

INSPECTION OF ENVIRONMENTAL PROTECTION

Methodology of nature monitoring

Methodological guide for:

Species of animals:

1308 Barbastella *Barbastella barbastellus* (Schreber, 1774)

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1308 **Barbastella** *Barbastella barbastellus* (Schreber, 1774)



Photo 1 Barbastelle Barbastella barbastellus(© I. Gottfried)



Photo 2 Hibernating barbastelles (© I. Gottfried)

I. INFORMATION CONCERNING THE SPECIES

1. Systematic position

Order: *Chiroptera* bats

Family: *Vespertilionidae*

2. Legal status and threat to the species

International law

Habitats Directive - Annex II and IV

Berne Convention - Annex II

Bonn Convention - Annex II

EUROBATS - Annex I

National law

protection of species - strict protection (the species requiring active protection)
zone protection - hibernation sites where during 3 consecutive years the number of over 200 bats was ascertained (irrespective of the species): year-round protection zone - rooms and roosts occupied by the bats.

IUCN threat category

IUCN Red List (2011) - NT
Red list of vanishing and endangered animals in Poland (2002) - DD
Red list for the Carpathian Mountains (2003) - VU (in PL - VU)

3. Description of the species**Appearance**

The barbastelle *Barbastella barbastellus* is an average-sized species of bat, whose length of the forearm is 36-44 mm. Pelt on the back is black with yellow or white endings and dark grey on the belly with low contrast with the back side. The barbastelle is the only bat in Poland whose colouration is so dark, almost black, and thanks to this fact it is relatively easy to distinguish it from other species when at rest. Additionally, a short snout, a distinctive arrangement of skin folds around nostrils and wide, short triangle-shaped ears, joined at the base in the middle of the head, give the bat its characteristic appearance (Photo 1, 2). Knife-shaped tragi go as far as the middle of the length of the ear. The wing membrane in this species is attached to the base of the toes. The barbastelle's wings are dark, relatively long and not too wide. They enable the bat to fly slowly, but they also allow for high manoeuvrability and even suspending in the air. At rest the wings are folded and held at the sides of the body. The calcar extends to the half of the distance between the heel and the tail. A lobe of skin reaches out of the calcar and it is not strengthened with a transverse cartilage. The end of the tail projects about 1 mm beyond the interfemoral membrane. Sexual dimorphism is not present in this species. A male can be distinguished from a female only after being caught: in males, on the ventral side, a penis can be seen. A young animal can be distinguished from an adult one in the period of about two months after birth. In this period, on the wings, when bones are being lit with a flashlight, epiphyseal plates will be visible before joints in the form of lighter stripes (Photo 3).

When at rest, it is hard to confuse a barbastelle with other species of bats. Whilst, when flying, correct designation on the basis of the silhouette is virtually impossible. There are no features that would help distinguish it, in the light of a flashlight, from pipistrelles, a whiskered bat or a Brandt's bat, which are of similar size, relatively dark, with slight contrast between their back and belly.

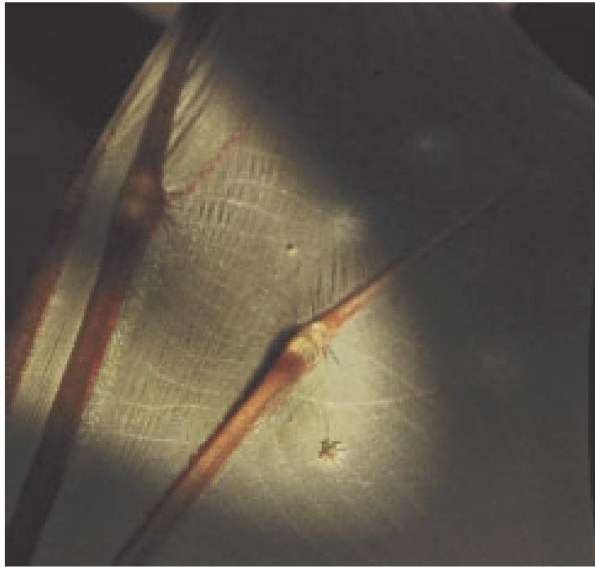


Photo 3 Young barbastelle - epiphyseal plates in the form of lines are visible on the wing (© I. Gottfried)

Echolocation

The barbastelle is a species producing calls of high variability, which are emitted by the bat both via their mouth and via their nostrils. The diversification is exceptional among European species of bats (Rydell et al. 1996, Dietz et al. 2009, Barataud 2005). The species regularly emits, alternately with a basic call, a substitute call - an alternative one.

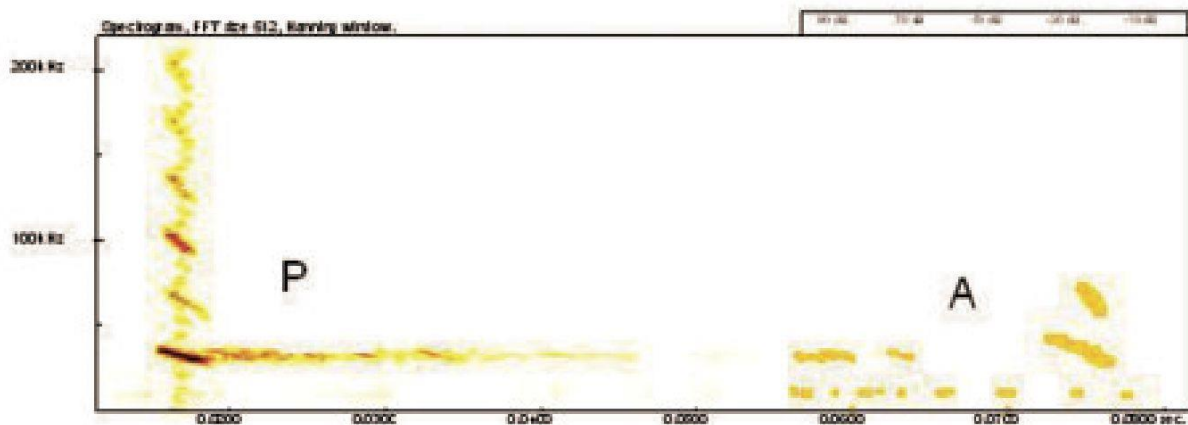


Fig. 1 Two echolocation calls used by the barbastelle alternatively, P = basic call, A - alternative call

Basic call (Fig. 1) is an FM sound (frequency modulated), of a short duration (normally 2.2-2.5 ms), with the best hearing frequency of 32-33 kHz. An average distance from which the call is heard is about 30 m. The alternative call is also an FM sound, of a much longer duration (3-6 ms in an open environment), with maximum energy of 41-45 kHz (Ahlen, Baag Oe 1999, Denzinger et al. 2001). It is heard from a distance of up to 15 metres (Barataud 2005).

The first type of the call is always more intensive and louder than the second one, so sending them alternately reminds of the sound of castanets (Barataud 2005). Such a way of emitting the basic call, alternately with the substitute call, results probably from the strategy of the hunt. Barbastelles hunt mainly for small species of flying insects that belong to the order of *Leidoptera* and of the net-winged insects *Neuroptera*, which have developed tympanal organs, so they hear echolocation signals of bats ranging 20-50 kHz. They account for 70-100% of their diet (Rydell et al. 1996, Sierro,

Arlettaz 1997, Sierro 2003, Barataud 2005). Probably the fact the barbastelle uses two types of calls makes it more difficult for insects to determine the location and distance from the bat.

The barbastelle may change the basic call depending on the structure of environment in which it is flying and because of that it may be similar to signals emitted by the bats of three other genera: long-eared bat *Plecotus*, mouse-eared bat *Myotis*, pipistrelle bat *Pipistrellus* (Barataud 2005). It may cause some difficulties in the correct determining of the species.

4. Biology of the species

Migration

The barbastelle is considered by some authors to be a sedentary species, i.e. its winter roosts are most often located up to a dozen kilometres from its summer roosts (Roer 1995, Steffens et al. 2004), whilst other researchers consider it to be a medium-distance migrant. In Central Europe flights on the distance of almost 300 km from Austria to Hungary were noted, which indicates that in this part of the continent this species may migrate (Rydell, Bogdanowicz 1997). Also Czech researchers classify this species as able to migrate (Gaisler et al. 2003). In Poland the longest registered flight of a barbastelle was 150-km-long (own data, not published). During migration the species avoids flying into open space and uses linear elements of the environment, forests and woodlots (Hermanns et al. 2003).

Non-winter season

Males live separately or form small groups. Females, after leaving hibernation sites, form groups, the so-called maternity colonies, where their pups are born. A single maternity colony can consist of between a couple and over 100 females. In the roosts located in trees there are usually 10-20 females (Dietz et al. 2009, Hermanns et al. 2003, Hillen et al. 2011, Russo et al. 2004, Weidner 2000). About the middle of June females give birth to 1-2 pups, which are being suckled for almost 6 weeks (Dietz et al. 2009). Colonies disperse in September-October (Sachanowicz, Ciechanowski 2005).

Mating season

The barbastelle, living in temperate climate, has to limit its mating season to one, short period in a year. The mating season for this species is in late summer and early autumn. Barbastelles fly in large numbers to their winter roosts at the turn of August and September. The mating season lasts for about two weeks. At that time dozens of bats fly round entrances to underground structures and also inside. One may hear then social calls, observe bats chasing one another and mating (Gottfried 2009).

Wintering

Barbastelles arrive at hibernation sites in November. The maximum number of bats of this species can be noted in January. Later the number of hibernating bats decreases. In March it is hard to observe one in their underground roosts (Fuszara et al. 2003a). Only insemination is the result of mating. A female stores sperm in her reproductive tract until spring. Conception takes place after the female emerges from hibernation (Dietz et al. 2009).

In Poland (starting from winter 1980) over 1000 objects are studied each year. In 2003 the results of winter counts were summarized. Over 700 winter roosts were controlled then and in about 31% of them hibernating barbastelles were found (Fuszara et al. 2003a). As their hibernation sites they most

often used forts (24% of hibernating barbastelles), large, brick cellars (22%) and bunkers (18%); caves, adits, canals or wells were used less often. In two types of roosts: bunkers and forts, the barbastelle was a dominating species, representing respectively 85 and 60% of the bats hibernating in these objects (Fuszara et al. 2003a, Fuszara et al. 2003b).

Międzyrzeczki System Umocniony in Nietoperek was not included in those counts; each year 1000-1400 of barbastelles winter there, which, up to 2003, constituted about 22% of bats of this species wintering in Poland (Urbańczyk 1987, Fuszara et al. 2003a). The counts also included the tunnel of an old factory in Krzystkowice, discovered in February 2005, where 1870 barbastelles hibernated (Wojtaszyn et al. 2005). Those sites are now, in terms of the number of hibernating barbastelles, the second and the third most known hibernation sites of this species in the world. Barbastelles are very attached to their roosts; especially to the winter roosts where they return to each year and the knowledge of them is passed from generation to generation.

That is why the biggest threat for the species is the loss of winter roosts where a high number of bats hibernate.



Photo 4 A fragment of a forest used by barbastelles in the mating season
(© I. Gottfried)



Photo 5 Barbastelles eagerly use flaking bark for summer roosts
(© I. Gottfried)

5. Habitat requirements

Feeding grounds

Occurrence of this bat is highly limited to forests. It forages in forests, on forest edges, in gaps in forest stands, on forest trails but also in areas covered with bushes or over waters with overgrown edges. The barbastelle flies relatively quickly and hunts mainly for insects which are flying. Such a style of hunting requires a more open habitat, which is probably one of the causes why the bats select old stands. Tree species composition may not be as important for the barbastelle as the presence of a complex age structure and of numerous gaps among trees is (Eriksson 2004, Dietz et al. 2009). However, most often the barbastelle can be found in deciduous forests (Photo 4, 5), although in the Swiss Alps they are most common in pine forests. Most common occurrence of the barbastelle in deciduous forests may be also connected with the availability and abundance of food. Small nocturnal butterflies represent up to 94% of diet of this bat (Rydell et al. 1996). Abundance of insect species of this order in spruce and pine forests is definitely smaller than in oak forests (34, 43

and 137 species respectively) (Eriksson 2004). The Barbastelle prefers stands which are over 60-year-old (Sierro 1999, Eriksson 2004, Hermanns et al. 2003, Hillen et al. 2011). The territory where one bat hunts is from 9 ha to as much as 2 500 ha (Sierro 1999, Hillen et al. 2011). Hunting grounds are usually 3-4.5 km away from their day roosts but they may also be as far as 10 km away. At night barbastelles visit 3-4 different feeding grounds, covering even 30 km (Sachanowicz, Ciechanowski 2005).

Summer roosts

For their mating colonies roosts barbastelles choose crevices under flaking bark, cavities in the trunk or branches. They prefer roosts in cavities in the trunks with a diameter of about 40 cm - mainly oaks and beeches. In trees of a similar diameter they occupy crevices formed in bifurcations in the trunk. Barbastelles were also found under flaking bark of dying trees with a diameter of at least 20 cm, but usually with a larger diameter. Often barbastelles' roosts were located in dead trees which, most probably, offer more roosts of this type. In beech forests in central Italy, 20 out of 33 localized roosts of barbastelles were found in dead trees, eight - in trees with boughs which were dead in 50%, and another five roosts - in trees with boughs dead in 50-90% (Hermanns et al. 2003, Russo et al. 2004). Barbastelles were also found behind shutters, in bridge crevices and, in Southern Europe, also in caves (Rydell et al. 1996, Rydell, Bogdanowicz 1997, Sachanowicz et al. 2004).

Mating sites

At the turn of August and September barbastelles arrive in large numbers to their hibernation sites. This phenomenon is called swarming, and can be also observed in other species of bats. Recent research has shown that barbastelle swarming near underground sites may be connected to mating (Gottfried 2009). The highest number of barbastelles mate in large, spacious objects, with easy access and including high passageways and rooms. Such structure of roosts enables them to perform mating flights, which probably play an important role in the mating ritual of bats (Parsons et al. 2003), and also creates better conditions for sound propagation, including mating signals. Those signals, just like physical fitness, may be a marker of a bat's quality and determine the choice of a partner.

Hibernation sites

The barbastelle hibernates in various types of underground sites, such as: cold stores, cellars, caves, adits, forts, bunkers and tunnels (Rydell and Bogdanowicz 1997, Fuszara et al. 2003a, Ciechanowski et al. 2006). It was also found in attics (Kowalski 1955). Most of the found hibernation roosts of the barbastelle are artificial, man-made objects. The world's largest known hibernation sites of this species are not of natural origin, either. They are: a railway tunnel in central Slovakia, where 6800-7800 bats hibernated (Uhrin 1995), an adit in Bavaria, which was a roost for 3000 barbastelles in 1970's (now 300-400 bats) and an adit in Slovakia, where 2000 bats spent the winter of 1963 - recently about 550 bats (Fuszara et al. 2003a).

For their hibernation roosts barbastelles select cool objects with good air circulation, where temperature in winter oscillates around 0°C: between -1°C and 6°C (Rydell, Bogdanowicz 1997, Jurczyszyn et al. 2003). The barbastelle is a bat that is one of the most frost-resistant ones. It can tolerate short lasting drops of temperature down to -9°C and it freezes in the temperature as low as -16°C (Weidner 2000, Sachanowicz, Ciechanowski 2005). Usually in hibernation sites of this species, alongside the low temperature, there is also low air humidity, even 40%. Such conditions are too

harsh for many bat species, especially of the mouse-eared bat genus *Myotis* (Rydell, Bogdanowicz 1997, Weidner 2000).

The bats are strongly attached to their roosts and they return to them each year, if the conditions have not changed. What is more, the barbastelle is considered to be a timid species that changes its roosts, especially when it is disturbed (Russo et al. 2004). That is why securing its hibernation sites, where large numbers of bats hibernate, seems to be one of the most important actions that can be undertaken in order to protect it. Uncontrolled penetration of underground sites during hibernation period may not only lead to reduction of the barbastelle roost, but also to death of bats. Frightened bats waste lots of energy before they find new roost, which makes them lose body fat before spring and the time insects occur.

It is also important for barbastelles to have free access to their roosts. It is best, if the entrance is at least 13-cm-high and about 50-cm-wide, which enables the bats to fly in without the risk of wing injuries.

Migration corridors

In the case of bats like the barbastelle - with a short range of echolocation signal, linear elements of the environment map out the flight/migration route (Hermanns et al. 2003). They are also an important element of the environment, as they provide shelter from unfavorable weather conditions and protect from predators. Thus, they are often used by the species which have a long range of signal.

6. Species distribution

In Poland the species is known almost all over the country (Fig. 2). It is relatively common in eastern, central and south-western part of Poland; in the Carpathian Mountains and Pomerania they are uncommon and occur locally.

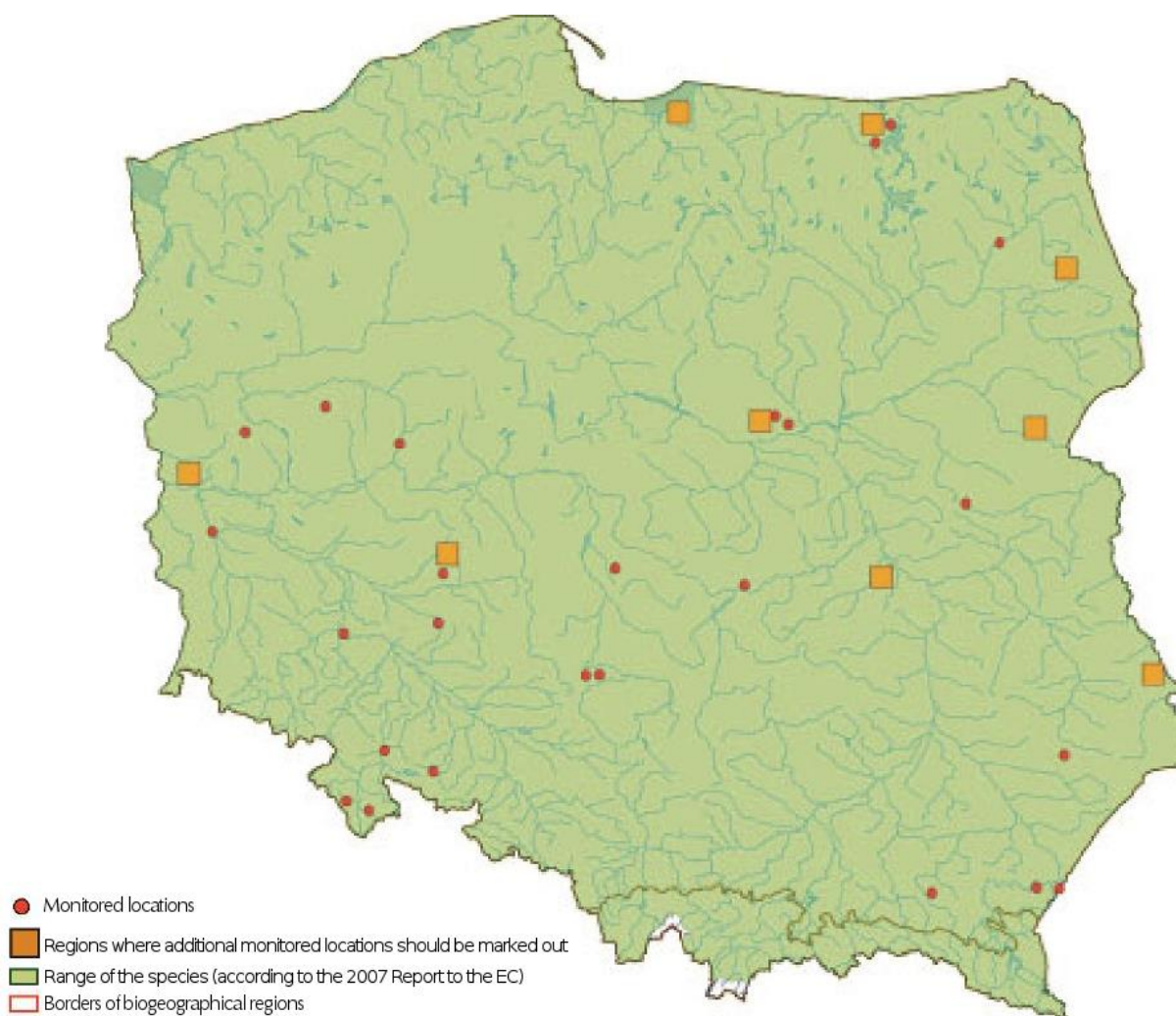


Fig. 2 Distribution of the barbastelle monitoring locations in Poland against the range of the species

Distribution of hibernation roosts of this species is relatively well known, which results from winter monitoring of bats conducted for years now (Fuszara et al. 2003a, Wojtaszyn et al. 2005, Piksa et al. 2011). Outside the winter season, knowledge on the barbastelle in Poland is based only on a couple of studies (Furmankiewicz et al. 2005, Ciechanowski 2008, Wojtaszyn et al. 2008, Gottfried 2009).

II. METHODOLOGY

1. Concept of monitoring of the species

Although the barbastelle is one of the most common bats in hibernation sites in the whole lowland part of Poland (Jurczyszyn et al. 2003, Fuszara et al. 2003a and 2003b, Gubańska et al. 2002, Gottfried 2009, Lesiński et al. 2011), little is known about biology of this species outside the winter season. The knowledge on the barbastelle in the period following the hibernation period, i.e. of its migrations, feeding grounds, summer roosts and mating, is based only on a few studies. Mating roosts are difficult to detect without involving telemetry studies, which results from the low abundance of barbastelles in colonies and also from the character of preferred roosts. No monitoring of summer roosts or feeding grounds was conducted. That is why the basic knowledge of the size of

the national population of the barbastelle comes from the results of winter counts in selected objects.

For about a dozen of years, the barbastelle has been included into studies which are a part of winter bat monitoring activities conducted independently by various research institutions and non-governmental organizations. Each year, within the same time limit (15.01-20.02) the majority of most important bats' winter roosts, including the barbastelle's roosts, are controlled. In Poland there is no central system for collecting and analyzing the data coming from bat monitoring, that would gather data coming from the whole country. Most of the hibernation sites are, however, controlled by non-governmental organizations and institutions which are members of the Agreement for Bat Protection (Porozumienie dla Ochrony Nietoperzy - PON). The studies are conducted with application of a uniform methodology by licensed counters (people who were trained properly, undertook traineeship and passed practical and theoretical examinations attesting their knowledge and skills connected to counting bat roosts).

The concept of summer monitoring is based on confirmation of the barbastelle reproduction in the studied area and evaluation of the activity in the roost. Moreover, condition of the roost is evaluated through establishing the number of dying and dead trees, number of trees with a large diameter and the deciduous forest areas and old forest areas within the study area. In the future, it would be advisable to extend the monitoring activities by monitoring of mating colonies and mating locations.

As the knowledge on the biology of the barbastelle is still not extensive, it would be advisable to label individuals outside the winter season, e.g. during autumn swarming near underground sites, in order to discover migration distances, length of life, connection between the observed decrease in the number of individuals in hibernation sites or in summer roosts and various threats. In order to ring bats, it is necessary to obtain consent of a competent authority for environmental protection (at present, the consent of the General Director for Environment Protection) and of the area administrator. In the future, the proposed methodology of the barbastelle summer monitoring may be modified, based on experiences from the subsequent stages of monitoring activities and the results of independent research.

The concept of monitoring of the barbastelle in hibernation sites, similarly like in the case of other species of bats (compare the chapter "Methodology of bat monitoring in hibernation roosts") is based mainly on controlling its abundance in selected roosts and determining accessibility to those roosts, protecting them against disturbances and controlling their microclimate conditions.

2. Indicators and assessment of the species conservation status

SUMMER ROOSTS

Indices of population status

The assumed indices for population status are supposed to define if a given forest area is used by the species during the period of breeding based on netting bats or finding breeding colonies in the monitored area (including the use of independent, current information on their location) and determining how intense their activity in that area is (Tab. 1, 2) through registering echolocation signals and analyzing them.

Indices of roost status

The offered indices are supposed to determine the condition of forest areas used by the barbastelle during the period of breeding. The indices concern the area of the studied complex of forests, structure of stand and the number of trees with a large diameter, dying and dead, preferred as roosts by this species of bat (Tab. 1, 2).

Table 1 Indices of population and habitat status - summer roosts

Index	Unit	Measurement/determination
Population		
Reproduction of the species	Descriptive index	Determining the number of lactating females and/or juveniles on the basis of netting bats in the period between 10.07 and 30.07 (acceptable up to 15.08) during 1-3 control nights and/or determining the number of individuals in the maternity colony found in the study area or near its boundaries - up to 500 m (newly discovered or known from literature)
Activity of the species	Number of signals per hour	Determining the number of registered flights of barbastelles per one hour of detector listening on the basis of recordings made in the period between 10.07 and 30.07 (acceptable up to 15.08) during catches
Roost		
Forested area	ha	Determine from forest management plans, tree stand management maps and orthophotomaps
Surface area of deciduous forests	ha	Determine from forest management plans and tree stand management maps
Surface area of historic stands	ha	Surface area of stands aged > 80 years should be determined from forest management plans and stand management maps
Surface area of deciduous historic stands	ha	Surface area of stands aged > 80 years should be determined from forest management plans and stand management maps
Number of dying and dead trees	N/1600 m ² (median and min. - max. range)	Dying and dead trees with a diameter at breast height > 25 cm should be counted in randomly chosen test areas
Diameter of live trees that ensure potential day roosts	cm (median and min. - max. range)	Diameter at breast height of all trees in the randomly chosen test areas should be measured with a calliper and the trees with a diameter at breast height of >25 cm should be counted

The way of valuing indices of population status and habitat of the species is presented in Tab. 2.

Table 2 Valuation of indices of population status and the barbastelle habitat - summer roosts

Index	Evaluation ¹			
	FV	U1	U2	XX
Population				
Reproduction of the species	Reproduction of the species was confirmed, i.e. a maternity colony of the barbastelle was found in the monitored area or near its boundaries (up to 500 m) and/or at least 1 lactating female and/or at least 1 juvenile of the barbastelle was caught	No maternity colony was found, no lactating female or a juvenile was caught, but reproduction was reported during previous control within the monitoring scheme	No maternity colony was found, no lactating female or a juvenile was caught during two consecutive controls within the monitoring scheme	No data enabling confirmation or lack of confirmation of reproduction of barbastelles in the monitored area
Activity of the species ²	Number of recorded echolocation signals of the barbastelle is not lower than 5 flights/hour and if it is lower, the reproduction is assessed as FV	Number of recorded echolocation signals of the barbastelle is lower than 5 flights/hour, and the reproduction is assessed as U1 or U2	No echolocation signals of the barbastelle have been recorded.	No data enabling confirmation or lack of confirmation of occurrence of barbastelles in the monitored area

¹ FV - satisfactory condition, U1 - unsatisfactory condition, U2 - bad condition, XX - no data available

² When valuing the indicator of activity of the species, the short range of echolocation signal of the barbastelle was taken into account, which is reflected in the number of the registered flights

Index	Evaluation ¹			
	FV	U1	U2	XX
Roost				
Forested area	Surface area of the forest complex is close to the condition of the reference year (commencement of monitoring) or greater	Surface area of the forest complex is reduced when compared to the condition of the reference year (commencement of monitoring) but not more than by 50 ha, that is by the surface of 5 minimal home ranges	Surface area of the forest complex is reduced when compared to the condition of the reference year (commencement of monitoring) by more than 50 ha	No information available, e.g. because of extension of boundaries of the monitored area
Surface area of deciduous forests	Surface area of deciduous forests is close to the condition of the reference year (commencement of monitoring) or greater	Surface area of deciduous forests is reduced when compared to the condition of the reference year (commencement of monitoring) but by no more than 30 ha, that is by the surface of 3 minimal home ranges	Surface area of deciduous forests is reduced when compared to the condition of the reference year (commencement of monitoring) by more than 30 ha	No information available, e.g. because of extension of boundaries of the monitored area
Surface area of historic stands	Surface area of historic stands is close to the condition of the reference year (commencement of monitoring) or greater	Surface area of deciduous historic stands is reduced when compared to the condition of the reference year (commencement of monitoring) but by no more than 20 ha, that is by the surface of 2 minimal home ranges	Surface area of deciduous historic stands is reduced when compared to the condition of the reference year (commencement of monitoring) by more than 20 ha	No information available, e.g. because of extension of boundaries of the monitored area
Surface area of deciduous historic stands	Surface area of deciduous historic stands is close to the condition of the reference year (commencement of monitoring) or greater	Surface area of deciduous historic stands is reduced when compared to the condition of the reference year (commencement of monitoring) but by no more than 20 ha, that is by the surface of 2 minimal home ranges	Surface area of deciduous historic stands is reduced when compared to the condition of the reference year (commencement of monitoring) by more than 20 ha	No information available, e.g. because of extension of boundaries of the monitored area
Number of dying and dead trees	Median above 2 trees/1600 m ²	Median between 1-2 trees/1600 m ²	Median below 1 tree/1600 m ²	No information available
Diameter of live trees that ensure potential day roosts	Median above 40 cm	Median between 30-40 cm	Median below 30 cm	No information available

Cardinal indices

Not distinguished

Evaluation of population status

Evaluation of indices of the population status of the species in a summer position is based on comparison of the results obtained in the given year, and in the case no reproduction was confirmed in the given area, on reference to two last seasons that were included into monitoring scheme (analysis of long-term changes).

Evaluation of the population parameter is determined as follows:

FV - if both indices were evaluated as FV;

U1 - if one index was evaluated as U1, lack of U2;
U2 - if one or both indices were evaluated as U2;
XX - if both evaluations were XX

Evaluation of roost status

When evaluating the roost status on the basis of individual indices, one should follow the rule:

FV - if all indices were evaluated as FV or almost two as XX or at most one as U1, and the rest as FV;
U1 - two or more as U1 or at most one as U2,
U2 - two or more as U2,
XX - if all evaluations were XX, or three or more were XX, and the rest as FV.

Conservation prospects

Evaluation of conservation prospects is an attempt to predict the conservation status of the barbastelle in the given site in the perspective of 10-15 years by the contractor of monitoring activities (expert assessment). If in such a perspective there are chances of maintaining satisfactory status or improve unsatisfactory status, then the conservation prospects should be evaluated as satisfactory (FV). If we assume that the satisfactory status will get worse or that the unsatisfactory status will be maintained, then the conservation prospects should be assessed as unsatisfactory (U1). If we think that the present unsatisfactory status will get worse or that bad status will be maintained, we assess the prospects as bad (U2). When assessing this parameter we take into account the current status of the population and habitat, current influences and expected threats for the species within the site (planned changes in use of the area, among others), the way the area is protected and also protection activities that have been undertaken so far. An interview with a manager of the area may be useful.

Overall assessment

The lowest score from one of the three parameters (population, habitat, conservation prospects) is a decisive factor when evaluating general species conservation status at the site.

HIBERNATION ROOSTS

Indices of population and habitat status

Assumed indices of population status and habitat status of the species are presented in Tab. 3. Notice: Indices regarding habitats relate to potential unfavorable changes in the area of the hibernation site available to the bats when compared to the year monitoring activities commenced, possibility of disturbing the animals as well as presence and passability of entrances to the roost (Tab. 3,4). The evaluation of the status of the habitat also includes potential changes in microclimate conditions underground and in the surroundings of the object, concerning the share of forested areas and migration corridors that ensure communication with other areas.

Because changes in those indices shall be assessed in relation to the reference year, one should really carefully describe location of the sites with conditions optimal for hibernation of barbastelles and also the places where temperature measurements were performed. A detailed description of measurements is presented in the next chapter.

Table 3 Indices of population and habitat status - hibernation roosts

Index	Unit	Measurement/determination
Population		
Abundance	Number of individual bats	Counting hibernating bats in a roost in the period between 15.01 - 15.02 and additionally 20.12-31.12
Roost		
Surface area of a hibernation site	Descriptive index	Expert evaluation concerning changes in the area of the roost convenient for bats (changes relate to the status in the reference period - the year monitoring commenced)
Ensuring that the bats are not disturbed	Descriptive index	Expert evaluation concerning the presence, appropriateness and status of securing a roost
Passability of entrances for bats	Descriptive index	Expert evaluation concerning the number of inlets available for bats, their passability, among others
Air temperature	oC	Measurement with use of a thermometer or thermohygrometer
Share of forested areas in the surroundings of the hibernation site	%	To be determined on the basis of an orthophotomaps (within the radius of 1 km from the roost)
Connection of the roost with potential summer biotopes	Descriptive index	Based on orthophotomaps and observations in the area, the number of linear elements (alleys, rivers) in the surroundings of the roost, connecting them with forests should be determined and if the forest surrounding the hibernation site is connected to other forest complexes

The way of valuing population status index and habitat status index of the species is presented in Tab. 4.

Table 4 Valuation of population status index and habitat status index - hibernation roosts

Index	Evaluation ³			
	FV	U1	U2	XX
Population				
Abundance	Number of individual animals is not lower than the one determined during the last control, and if the data is available, average abundance from the last 10 years is greater than 70% of the maximum abundance determined at the site	Intermediate results between FV and U2	Number of individual animals is lower than 50% of the number from the last control, and if the data is available, average abundance from the last 10 years is smaller than 40% of the maximum quantity abundance at the site	No comparative data from the previous year and from the multiannual period available or no data from this year available

³ FV - satisfactory condition, U1 - unsatisfactory condition, U2 - bad condition, XX - no data available

Index	Evaluation ³			
	FV	U1	U2	XX
Roost				
Surface area of a hibernation site	Surface area of the hibernation site available and used by barbastelles without changes or greater when compared to the reference period (the year monitoring commenced) or smaller, but abundance assessed as FV	Surface area of the hibernation site available and used by barbastelles decreased when compared to the reference period (the year monitoring commenced), but it does not refer to the fragments of key importance for barbastelles, and abundance of the species assessed as U1	Surface area of the hibernation site available and used by barbastelles decreased when compared to the reference period (the year monitoring commenced) by the fragments of key importance for this species	Surface area of the hibernation site available and used by barbastelles decreased when compared to the reference period (the year monitoring commenced), but it is not known if the excluded fragments were important for barbastelles
Ensuring that the bats are not disturbed	The roost secured and hibernating bats are not disturbed by people	Access of people to the inside of the roost is difficult but still possible and there are cases of bats being disturbed or the access not being secured; however, the pressure is low	The roosts are not secured or secured ineffectively and the pressure from people is significant or potentially significant	Access of people to the inside of the roost is difficult or hard to determine and there is no data available that would allow assessing the existing or potential pressure
Passability of entrances for bats	Sufficient number of passable entrances continuously available in each of the separate parts of the hibernation site and there are no factors hindering barbastelles using them	Considerable number of entrances in each of the separate parts of the hibernation site are not passable any more, but there are entrances that barbastelles may freely use to fly into the underground site	All entrances in each of the separate parts of the hibernation site are not passable any more or there are obstacles that make it difficult for barbastelles to fly into the underground sites	No information available on the exact number and availability of entrances
Air temperature	Temperature in the parts of the site preferred by barbastelles in the range from -5°C to +4°C	Temperature in the parts of the site preferred by barbastelles in the ranges: below -5°C down to -7°C or above +4°C up to +8°C	Temperature in the parts of the site preferred by barbastelles below -7°C or above +8°C	No information available on microclimate conditions at the site
Share of forested areas in the surroundings of the hibernation site	Share of forested areas in the surroundings of the roost close to the condition of the reference period (the year monitoring commenced) or reduced by more than 10%	Share of forested areas in the surroundings of the roost reduced by 10-50% when compared to the condition of the reference period (the year monitoring commenced)	Share of forested areas in the surroundings of the roost reduced by more than 50% when compared to the condition of the reference period (the year monitoring commenced)	No information that would enable evaluation available

Index	Evaluation ³			
	FV	U1	U2	XX
Connection of the roost with potential summer biotopes	Number of continuous (distances between elements are not longer than 10 m), linear elements of the environment (alleys, rivers) and/or connection between the forest surrounding the hibernation site and other forest complexes close to the condition of the reference period (the year monitoring commenced)	Number of continuous linear elements of the environment and/or connection between the forest surrounding the hibernation site and other forest complexes reduced when compared to the condition of the reference period (the year monitoring commenced) by 10-50%	Number of continuous linear elements of the environment and/or connection between the forest surrounding the hibernation site and other forest complexes reduced when compared to the condition of the reference period (the year monitoring commenced) by over 50%	No data available on linear elements ensuring safe flight and connected to forests and/or connection between the forest surrounding the hibernation site and other forest complexes

Cardinal indices

Not distinguished

Evaluation of population status

Assessment of population status of the species in the hibernation site corresponds to the assessment of the only abundance index, which is based on a comparison of the abundance observed in the given year with the data from the previous season and on an analysis of long-term trends in abundance. When designing indexation of the abundance index, various characteristics of the barbastelle population dynamics were taken into account; however, the assumed percentage limit values are arbitrary, taking into account the past experience.

Evaluation of roost status

When making an evaluation of the status on the basis of evaluations for indices, one should follow the rule applicable in drafting reports for the European Commission from the results of monitoring of the condition of conservation of species and types of natural habitats:

FV - if all the evaluations for indices are FV or one is XX, and the remaining are FV;

U1 - if one or more are U1, there are no U2;

U2 - one or more are U2;

XX - if all are XX, or two or more are XX, and the rest are FV.

Conservation prospects

It is a prognosis of the species population and habitat status in the perspective of 10-15 years. It should refer to the current status of the population and habitat, take into account the observed trends in changes in those parameters and all the actions and plans (threats), whose results may influence the current conservation status of the population and habitat in the studied site (e.g. changes in the use of land where the site is located, applied or possible to apply protection activities). An expert evaluates whether there are chances of maintaining current good status or improvement of unfavorable status or deterioration of the condition is inevitable. The expert should also take into account other information, e.g. existing data on the species in the given site.

Overall assessment

The lowest score out of the three partial evaluations (population, habitat, conservation prospects) is a key factor when carrying out the general evaluation of the species conservation status at the site.

Notice: The adjustment of population and habitat indices, both during the period of breeding and hibernation, presented above, is the first proposal in this scope, that is why during the next control within the national barbastelle monitoring scheme (after about 6 years), it is advisable to verify the way of evaluation of indices and of selection of the indices, especially when referring to summer sites.

3. Description of monitoring studies

Selection of monitored locations and their suggested size

SUMMER ROOSTS

When selecting study areas, one should take into account preferences of the species. The barbastelle is a species connected to woodlands. It is most often noted in deciduous forests and its roosts were usually found in oaks and beeches (Hermanns et al. 2003). Thus, a whole forest complex or its fragment is a monitored summer site/study area. When selecting a monitoring area, one should take into account that the surface area of the habitat of one barbastelle covers from 9 to over 2500 ha (Eriksson 2004, Hillen et al. 2011, Sierro 1999). For the research carried out in Germany (no such data available from Poland), the median of a habitat size of one bat was 403 ha (Hillen et al. 2011). Feeding grounds are usually up to 4.5 km away from their roost, but they may also be as far as 10 km away. At night barbastelles visit 3-4 different feeding grounds (Hillen et al. 2011). That is why the area selected for monitoring activities in summer season should have at least 1000 ha.

Study areas should be located all over the national range of the species (considering unequal reconnaissance in various regions). Moreover, in the first place, areas where reproduction of barbastelles has been ascertained should be included into the monitoring.

Inclusion of about dozen of forest areas into monitoring activities in the following locations is suggested (compare Fig. 2):

- The Śnieżnik Mountains,
- Czeszowska plain,
- Pniewy Forest District,
- Kłobuck Forest District,
- Poddębice Forest District,
- Naruszewo Protected Landscape Area,
- Łuków Forests,
- Roztocze National Park
- Knyszyn Primeval Forest,
- Strzelce Forests,
- Forests near Gierłoż and/or forests near Mamerki,
- Rzepin Primeval Forest,
- Kozienice Primeval Forest,
- Krotoszyn Oak Forests,
- Wysoczyzna Elbląska.

HIBERNATION ROOSTS

A winter monitoring site is a single underground object or a complex of such objects situated close to each other (about 200 m between entrances). These usually are caves, adits, fortifications, tunnels and, less often, spacious cellars. Barbastelles hibernate also in household cellars or wells, however, in objects of this type few bats can be found, so most probably they do not have a significant impact on trends in abundance of the national population. Monitoring should include all possible known hibernation sites, especially those composed of at least 100 hibernating animals, and for the needs of the national population status monitoring such data should be analysed jointly.

The following criteria should be taken into account when winter monitoring sites are selected:

- they should be located all over the national range of the species (considering unequal reconnaissance in various regions);
- hibernation sites of at least regional importance should be included into the annual monitoring activities as first, according to the criteria adopted in relation to this species for Poland by PON and repeated by the Regulation of the Minister of Environment of 16 May 2005 on types of natural habitats and plant and animal species requiring protection in the form of designation as Natura 2000 areas - Journal of Laws of 2005 No. 94, item 795 (simplified: the hibernation sites with 100 or more barbastelles; however, if there are high numbers of other bats in the hibernation site or the site is important for some other reason - e.g. it is located on the verge of the range of the species, the numbers may also be lower).
- the largest hibernation sites of this species in Europe, namely a tunnel in Krzystkowice, an underground system of Międzyrzecki Rejon Umocniony (Nietoperek), and also a bunker in Konewka, Modlin Forts, Szachownica Cave, Fortifications in Gierłoż and Mamerki and a circulation adit in Młoty should definitely be included in annual monitoring. A list of national hibernation sites proposed for monitoring activities, where more than 100 of barbastelles in the period of hibernation were noted in previous years, is presented below (Jurczyszyn et al. 2002, Mleczek 2002, Fuszara et al. 2003a, Wojtaszyn et al. 2005, Gottfried 2009). These are the largest barbastelle hibernacula in Poland, which are a good representation of the wintering population of this species. The sites are located within the main area in the country where the species is found, in the following regions:
 - South-East: forts near Przemyśl, adits in Węglówka;
 - South-West: adit in Młoty, adit in Skałki Stoleckie, forts in Nysa;
 - Central-East: Modlin Forts; Koszewo II Fort, Fighting bunker in Anusin (Brest Fortified Region);
 - Central: Konewka, Szachownica Cave, Cold Storage Room in Cieszków;
 - Central-West: Nietoperek, Fort I in Poznań, tunnel in Krzystkowice, Monastery in Lubiąż;
 - North-East: Gierłoż, Mamerki, Central Fort of the Osowiec Fortress. All the sites listed above are under protection within the Natura 2000 European

Network. If a new, large hibernation site of the barbastelle is discovered (like in 2005, when the tunnel in Krzystkowice was discovered), it should be included into monitoring activities.

Study method

SUMMER ROOSTS

General remarks

In the year a given site is included into the barbastelle monitoring activities, the condition of the habitat should be documented, which aims at recording changes over the years. A map of the studies area should be drawn (1:25 000 scale) and coordinates of catches, detector listenings and locations of the discovered maternity colonies should be noted.

Indices for population status should be determined

Reproduction. Finding a maternity colony roost of barbastelles in the studied area would be irrefutable evidence that the bats use the selected area during the period of breeding. Maternity colonies are formed by a few to several dozens of females that relatively quickly change their roosts. Thus, finding a roost for a maternity colony without application of a specialist, costly method of telemetry is really difficult. However, one may search crevices and cracks in trees, flaking bark or wooden siding of houses located near a forest (study area). Another way that enables one to confirm that the given area is used by the barbastelle during the period of breeding is the method of netting the bats in the monitored area.

A few rules should be followed when conducting the barbastelle catches in order to confirm reproduction:

- Group leaders are responsible for obtaining consents of competent authorities for environmental protection (at present it is a consent of the General Director for Environment Protection) and of the area administrator.
- Catches should be performed by people whose ability to distinguish bats and knowledge of the rules of conduct during the activity is confirmed (e.g. by a chiropterological license of appropriate level issued by PON). The group performing catches may additionally be composed of inexperienced persons, provided that they have been instructed by the leader on the rules of conduct during the activity.
- 1-3 nights of catches should be conducted. If during the first control reproduction is confirmed (a lactating female - Photo 6 - or a juvenile is caught), no additional controls are necessary.
- Controls should be conducted in as good weather conditions as possible, during warm nights, without rainfalls and wind, so as to eliminate the influence of weather on the result. In the period of cool weather and rainfalls bats are less active or they do not leave their roosts at all. Catches should be conducted during the first 4 hours after the sunset - during the highest activity of the bats.
- During each control 3-5 chiropterological nets should be strung and they should be checked at least every 15 minutes. Thus, at least two persons experienced in disentangling bats from the net need to take part in the catches. Nets should be positioned on forest trails, where at the sides
- of the trail there is dense underbrush and the overhanging branches of the trees adjoin. In this way the nets will be positioned in a "tunnel", which will increase the prospects for catching bats.



Photo 6 In the period of suckling swollen nipples are visible in a lactating female of the barbastelle (© I. Gottfried)

Activity. In order to determine this index, simultaneously to net catches one should also record barbastelles' calls with an ultrasound detector working in the high frequency recording system, divider or zero-crossings analysis, enabling recording on an internal memory card or a connected digital recorder and later computer bio-acoustic analysis and determining the species of the bat. Listening activities should be performed for the first 4 hours after the sunset (during the catches). The number of the recorded signals of barbastelles should be calculated for 1 hour of recording and in this way determine activity of the species in the studies area as the number of flights/1 hour.

It should be stressed that in case of negative results of the catches (bats detect the nets and avoid them), thanks to the listening activities a researcher can determine if the species is present in the area during the period of breeding but it just was not caught or if barbastelles do not use this habitat at this time of the year.

Results of the monitoring of individual areas do not allow evaluating the population trends in the whole country. In order to do this a statistical analysis of the results coming from many areas and from a longer period of research is necessary.

Determining indices of the habitat status

Initially a study over six indices was assumed (Tab. 3, 4). Evaluation of indices relating to the area of the studied forest complex and the area of various types of stands requires a reference of the current values to the "zero" values from the year monitoring commenced, so in the reference year the indices are not evaluated. In the year the area was included into the barbastelle monitoring scheme a map of the study area should be drawn and the coordinates of the places where catches and detector listenings took place should be marked.

Forested area. This index is used to take account of the changes in the degree of afforestation in the selected area of the forest complex/fragment of the forest complex which is being included into

monitoring of the barbastelle during the period of breeding. Those changes should be defined by an analysis of an orthophotomap and forest management plans and also stand management maps. Borders of the study area are defined by an expert in the year monitoring commenced (the reference year). They should be marked on maps in the 1:25 000 scale so that, when the study is repeated in the following years, there are no doubts concerning the boundaries of the studied area.

Area of deciduous forests. This index enables the researchers to track changes in the area of the deciduous stand within the limits of the determined study area, in relation to the year monitoring commenced. Those changes should be defined by analyzing forest management plans and also stand management maps and summing up the area of forest management units which are dominated by deciduous species.

Area of historic stands. This index enables the researchers to track changes in the area of the historic stands (stands aged > 80 years) within the limits of the whole study area, in relation to the year monitoring commenced. Those changes should be defined by analyzing forest management plans and also stand management maps and summing up the area of forest management units in which the age of the stand was determined as > 80 years.

Surface area of deciduous historic stands. This indicator enables us to track changes in the area of deciduous historic stands (deciduous forests aged >80) all over the studied area in relation to the year monitoring commenced. Those changes should be defined by analyzing forest management plans and also stand management maps and summing up the area of forest management units in which deciduous species dominate and in which the age of the stand was determined as > 80 years.

Number of dying and dead trees. This indicator allows tracking changes in the number of dying and dead trees with the diameter at breast height >25cm, that offer potential day roosts for barbastelles and insects of the orders of Lepidoptera butterflies, in relation to the year monitoring commenced. During each monitoring cycle, measurements are made in 30 randomly chosen plots (squares sized 40 x 40 m) in deciduous historic stands (within borders of the outlined study area). Stands of this type are preferred by this species. Before the field work commence, on the basis of forest management plans and also stand management maps, fragments of area where deciduous species dominate and in which the age of the stand was determined as > 80 years should be mapped out. They should be divided with a net into 1600 m² squares and numbered. Then choose randomly 30 plots, mark them out with a string and count all dead and dying trees with a diameter at breast height > 25 cm. Researchers should measure the diameter at breast height of each dying and dead tree with a tree calliper (calliper) and count the ones whose diameter at breast height is >25 cm. The result has a form of a median and the range defining limit values of the measurements obtained after comparing them with the rest of the data from all studied squares.

Diameter of live trees that offer potential day roosts. This index also enables tracking changes in diameter of all trees with the diameter at breast height above 25 cm (trees of those sizes are preferred by the species), in relation to the reference year. On the same plots where the number of dying and dead trees was determined, the diameter at breast height of all live trees is measured and those with the diameter at breast height bigger than 25 cm are counted. The result has a form of a median and the range defining limit values of the measurements obtained after comparing them with the rest of the data from all studied squares.

HIBERNATION ROOSTS

Detailed requirements for winter counts of the barbastelle can be found in the chapter "Methodology of bat monitoring in hibernation roosts", as they are the same for other bat species.

Below, there are several guidelines concerning winter barbastelle monitoring activities specific for the species.

Indices for population status should be determined

An index that is monitored is the abundance of barbastelles in hibernation sites, which is determined by comparing it with the results of the previous control, and, if the researcher has the data from the last 10 years, then the calculated average abundance of this period relates to the maximum abundance determined in the object. Data concerning the greatest abundances of the barbastelles at the site should be determined on the basis of information available in literature or in the SDF form of the given Natura 2000 site in which the hibernation site is located. Description of the research on the index can be found in the next chapter.

Determining indices of the habitat status

Initially a study on six indices was assumed (Tab. 1). Evaluation of the indices of the habitat status requires reference of the current status to the status of the year monitoring commenced, so values from the reference year are not evaluated. Situations, when winter counts of the barbastelle had been conducted earlier in the given roost, in accordance with the methodology generally accepted in Poland, by the same persons, are the exception here. Then the researchers have the data from previous years and evaluation of the status of the given hibernation site is possible as early as in the first year of it being included into the national monitoring of this species.

In the year the given site is included into the barbastelle monitoring, status of the habitat should be documented, which aims at recording changes at the site. A detailed sketch of the hibernation site should be drawn, with all the parts and elements which are crucial for the species marked. On the sketch the entrances accessible for the bats and spots where temperature was measured should also be marked. It is also necessary to document entrances and protections on the object. A sketch of the surroundings of the roost should be drafted and all wild-life corridors and forests within the radius of 1 km from the sites should be marked. During each control it should be noted if the counts of hibernating bats included the whole object or its fragment. It is also advisable to note the number of bats hibernating in underground sites for each fragment of the hibernation site separately so that, when the part of the object is collapsed, researchers would know how important it was.

Description of the research on the indices: Surface area of the hibernation site, Protecting the bats against disturbances, Availability of entrances to bats and Air temperature can be found in the chapter "Methodology of bat monitoring in hibernation roosts".

Share of forested areas in the surroundings of the roost. This index relates to large-area changes in the degree of afforestation of the closest surrounding of the object (within the radius of up to 1 km from the site) that may occur as a result of deforestation, road investments or development of spatial infrastructure. Forested area within the radius of 1 km from the hibernation site should be measured on the basis of orthophotomaps and compared with the area of the reference year.

Ecological connection of the roost with potential summer biotopes. This index determines changes in the number of continuous (distances not longer than 10 m) linear elements of the environment (alleys, rows of bushes, hedges, etc., and rivers) in the surroundings of the hibernation site, ensuring safe flight to the closest forests. It also relates to the number of linear elements connecting the forest surrounding the hibernation site with other forest fragments. Number of linear elements of the landscape within the radius of 1 km from the hibernation site should be determined on the basis of orthophotomaps and their presence in place should be confirmed (distance between

the trees forming alleys, retention of natural river banks among others) and compared with the area of the reference year.

Time and frequency of the studies

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Monitoring of summer sites used during the period of breeding should be performed at least once in 2-3 years, between 10.07 and 30.07, exceptionally up to 15.08., in the case of weather breakdown, for example. In this period bats will be caught when the young bats are able to fly and are independent. Therefore, females will not be disturbed in the period of raising their young and the opportunity to confirm bat reproduction in the area (catching a lactating female or a juvenile) at that time is greater. Later time increases the risk of catching migrating bats.

Each study area should be controlled 1-3 times in good weather conditions (without any rainfalls and wind, on warm nights).

Indices of the habitat status should be determined with the frequency of about 6 years, as the status of a forest habitat does not change quickly. It is also advisable to include into monitoring the known roosts of maternity colonies, identify mating location and study migration routes to feeding grounds, locations of feeding grounds from roosts of maternity colonies and determine habitats used by the species as feeding grounds.

HIBERNATION ROOSTS

Hibernation sites monitoring should be performed every year. At least one control is required. Experience gained from monitoring activities show great dynamics of abundance of the species in the controlled objects. Only regular controls of hibernation sites during the deepest hibernation of barbastelles, that is between 15.01 and 15.02, will enable proper evaluation of abundance of the species. It is advisable to perform an additional control in the period between 15.12 and 30.12, as the abundance of barbastelles in hibernation sites depends largely on the conditions outside. Barbastelles quickly react to an increase in temperature during winter and in such a situation they leave their hibernation sites. If the object is controlled only once in the season

and the control is during a thaw, then the registered abundance will be low. Thus, it is required that during the barbastelle winter counts the counting activities were performed at time when at least 5 days before the control the day temperature (both during the day and at night) stays below 0°C.

Equipment and materials used in the studies

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- at least 2 torches, including one headlamp;
- a camera, macro and wide-angle lens, tripod, flash;
- night vision goggles;
- 3-5 mist nets, poles and strings to attach them;
- pesola scales (10 g) and a calliper;
- ultrasound detectors with internal memory card or connected to recorders (with batteries);
- GPS receivers;
- exact topographic map (1 : 10 000 recommended);

- aerial photos of the area;
- tree calliper (calliper);
- 90-m-long string to allot study squares (plots) within the selected area;
- notebook, writing implements.

HIBERNATION ROOSTS

The list of equipment and materials can be found in the chapter “Methodology of bat monitoring in hibernation roosts”.

4. Sample species observation sheet for the site

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Species observation sheet for a monitored location	
Code and name of the species	Code of the species as in the Habitats Directive, Polish and Latin names, author, as in the current terminology 1308 barbastelle <i>Barbastella barbastellus</i> (Schreber, 1774)
Site name	Name of the monitored location Czeszowska Plain
Site type	Write: research/reference Research
Protected areas where the site is located	(Natura 2000, nature reserves, national and landscape parks, sites of ecological interest, documentation positions, etc.) Unprotected area
Geographic coordinates	Give geographic coordinates (GPS) of the central point of the site N XX°XX'XX.X"; E XX°XX'XX.X"
Elevation a.s.l.	Give elevation a.s.l. of location of the site: range from... to... 120-228 m. a.s.l.
Description of the site	Description is supposed to help identify the site. Location and features of terrain should be described. Give area of the site. Forests of the Oleśnica State Forest District located in Czeszowska Plain, among the towns of Ludgierzowice, Białe Błoto, Złotów, Czeszów, Pęciszów and Zawonia. Study surface area is 56.94 km ² .
Profile of the habitat of the species at the site	Give range of the potential habitat (whole forest complex or only its part, how big); describe conditions in the habitat: species structure of the stand (dominating tree species, share of deciduous historic stand), presence of rivers and water bodies, land-use pattern; describe direct surroundings of the studies site (e.g. connections with other forest complexes, proximity of roads and other factors that could be of significance for bats) The pine is the main species the forests are composed of. Deciduous forests, preferred by the species, cover the area of 1230.11 ha, including historic deciduous stands of 232.01 ha. The number of dying and dead trees was 0-3 trees/40m ² . Only small rivers flow through this area, some of them have their springs here. Water bodies are located in western and north-western part of the studied area. The forests in the whole area are managed. The study area has numerous connections with other forest areas: with forests covering the Trzebnickie Hills, those located in the valley of the Barycz River or the ones located as far as behind Twardogóra, among others.
Information on the species at the site	Synthetic data on the presence of the species at the site (presence of lactating females or juveniles, recording echolocation signals of barbastelles, presence of a maternity colony in the study area or in its surroundings) research completed until now and other relevant facts; results of evaluations of previous years, especially those relating to reproduction of barbastelles Reproduction of barbastelles was found in the area in 2003, when dispersion of barbastelles from the colony was observed (about dozen of bats). In 2011 three nights of catches were conducted (23.07, 25.07, 29.07) in the selected area, during which recording of echolocation signals of the bats was done (during first 4 hours after the sunset). One lactating female was caught, which is a confirmation of reproduction of this species in the area. The number of recorded signals was 4.2 flights/1 hour. However, on the assigned date of the study the weather got cooler. Unfavorable weather conditions (decrease in temperature, showers and wind) could influence the result by understating it.
Is monitoring in the following years required?	Write yes/no; in case of "no" justify why resignation from this site is suggested Yes, as presence of barbastelles has been recorded in the study area for the last few years. The area of study can be extended in the future, to the north, for example, where larger fragments of forests with beech prevailing are located, as this type of stand is preferred by the species.
Observer	Name/surname of monitoring contractor at the site Iwona Gottfried
Dates of observations	Dates or the date the control was conducted in the season that the report concerned 23.07.2011; 25.07.2011; 29.07.2011; 17.08.2011; 18.08.2011

Species protection status at the site				
Parameter/Indices		Index value and comment	Evaluation	
Population	Reproduction of the species	Complete with the number of caught lactating females (e.g. 2 f) or juveniles (e.g. 4 juv.) or the number of bats in the maternity colony 1f	FV	U1
	Activity of the species	Complete with the number of recorded signals /hour. 4.2 flights/hour	U1	
Habitat	Forested area	Complete with surface area in ha 7184.99 ha	XX	U1
	Surface area of deciduous forests	Complete with surface area in ha 1230.11 ha	XX	
	Surface area of historic stands	Complete with surface area in ha 1077.97 ha	XX	
	Surface area of deciduous historic stands	Complete with surface area in ha 232.01 ha. Current status was evaluated as Unsatisfactory.	XX	
	Number of dying and dead trees	Complete with the number of dying and dead trees with the diameter at breast height of >25 cm (median and min. - max. spread of 30 squares) 0 (0-3)	U2	
	Diameter of live trees that ensure potential day roosts	Complete with the diameter in cm (median and min. - max. spread of 30 squares) of all the trees with the diameter at breast height of >25 cm 43 cm (26-112 cm)	FV	
Conservation prospects		Brief forecast of population and habitat status of the species at the site in the next 10-15 years in the context of their current status and observed evolution, considering all actions and plans that may impact the species and its habitat Reproduction of barbastelles was found in the area in 2007. The studies in 2011 confirmed current presence of this species at the site. If the strategy of management of the area is continued, it seems that the population status will be maintained during the next 10-15 years, but because no data from previous years are available, it is hard to assess the species conservation prospects in the given area.	XX	
Overall assessment			U1	

A list of the most important current and predictable impacts (threats) on the species and its habitat in the studied environment (including current use, planned investments, planned changes in management and use); coding of impacts/threats as in Annex E to the Standard Data Form for Natura 2000 areas; effect of the impact: "+" - positive, "-" - negative, "0" - neutral; intensity of the impact: A - high, B - moderate, C - low.

If the proper code is lacking - only description in the table "Other information" in the field "Other remarks".

Current impacts				
Code	Name of activity	Intensity A/B/C	Impact +/0/-	Synthetic description
164	Logging	B	-	Logging that is the cause of loss of roosts and feeding grounds. Also stand rehabilitation through clearcut logging.
948	Fire (natural)	A	-	Threat for the existence of a forest.
166	Removal of dead and dying trees	B	-	Loss of roosts.
502	Roads, highways	B	-	Habitat fragmentation. Increase in mortality as a result of collision with vehicles.

Current impacts				
Threats (future, anticipated impacts)				
164	Logging	B	-	Logging that is the cause of loss of roosts and feeding grounds. Also stand rehabilitation through clearcut logging.
948	Fire (natural)	A	-	Threat for the existence of a forest.
166	Removal of dead and dying trees	B	-	Loss of roosts.
167	Exploitation of forest without restoration	B	-	Logging that is the cause of loss of roosts and feeding grounds.
419	Other industry and commercial areas	B	-	Location of wind farms 1 km away from the edge of the forest.
502	Roads, highways	B	-	Habitat fragmentation. Increase in mortality as a result of collision with vehicles.

Other information	
Other natural values	Other animal and plant species from the annexes of Habitats and Bird Directives, observed during monitoring operations: endangered and rare species (Redbook), protected species (cite abundance in scale: abundant, average, scarce). One should also cite here information on abundance of other species of bats using the habitat in the summer (if known). During catches also other species of bats were caught: Noctule bat <i>Nyctalus noctula</i> - 6 bats Serotine bat <i>Eptesicus serotinus</i> - 6 bats Natterer's bat <i>Myotis nattereri</i> - 1 bat Whiskered bat <i>Myotis mystacinus</i> - 1 bat
Alien and invasive species	Observed alien and invasive species Not observed.
Other remarks	Any information useful when interpreting the results; also remarks concerning methodology Coordinates of the places where the catches and detector listenings were performed: N 51°XX'XX" E 17° XX'XXX" N 51°XX'XX" E 17° XX'XXX" N 51oXX'XX" E 17o XX'XXX" 3-5 nets were positioned on forest trails, in the places where underbrush on both sides of the trail was dense. If it was possible, the net was positioned in places where branches of the trees growing on both sides of the trail connected. In this way the underbrush and the branches overhanging the trail formed a "tunnel". Positioning nets in places like that increases the chances of catching bats. Catches should be performed in the best weather conditions possible (warm nights, without any rainfalls and wind). Catches should be performed in the period between 15.07-15.08 (up to 30.07 at best) and the nets should be checked every 10-15 minutes. During the catches detector listening activities should be performed. A detector should be positioned at the height of 1.5 m above the ground. Listening activities should be performed during the first 4 hours after the sunset.
Photographic and cartographic documentation	Annexes to database (electronic version): At least 3 photos per site (species, microhabitat and macrohabitat), site boundaries marked on a proper cartographic base.

HIBERNATION ROOSTS

An observation sheet for the barbastelle hibernation sites is, in general, the same as observation sheets for hibernation sites of other species of bats hibernating in underground roosts. A template of such a sheet can be found in the chapter "Methodology of bat monitoring in hibernation roosts". Apart from the standard sheet with the results of the monitoring of the species at the site, it is recommended to complete an additional, simplified data record sheet for the data collected in the area of hibernation sites that contains collective data for all the bats found during monitoring activities in the given environment (a template can be found in the chapter "Methodology of bat monitoring in hibernation roosts").

5. Species with similar ecological requirements for which the designed methodology can be adapted

MONITORING OF SUMMER ROOSTS

Monitoring of the barbastelle summer roosts is conducted only for this species. Some elements (e.g. methodology of catches, evaluation of some characteristics of the forest environment) may be applied to other bats, which in Poland start their maternity colonies mainly in tree hollows and feed in forests. It concerns mainly the following species:

- mouse-eared bat *Myotis bechsteinii*,
- Natterer's bat *Myotis nattereri*
- brown long-eared bat *Plecotus auritus*.

MONITORING OF HIBERNATION SITES

As a part of winter monitoring of the bats species using underground objects as hibernacula, the same methodology as the presented below for the barbastelle is applied. In the undergrounds used by the barbastelle for hibernation sites, 13 other bats species can be found: the lesser horseshoe bat *Rhinolophus hipposideros*, greater mouse-eared bat *Myotis myotis*, Bechstein's bat *Myotis bechsteinii*, Natterer's bat *Myotis nattereri*, Geoffroy's bat *Myotis emarginatus*, whiskered bat *Myotis mystacinus*, Brandt's bat *Myotis brandtii*, pond bat *Myotis dasycneme*, Daubenton's bat *Myotis daubentonii*, northern bat *Eptesicus nilssonii*, serotine bat *Eptesicus serotinus*, brown long-eared bat *Plecotus auritus*, grey long-eared bat *Plecotus austriacus*. For their hibernation sites, barbastelles select objects with good air circulation, cool with low humidity, where the temperature in winter oscillates around 0°C: between -1°C and 6°C (Rydell, Bogdanowicz 1997). Such conditions are too harsh for many bat species, especially of the horseshoe bat *Rhinolophus* and the mouse-eared bat genera *Myotis*. That is why in big objects that are hibernation sites for the barbastelle, only individual bats of other genera can hibernate. Thus when planning winter bat monitoring activities and selecting the sites, one should carefully analyze situation of each genus separately.

6. Protection of the species

The barbastelle is a species which is vulnerable. It is one of the least common bats in Western Europe. In most of the countries it has a threatened species status. In Holland it got extinct in the late 1990's and in Denmark and Belgium it is on the verge of extinction. In Germany and France it is relatively rare. In Norway it was observed over 50 years ago, and now it is considered to be an extinct species. In the last decades a decrease in the barbastelle's abundance in hibernation sites in Western Europe was observed. In Central Europe (Poland, the Czech Republic, Slovakia) it is more common than in the West and its population seems to be stable (Rydell et al. 1996, Rydell and Bogdanowicz 1997, Russo et al. 2004, Sachanowicz and Ciechanowski 2005). In Poland, despite being relatively common, the barbastelle was entered in the Red List of the Threatened Species in Poland in the category of species with unrecognized status (DD category; Głowaciński 2002).

Although the barbastelle is one of the most common bats in hibernation sites in the whole lowland part of Poland, little is known about biology of this species outside the winter season. The knowledge of the barbastelle in the period following the hibernation period, i.e. of its migrations, summer roosts and mating, is based only on a few studies. The lack of knowledge on life

requirements causes difficulties in undertaking successful protective measures aiming at conservation of the species.

The barbastelle is considered by some authors to be a sedentary species, i.e. its winter roosts are most often located up to a dozen kilometers from its summer roosts (Roer 1995, Steffens et al. 2004), and by others by the species that may migrate (Gaisler et al. 2003, Rydell, Bogdanowicz 1997). So, assuming that the barbastelle is a medium-distance migrant, it seems that determining the species population status in the biogeographical continental region on the basis of abundance status in the selected hibernation sites is justified and indicative (the same bats that use the area in winter season probably feed and mate in it). On the basis of the research conducted within the national barbastelle monitoring scheme in 2011, it is estimated that the Polish barbastelle population is as large as 6000-7000 bats.

Unsatisfactory status of the barbastelle habitat, determined during the monitoring activities in 2011, may lead to a decrease in the species status over the next few years. It may be prevented by application of protective measures. In the nearest future it is necessary to:

- secure the largest barbastelle hibernation sites and minimize pressure on the species, which is the result of increased uncontrolled visiting of underground sites during the bat hibernation period;
- monitor microclimate conditions in underground sites;
- educate and, if possible, make the underground sites available for visiting only in summer season;
- adopt measures aimed at changing forest management activities, so that a greater number of dying and dead trees is left in forests, and, where possible, also to change composition of stands that would lead to increase in the share of deciduous stands, especially deciduous historic stands with plenty of oak and beech, which are preferred by the species;
- carry out tree felling in the period between 15.10-30.03;
- in forests, where the number of dying and dead trees with the diameter at breast height of more than 25 cm which offer roosts is insufficient for the species, some boards, protected at the top, may be attached to trees at the height of about 5-7 m. They imitate crevices (2-4 cm), cracks and flaking bark, which are the roosts preferred by the species;
- try to limit or stop the use of chemical insect control in forests;
- prevent fragmentation of woodlands and isolation of population; especially alleys and woodlots should be protected, as they constitute bat migration routes;
- prevent construction of wind farms within the radius of 3 km from big hibernation sites of the species or of maternity colonies sites.

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