BAT SURVEY IN THE SLOVENSKY RAJ NATIONAL PARK (SLOVAKIA)

Photo: Peter Kanuch

Final report

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Barbastella barbastellus

Picture: Katarina Janeckova

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Summary

Slovensky Raj National Park is a karst area with high number of caves and underground spaces, as well as suitable buildings in surroundings, thus being very important habitat for bats. The aim of the project was to assess species composition, abundance and distribution of bats in the Slovensky Raj using different survey methods, to identify current and potential threats, and to provide conservation recommendations.

Within the project, 104 buildings were checked for summer occurrence of bats. Eight bat species were found (total of 1390 individuals). The most important discoveries were three large maternal colonies (300-550 ex.) of the greater mouse-eared bat (*Myotis myotis*) found in churches, and several small maternal colonies of the lesser horseshoe bat (*Rhinolophus hipposideros*) and the brown long-eared bat (*Plecotus auritus*). The survey was accompanied by providing information and establishing of contacts with owners and users of buildings to prevent threats. Summer mistnetting was positive at seven sites, with ten species trapped. Although numbers of trapped individuals were low, results were very interesting and beneficial by high species diversity. Using a non-invasive method, an ultrasound detectoring, 28 different sites were surveyed. A relatively high number of species (10) was recorded, even the species that are not easy to detect using other methods, and in some cases new species for surveyed sites. Autumn mistnetting was carried out at the entrance of two caves, and provided very interesting and useful data. During winter checking, 30 potential bat hibernating sites were visited. Twenty sites were positive and 462 individuals in 11 species were recorded. The most important hibernating sites found in Slovensky Raj is Medvedia Cave, with 180 individuals in six species. Hibernating sites were assessed for threats, and small adjustments at existing enclosures, and providing one cave (Certova diera) with an enclosure were proposed. Together, a total of 18 bat species were discovered in Slovensky Raj, the most abundant being the greater mouse-eared bat (*Myotis myotis*) and the lesser horseshoe bat (*Rhinolophus hipposideros*).

Important part of the project was work with the public, and cooperation with local NGOs, authorities and students. The aim was to increase public awareness and create a positive unprejudiced attitude of people towards the bats and their protection. Through the project, training of local people in bat research and monitoring techniques was provided. Many valuable contacts were established for future collaboration and help in solving problems with bats, especially with owners and users of buildings inhabited by bat colonies. Within the project, leaflets on bats of Slovensky Raj were produced and distributed. The most successful activity to increase public awareness for bat conservation was the European Bat Night. This event was attended by more than 150 people, and had a very positive and keen response, also from the Mayor of a nearby village. Further activities included lectures for students at local schools and presentation for public in district town Kosice. The team prepared also several articles for different newspapers and magazines, and a short interview for local television TV Reduta.

The project was supported by the BP Conservation Programme, the Administration of Slovensky Raj National Park and the local non-government organization Slovak Conservation Association SZOPK Slovensky Raj.

1. Introduction

Bats (Chiroptera) are one of the most endangered mammal species. They are endangered by destroying of their habitats (cutting down of old forest stands, dehumidification of wetlands used as foraging habitats, enclosures of lofts in buildings, etc.). Other threats include contamination of food chain (from pesticides) and disturbing their roosts (in caves, lofts in buildings, etc.). Bats are original and characteristic part of Carpathian biocoenosis. At the area of Slovakia, there are 25 species of bats present.

Slovensky Raj National Park (Fig. 1) is situated in the north-eastern part of the Slovak Republic (Europe), in central part of the Western Carpathians. The area was declared as national park in 1988. Slovensky Raj (in translation "Slovak Paradise") is the area with high biodiversity and well-preserved natural habitats. It is inhabited by typical Carpathian fauna, including stable populations of large carnivores, such as the wolf, bear, lynx, otter, etc. It is a karst area with high number of caves and underground spaces. More than 90% of the park area is covered by woods. These factors, together with presence of suitable buildings in surroundings, make the area very important habitat for bats. The location of more than 350 caves is known from the area of the park, including the second largest cave in Slovakia, the Stratenska Cave, which is 21 km long.

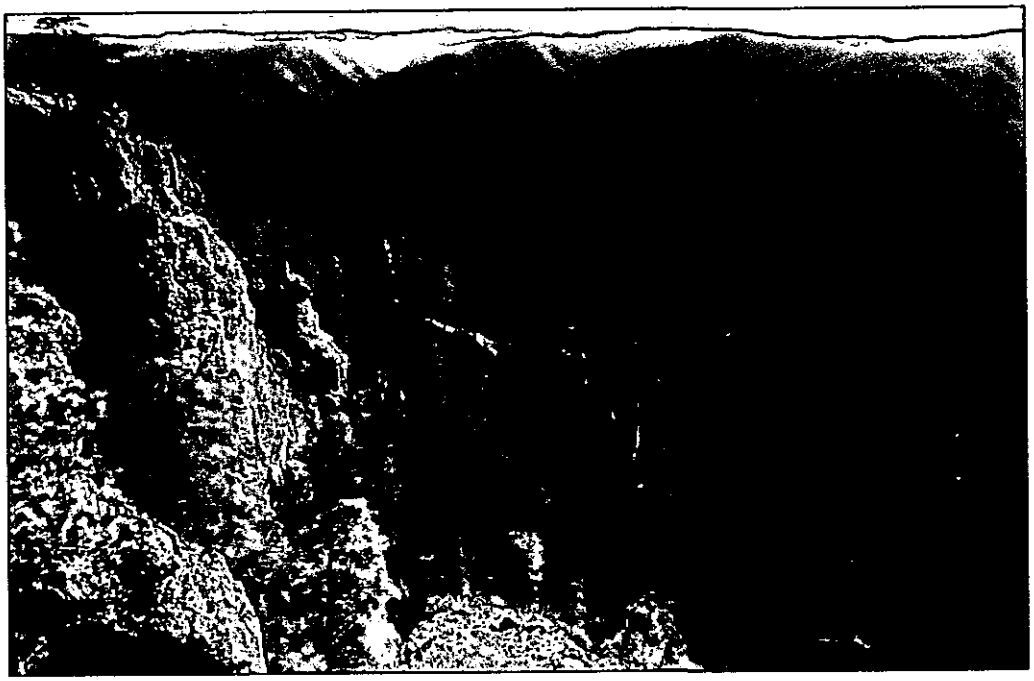


Photo: Peter Oleksak

Fig. 1. Slovensky Raj National Park

Although the area of Slovensky Raj provides many suitable habitats for bats, information on bat species composition and distribution was until recently quite scarce. In the past, the attention was paid to only one site, Dobsinska Ice Cave, which was recently (2000) recognized as UNESCO Natural Heritage Site. This cave is one of the most important localities of the whiskered bat (*Myotis mystacinus*) and Brandt's bat (*Myotis brandtii*) in the Central and Eastern Europe. The bats of this cave were studied by GAISLER & HANAK (1970,

1972, 1973), GAISLER (1975), HORACEK (1976), ZUKAL & GAISLER (1989) and UHRIN (1998). Except the Dobsinska Ice Cave, small bat survey was done in Stratenska Cave (UHRIN 1998). Only in last three years, from the initiative of the park administration and with help of several researchers and students, the bat survey started to be slightly more intensive. Preliminary survey started in the winter 2000/2001 (checking of several caves), and continued in the years 2001 and 2002 by the checking of other caves and several buildings, as well as by first mistnettings and ultrasound detector surveys (HAJKOVA 2000, 2001, HAJEK at al. 2002). This survey discovered the presence of 15 bat species at the area of Slovensky Raj National Park: the barbastelle (*Barbastellus barbastellus*), Bechstein's bat (*Myotis bechsteinii*), the pond bat (*Myotis dasycneme*), Geoffroy's bat (*Myotis emarginatus*), the lesser horseshoe bat (*Rhinolophus hipposideros*), the greater mouse-eared bat (*Myotis myotis*), the greater horseshoe bat (*Rhinolophus ferrumequinum*), Daubenton's bat (*Myotis daubentonii*), Natterer's bat (*Myotis nattereri*), the whiskered bat (*Myotis mystacinus*), Brandt's bat (*Myotis brandtii*), the northern bat (*Eptesicus nilssoni*), the serotine bat (*Eptesicus serotinus*), the brown long-eared bat (*Plecotus auritus*), and the grey long-eared bat (*Plecotus austriacus*).

These initial surveys indicated that the greater mouse-eared bat (*Myotis myotis*) and the lesser horseshoe bat (*Rhinolophus hipposideros*) seem to be the most abundant bat species in the park. Both species are listed in the IUCN Red List of Threatened Animals (1996); *Myotis myotis* (LR/nt) and *Rhinolophus hipposideros* (VU A2c). Other five species present at the area of the national park are considered as threatened according the IUCN Red List of Threatened Animals (1996): *Barbastella barbastellus* (VU A2c), *Myotis bechsteinii* (VU A2c), *Myotis dasycneme* (VU A2c), *Myotis emarginatus* (VU A2c), and *Rhinolophus ferrumequinum* (LR/nt).

All team members actively cooperated already on this initial survey (2000-2002). However, before starting of the present project, more than 85% of caves were still non-investigated for occurrence of bats, and very little data were known about forest bat species, and about summer colonies in the buildings, which are potentially endangered by reconstructions and negative attitudes of owners.

2. Aims and Objectives

Aims:

To increase the knowledge of bat species composition, abundance and distribution in the Slovensky Raj National Park and to raise conservation and public awareness of these threatened species.

Objectives:

1. To survey species composition, abundance and distribution of bats in different seasons by different methods, during 1 year, in Slovensky Raj National Park.
1. To assess current and potential threats to bat populations.
2. To propose steps for protection of the bats and their habitats (e.g. cave enclosures and bat-friendly building reconstructions).

3. To increase public awareness and support for bat conservation through cooperation with local NGOs, authorities and schools.
4. To provide training to local people in bat research and monitoring techniques.

3. Methods

Field work included use of several techniques:

a) Summer checking of building roofs
b) Summer mistnetting
c) Ultrasound detectoring
d) Autumn mistnetting at the entrance of caves
e) Winter checking of hibernating sites

a) Survey of buildings was based on species identification and visual census of specimens in their day-shelters. It included survey for maternal roosts (females + juveniles), male colonies and single individuals in lofts and roofs of buildings, especially churches, and checking of different types of potential shelters (e.g. window-shutters; Fig. 2, Fig. 3).

Photo: Bedrich Hajek

Fig. 2. Checking of window-shutter of recreation cottage in Palcmanska Masa, 8th July 2003

Photo: Katarina Janeckova

Fig. 3. Checking of barn loft, Majer, 16th July 2003

Species were determined based on experience and with the aid of keys (FERIANCOVA-MASAROVA & HANAK 1965, SLADEK & MOSANSKY 1985, MACDONALD & BARRETT 1993). This survey was carried out from 7th to 23rd July 2003 and on 20th August 2003.

Together, 104 buildings were checked, from that 80 recreation cottages (checking of window-shutters), 19 ramshackles or partially inhabited buildings (checking of dark undisturbed places) and 5 churches (checking of lofts and towers). Survey of buildings was accompanied by establishing of contacts with owners and users of buildings and gaining information about the present status and potential threats for bats.

b) Summer mistnetting was done using 6–8 m long four-bagged mistnets at eight sites near water (small ponds, lake, river and streams; Fig. 4). It was accompanied by ultrasound detectoring. Trapped specimens were handled as less as possible to minimize stress. The species and sex were determined, and bats were released. No specimen was taken for collection. This survey was done on 8-14th July and 9-10th August 2003.

Photo: Andrea Hajkova

Fig. 4. Mistnetting at Havrania Dolina, 8th July 2003

c) Ultrasound detectoring surveys (Fig. 5) were performed at 28 different localities (25 sites and 3 transects). They included 14 water habitats, 7 borders of meadows, 3 field roads, 2 sites in forest stands of different age and structure and 2 sites around street lights. The method is based on identification of species either by direct listening of echolocation calls of bats converted by the detector in heterodyne mode, with the aid of visual observation (AHLEN 1980, 1981, 1990), or using following computer spectrographic analysing of the bat calls recorded from the ultrasound bat detector in time extension mode (JONES et al. 2000; SCHNITZLER & KALKO 2001, VAUGHAN et al. 1997; JONES & PARIS 1993). In this way also an identification of cryptic species *Pipistrellus pygmaeus*, which was recently discovered as a new species for Slovakia, is possible. Echolocation calls of bats were recorded and converted by the Pettersson ultrasound detector D 240. Recordings were analysed using Bat

Sound and Gram software programmes. Ultrasound detectoring was done on 7-23th July 2003 and accompanied also all mistnetting surveys.

Photo: Bedrich Hajek

Fig. 5. Ultrasound detectoring at Klauzy, 16th July 2003

d) Autumn mistnetting (Fig. 6) at cave entrances was done at two localities that were expected to be important mating and hibernation sites, Medvedia Cave (26th September 2003) and Stratenska Cave (19th October 2003). The method is based on trapping bats entering and leaving the cave that is used at mating place and usually is accompanied also by ultrasound detectoring. This part of field work was done also with the aim of training (survey techniques, species determination, etc.) of several young local people, students of natural sciences.

Photo: Marek Zajko

Fig. 6. Mistnetting at Stratenska Cave, 19th October 2003

e) Before winter checking of caves, a reconnaissance survey of some caves was conducted between August and October 2003. It was done with help of local speleologists. The aim was to obtain detailed information on their location (using GPS), because in winter, there is often very high snow cover and orientation is hard. Winter checking of hibernating sites consisted in visual census of hibernating bats in caves, abysses and old mines (Fig. 7). Between December 2003 and February 2004, 30 potential bat hibernating sites were visited. Using halogen torches and headlights, and in some cases climbing and speleological equipment, all underground spaces at these sites were thoroughly checked for hibernating bats. During most of cave surveys we were guided by local speleologists. Winter survey was extended to checking of several caves and old mines also in wider surroundings of Slovensky Raj National Park. During the survey we were also gaining information on actual and potential threats to hibernating roosts and sites.

Photo: Bedrich Hajek

Fig. 7. Winter checking of Medvedia Cave, 26th February 2004

4. Results

Pre-project activities

First phase of the project included meetings of the team, establishing contacts, preparation of detailed plans, and purchase of the equipment. We contacted all local organisations involved to the project, especially the Administration of Slovensky Raj National Park and NGO Slovak Conservation Association SZOPK Slovensky Raj, as well as other organisations, such as Group for Protection of Bats in the Slovak Republic (SON) and Slovak Speleological Society, Speleological Club Slovensky Raj. At the first meetings, areas and sites for survey were defined and detailed itinerary of fieldwork, including organisation

of transport and accommodation, was prepared. Next step was acquiring and preparation of equipment. In the project proposal, it was planned to buy a heterodyne/time expansion ultrasound detector for non-invasive identification of bat species, without need to catch them and without any disturbing. The Pettersson ULTRASOUND DETECTOR D 240 (Pettersson Elektronik AB) was bought from the company Jüdes-Ultraschall, Germany. This type of the detector has two ultrasound conversion systems, heterodyne and time expansion (10x), of both possible to hear and record transformed bat calls in the same time. Acquired recordings of time expanded signals are well suited for many forms of advanced signal analysis with sound analysis software package. Some other equipment was bought, such as portable mini-disc recorder for bat detector, halogen torches, headlights, helmets, battery charger, and notebook for data recording and ultrasound analysis directly in the field. The notebook was widely used also for data processing and subsequent analyses, preparing presentations, lectures and leaflets, as well as for writing reports and articles.

One of the team members, Andrea Hajkova, participated on BP CP Training Course and Awards Ceremony. The participation on the training course was very useful and important both for her and the team. It was a great opportunity to learn new skills and wide the knowledge, establish contacts and obtain huge support for our work. She brought to the team a lot of interesting information, materials, experience and enthusiasm.

Field work

a) Summer checking of building roofs

During summer checking, a total of 104 buildings were checked. From all these buildings, 24 were positive for bat occurrence and 80 negative. Eight bat species were found (in total 1390 individuals); for detailed results see table 1. We discovered three large maternal colonies (300-550 ex.) of the greater mouse-eared bat (*Myotis myotis*) in churches of Spisske Bystre, Hranovnica (Fig. 8) and Dobsina. We also discovered maternal colonies of the lesser horseshoe bat (*Rhinolophus hipposideros*), counting 6 ex. in church of Hnilec, 9 ex. in cellar of cottage and 18 ex. in old store, both in the recreation centre Kosariska. Maternal colony of the brown long-eared bat (*Plecotus auritus*), counting 8 females with juveniles, was discovered in the building of local Administration of State Forests at Kosiarny briezok. Very interesting finding was occurrence of male colony of the parti-coloured bat (*Vespertilio murinus*) – 16 ex. behind the window-shutter of recreation cottage at Klastorisko, and the presence of the greater horseshoe bat (*Rhinolophus ferrumequinum*) in church tower in Dobsina. Both records are the first summer records of these species at the area of Slovensky Raj National Park. Further, three small caves were checked, and one of them was positive, with 1 ex. of the lesser horseshoe bat (*Rhinolophus hipposideros*). Survey of buildings was accompanied by establishing of contacts with owners and users of buildings and gaining information about the present status and potential threats for bats. We distributed leaflets and provided information on bats, their life, importance and conservation. At the time of survey, no colony was endangered by reconstructions or other human activities, but the colonies should be regularly monitored.

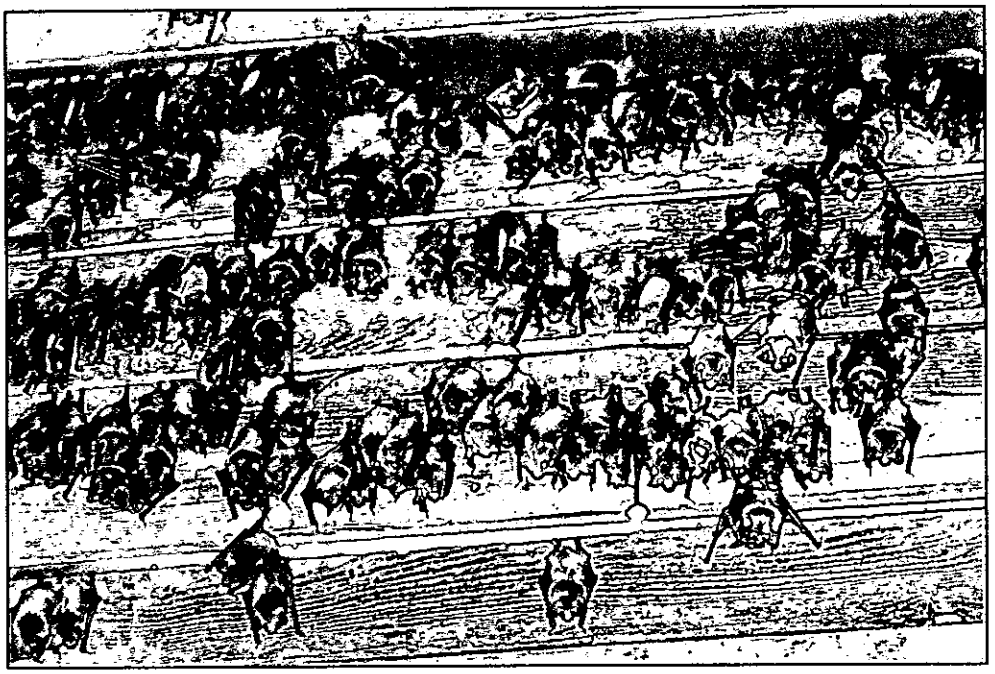


Photo: Peter Kanuch

Fig. 8. Summer colony of the greater mouse-eared bat (*Myotis myotis*), Hranovnica church, 17th July 2003

b) Summer mistnetting

Summer mistnetting was done using 6–8 m long nets at eight sites near water (small ponds, lake, river and streams). Mistnetting was positive at seven sites, with ten species caught, though their numbers were low (for detailed results see table 2). These misnettings were very interesting and beneficial by high species diversity. One site was monitored repeatedly, in two different dates, and different species were trapped, what may indicate diverse species distribution in time and/or in use of habitat under different conditions.

Photo: Petra Hajkova

Fig. 9. The whiskered bat (*Myotis mystacinus*), trapped at Velka biela voda, 9th august 2003

The significance of this method consisted also in confirmation of species discovered by ultrasound detectoring. The most important findings was trapping of the pond bat (*Myotis dasycneme*), Daubenton's bat (*Myotis daubentoni*), and especially of a rarely recorded natterer's bat (*Myotis nattereri*) that are very difficult to find in summer shelters.

c) Ultrasound detectoring

Non-invasive and probably the most beneficial method was ultrasound detectoring. Bat species were identified either by direct listening of echolocation calls of bats converted by the detector in heterodyne mode, or using following computer spectrographic analysing of the bat calls recorded from the ultrasound bat detector in time extension mode (Fig. 10, 11). This survey technique was used at 28 different localities. A total of 10 species were discovered (for detailed results see table 3). Using this method, relatively high number of species was recorded, even the species that are not easy to detect using other methods, and in some cases new species for surveyed localites were discovered. The site Dedinky – Palcmanska Masa Dam was surveyed twice. Repeated occurrence of the pond bat (*Myotis dasycneme*) was recorded, with one another species, the noctule (*Nyctalus noctula*), recorded during the second survey only. Interesting outcome was detecting of the parti-coloured bat (*Vespertilio murinus*) at Havrania dolina and Klauzy fishponds. This species was not trapped, but can be unambiguously determined through ultrasound detectoring. The method is very beneficial also owning to no need for handling bats, i.e. no stress and influence on their behaviour. Hovewer, it is an experience-demanding method. Ultrasound detectoring brings data not only on species presence, but also on its actual activity, e.g. flying, foraging, etc.

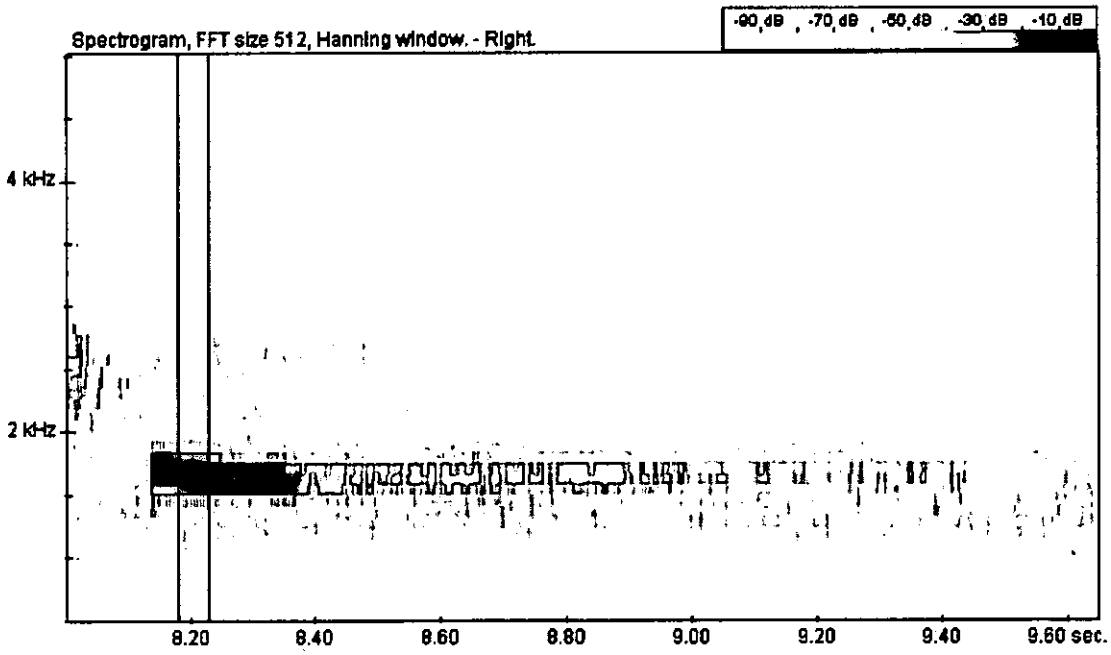


Fig. 10. Spectrogram – output of spectrographic analysis by Bat Sound software. Spectrogram presents 10-times slowed down record of the noctule (*Nyctalus noctula*) flying high above the lake at Hrabusicka Pila, 11th July 2003. Note that time data and frequencies are not real, i.e. 2 kH should be converted into 20 kH and 9 sec into 0.9 sec.

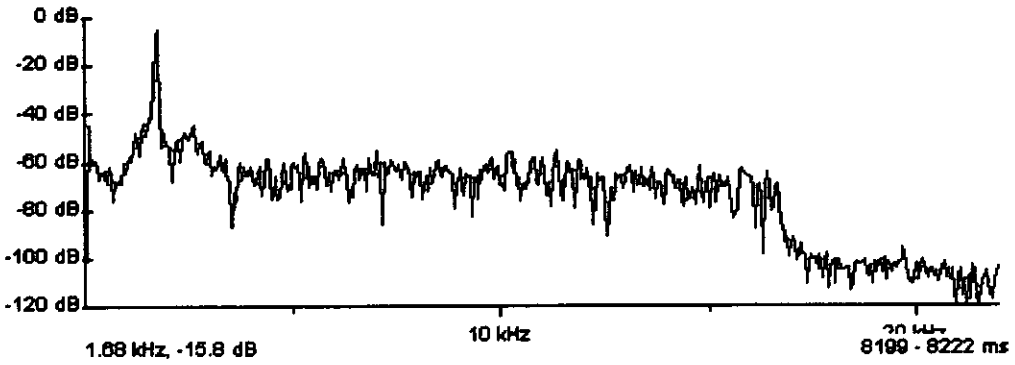


Fig. 11. The „power-spectrum analysis" of a profile marked by vertical lines in the above spectrogram, showing distribution of the power (energy). Frequency with the highest energy invested (expressed in decibels), is called peak frequency. Determination of peak frequency allows species identification. In this case, it is about 1.68 kH or 16.8 kH in the real time.

d) Autumn mistnetting at the entrance of caves

Autumn mistnetting at the entrance of caves was done at two sites. In front of Medvedia cave, four bat species were trapped (see table 4), and one more species (parti-coloured bat, *Vespertilio murinus*) was detected only by ultrasound detector. Two of species trapped, the barbastelle (*Barbastella barbastellus*) and the brown long-eared bat (*Plecotus auritus*) are very rare at this locality, therefore their identification by mistnetting was very important. In front of Stratenska Cave, six bat species (see table 4) were catched, and presence of one of them, Bechstein's bat (*Myotis bechsteinii*), was confirmed for the first time there.

Photo: Martin Celuch

Fig. 12. The lesser horseshoe bat (*Rhinolophus hipposideros*), trapped at the entrance to Stratenska Cave, 19th October 2003

e) Winter checking of hibernating sites

During winter checking, 30 potential bat hibernating sites were visited. From all surveyed sites, 20 were positive and 10 negative for occurence of bats. Together, 462 individuals in 11 species were recorded (for detailed results see table 5). The most important hibernating sites discovered during our survey were Medvedia Cave, Ladova Cave, Spodny paternoster, Pleky and Jaskyna kvapkajucej vody.

At the most important hibernating site, Medvedia Cave, 180 individuals in six species were discovered. It is an important hibernating site of the greater mouse-eared bat (*Myotis myotis*), the lesser horseshoe bat (*Rhinolophus hipposideros*) and Geoffroy's bat (*Myotis emarginatus*). A few individulas of greater horseshoe bat (*Rhinolophus ferrumequinum*) were also found at this site what is quite interesting as this species is generally more thermophilic, usually being found at southern sites. Two more species, the serotine bat (*Eptesicus serotinus*) and the barbastelle (*Barbastella barbastellus*) occured in colder entrance part of the cave.

Ladova Cave is located in the surroundings of Slovensky Raj, at location Drevenik. The most abundant species found was the greater mouse-eared bat (*Myotis myotis*), but also the whiskered bat (*Myotis mystacinus*), Brandt's bat (*Myotis brandtii*) and the barbastelle (*Barbastella barbastellus*) occured.

Spodny paternoster is an old abandoned mine with very suitable conditions for bat hibernation. The most abundant species were the lesser horseshoe bat (*Rhinolophus hipposideros*), the greater mouse-eared bat (*Myotis myotis*) and Geoffrey's bat (*Myotis emarginatus*).

Pleky is an abyss located at Drevenik. It was inhabited mostly by the lesser horseshoe bat (*Rhinolophus hipposideros*), but also the greater mouse-eared bat (*Myotis myotis*), the greater horseshoe bat (*Rhinolophus ferrumequinum*) and Geoffrey's bat (*Myotis emarginatus*) were found.

Jaskyna kvapkajucej vody was discovered only recently by one of the team members, Miroslav Lehocky. With regard to its relatively small dimensions, a relatively high number of bats was found there. The most abundant were the lesser horseshoe bat (*Rhinolophus hipposideros*) and the greater mouse-eared bat (*Myotis myotis*) – the most typical species for the area of Slovensky Raj. Next species included the brown long-eared bat (*Plecotus auritus*) and the barbastelle (*Barbastella barbastellus*). We suggest that this cave should be monitored regularly.

Next important sites are Certova Cave (cave of abyss character, with dominant species the lesser horseshoe bat, *Rhinolophus hipposideros*) and a relatively large cave complex Psie Diery. We suggest to devote special attention to Psie Diery site in the future.

All above mentioned caves – the most important bat hibernating sites in the Slovensky Raj – should be regularly monitored. Based on results of our survey, the most abundant bat species in Slovensky Raj are the greater mouse-eared bat (*Myotis myotis*; Fig. 13) and the lesser horseshoe bat (*Rhinolophus hipposideros*). Next relatively abundant species is Geoffrey's bat (*Myotis emarginatus*). Very important is the occurrence of rare highly endangered species, the greater horseshoe bat (*Rhinolophus ferrumequinum*; Fig. 14). During the survey we were also gaining information on actual and potential threats to hibernating roosts and sites, with the aim to propose practical conservation measures when necessary.

Photo: Katarina Janeckova

Fig. 13. Hibernating greater mouse-eared bat (*Myotis myotis*), Zlata diera Cave, 28th December 2003

Photo: Andrea Hajkova

Fig. 14. Hibernating greater horseshoe bat (*Rhinolophus ferrumequinum*), Medvedia Cave, 26th February 2004

Public awareness

During the field work the team was in close contact with many local people. This was a great opportunity for providing information on bats, as well as for discussions and establishing contacts. Especially at building checking, we always communicated a lot with their owners or users. We distributed leaflets of Group for Bat Protection in Slovakia, devoted to summer occurrence of bats in buildings, their protection and problems solving suggestions. Many local people showed great interest in our work, they followed us and even actively helped us (Fig. 15). The people were very interested in bats and information about their life, and especially appreciated the explanation of superstitions (e.g. that bats are not dangerous, do not entangle into hair, do not feed on blood, etc.).

Together with local people, also several people from four different conservation-related NGOs joined us (SZOPK Slovensky raj, SZOPK Bocian, Carpathian Foundation and SEO Bambi). During the fieldwork, members of these NGOs as well as several young local people (mostly university students) were familiarized and trained in basic techniques of bat research and monitoring.

Photo: Andrea Hajkova

Fig. 15. Local people participating at the mistnetting, Stratenska Pila, 9th July 2003

The most successful activity to increase public awareness for bat conservation was the European Bat Night event, held by the team on 20th August 2003 in Podlesok Tourist Centre. It is an international educational activity for the public presented every year in August – September in many European countries. However, it was held for the first time in Slovensky Raj. The event provided a great opportunity to acquaint people with bats, their protection and research. This interesting event started with slide lecture (Fig. 16) where all bat species living in Slovakia were introduced, including information on their life and research, followed by discussion on threats, their importance and conservation.

Photo: Frantisek Divok

Fig. 16. Lecture during the European Bat Night, 20th August 2003

Subsequently, an ultrasound detector was shown and people could listen to recorded and real-time bat sounds. At the end of the lecture, the team distributed leaflets with information on bats and their protection and took the group mistnetting (Fig. 17). Most people were seeing live bats for the first time in their lives and all were very excited and enthralled by these flying mammals. More than 150 locals and tourists participated in the event. Even the Mayor of a nearby village participated in the event and was very enthusiastic about the project and offered us co-operation and support for such activities in the future.

Photo: František Divok

Fig. 17. Practical demonstration of bat survey techniques, European Bat Night, 20th August 2003

Except this great activity, the team prepared another 5 lectures for students of local schools (Fig. 18) as well as presentation for public in district town Kosice. All these actions were met with interest of students and support of teachers and officials.

Within the project, the team produced the leaflet titled "Bats of Slovensky Raj National Park". It includes basic information on bat species of Slovensky Raj, the most important sites, threats and protection. It was produced both in Slovak and English language. The leaflet was distributed during the field survey and all educational activities.

Next way how to contribute to publicity of bat research and conservation was press release and presentations in media. The team prepared several articles for local and regional newspapers and magazines, both public and nature conservation related. Short information about our project was published also in European magazine PAN Parks Courier. Moreover, during field work we had a great opportunity to cooperate with local TV Reduta. We took them to nice places with bats and provided a short interview about bats, their life and conservation.

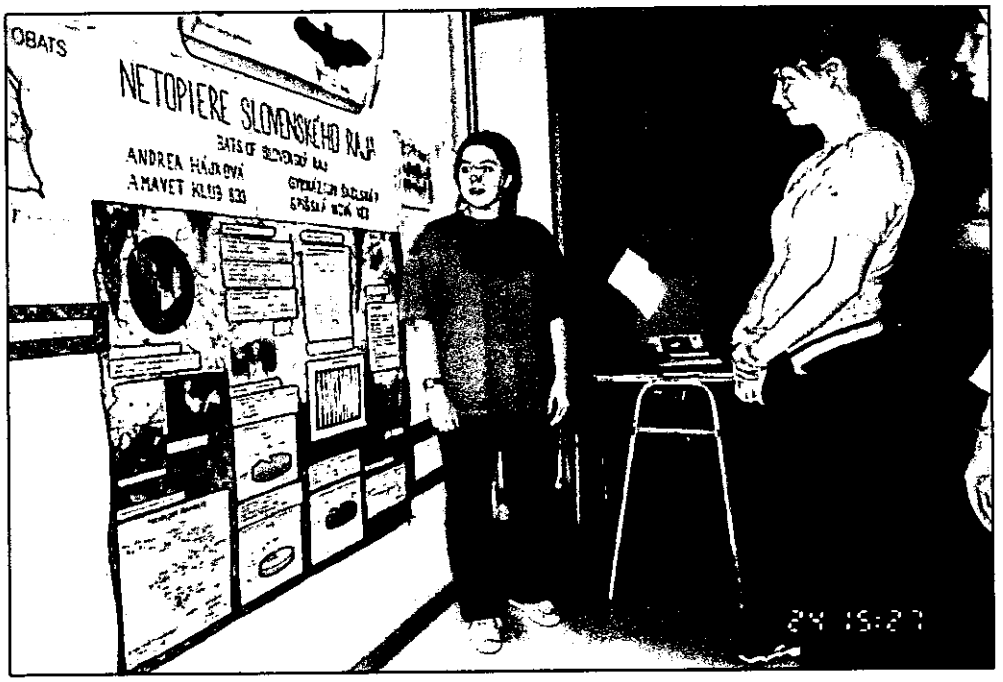


Photo: Petra Hajkova

Fig. 18. Lecture for students, 29th September 2003

5. Threats assessment and conservation recommendations

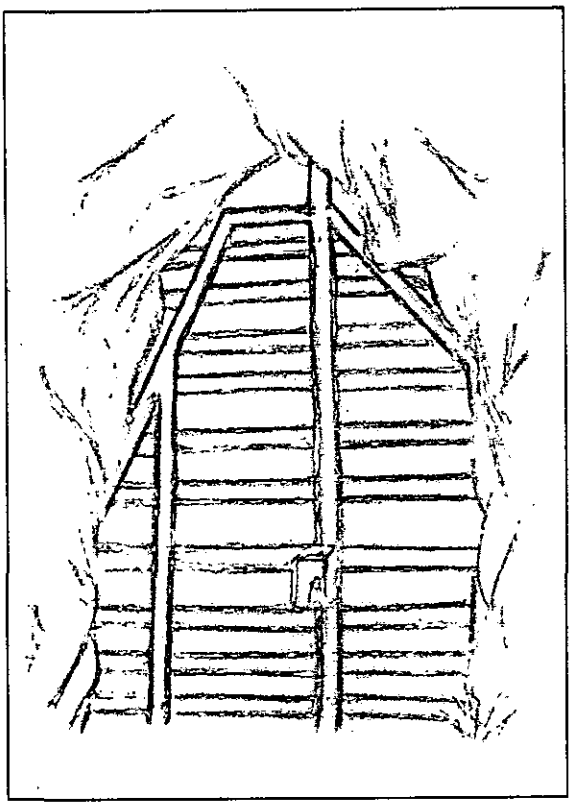
The most important cave habitats for bats in Slovensky Raj are Stratenska Cave and Medvedia Cave. Both these caves are inaccessible, secured by steel gates with fly-in holes. These gates provide effective protection against unauthorized access; however, it might be useful to enlarge the size of holes, to enable bats easier flight (Fig. 19). All caves that are used as hibernating sites should be not disturbed during the winter. Speleological survey as well as all work in underground should be shift to summer season when the caves are not inhabited by bats. We discussed these recommendations both with Slovak Speleological Society, Speleological Club Slovensky Raj and the Administration of Slovensky Raj National Park. From other caves, we strongly suggest to secure Certova Diera Cave. This cave is relatively easy accessible and known by tourists, hence often visited what leads to damages of the cave and disturbing the bats. The most suitable would be a grate gate that would not influence microclimate of the cave but enable bats and other animals an easy entrance (Fig. 20). The grates need to fulfil several requirements: (1) spacing of horizontal grates must suit wing span dimensions of different bat species; (2) construction must be robust and embedded into the rock to eliminate encroachment (STUTZ & HAFFNER 1997).

The most important summer sites for bats in Slovensky Raj and surroundings are churches in Hranovnica, Dobsina and Spisske Bystre, inhabited by large maternal colonies of the greater mouse-eared bat (*Myotis myotis*). These sites are not endangered by reconstructions at the presence, but it is necessary to preserve present state (access to the lofts and undisturbed life for bats). During the field work, we made very useful contacts with owners and users of the buildings for the case of future problems (i.e. with accumulation of guano), regarding planning reconstructions, etc. We were providing information on bats,

their significance and conservation, and distributed leaflets. Education and providing information was an important part of our project and included many different activities from lectures, articles, etc., to practical demonstration of field work.

Photo: Andrea Hajkova

Fig. 19. Gates at Psie Diery Cave



Picture: Andrea Hajkova

Fig. 20. Proposal for gates for Certova Diera Cave

Our recommendations regarding caves and buildings were submitted and discussed with relevant bodies and officials, both state and local authorities, NGOs and people. It included State Nature Conservancy, Administration of Slovensky Raj National Park, Slovak Speleological Society, Speleological Club Slovensky Raj, NGO Slovak Conservation Association SZOPK Slovensky Raj, NGO Group for Protection of Bats in the Slovak Republic, Local Councils, Mayors, owners of buildings with bat occurrence, etc.

6. Conclusions

The project increased significantly the knowledge on bat species composition, abundance and distribution at the area of Slovensky Raj. Further, it identified current and potential threats and provided conservation recommendations. At the area of national park and surroundings 18 bat species were discovered, and the most important bat sites were identified. Three new species for Slovensky Raj were discovered. The greater mouse-eared bat (*Myotis myotis*) and the lesser horseshoe bat (*Rhinolophus hipposideros*) were confirmed as the most abundant species. Outcomes of the project will be used by the park administration in preparation of management plans as well as for realisation of practical care and conservation of bats. Another importance of the proposed project consisted in providing basis (data on bat occurrence) for involvement of Slovensky Raj National Park into European ecological network NATURA 2000 (Special Areas of Conservation, Council Directive 92/43/EEC). The results of the project are provided also to the Ministry of the Environment of the Slovak Republic for preparation of Action Plan for Bats which is intended to start this year.

The outcomes of this project provide basis for future research that could be aimed to ecological requirements of the individual bat species, population dynamics, foraging and feeding ecology, behaviour, etc. We identified the most important sites that should be monitored. At the present, the most important is the conservation of sites used by bats as shelters, both during the winter (caves) and summer (buildings) season. However, though the most important bat sites have already been discovered, the area of Slovensky Raj still hides many sites that were not surveyed so far. Therefore, the continuation of the survey, as well as monitoring of the most important sites, is highly advisable.

In addition to survey activities, the project included also work with the public, e.g. cooperation with local NGOs, authorities and school students. Our educational activities had very positive response and support of teachers and officials. Through the project, the training was provided to local people (students and members of local NGO Slovak Conservation Association SZOPK Slovensky Raj) in bat research and monitoring techniques with the aim to encourage continuation of conservation activities after finishing the project. After finishing the field work, part of our equipment (torches, helmets, mistnet) was donated to above mentioned NGO. We are still in close contact with this NGO and we believe to support further bat survey and conservation activities at the area of Slovensky Raj. We established also many contacts for potential collaboration and help in solving problems with bats, especially with owners and users of buildings inhabited by bat colonies.

The project was strongly supported by the BP Conservation Programme, the Administration of Slovensky Raj National Park as well as by local NGO Slovak Conservation Association SZOPK Slovensky Raj.

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8. Budget

Pre-project expenses

Administration

- communication & consultations	188.52 £
(mailing and phone costs, internet, meetings, administration costs)	
- training & reconnaissance survey of new caves	271.92 £
(field costs, guidance by speleologists)	
- insurance	69.32 £
- development & production of leaflets	176.31 £

Equipment

- field equipment	2 035.52 £
(ultrasound detector 741.09 £, mini-disc recorder 174.51 £, notebook 961.16 £, halogen torches + headlights 64.04 £, battery charger 21.24 £, climbing equipment 48.62 £, miscelaneous (helmets, maps, etc.) 24.86 £	
- field rations	332.18 £

Field expenses

- personel costs (speleologist guides, travel allowance)	842.02 £
- fuel costs	296.31 £

Post-project expenses

- report production, photographs, administration	202.75 £
SUBTOTAL	**4 414.85 £**
Contingency (10%)	**441.49 £**
TOTAL	**4 856.34 £**

Notes:
Expenses incurred in SKK (Slovak Crowns) where 1 GBP (£) ≈57.7 SKK.
Original budget proposal was observed, only little changes occurred.
The budget includes all costs of the project, not only that covered by BP Conservation Programme Award. The difference (ca 145 £) was the contribution of NGO Slovak Conservation Association SZOPK Slovensky Raj that participated partially on field expenses and on production of leaflets.
Administration of Slovensky Raj National Park provided free accommodation and car for the field work.

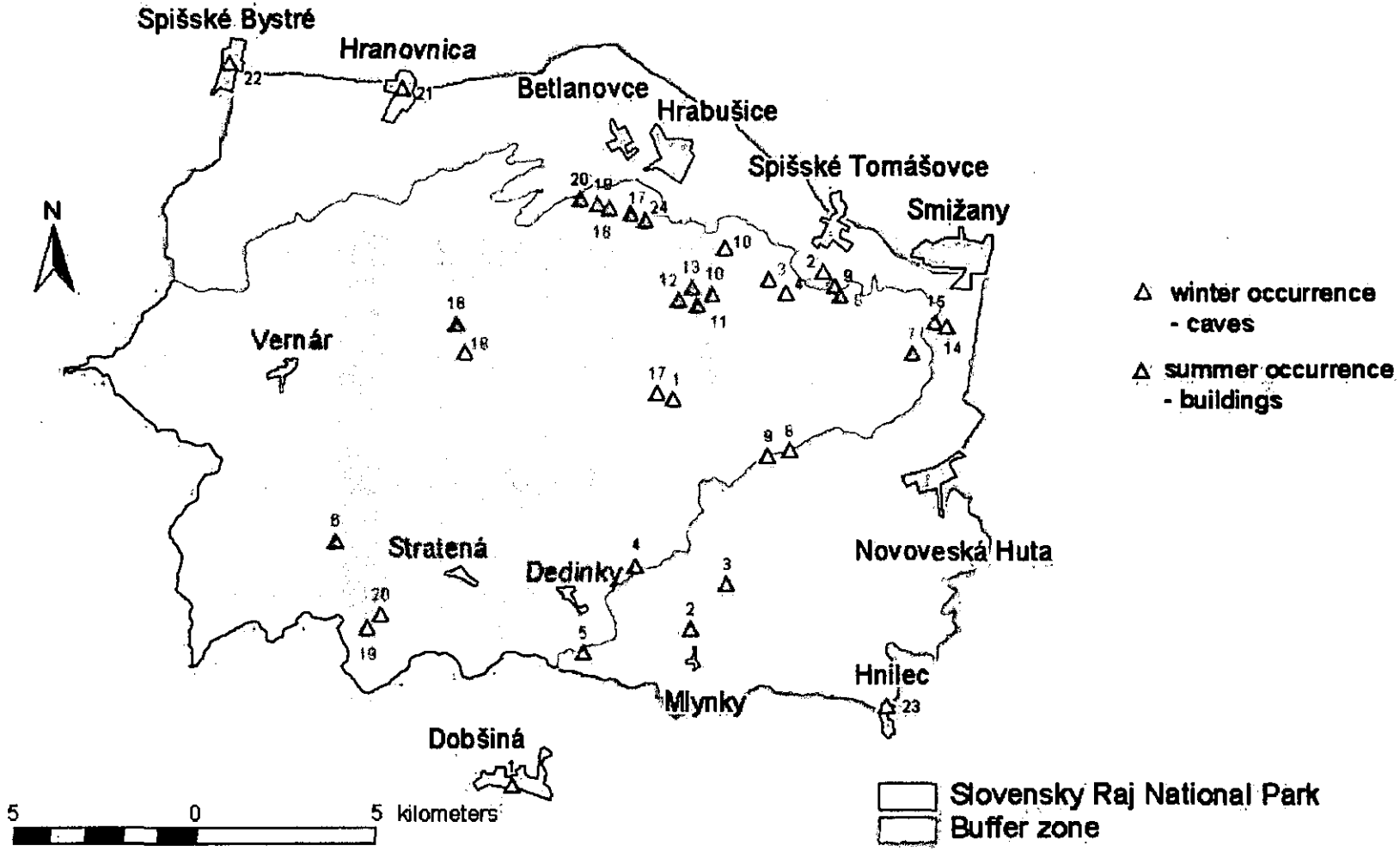

Fig. 21. Map of the Slovensky Raj National Park with positive sites of bat occurrence, marked by different colours according different seasons and used methods. Numbers match with the numbers of sites in the tables with results (Tab. 1, 5).

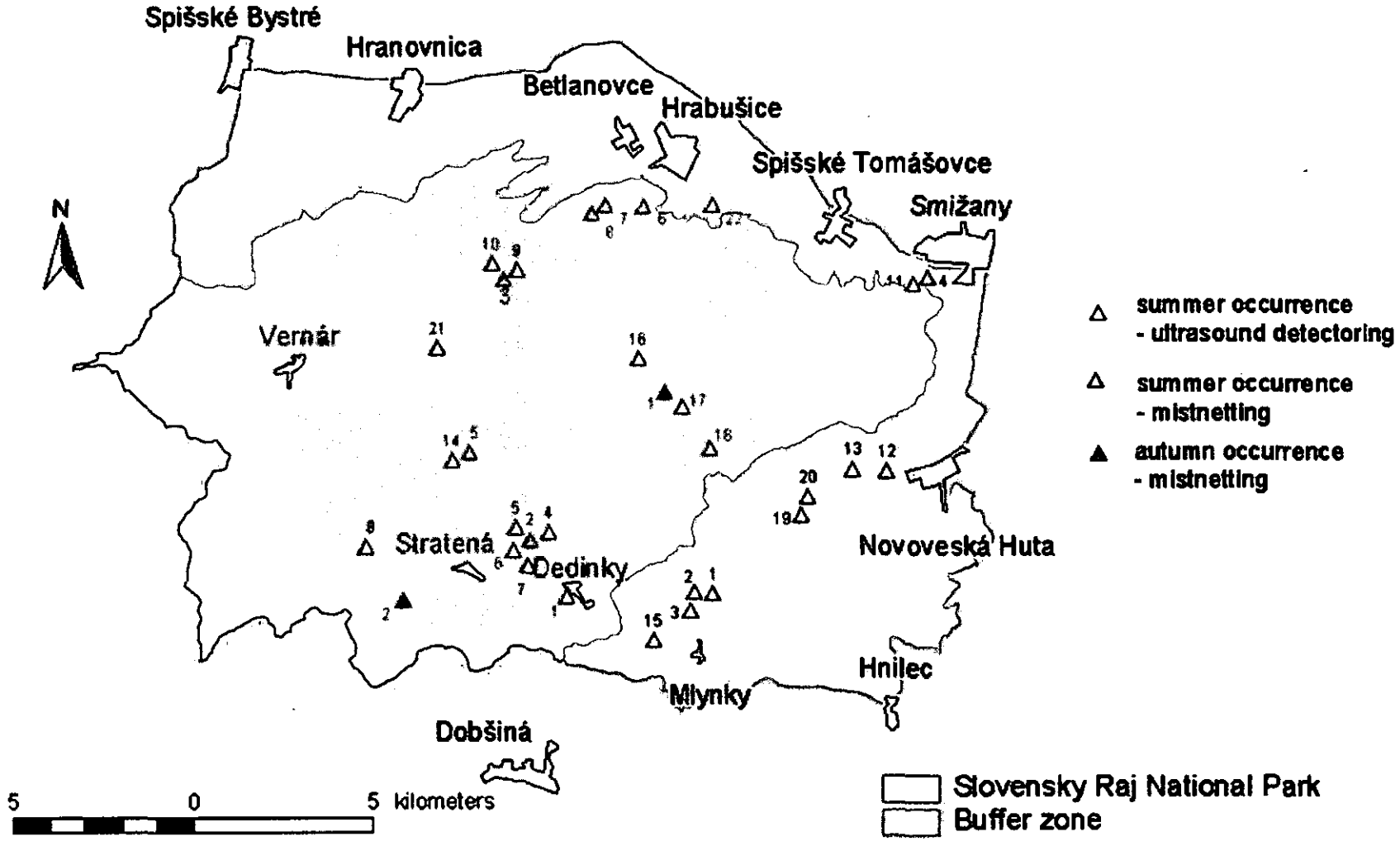

Fig. 22. Map of the Slovensky Raj National Park with positive sites of bat occurrence, marked by different colours according different seasons and used methods. Numbers match with numbers of sites in the tables with results (Tab. 2, 3, 4).

Review of obtained results

Tab. 1. Review of summer occurrence of bats – buildings checking

No.	Date/ 2003	Name of locality	Species * (# ex.)									Total
			Enil	Mbra	Mmyo	Mmys	Mmys/ bra	Paur	Rfer	Rhip	Vmur	8
1	7 July	Dobsina – Catholic Church			550				2	8		**560**
2.	8 July	Havrania Dolina – building								1		**1**
3.	8 July	Havrania Dolina – recreation cottage No. 3113									2	**2**
4.	8 July	Biele vody – gamekeeper's lodge No. 270								1		**1**
5.	8 July	Palcmanska Masa – recreation cottage No. 346									1	**1**
6.	10 July	Dobs. Lad. Jaskyna – State forests building		1								**1**
7.	11 July	Kosiarny briezok – State forests building						8				**8**
8.	11 July	Cingov – hutted camp, Hut No. 7				1						**1**
9.	11 July	Cingov – hutted camp, Hut No. 6	1									**1**
10.	12 July	Klastorisko – cottage No. 8					1				16	**17**
11.	12 July	Klastorisko – cottage No. 10				1						**1**
12.	12 July	Klastorisko – cottage No. 1									4	**4**
13.	12 July	Klastorisko – cottage No. 17									1	**1**
14.	13 July	Kosiarny briezok – hutted camp, Hut No. 584				2						**2**
15.	13 July	Kosiarny briezok – hutted camp, Hut No. 582				1						**1**
16.	15 July	Sokol – building No. 447								2		**2**
17.	16 July	Kosariska – cellar of recreation cottage								9		**9**
18.	16 July	Podlesok – Koliba, cottage No. 16 A									1	**1**
19.	16 July	Podlesok – Caravan site, cottage No. 6									1	**1**
20.	16 July	Majer – building across house No. 697								1		**1**
21.	17 July	Hranovnica – Catholic Church			450							**450**
22.	17 July	Spisske Bystre – Church			300							**300**
23.	23 July	Hnilec – Church								6		**6**
24.	20 August	Kosariska – store of recreation centre								18		**18**
	Total		**1**	**1**	**1300**	**5**	**1**	**8**	**2**	**46**	**26**	**1390**

*** Abbreviations of bat species names:**

Enil - Northern bat (*Eptesicus nilssoni*)
Mbra – Brandt's bat (*Myotis brandtii*)
Mmyo - Greater mouse-eared bat (*Myotis myotis*)
Mmys - Whiskered bat (*Myotis mystacinus*)
Mmys/bra - Whiskered/Brandt's bat (*Myotis mystacinus/brandtii*)
Paur - Brown long-eared bat (*Plecotus auritus*)
Rfer - Greater horseshoe bat (*Rhinolophus ferrumequinum*)
Rhip - Lesser horseshoe bat (*Rhinolophus hipposideros*)
Vmur - Parti-coloured bat (*Vespertilio murinus*)

Tab. 2. Review of summer occurrence of bats – mistnetting

No.	Date/ 2003	Name of locality	Species ** (# ex.)											Total
			Enil	Eser	Mbra	Mmys	Mmys/bra	Mdas	Mdau	Mnat	Mmyo	Rhip	Nnoc	10
1.	8 July	Havrania Dolina – fishpond	1					1			3			5
2.	9 July	Stratenska Pila – Piesky – fishpond												0
3.	11 July	Hrabusicka Pila – fishpond	5											5
4.	12 July	Smizanska Masa – Hornad River											1	1
5.	14 July	Lipovec - Ponds			1						3			4
6.	9 August	Velka biela voda - stream			1	1			4				1	7
7.	10 August	Sucha Bela Gorge		1		2	3							6
8.	20 August	Sucha Bela Gorge				2				1		1		4
	Total		**6**	**1**	**2**	**5**	**3**	**1**	**4**	**1**	**6**	**1**	**2**	**32**

**** Abbreviations of bat species names:**

Enil – Northern bat (*Eptesicus nilssoni*)
Eser - Serotine bat (*eptesicus serotinus)*
Mbra – Brandt's bat (*Myotis brandtii*)
Mmys - Whiskered bat (*Myotis mystacinus*)
Mmys/bra - Whiskered/Brandt's bat (*Myotis mystacinus/brandtii*)
Mdas – Pond bat (*Myotis dasycneme)*
Mdau – Daubenton's bat (*Myotis daubentoni)*
Mnat – Natterer's bat (*Myotis nattereri)*
Mmyo – Greater mouse-eared bat (*Myotis myotis*)
Rhip - Lesser horseshoe bat (*Rhinolophus hipposideros*)
Nnoc – Noctule (*Nyctalus noctula)*

Tab. 3. Review of summer occurrence of bats – ultrasound detectoring

No.	Date/ 2003	Name of locality	Species ***										Total
			Enil	Eser	Mdas	Mdau	Mmyo	Mmys/ bra	Mnat	Nnoc	Vmur	Msp.	Indet.	10
1.	7 July 9 July	Dedinky – Palcmanska Masa Dam Dedinky – Palcmanska Masa Dam			X X					 X				2
2.	8 July	Havrania Dolina – fishpond	X			X					X			3
3.	8 July	Havrania Dolina – street light	X											1
4.	9 July	Stratenska Pila – Piesky – fishpond						X						1
5.	9 July	Stratenska Pila – stream up of fishpond										X		1
6.	9 July	Stratenska Pila – stream down of fishpond										X		1
7.	9 July	Stratenska Pila – Palcmanska Masa Dam				X								1
8.	9 July	Dobsinska Ladova Jaskyna – Hnilec Stream	X											1
9.	11 July	Hrabusicka pila – fishpond	X							X		X		3
10.	11 July	Hrabusicka pila – street light	X											1
11.	12 July	Smizanska Masa – River Hornad				X				X				2
12.	13 July	Novoveska Huta – field road		X			X							2
13.	13 July	Novoveska Huta – fishpond				X								1
14.	14 July	Lipovec – ponds					X							1
15.	14 July	Mlynky – Prostredny Hamor – fishpond			X									1
16.	15 July	Meadow near Hamburgerky								X				1
17.	16 July	Klauzy – fishpond			X	X			X	X	X			5
18.	16 July	Turnik sedło – meadow											X	1
19.	16 July	Vojtechova osada – fishpond				X								1
20.	16 July	Vojtechova osada – meadow											X	1
21.	17 July	Blajzloch – fishpond				X							X	2
22.	23 July	Hrabusice's Peatbog								X				1
	Total		**5**	**1**	**3**	**7**	**2**	**1**	**1**	**6**	**2**	**3**	**3**	**34**

*** **Abbreviations of bat species names:**

Enil - Northern bat (*Eptesicus nilssoni*)
Eser - Serotine bat (*eptesicus serotinus)*
Mdas - Pond bat (*Myotis dasycneme)*
Mdau – Daubenton's bat (*Myotis daubentoni)*
Mmyo - Greater mouse-eared bat (*Myotis myotis*)
Mmys/bra - Whiskered/Brandt's bat (*Myotis mystacinus/brandtii*)
Mnat – Natterer's bat (*Myotis nattereri)*
Nnoc - Noctule (*Nyctalus noctula)*
Vmur - Parti-coloured bat (*Vespertilio murinus*)
Msp. – Genus determination – *Myotis* species
indet – indetermination – indet.

Tab. 4. Review of autumn mistnetting – entrance of caves

No.	Date/ 2003	Name of locality	Species **** (# ex.)								Total
			Mnat	Paur	Mmyo	Bbar	Rhip	Mdas	Mbech	Moxy	8
1.	26 September	Medvedia Cave	1	1	2	1					5
2.	19 October	Stratenska Cave		2	13		1	1	4	1	22
	Total		**1**	**3**	**15**	**1**	**1**	**1**	**4**	**1**	**27**

**** **Abbreviations of bat species names:**

Mnat – Natterer's bat (*Myotis nattereri)*
Paur - Brown long-eared bat (*Plecotus auritus*)
Mmyo - Greater mouse-eared bat (*Myotis myotis*)
Bbar - Barbastelle bat *(Barbastellus barbastellus*)
Rhip - Lesser horseshoe bat (*Rhinolophus hipposideros*)
Mdas - Pond bat (*Myotis dasycneme)*
Mbech – Bechstein's bat *(Myotis bechsteinii)*
Moxy – Lesser mouse-eared bat *(Myotis oxygnathus)*

Tab. 5. Review of winter occurrence of bats – checking of hibernating sites

No.	Date/ 2003-2004	Name of locality	Species ***** (# ex.)												Total
			Eser	Mema	Bbar	Mmyo	Mdau	Mbra	Mmys	Mmys/ bra	Paur	Paus	Rfer	Rhip	Msp.	11
1.	28 December	Zlata diera				7				2						9
2.	31 December	Tomasovska Cave												8		8
3.	31 December	Certova Cave		1										15		16
4.	31 December	Certova diera	2		1											3
5.	1 January	Vrchny Paternoster				1								8		9
6.	1 January	Spodny Paternoster		5		14		2			1			21		43
7.	1 Janary	Katarina		1		5								3		9
8.	2 January	Liscia priepast				5			1					1		7
9.	2 January	Pusta Cave				1								1		2
10.	2 January	Cave Lievik										1				1
11.	3 January	Pleky		1		8							6	27		42
12.	3 January	Meduzova Cave			1											1
13.	3 January	Esovita Cave			1									3		4
14.	3 January	Ladova Cave			3	61	1			4					2	71
15.	3 January	Velka priepast				3						1	3	3		10
16.	3 January	Pod hradom – Temna				12							2	2		16
17.	26 February	Medvedia Cave	1	25	1	109							4	40		180
18.	27 February	Jaskyna kvapk.vody			1	7					1			14		23
19.	28 February	Jaskyna nad kosiarom	2							1	1					4
20.	28 February	Psie diery				2				1					1	4
	Total		**5**	**33**	**8**	**235**	**1**	**2**	**1**	**8**	**3**	**2**	**15**	**146**	**3**	**462**

***** **Abbreviations of bat species names:**

Eser - Serotine bat (*eptesicus serotinus)*
Mema – Geoffroy's bat *(Myotis emarginatus)*
Bbar - Barbastelle bat *(Barbastellus barbastellus)*
Mmyo - Greater mouse-eared bat (*Myotis myotis*)
Mdau – Daubenton's bat (*Myotis daubentoni)*
Mbra – Brandt's bat (*Myotis brandtii*)
Mmys - Whiskered bat (*Myotis mystacinus*)
Mmys/Mbra - Whiskered/Brandt's bat (*Myotis mystacinus/brandtii*)
Paur - Brown long-eared bat (*Plecotus auritus*)
Paus - Grey long-eared bat *(Plecotus austriacus)*
Rfer - Greater horseshoe bat (*Rhinolophus ferrumequinum*)
Rhip - Lesser horseshoe bat (*Rhinolophus hipposideros*)
Msp. – Genus determination – *Myotis* species