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Breeding sites of the barbastelle *Barbastella barbastellus* (Schreber, 1774) in Poland

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Abstract. The paper presents breeding records of the barbastelle (*Barbastella barbastellus*) from the whole current territory of Poland, both published data from papers and conference abstracts, and unpublished data collected by the authors. Up to 1999, known locations of maternity colonies and sites where young or lactating females had been caught, were assigned to only five forest regions or 16 Universal Transverse Mercator (UTM) squares. The number of such sites has significantly increased since 2000. Breeding sites of barbastelle have now been recorded in all Polish forest regions in 68 UTM squares. Most of the barbastelle sites were located in forest stands with high proportions of beech and oak (65%, N=46), and/or old-growth forest (over 32%, N=23). The highest elevation of a breeding site was at about 500 m.a.s.l. This paper summarises new records of maternity colonies of barbastelles for the first time, as a preliminary step to develop a more comprehensive conservation and monitoring plan for this near-threatened species.

Key words: *Barbastella barbastellus*, the barbastelle, bat, maternity colonies, Poland, habitat, forest regions, old-growth forest.

Introduction

The barbastelle is a woodland species; its summer roosts and maternity colonies are located mainly in woods and forests where the bat usually forages. Sometimes, especially in late July and August, wet woodland and hedgerows also become important habitat for the bulk of forage time (Greenaway 2008, Hillen et al. 2011). Upon leaving hibernacula, female barbastelles form colonies where, in mid-June, they give birth and then rear their young (Weidner 2000, Hermanns et al. 2003, Russo et al. 2004, Hillen et al. 2011). These groups disperse by September–October when mating begins (Weidner 2000, Gottfried 2009).

Barbastelles roost mainly under loose bark and in crevices in tree trunks or branches (especially in oak *Quercus* spp. and beech *Fagus* sp.) and seldom in rocks (Hermanns et al. 2003) or buildings (Wojtaszyn et al. 2008). Although tree roosts are not long-lasting, females return yearly to the known, safe hideouts if these last through the winter (Russo et al. 2004, Hillen et al. 2009) therefore only small (if any) change occurs in the distribution of colonies and territories (Greenaway, F. pers. comm. 2010). Such high site fidelity makes the protection of existing roosts and foraging habitats crucial for successful conservation of the barbastelle. Poland is home to relatively large numbers of barbastelles, recorded mainly during winter bat surveys. The largest known winter roosts house approximately 7000 bats each year. On the other hand, data on the species' summer distribution is scarce, mainly due to the bats' elusiveness - roosts are hard to find, maternity colonies are small, usually 10–20 females (Hermanns et al. 2003, Hillen et al. 2011, Weidner 2000), and the bats have relatively weak echolocation calls. This paper summarises the current state of knowledge of the distribution of barbastelles in Poland. It is the first step towards broadening the current, incomplete conservation measures that almost exclusively protect winter roosts, with a new, comprehensive protection plan allowing the maintenance of the favourable conservation status of this globally decreasing, near-threatened bat species

(IUCN 2013). However, to achieve this, one needs detailed knowledge of the bat's summer distribution.

To investigate where we should focus our future summer survey efforts, we compared summer roosting data gathered up to date with the general pattern of forest types in Poland. As this work was planned as a starting point towards better understanding of the distribution of the barbastelle, we aimed at finding possible clues as to where the future research should be concentrated.

Material and methods

This paper presents breeding records of the barbastelle from the whole current territory of Poland, from published data - papers and conference abstracts, and unpublished data collected by the authors. A breeding site is identified as either a known maternity colony or a record of a lactating female or a juvenile caught in a mist net (before mid-August), as female barbastelles tend to forage within 3–4.5 km from their roosts (Russo et al. 2004, Hillen et al. 2009). All the known breeding sites are shown in Table 1 and have been assigned to the 10 × 10 km Universal Transverse Mercator (UTM) grid (Fig. 1.).

Railway network

The known breeding sites of barbastelle were also compared with ecological forest stand type regions (henceforth called forest regions). These are classified based on the diversity of geology, climate, type of natural landscape and main forest tree species in Poland (Trampler et al. 1990) and published in a map provided by the Bank Danych o Lasach (Forest Data Bank). We calculated the habitat parameters presented in Table 2 using 2012 data on forest management planning available on the Forest Data Bank web site (BDL 2013). We also used data on the location of larger barbastelle hibernacula (an individual or group of underground sites) where at least 50 individuals of barbastelle were recorded during one visit (Mleczek 2001, Fuszara & Fuszara 2002a, 2002b, Hebda & Nowak 2002, Kasprzyk et al. 2002, Sachanowicz & Zub 2002, Fuszara et al. 2003b, Wojtaszyn et al. 2005, Lesiński et al. 2011, Mleczek & Szatkowski 2013).

Results

We identified 68 breeding sites of barbastelle in Poland (Table 1). From these, maternity sites known before 1999 were assigned to only five forest regions and 16 UTM squares (Fig. 1., Table 1). Since 2000, the number of such sites has increased. Breeding sites of barbastelle have now been recorded in all forest regions and in 68 UTM squares. Most new breeding records were found in south-western and eastern Poland. No studies have been done to confirm the existence of breeding sites from the 1980–1999 period, except in two regions. Barbastelle breeding has been recorded most frequently in central, eastern and south-western Poland. The northernmost breeding site is in the Puszcza Romincka, and the southernmost is in the western Bieszczady Mountains. The highest elevation of a maternity colony in the '90s was in the Pieniny Mountains, about 500 m.a.s.l., while in 2010, maternity colonies were found in Różanka and Kamienna, settlements located at 520 m.a.s.l.

Most of the barbastelle breeding sites were found in forest regions with a high proportion of beech and oak (65%, N=46), and/or a high proportion of old-growth forest (forest over 80 years old) (> 32%, N=23; Table 1). The greatest number of breeding sites (24) was found in the Małopolska region, with forest cover ca. 24%, and the proportion of old-growth forest ca. 23%. Another large concentration of breeding sites (14) was recorded in Mazowiecko-Podlaska region, with 20% forest cover and more than 15% old-growth forest. Tree species preferred by barbastelle — oak and beech — made up ca. 7% of the forest (Table 2).

However, the highest density of breeding sites (1 number of sites per 1000 km²) was recorded in the Sudecka region. It is one of the most forested areas of Poland, with forest covering 38% of the area, out of which ca. 27% being and old-growth. The beech and oak stands cover ca. 21% of the forested area.

In turn, the highest number of important wintering sites (≥ 50 individuals) was found in the Wielkopolsko-Pomorska region (six sites), with the maximum count of hibernating individuals (3966 ind, see Table 2). However, there were only nine breeding sites of barbastelle found in this region. Małopolska and Mazursko-Podlaska regions hosted the second largest density of barbastelle hibernacula. Few wintering barbastelles were recorded in uplands and mountain areas. In the Bałtycka region no wintering site was found, and the number of breeding sites was also the lowest in the country.

Discussion

Barbastelles occur over almost the whole territory of Poland. Their winter distribution is relatively well known, thanks to years of national monitoring of wintering bats (Fuszara et al. 2003b,

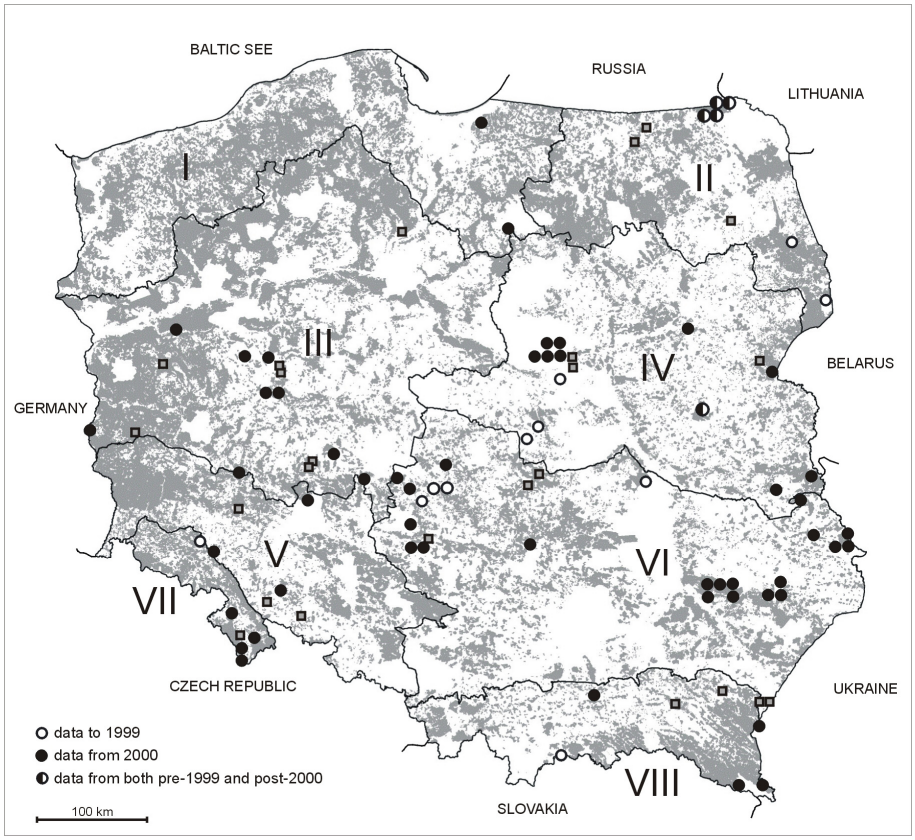

Figure 1. Habitat mapping of barbastelle *Barbastella barbastellus* breeding sites (circles) and larger winter sites (squares) with forest cover (grey shading) and the forest stand type regions of Poland. Regions are: I – Bałtycka, II – Mazursko-Podlaska, III – Wielkopolsko-Pomorska, IV – Mazowiecko-Podlaska, V – Śląska, VI – Małopolska, VII – Sudecka, VIII – Karpacka.

Table 1. Known breeding sites of the barbastelle *Barbastella barbastellus* in Poland, assigned to the geophysical regions of Poland and UTM squares.

Name and code of the geophysical regions of Poland after Kondracki 2009	Site	UTM	Date of record	Tree stand dominating on site	Source of data
Warsaw Basin 318.73	Kampinoska Primeval Forest (Granica)	DC69	Jun 1998	Mixed and coniferous mesic forests with the share of old-growth forest	Kowalski & Lesiński 1995, Kowalski & Szkudlarek 2003
Białystok High Plain 843.33	Knyszyńska Primeval Forest (Podsokołda)	FE60	1980-1990	Mixed and coniferous mesic forests	Kasprzyk & Fuszara 1992; Kowalski & Szkudlarek 2003; Kowalski et al. 2002
Rożnów Upland 513.61	Ciężkowice-Rożnów Landscape Park	DA82	Aug 2006	Neutrophilous beech forest with the share of old-growth forest	Bator et al. 2008
Bystrzyca Mountains 332.53	Bystrzyca Mountains (Różanka)	XR15	Jun 2008	Norway spruce forest and deciduous forest with the share of old-growth forest	Wojtaszyn et al. 2008
Głogów Glacial Valley 318.32	Valley of Barycz (Wierzowice Wielkie)	XT01	Jun 2008	Deciduous forest with numerous old oaks	Wojtaszyn et al. 2008

Table 1. (continued)

Name and code of the geophysical regions of Poland after Kondracki 2009	Site	UTM	Date of record	Tree stand dominating on site	Source of data
Bystrzyca Mountains 332.53	Bystrzyca Mountains (Pokrzywno)	XR09	Jun 2008	Norway spruce forest and deciduous forests	Wojtaszyn et al. 2008
Dubienka Depression 845.33	Strzelce Landscape Park	GB04, FB75, FB94, GB05	2000-2003, Jul 2001, May 2002, Jul 2006	Oak-hornbeam forest with dominace of oak and mixed forest	Wojtowicz et al. 2003, Piskorski et al. 2009
Gniezno Lakeland 315.54	Zielonka Forest Landscape Park	XU21	Apr - Jul 2002, Apr - Jul 2004	Scots pine forest and mixed forest with the share of old-growth forest	Łochyński & Grzywiński 2009, Kowalski & Szkudlarek 2003
Kalisz High Plain 318.12	Kalisz High Plain (Namysłaki)	BC91	Jul 2007	Mixed forest with Scots pine dominance	Ekiert & Dolata 2009
Bielsk Plain 843.37	The Białowieża Primeval Forest	FD95	Aug 1994, Aug 1995	Oak-hornbeam forest with the share of old-growth forest	Rachwald 2001, Kowalski & Szkudlarek 2003
Lubawa Hummock 315.15	Dylewo Hills Landscape Park	DE22	Jul 2001	Neutrophilous beech forest and oak-hornbeam forest with the share of *Fagus sylvatica*	Ciechanowski & Duriasz 2005
Łuków Plain 318.96	Łuków Forest (Dąbrówka)	EC86	Jun Aug 1995, Jul 1997, Aug 2011	Mixed forest of silver fir, oak and hornbeam with the share of old-growth forest	Sachanowicz & Krasnodębski 2003; Piskorski, pers. comm. 2013
Łask High Plain 318.19	Łask High Plain (Pratków)	CC52	Aug 2004, Jul 2011	Silver fir mixed forest and oak-hornbeam forest with the share of oak and silver fir	Furmankiewicz et al. 2005
Łask High Plain 318.19	Wojsławice Reserve	CC62	Jul 2011	Silver fir mixed forest and oak-hornbeam forest with the share of oak and silver fir	Ignaczak, pers. comm. 2013
Strzegom Hills 332.11	Sudeten Foreland (Roztoka)	WS84	Jul 2004	Deciduous forest	Furmankiewicz et al. 2005
Płońsk High Plain 318.61	Płońsk High Plain (Naruszewo)	DD41, DD51, DD52, DD61, DD62	Jul 2004, Aug 2004	Mixed forest with the high share of oak; old-growth forest	Lesiński et al. 2006
Wieluń Upland 341.21	Beech Mountain Reserve	CB35	Jul 2001, Jul 2002, Aug 2002	Acidophilous beech forest with the share of silver fir and mixed forest; the presence of old-growth forest	Ignaczak 2003
Romincka Forest 842.71	Romincka Forest	EF91, FF01, FF02, FF12	Jun - Aug 1996, Jun - Aug 2001	Mixed acidophilous forest with Scots pine and Norway Spruce; oak-hornbeam forest	Sachanowicz et al. 2001, Sachanowicz et al. 2004
Biłgoraj Plain 512.47	Janów Forests Reserve	FB00, EB80, EB81, EB91, FB01	Jul 2005, Jul 2006, Jul 2007	Scots pine and silver fir forest with the high share of beech and oak	Piskorski 2007
Biłgoraj Plain 512.47	Jastkowice Reserve	EB81	Jul 2005, Jul 2006, Jul 2007	Scots pine and silver fir forest with the high share of beech and oak	Piskorski 2007
Biłgoraj Plain 512.47	Łęka Reserve (Gierłachy)	EB91	Jul 2005, Jul 2006, Jul 2007	Scots pine and silver fir forest with the high share of beech and oak	Piskorski 2007
Central Roztochia 343.22	Roztocze National Park	FB41, FB40, FB30, FB49	Jul 2008, Aug 2011	Beech and silver fir forest; as well as mixed forest	Piskorski 2008

Table 1. (continued)

Name and code of the geophysical regions of Poland after Kondracki 2009	Site	UTM	Date of record	Tree stand dominating on site	Source of data
Poznań Lakeland 315.51	Samica Valley	XU01	Jul 2008	Mixed forest with the fragment of oak forest, oak-hornbeam forest and alder carr	Demuth & Szubert-Kruszyńska 2008
Wieluń Upland 341.21	Załęcze Landscape Park	CB35, CB37, CB45	May 2008, Jul 2008	Coniferus and deciduous forest	Ignaczak 2003, Ignaczak et al. 2008
Szczerców Basin 318.23	Warta-Widawka Landscape Park	CC50, CB49, CC60	Jul 1997, Jul 1998, Jul 1999	Scots pine forest with the small share of deciduous trees	Ignaczak et al. 2001
Kaczawa Upland 332.27	Chełm Landscape Park (Muchów)	WS75	Jul 2000	Ravine, lime and maple forests and oak forests	Dudek et al. 2000
The Pieniny 514.12	Pieniny Mountain	DV57	Jul 1993	Beech and fir-beech forests	Paszkiewicz et al. 1998, Kowalski & Szkudlarek 2003
Łowicz-Błonie Plain 318.72	Skierniewice High Plain	DC45	Jul 1994, Jul 1995, Jul 1996	Scots pine forest	Górecki 1998, Kowalski & Szkudlarek 2003
Elbląg High Plain 313.55	Elbląg Upland Landscape Park	DF01	2011-2012	Beech forest with the share of old-growth forest	Ciechanowski et al. 2013
Łopuszno Hills 342.16	Przedborski Landscape Park	DB35	summer 2001 and 2002	Mesic and dry coniferous forest; patches of beech-old-growth forest	Hejduk et al. 2002
Łęczna-Włodawa Plain 845.16	Sobibór Landscape Park	FC70	2000-2003	Mesic coniferous forest	Wojtowicz et al. 2003
Bug River Podlaski Breakthrough 318.91	Ceranów Forests	ED73	2000-2003	Mesic coniferous forest	Wojtowicz et al. 2003
Chełm Hills, Dubienka Depression 845.32, 845.33	Chełm Landscape Park	FB68	Jul 2000-2003	Deciduous and mixed mesic forests with the share of oaks	Kowalski et al. 2002, Wojtowicz et al. 2003
Podlachian Western Bug Defile 318.91	Podlachian Western Bug Defile	FC49	2000-2003	Deciduous and mixed mesic forest	Wojtowicz et al. 2003
Łódź Heights 318.82	Łódź Hills Landscape Park	DC34	Jul 1999	Deciduous, old-growth forest	Hejduk et al. 1999
Kozienice Plain 318.77	The Kozienicka Forest	EC30	Aug 1992	Coniferous forest, oak and oak-hornbeam forest; the share of old-growth forest	Kowalski et al. 1996, Kowalski & Szkudlarek 2003
Sanok-Turka Mountains 522.11	Słonne Mountains Landscape Park	FV29	Aug 2010	Beech forest with the share of old-growth forest	Sachanowicz, pers. comm. 2013
Trzebnica Hills 318.44	Czeszów Upland (Malerzów)	XS69	Jul 2011, Jul 2012	Mixed forest with the share of beech	Gottfried, Gottfried pers. comm. 2013
Gorzów Basin 315.32	Sieraków Landscape Park	WU43	Jul 2011	Scots pine forest, deciduous and mixed forest with the share of oak and beech	Jaros, pers. comm.2013
Kalisz High Plain 318.12	Krotoszyn Forests	XT83	Jul 2012, Jul 2012	Acidophilous oak forest	Gottfried, Gottfried, pers. comm.2013
Niemcza-Strzelin Hills 332.14	Strzelin Hills	XS30	Jul 2010	Acidophilous oak forest; eutrophic oak-hornbeam forest, neutrophilous and acidophilous mountain beech forest; old-growth forest	Gottfried, pers. comm. 2013
Szczerców Basin 318.23	Hołda Reserve	CB49	Jul 2009	Oak-hornbeam and riparian forest; coniferous mesic and moist forest; old-growth forest with the high share of oak	Jaros, pers. comm. 2013

Table 1. (continued)

Name and code of the geophysical regions of Poland after Kondracki 2009	Site	UTM	Date of record	Tree stand dominating on site	Source of data
Złoczew High Plain 318.22	New Village Recerve	CC30	Jul 2009	Mixed forest with the share of beech and silver fir	Jaros, pers. comm.2013
Złoczew High Plain 318.22	Wrząca Reserve	CC21	Jul 2009	Lowland beech forest with the share of oak	Jaros, pers. comm. 2013
Śrem Basin 315.64	The Rogalin Landscape Park in the Warta Valley	XT28, XT38	Jul 2007	Coniferous forest and mixed forest with the share of oak	Jaros, pers. comm. 2013
Zasieki Basin 317.23	Uroczysko Węglinieckie Reserve	VT74	Jul 2011	Deciduous forest with the high share of oak and beech; old-growth forest	Wojtaszyn, pers. comm. 2013
Bystrzyca Mountains 332.53	Ponikwa	XR16	Jun - Jul 2011, Jul 2012	Mixed forest with the dominance of Norway spruce	Gottfried, Gottfried, pers. comm. 2013
Kłodzko Basin 332.54	Kamienna	XR27	Jul 2011	Mixed forest with the dominance of Norway spruce	Gottfried, Gottfried, pers. comm. 2013
Western Bieszczady 522.12	Ustrzyki Górne	FV24	Jul 2009	Deciduous forest with the high share of beech; old-growth forest	Sachanowicz & Wower 2013
Western Bieszczady 522.12	Wetlina	FV04	Jul 2010	Deciduous forest with the high share of beech; old-growth forest	Sachanowicz & Wower 2013

Table 2. Selected parameters describing the forest stand type regions of Poland from the Forest Data Bank, with the recorded number of barbastelle *Barbastella barbastellus* breeding and wintering sites. Numbers in brackets are mean percentage of Poland covered by each region (column 1) and greatest recorded number of wintering barbastelles (column 6).

Forest stand type region	Forest cover of the region (%)	Proportion of old-growth forest over 80 years old (%)	Proportion of broad-leaves (%)	Proportion of oak and beech (%)	Number of large winter sites (Nmax)	Number of breeding sites
Bałtycka (15.2)	30.5	22.9	35	12.1	0	2
Mazursko-Podlaska (9.18)	31.6	28	24.1	7.7	3 (1263)	6
Wielkopolsko-Pomorska (19.7)	30.3	22.5	13.2	6.9	6 (3966)	9
Mazowiecko-Podlaska (18.62)	19.6	15.5	24.6	7.3	4 (686)	14
Śląska (9.74)	26.3	20.9	23.3	13.2	3 (406)	3
Małopolska (20.15)	24.2	22.6	22.5	11.6	5 (1654)	24
Sudecka (1.66)	38	26.7	26.3	20.7	1 (370)	5
Karpacka (5.75)	40	26.5	45.2	36	2 (360)	5

Wojtaszyn et al. 2005, Lesiński et al. 2011, Piksa et al. 2011). These studies showed that there are more colonies and higher number of barbastelles which over-winter in the eastern, central and south-western parts of the country. In the Carpathians and Pomerania barbastelles are not numerous. Despite being among the most common bats at winter sites throughout lowland Poland (Gubańska et al. 2002, Fuszara et al. 2003a, 2003b, Gottfried 2009, Lesiński et al. 2011), knowledge on the distribution of barbastelle summer sites is poor. New records in recent years in regions where the barbastelle had not previously been recorded most likely result from undertaking research in new areas. Up to 1999, only 16 breeding sites were known. Since 2000, the number of known breeding sites has increased more than fourfold, to 68 sites. However, taking into account the numbers of barbastelles in the known larger wintering sites and the fact that the species migrates to short () or medium distances – the longest movement recorded was 290 km (Roer 1995, Rydell & Bogdanowicz 1997, Gaisler et al. 2003, Steffens et al. 2004), more breeding sites are expected to be identified in most forest regions of Poland, especially in the Wielkopolsko-Pomorska

region where the number of winter sites is the highest, and the two largest wintering sites are known.

The recognised breeding sites are not concentrated in the region holding the greatest forest cover (Table 2). It seems that the quality of local habitat patch is more important, as most sites are located in forest parts with high proportions of oak and beech or old-growth deciduous stands. It seems probable that barbastelles were more common and widespread in the past, but after habitat change and deforestation larger populations survived only in the more extensive and better preserved forest fragments. It is also possible that because barbastelles are dependent on mature deciduous forest stands, their foraging behaviour varies considerably over different landscapes and regions (Hillen et al. 2011, Rebelo et al. 2012). For example, the average home range of barbastelles in the Swiss Alps is reported to be 8 ha (Sierro 1999), while in Germany it reaches 403 ha (Hillen et al. 2009). This could explain the relatively large number of breeding sites in the Mazowiecko-Podlaska region, with 20% forest cover and low landscape connectivity. Presence of suitable wintering sites may also be important. However, the decline of the barbastelle in other European countries for example Belgium, Switzerland (Rydell & Bogdanowicz 1997, , Fairon & Busch 2003, Lesiński et. al. 2005) seems to be independent of availability of winter sites and suggests a crucial role for summer areas of appropriate size and quality. Two factors may particularly affect habitat selection for the breeding season: accessibility of food and shelter (Fenton 1997). Other critical factors may also be forest structure (Jung et al. 1999, Patriquin & Barclay 2003), age of the forest (Crampton & Barclay 1998), forest fragmentation (Grindal & Brigham 1998), forest size, and consequently, distance from the forest edge, distance from water (Ciechanowski 2002), presence and size of forest clearings (Fukui et al. 2011) and forest management patterns (Rachwald & Labocha 1996, Patriquin & Barclay 2003).

Age of the tree stand

Barbastelles are thought to fly quite fast and to hunt insects in flight. This is probably one of the reasons for their preference for old-growth forest with abundant clearings (Sierro 1999, Hermanns et al. 2003, Hillen et al. 2011). In Poland, breeding sites are found in old-growth deciduous stands or in their immediate vicinity. The shelters were often found in dead or dying trees which occur more often in old-growth forest (Hermanns et al. 2003, Russo et al. 2004). The highest density of sites was found in the Sudecka region, which appears to confirm the importance of old-growth forest in barbastelle breeding areas.

Tree species composition

Research shows that barbastelle prefers beech and oak for shelters (Hermanns et al. 2003, Russo et al. 2004). These species were most prevalent in the Karpacka (36%) and Sudecka (ca. 21%) regions. However, in the Karpacka region only five barbastelle breeding sites were recorded, which may partially be caused by the higher elevation of this region. They most often choose sites and hunt below 1200 m.a.s.l. (Sierro 1999). The Karpacka region contains high mountains with the highest peak 2499 m.a.s.l. The Sudecka region has lower mean elevation (highest peak 1602 m.a.s.l.) and this region also holds the highest density of breeding sites. Small nocturnal Lepidoptera comprise up to 94% of the barbastelle diet (Andreas et al. 2012). Species diversity of insects from this order is much lower in fir and pine forest than in oak stands. In terms of species richness, especially *Picea* (34 species), but also *Pinus* (43) constitute a very mediocre food source for the Lepidopterans, compared to *Quercus* (137) (Brändle & Brandl 2001).

Data collected in this study relates to the whole forested region of Poland, and does not allow analysis of other parameters which may be important for the barbastelle, like for example the size of the non-fragmented areas. Continuous forest cover offers shelter and barbastelle feeding habitat (Entwistle et al. 2001, Hermanns et al. 2003, Kaňuch et al. 2008). The mean hunting area of a barbastelle female in Germany is 403 ha (Hillen et al. 2009), so the size of the forested area may be an important factor. Local occurrence of sedentary species or short distance migrant bats may depend on the presence of winter sites and their distribution in relation with optimal summer habitats. In Poland, the longest recorded movement of barbastelle was 150 km (Gottfried and Hebda unpub). The comparison of the spatial distribution of breeding sites and the largest winter sites (Gottfried 2012) shows a similar pattern. This suggests that barbastelle may select forest habitats optimal for breeding in the vicinity of the hibernacula.

The location of maternity colonies of shy spe-

cies such as barbastelle is difficult to be identify. Radio-tracking is the most robust method to locate maternity colonies, but it is highly invasive and difficult to use on large scale. Most records of breeding sites where collected during mist-netting before mid-August, as female barbastelles tend to forage just 3–4.5 km from their roosts (Russo et al. 2004, Hillen et al. 2009). Such mist-netting results do not allow estimation of local population size. Therefore, basic data on the national population of barbastelle is derived from winter monitoring in selected sites. We lack repeated surveys of most maternity colonies (only two regions are covered, Puszcza Romincka and Lasy Łukowskie, see also Table 1), thus information on the continuity or turnover of maternal colonies is scanty. Also, a regular monitoring of forested areas may uncover any potential shifts in the barbastelle's habitat preferences. This should be important for the species' conservation, as gaps in the knowledge of distribution and habitat selection during the reproductive season makes conservation measures difficult to implement. Deciduous forests with a high proportion of old-growth forest cover are most likely the primary habitats of the barbastelle. Thus effective protection of these sites is needed for the success of conservation methods targeting the barbastelle, while a throughout knowledge of the local habitat use of individual barbastelle populations may provide proper steps for the conservation of the species.

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