

BAT GEOGRAPHIC DISTRIBUTION NORTH OF THE CARPATHIANS

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Abstract. Recent bat fauna in the area North of the Carpathians (Poland) consist of 25 species (2 Rhinolophidae and 23 Vespertilionidae). 25 bat species recorded so far from Poland can be divided into three groups: 1. Species limited to the southern Poland, occurred in the Polish Segment of the Carpathians (Beskidy Mts.), the Sudety Mts., and the Kraków-Częstochowa Upland; 2. Species with North-eastern limit of the distribution in the West and Central Poland, for example *Myotis myotis*; 3. Species with unlimited distribution on Polish territory, occurred also in the North-eastern Poland.

Résumé. La faune actuelle de chauve-souris de la zone du nord des Monts Carpates (sud de la Pologne) est formée de 25 espèces (2 Rhinolophidae et 23 Vespertilionidae). En Pologne, le mode de distribution nous montre un gradient de latitude. Ce gradient prononcé du sud-ouest vers le nord-est reflète le passage d'un climat atlantique vers un climat continental. Une croissance récente de la faune du nord des Carpates, tant du point de vue systématique que de la densité de la population a trois causes: la récupération de la faune de chauve-souris après la crise écologique apparue dans la seconde moitié du siècle précédent (i.e. *Rhinolophus hipposideros*, *Myotis emarginatus*); la migration récente de quelques espèces de chauve-souris vers le sud de la Pologne (*Rhinolophus ferrumequinum*, *Myotis blythi*, *Pipistrellus kuhlii*); la confirmation de la présence d'espèces récemment décrites (*Myotis alcathoe*, et probablement *Plecotus macrobullaris*).

Key words: Chiroptera, species richness gradient, enrichments of bat fauna, southern Poland.

INTRODUCTION

Bats are more numerous in tropical and subtropical regions, but three families: Molossidae, Rhinolophidae, and Vespertilionidae are adapted to the cooler climate and distributed in temperate zones too, as it is in case of Palaearctic Region. Thus, the appearance of every bat species depends on geographical position. We can also observe these phenomena in the Carpathian Mountains (Fig. 1).

MATERIAL AND METHODS

Pattern of bat distribution North of the Carpathians

Of the 45 European bats species, 32 are reported from the Carpathians Mts. This means about 70 % of whole European bat fauna. This area is an important eco-region offering suitable conditions for hibernation, shelters for nursery colonies and foraging areas (Wołoszyn & Bashta, 2001; Wołoszyn et al., 2008).

In periods of harsh climate (Pleistocene) the range of the bats could have been even more restricted, excluded to roost areas lying in the basin of the Mediterranean.

In warmer periods the bats migrated to the North, colonized the Carpathian Basin, and in optimum climate crossed the barrier of the Carpathians and colonized the mountain areas.

Ecological corridors across the Carpathian Mts. are very important for bat migration to the North. Their existence enabled dispersion of bats to the Mediterranean from Pleistocene roosts during postglacial period (Fig. 2).



Fig. 1 - Distribution pattern of horseshoe bats (Rhinolophidae) North of the Mediterranean Region. Numbers from 1 to 6 show the number of horseshoe bat species occurring in a region.

Fig. 2 - A possible eco-corridor of bat migration to the North during Late Pleistocene and Holocene along of the Carpathians Range; BMS – Balkan – Mediterranean Segment, PS – Pannonia Segment, NCS – North Carpathians Segment.

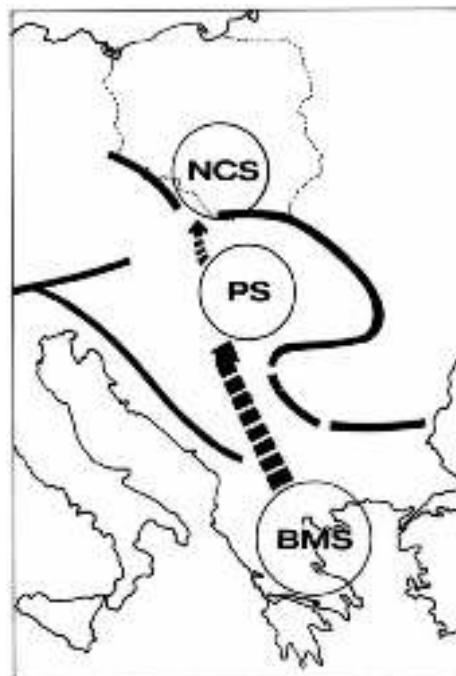


Table 1
Latitude gradient of bat species distribution along of the Carpathian Mountains
(after Pereswiet-Soltan & Wołoszyn, 2009).

Region \ Taxa	Families		Genus		Species	
	N	%	N	%	N	%
South Carpathian Mountains (and Balkan Peninsula)	4	100	11	100	32	100
Pannonian Region	3	75	10	91	29	91
Southern Poland (North Carpathians)	2	50	9	82	25	78
North of Poland	1	25	7	64	17	53

Biogeographic aspects of bat distribution in Poland

Recent bat fauna in the area North of the Carpathians (Southern Poland) consists of 25 species (2 Rhinolophidae and 23 Vespertilionidae) (Sachanowicz & Ciechanowski, 2005; Sachanowicz et al., 2006; Wołoszyn, 2001 a, 2004).

RESULTS AND DISSCUSSIONS

List of bat species from Poland

Family Rhinolophidae

- RHH Lesser horseshoe bat *Rhinolophus hipposideros* (Bechstein, 1800)
RHF Greater horseshoe bat *Rhinolophus ferrumequinum* (Schreber, 1774)

Family Vespertilionidae

- MYM Mouse-eared bat *Myotis myotis* (Borkhausen, 1797)
MBO Lesser mouse-eared bat *Myotis blythii* (Tomes, 1857)
MBE Bechstein's bat *Myotis bechsteinii* (Kuhl, 1817)
MYN Natterer's bat *Myotis nattereri* (Kuhl, 1817)
MEM Geoffroy's bat *Myotis emerginatus* (Geoffroy, 1806)
MYS Whiskered bat *Myotis mystacinus* (Kuhl, 1817)
MYB Brandt's bat *Myotis brandtii* (Eversmann, 1845)
MAL Alcahote bat *Myotis alcathoe* van Helversen and Heller, 2001
MDA Daubenton's bat *Myotis daubentonii* (Kuhl, 1817)
MDS Pond bat *Myotis dasycneme* (Boie, 1825)
VMU Parti-coloured bat *Vespertilio murinus* Linnaeus, 1758
ENI Northern bat *Eptesicus nilssonii* (Keyserling et Blasius, 1839)
ESE Serotine bat *Eptesicus serotinus* (Schreber, 1774)
PIP Common pipistrelle *Pipistrellus pipistrellus* (Schreber, 1774)
PPY Midget pipistrelle bat *Pipistrellus pygmaeus* (Leach, 1825)
PIN Nathusius' pipistrelle *Pipistrellus nathusii* (Keyserling et Blasius, 1839)
PIK Kuhl's Pipistrelle *Pipistrellus kuhli* (Natterer, 1819)
NLA Giant noctule *Nyctalus lasiopterus* (Schreber, 1780)
NYN Common noctule *Nyctalus noctula* (Schreber, 1774)
NYL Leisler's noctule *Nyctalus leisleri* (Kuhl, 1817)

PAR	Common long-eared bat	<i>Plecotus auritus</i> (Linnaeus, 1758)
PAS	Grey long-eared bat	<i>Plecotus austriacus</i> (Fischer, 1829)
PAM	Alpine long-eared bat	<i>Plecotus macrobularis</i> Kuzjakin, 1956*
BAR	Barbastelle	<i>Barbastella barbastellus</i> (Schreber, 1774)
MIS	Schreiber's bat	<i>Miniopterus schreibersii</i> (Kuhl, 1817)*

Acronyms and English names are given as based on: Wołoszyn, 2001 a (modified following the most recent data), Latin names: Annex 1, Agreement on the Conservation of Populations of European Bats, EUROBATS, 1991.

Three different types of bat faunas overlap in Poland (Horaček et al., 2000), which makes this a territory of a special interest from the zoogeographical viewpoint:

1. Boreal zone;
2. Northwestern temperate zone;
3. Southern European (Northern Mediterranean).

A gradient of species richness may be identified in Poland. Bat species density responded almost linearly to change in latitude. The pronounced South-West to North-East gradient reflects both latitude gradient of bat distribution and also transition from an Atlantic to a continental climate (Sachanowicz et al., 2006; Wołoszyn, 1994, 2001) (Tab. 2). We can observe loss of species number along this gradient.

Thus, the appearance of every bat species depends on geographical position. In southern Poland it is possible to meet a higher number of species than in territories located further to the North. Several southerly species reach their northern range limits in Poland. However, it needs to be noted that bats could easily be an object of passive transport for large enough distances, the reason why the finding of a single representative of a species far from its original areal extent does not really provide evidence of permanent occurrence.

Three species of bats are characteristic to Polish segment of the Carpathians: *Rhinolophus ferrumequinum*, *R. hipposideros* and *Myotis emarginatus*. These species reach their North limits in this region (Fig. 3) (Sachanowicz & Ciechanowski, 2005; Wołoszyn, 2001 b, c, d). In figures 4 and 5, the distribution of two bat species in Poland is presented.

Table 2

Appearance of bats in different regions of Poland
(partly based on Wołoszyn, 1994, 2001 and Sachanowicz & Ciechanowski, 2006).

Group 1: Species which occupy large areas and could be found throughout Poland	MYS, MYB, MDA, MDS, MYN, PIP, PPY, PIN, ESE, ENI, VMU, NYN, PAR, BAR
Group 2: Species limited in their occurrence to southern, central-western and North-western Poland	MYM, MBE, NYL, PAS, NLA,
Group 3: Species occurring in southern Poland (Carpathians, Sudetes, Krakow-Częstochowa Upland).	RHF, RHH, MEM MBO, MAL
Group 4: Species not found so far in Poland; but their occurrence here is still possible	PAM, MIS



Fig. 3 - Pattern of bat distribution in Poland: 1. Species limited to the Southern Poland, occurred in the Polish Segment of the Carpathians (Beskidy Mts.), the Sudety Mts., and the Kraków-Częstochowa Upland (lower spot); 2. Species with North-eastern limit of the distribution in the West and Central Poland (middle spot); 3. Species with no limit of distribution on Polish territory, occurred also in the North-eastern Poland (higher spot).

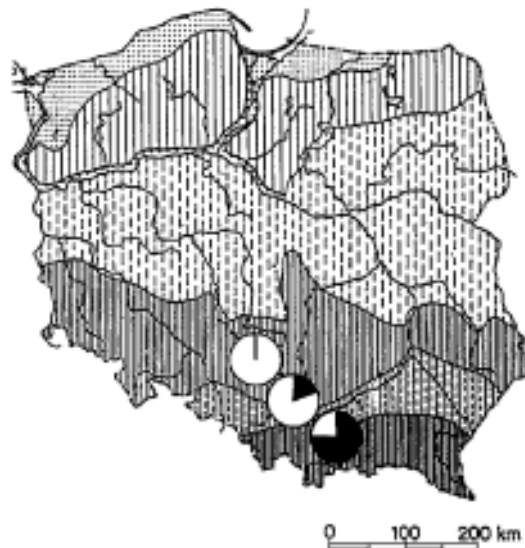


Fig. 4 - Frequency of Lesser horseshoe bat (*Rhinolophus hipposideros*) in three localities in: the Southern Poland (from the South-East to the North-West): Diabla Dziura Cave (Polish Segment of the Carpathians), Nietoperzowa Cave, (Kraków – Częstochowa Upland: Southern part), Na Świniszce Cave (Kraków – Częstochowa Upland: northern part). Circle denotes 100 % of bat population recorded at the site, darkened part of a circle denotes percentage contribution of Lesser horseshoe bat (after Wołoszyn, 1996).

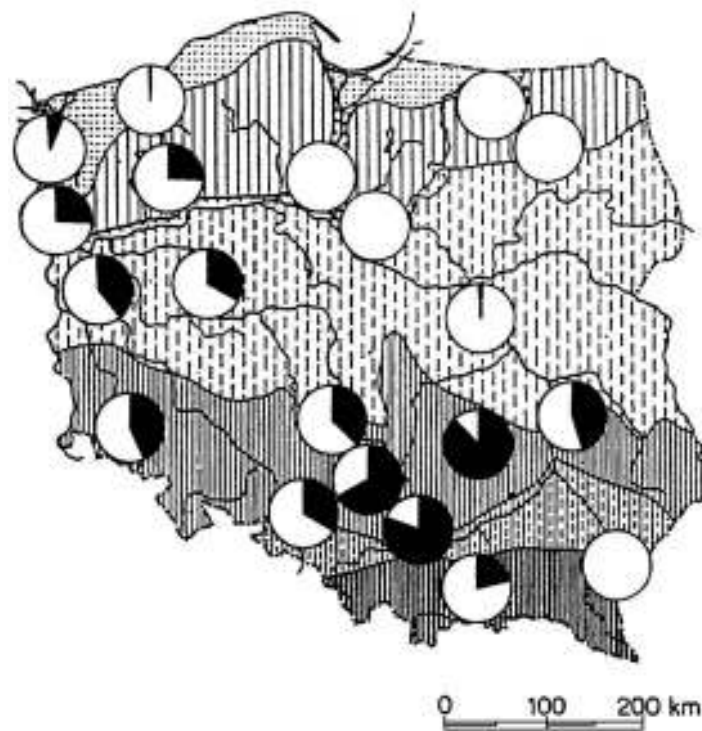


Fig. 5 - Frequency of Mouse-eared bat (*Myotis myotis*) in different localities in Poland. Circle denotes 100% of bat population recorded at the site, darkened part of a circle denotes percentage contribution of Mouse-eared bat (after Wołoszyn, 1996).

Conclusions

Recent bat fauna in the area north of the Carpathians (Southern Poland) consists of 25 species (2 Rhinolophidae and 23 Vespertilionidae).

Pattern of bat distribution in Poland shows latitudes gradient. The pronounced south-west to the north-east gradient reflects transition from an Atlantic to a continental climate.

Recently observed process of enrichments of bat fauna north of the Carpathians, both from systematic and population density points of view, is due to three reasons:

- recuperation of bat fauna after ecological crisis which occurred in the second half of the past century (i.e. *Rhinolophus hipposideros*, *Myotis emarginatus*);
- recent migration of same bat species to Southern Poland (*Rhinolophus ferrumequinum*, *Myotis blythi*, *Pipistrellus kuhlii*);
- confirmation of the existence of some newly described bat species (*Myotis alcathoe*, and probably *Plecotus macrobullaris*).

RĂSPÂNDIREA GEOGRAFICĂ A LILIECILOR LA NORDUL CARPAȚILOR

REZUMAT

Fauna actuală de lilieci în zona de nord a Munților Carpați (sudul Poloniei) cuprinde 25 de specii (2 de *Rhinolophidae* și 23 de *Vespertilionidae*). Modelele de distribuție ale speciilor de lilieci din Polonia prezintă un gradient latitudinal. Gradientul pronunțat pe direcția sud-vest spre nord-est reflectă de fapt tranziția de la climatul Atlantic la cel continental.

Îmbogățirea recentă a faunei de lilieci de la nordul Carpaților, atât din punct de vedere sistematic cât și al densității populației, are la bază următoarele trei cauze:

- recuperarea faunei de lilieci după criza ecologică apărută în a doua jumătate a secolului trecut (i.e. *Rhinolophus hipposideros*, *Myotis emarginatus*);

- migrația recentă a unor specii de lilieci spre sudul Poloniei (*Rhinolophus ferrumequinum*, *Myotis blythi*, *Pipistrellus kuhlii*);

- confirmarea prezenței unor specii de lilieci nou descise (*Myotis alcathoe*, și probabil *Plecotus macrobullaris*).

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