

Table IV.

Birds of dwarf beech forest. Columns 2, 3, 4, 5, 6 and 7 present numbers of given species recorded from each transect in 1987 and 1988. Total density for the whole area of counts in 1987 and 1988, calculated as the number of all pairs in the total area of transects is given in columns 8,9. Columns 10 and 11 give the domination and columns 12 and 13 the categories of breeding (see "Study area and methods", p. 499) for species listed in column 1. Data were obtained from transects "M" (3 ha in area) and "Z" (6.5 ha) and "P" (5.5 ha) - total area: ca 15 ha - in 1987; in the same transects "M" (9 ha), "Z" (8 ha) and "P" (8 ha) - total area: ca 25a - in 1988.

Species	Transect						Total for whole transect area					
	M		P		Z		density		domination		br. cat.	
	'87	'88	'87	'88	'87	'88	'87	'88	'87	'88	'87	'88
<i>Fringilla coelebs</i>	4	9	7	9	14	11	16.6	11.5	56.8	39.5	D	C
<i>Erithacus rubecula</i>	2	3	0	3	1	3	2.0	3.6	6.8	12.4	B	B
<i>Cuculus canorus</i>	0	0	0	0	1	0	0.6	0	2.3	—	B	—
<i>Phylloscopus sibilatrix</i>	0	1	1	2	2	3	2.0	2.4	6.8	8.2	B	B
<i>Sylvia atricapilla</i>	0	1	1	0	2	5	2.0	2.4	6.8	8.2	B	B
<i>Phylloscopus collybita</i>	1	1	0	0	2	3	2.0	1.6	6.8	5.5	B	B
<i>Anthus trivialis</i>	1	2	2	0	1	2	2.7	1.6	9.0	5.5	C	C
<i>Regulus sp.</i>	1	—	0	—	0	—	0.6	—	2.3	—	B	—
<i>Regulus regulus</i>	—	1	—	2	0	0	—	1.2	—	4.1	—	B
<i>Sitta europea</i>	0	1	0	1	0	1	0	1.2	—	4.1	—	C
<i>Turdus merula</i>	0	1	0	1	0	1	0	1.2	—	4.1	—	B
<i>Parus major</i>	1	0	0	0	0	1	0.6	0.4	2.3	1.4	B	B
<i>Troglodytes troglodytes</i>	0	0	0	1	0	0	0	0.4	—	1.4	—	D
<i>Sylvia borin</i>	0	1	0	0	0	0	0	0.4	—	1.4	—	B
<i>Phylloscopus trochilus</i>	0	1	0	0	0	0	0	0.4	—	1.4	—	B
<i>Turdus torquatus</i>	0	0	0	0	0	1	0	0.4	—	1.4	—	B
<i>Turdus philomelos</i>	0	0	0	1	0	0	0	0.4	—	1.4	—	B
Total (17 sp.):	33.2	28.1	19.9	24.7	35.3	38.8	29.1	29.1	100	100	9	15

Table V.

Birds of alpine meadows. Columns 2 and 3 present densities of species recorded from the whole area of counts in 1987 and 1988, calculated as the number of all pairs in the area of transect. Columns 4 and 5 give the domination and columns 6 and 7 the categories of breeding (see "Study area and methods", p. 499) for species listed in column 1. Data were obtained from single transect "Pi", ca 44 ha in area, in both years of study.

Species	Density in pairs/10 ha		Domination %		Category of breeding	
	'87	'88	'87	'88	'87	'88
<i>Anthus spinoletta</i>	2.3	3.2	32.2	42.1	C	D
<i>Anthus trivialis</i>	2.9	2.4	41.9	31.7	C	C
<i>Fringilla coelebs</i>	0.7	0.5	9.7	6.6	B	B
<i>Saxicola rubetra</i>	0.0	0.5	—	6.6	—	D
<i>Sylvia communis</i>	0.5	0.2	6.5	2.6	C	B
<i>Phyllosc. trochilus</i>	0.5	0.2	6.5	2.6	B	B
<i>Phyllosc. collybita</i>	0.2	0.2	3.2	2.6	B	B
<i>Sylvia atricapilla</i>	0.0	0.2	—	2.6	—	B
<i>Cuculus canorus</i>	0.0	0.2	—	2.6	—	B
Total: 9 species	7.1	7.6	100	100	6	9

characteristic of grass communities (*Anthus spinoletta*) and small open scrubs (*Sylvia communis* and *Phylloscopus trochilus*) were dominant species of alpine meadows.

In Carpathian beech forest there were no statistically significant differences between transects in density of dominant species (two way analysis of variance,  $F=2.05$ ,  $N_1=7$ ,  $N_2=3$ ,  $P>0.05$ ). In the dwarf beech forest there were no significant differences between transects in density of dominant species, with the exception of the difference between transect "Z" and transect "P" which was significant (two way analysis of variance,  $F=4.83$ ,  $N_1=7$ ,  $N_2=3$ ,  $P<0.05$ ).

#### IV. COMMENTS

During both years of the study, the density of birds of all the species recorded was similar in Carpathian beech forest (Table III), in dwarf beech forest (Table IV) and on alpine meadows (Table V), which confirms the accuracy and the repeatability of the method used.

The lack of differences in densities of dominant species, between the areas in which counts were performed confirms that the areas chosen were homogeneous. The difference



in density of dominant species between transects "Z" and "P" can be explained by the fact, that transect "P" was placed close and parallel to the edge of the forest, which situation caused the differences in density, concerning mainly warblers.

Assuming that the methods adopted allow making comparisons (WALANKIEWICZ 1986), some differences in size and structure of avifauna can be found between the Carpathian beech forest of Bd.N.P., and the Carpathian beech forest in Gorce National Park (Table VI).

Table VI.

Quantitative differences between Carpathian beech forest of Bd. N. P. and Carpathian mountain beech forest of G. N. P. (GŁOWACIŃSKI 1990).

Criterion	Bieszczady N. P.	Gorce N. P.
N species in counting area <sup>(1)</sup>	29	26
Total density <sup>(2)</sup>	41.90	75.00 <sup>(3)</sup>
S dominants species	5	7
Density of chaffinch <sup>(3)</sup>	14.9	13.1
Domination of chaffinch	36.3	17.4
Shannon coefficient H'	3.44	3.98
Coefficient of species share in total density J' <sup>(4)</sup>	0.755	0.83
S of hole nesting species <sup>(1)</sup>	11	9
Density of hole nesters <sup>(2)</sup>	5.6	14.3
Domination of hole nesters	13.4	19.4
S of <i>Sylvinae</i> species <sup>(1)</sup>	6	4
Density of warblers <sup>(2)</sup>	8.9	15.6
Domination of warblers	21.75	20.8

<sup>(1)</sup> values without species recorded outside transects.

<sup>(2)</sup> all densities are expressed in number of pairs/10 ha;

<sup>(3)</sup> without Ural Owl and Hazel Hen - see below;

<sup>(4)</sup> coefficient of share of a given species in total density, J';

The number of species recorded from transects in the Bieszczady was higher than that from the Gorce; but the density of birds of all species is clearly higher in the Gorce N. P. This difference is still distinct after the species of large body size (e.g. *Stirx uralensis*) have been excluded from GŁOWACIŃSKI's (1990) data. Their densities were not calculated in the studies of Bd.N.P., because their territories seem to have exceeded the transect width.

There is a lower number of dominant species in Bd.N.P. than in G.N.P. The quantitative structure of dominant species is also different (Fig.2.). Chaffinch in the Bieszczady very considerably out numbers the rest of dominant species (see Table III), whereas in G.N.P. the density of dominant species is more even. In the Bieszczady the density of the most numerous species - the Chaffinch, does not much differ from its density in G.N.P., but a comparison of domination suggests that this small difference is a result of the generally higher density of birds of all species in the Gorce beech forest. Relative comparison with other species points out that the Chaffinch is much more numerous in Bd.N.P. than in G.N.P.

A comparison of the SHANNON indices and the indices of equality of the proportion of species in the total number implies a lower diversity in the avifauna of Bd.N.P.

The above-mentioned differences can be explained by the character of mountain beech forests in Bd.N.P, which are compact, with a small admixture of other species, without clearings and windfalls, with roads and streams completely hidden under the beech canopy. The lack of sun light causes that the ground cover is very weakly developed and undergrowth is lacking. Such a forest is a poor habitat for birds with regard to food conditions, nest places and refuges. In the mountain beech forest of G.N.P. there are more

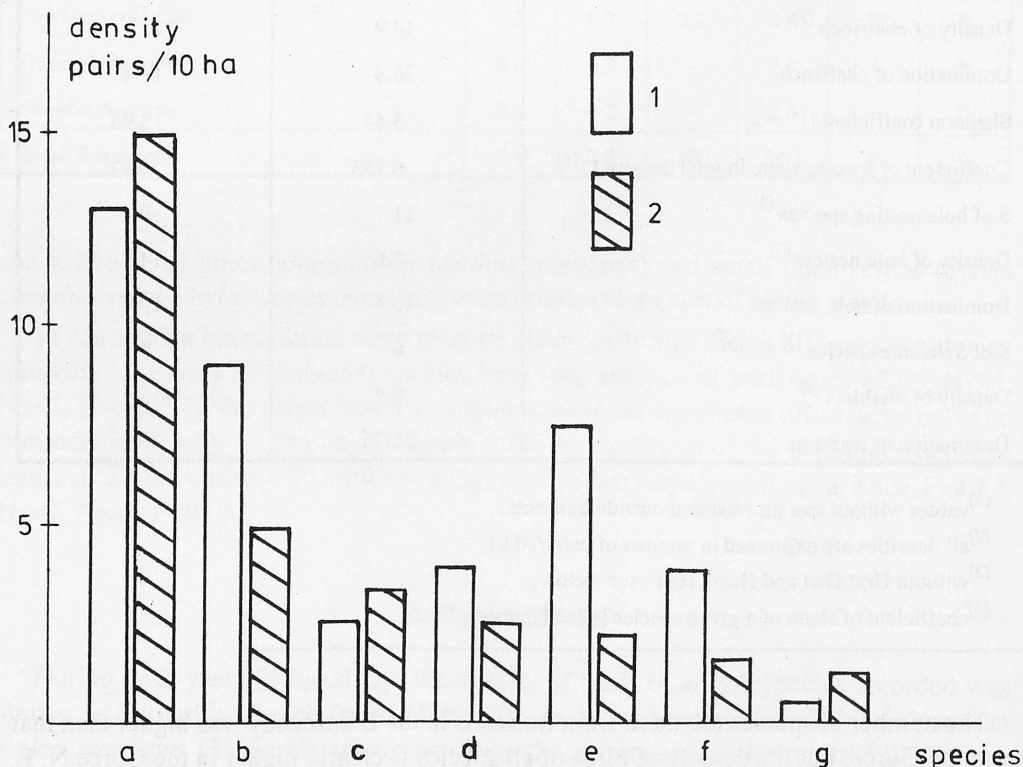


Fig. 2. Comparison of Gorce National Park (1) and Bieszczady N. P. (2) with regard to the number of dominant species: a - *Fringilla coelebs*, b - *Erithacus rubecula*, c - *Phylloscopus sibilatrix*, d - *Phylloscopus collybita*, e - *Sylvia atricapilla*, f - *Troglodytes troglodytes*, g - *Parus major*

open places, where the ground cover and undergrowth develop well. Along streams *Arctium* comes into the forest, there are many small marshes. The mean age of wood (over 150 years) is much higher than at Bd.N.P. All of those factors cause that the Gorce habitat is much more diversified and rich - so it is able to support much more numerous populations.

The above considerations are confirmed by a comparison of two ecological groups of birds: hole nesters and warblers, in Bd.N.P. and G.N.P. (Table VI).

According to GŁOWACIŃSKI (1981), in general the presence of a large number of species and the high density of hole nesting birds are characteristic of climax deciduous forests. It is due to old trees with many holes in which birds can find good nesting places. In the Gorce there is a slightly lower number of hole nesting species than in the Bieszczady, but their density is almost three times higher with clearly higher dominance (Table VI.). It is the result of the presence of old woods in G.N.P., whereas in Bd.N.P. most of the woods are young. The large number of recorded hole nesting species is the result of the adoption of the transect method, which in comparison with other methods of counting is very effective in discovering the presence of species (WALANKIEWICZ 1986). It is well known (WALANKIEWICZ 1986) that the number of recorded species is proportional to the area of penetration. In the Bieszczady the area penetrated was much bigger (29 ha in 1987 and 40 ha in 1988 in comparison with 18 ha in G.N.P.), and within its boundaries there were some areas of very old forest. These remarks also concern the larger number of all the bird species recorded from transects in Bd.N.P. in comparison with G.N.P..

According to GŁOWACIŃSKI (1981), the occurrence of warblers (*Sylviinae*) is characteristic of earlier stages of forest succession. Warblers in the Bieszczady are more numerous than in, G.N.P., but this difference may be caused by the bigger area of counting in Bd.N.P. The warblers' density is clearly higher in the Gorce, whereas the indices of domination are similar. This results from the existence of more open areas in G.N.P., where undergrowth much better developed makes an optimal habitat for warblers. In Bd.N.P. the occurrence of warblers is connected with the presence of undergrowth which develops on the edges of glades. This is confirmed by the presence of *Sylvia borin* and *Sylvia curruca*, their occurrence being strictly linked with the earliest stages of forest succession. A big share of warblers in the avifauna of Bd.N.P. is a result of the low general density of birds of all species, hence the small number of pairs occurring in not numerous glades or any other open areas makes a big share in the total density of birds in the Carpathian beech forest of Bd.N.P.

As for dwarf mountain beech forest, it can be concluded that this community was simplified in comparison with the Carpathian beech forest. The species composition was poorer ( $H'_d = 2.21$  and  $J'_d = 0.70$  in 1987 and  $H'_d = 13.03$  and  $J'_d = 0.78$  in 1988) and the quantitative structure of avifauna was unstable. For example the Chaffinch domination in 1988 decreased by 17.2 % in comparison with that in the year before, and *Cuculus canorus*, which in 1987 was among the dominant species, was not recorded in 1988 at all.

Alpine meadows are exposed to very severe physical factors, so this biocenosis has the simplest character. It is confirmed by the quantitative and qualitative composition of the avifauna ( $H'_m = 2.05$  and  $J'_m = 0.79$  in 1987 and  $H'_m = 2.29$  and  $J'_m = 0.72$  in 1988).



Among the dominants there are species characteristic of grass habitats and the earliest stages of forest succession, as according to GŁOWACIŃSKI (1981) the occurrence of *Sylvia communis*, is typical of the successional stage of deciduous forests 1 - 15 years old, and of *Phylloscopus trochilus* - of the successional stage of deciduous forest 15 - 19 years old. The density of *Fringilla coelebs* is like that in fresh forests 15 - 19 years old (its occurrence on alpine meadows is due to the presence of mountain ash scrubs).

The coefficient of equal share of given species in the total density of birds for alpine meadows  $J'_m = 0.79$  and is higher than that for Carpathian beech forest. This is due to the small number of species inhabiting similar ecological niches and reaching similar densities.

The avifauna of Bd.N.P. and surroundings had a large number of species ( $N = 107$ ), which resulted from the large diversity of accessible habitats. The breeding avifauna (categories B, C, D) was composed of 88 species. There was no evidence of breeding (cat. A) for the rest of observed species. Part of them stayed in the study area only during migrations, others may have only foraged within the boundaries of the study area, the remaining ones perhaps stayed there without attempting to breed. In the case of some species it was impossible to discover any traces of breeding.

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## 1. INTRODUCTION

During the last tens of years the Polish avian fauna has been undergoing considerable changes (TOMIAŁO 1990). Therefore, the necessity to undertake detailed faunistic and quantitative investigations. So far quantitative studies of birds of mountain biotopes in Poland have been carried out in the Karkonosze Mts (DYRZ 1974), Gorce (ZARZYCKI 1974, GŁOWACKI 1990), Bieszczady (CICHON & ZARZYCKI 1971), in Mt Polica (CICHON 1971) and in the Tatry (GŁOWACKI & PROCHNIEWSKI 1977).

Babi Góra is a small hill next to the Tatry Mts in which is the Polish part of the Carpathians. Natural plant communities are well preserved here. Most of them go to the making of the vegetation of the Babi Góra National Park, which has been entered on the world list of biosphere reserves.

The most complete studies of the bird fauna of Polish and Slovakian parts of Mt Babi Góra were published by now by BOCHNIEWSKI (1973) and BUCHAŁA (1975 and KOCHAN 1985). They do not contain, however, comparable quantitative data. The other papers are more fragmentary or even popular (PILCH 1930, DŁUGA-JANIA 1962, WILK 1978, KASAB 1989).

