

# First record of *Hypsugo savii* in Prague and summary of winter records of *Pipistrellus nathusii* from Prague and close surroundings (Czech Republic)

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**Abstract.** On 12 December 2013, a Savi's pipistrelle (*Hypsugo savii*) was found inside a building close to the centre of Prague. The bat was released in the Stromovka (Královská obora) city park after hibernation. This park is close to urban areas and the river and its old trees provide many roosting opportunities for bats. During the winter seasons (December, January, February) of 2008–2014, altogether 30 *Nathusius*' pipistrelles (*Pipistrellus nathusii*) were found hibernating in Prague and close surroundings. Besides single individuals, we found three hibernating groups: two of them were composed of five bats and were found in the Stromovka city park during tree cutting in 2012 and 2013. The third group, hibernating in a pile of wood, was composed of four bats and was found 6 km from the edge of Prague in Dobřichovice in 2014. This contribution also summarizes other records of *Nathusius*' pipistrelles found during winter period, which partly covers the migration period as well.

***Hypsugo savii*, *Pipistrellus nathusii*, winter records, Prague, hibernation**

## Introduction

During the last decades, northward expansion and changes in wintering and breeding areas have been reported in several European bat species. At the same time, a shift in roosting strategy has occurred at the northern margins of their distribution (Sachanowicz et al. 2006, Lundy et al. 2010).

The Savi's pipistrelle (*Hypsugo savii*) is a typical Mediterranean species. Near the northern margin of its range this species roosts synantropically, whereas in the south it prefers mainly rocky habitats (Spitzenberger 1997, Lehotská & Lehotský 2006, Danko 2007, Reiter et al. 2010a, b). New data on its distribution in European countries have been summarized by Uhrin et al. (2012). In the Czech Republic, the species occurs occasionally but regularly with increasing evidence in southern Moravia in different parts of the year (Gaisler 2001, Gaisler & Vlašín 2003, Bartonička & Kaňuch 2006, Reiter et al. 2010a).

Similar range expansion trends were recorded also in another Mediterranean species, the Kuhl's pipistrelle (*Pipistrellus kuhlii*), which also prefers to roost in the urbanized environment in Central Europe (Bogdanowicz 2004, Sachanowicz et al. 2006, Ceřuch & Ševčík 2006, Danko 2007, Horáček & Uhrin 2010). The first record of the species in the Czech Republic was made in Znojmo

in the summer 2007 (Reiter et al. 2007). The second occurrence was recorded in Brno during the breeding season of 2012 (Wawrocka et al. 2012), and during the late summer and autumn 2014, two individuals were found in Olomouc (J. Šafář & E. Tošenovský, pers. comm.).

Changes in the distribution range were observed also in a long-distance migratory species, *Nathusius' pipistrelle* (*Pipistrellus nathusii*). From its breeding areas which are situated mainly in the northeastern part of Europe, this bat migrates to southwestern or southern Europe during the late summer and autumn period (Hutterer et al. 2005). Within the last decades a shift of the breeding area to the south and west has been recorded (Russ et al. 1998, 2001, Martinoli et al. 2000), while hibernating individuals have been found further in the north (Sachanowicz & Ciechanowski 2006, Lundy et al. 2010). It seems that in suitable regions of Central and western Europe (Austria, Czech Republic, Germany, Netherlands, Switzerland, United Kingdom), this species forms resident populations which mix with migrants (Arnold et al. 1996, Russ et al. 2001, Hanák et al. 2009). Records of hibernating bats in Central Europe are restricted to single individuals found in urban habitats and occupying various types of crevice roosts, such as spaces between bricks, fissures in walling, tree cavities, piles of wood etc. (Spitzenberger 2001, Braun 2003, Vierhaus 2004). Within the Czech Republic, this species seems to be relatively abundant in suitable habitats but hibernating bats have been found only occasionally, yet with increasing frequency (Řehák & Foral 1992, Benda & Hotový 2004, Jahelková et al. 2008, Hanák et al. 2009).

Hibernating *Nathusius' pipistrelles* have been recorded in Prague regularly since 2008. In this report, we summarize winter records gathered from the beginning of 2008 till present and refer about the first record of the Savi's pipistrelle (*Hypsugo savii*) in Prague.

## Material and Methods

The data were gathered by members of the Czech Union of Nature Conservationists (ZO ČSOP) *Nyctalus* and staff of the Prague Rescue Center for Wild Living Animals (ZS LHMP). The bats were collected by workers of both organizations or with the help of the public (complete data) or were transported from the place of discovery by employees of the Prague animal first aid working under the ČSOP or by the police of the capital city of Prague (incomplete data). Some data are missing due to the fact that not all finding protocols were fully completed. Distances of bat locations to the nearest rivers or streams were measured in a straight line. In the case of inaccurate location (e.g. street name without a building number), the value was calculated as a mean of the longest and shortest distances from the respective street or borders of the park.

## Results

During the winter periods of 2008–2014 (15 October – 15 April), altogether 43 males and females of the *Nathusius' pipistrelle* (*Pipistrellus nathusii*) were found at 32 localities in Prague and Central Bohemia. Of them, 31 individuals (at 20 localities) were recorded in the hibernation period (December, January, February): 16 males, 7 females and 8 individuals with unknown sex. Individual bats were mostly found on the ground (five sites) or inside a building or on a balcony (five sites). Some bats were also recorded in their hibernation roosts such as tree cavities discovered during tree cutting (two hibernating groups composed of five individuals), a pile of wood (one hibernating group of four individuals), a fissure in the walling and a decoration in a theater repository. In one case, predation (by *Crocidura* sp.) of a torpid bat was directly observed in its roost. During the hibernation period on 12 December 2013 we rescued a male Savi's pipistrelle (*Hypsugo savii*) which flew inside a building (the outdoor air temperature was about 3 °C) in the city center close to the Vltava river. This is the first record of this species in Prague (Tables 1, 2).

The mean distance of the findings from the nearest stream (Vltava river, Berounka river, Labe river, smaller streams running through the city) was 458.2 m. During the hibernation period,

Table 1. Summary of the findings of *Pipistrellus nathusii* and *Hypsugo savii* during the hibernation period (December, January, February) in Prague during the years 2008–2014. ind. – individual of the sex undefined, \* data collected by the ZS LHMP rescue center, other data by ZO ČSOP Nyctalus

sex	date	street	district	place
<i>Pipistrellus nathusii</i> – Prague				
♂	20 Jan 2008	Stromovka, park	Praha 7	on the ground
♀+♂	19 Jan 2009	St. Thomas church	Praha 1	during construction
♀+♂	15 Dec 2009	Na Kleovce 3	Praha 2	–
ind.	4 Jan 2011	Stromovka, park	Praha 7	on the ground in a sport place
♀	18 Dec 2011	Křížíkova	Praha 8	–
2 ♀♀, 3 ♂♂	20 Jan 2012	Stromovka, park	Praha 7	fallen free
♀+♂	9 Feb 2012	Viničná 3	Praha 2	hibernating in an unsuitable roost
♂	23 Feb 2012	Jagellonská 8	Praha 3	on the ground
ind.*	12 Dec 2012	Bulovka 1	Praha 7	flew into the building
♂	17 Jan 2013	Na Ládví 22	Praha 8	flew to the balcony
♂	27 Jan 2013	Hostivítova 6	Praha 2	–
♂	31 Jan 2013	Pertoldova	Praha 4	on the ground
ind.*	3 Feb 2013	U Okrouhlíku 7	Praha 5	flew into the building
♂	9 Feb 2013	Křesomyslova 6	Praha 4	flew into the building
♂*	12 Feb 2013	Zborovská 16	Praha 5	–
5 ♂♀*	26 Feb 2013	Stromovka, park	Praha 7	fallen tree
♂	26 Jan 2014	Nosticova 4	Praha 1	on the ground
<i>Pipistrellus nathusii</i> – Central Bohemia				
♂	10 Jan 2011	Hředle 67	Zdice	hibernating in walling
♀+♂, 3 ♂♂	17 Jan 2014	Pražská 790	Dobřichovice	hibernating in a pile of wood
<i>Hypsugo savii</i> – Prague				
♂	12 Dec 2013	U železných lávků 10	Praha 1	flew into the building

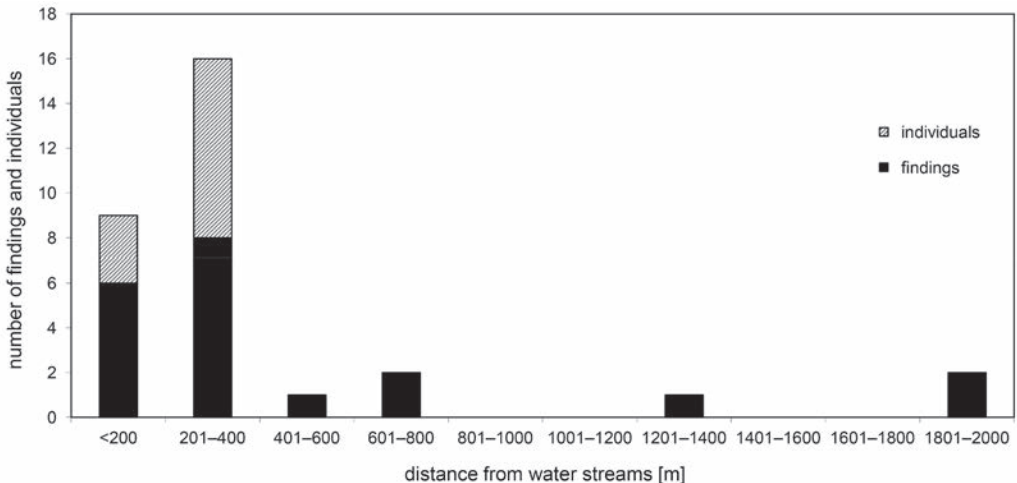


Fig. 1. Distance of the records of *Pipistrellus nathusii* from water streams in the hibernation period 2008–2014 (December, January, February). Individuals – number of all bats, finding – one location in which one or more bats were found.

Table 2. Summary of the findings of *Pipistrellus nathusii* during the winter period (15 November – 15 April) excluding true winter months (December, January, February) in Prague during the years 2008–2014. \* data collected by the ZS LHMP rescue center, other data by ZO ČSOP Nyctalus.

sex	date	street	district	place
Prague				
♂	10 Mar 2009	Sokolovská 136	Praha 8	flew into the building
♂	11 Mar 2009	Fričova 13	Praha 2	–
♂	12 Apr 2012	Padovská 585	Praha 15	unsuitable roost
♂	22 Oct 2012	U Továren 31	Praha 10	–
♂	30 Nov 2012	Na Kampě	Praha 1	in a drain
♂	26 Mar 2013	Hloubětínská 700	Praha 9	flew into the building
♂	12 Apr 2013	Nerudova	Praha 1	flew into the building
♂	13 Apr 2013	Lidického 8	Praha 10	on the ground
♂	4 Nov 2013	Nádraží Holešovice	Praha 7	unsuitable roost
♂	19 Nov 2013	Korunovační	Praha 7	on the ground
Central Bohemia				
♂	6 Mar 2008	–	Čelákovice	–
♂	19 Oct 2012	Ke Kapli 191	Zdiměřice	on the ground

the mean distance of the findings from the nearest stream was 521.3 m, ranging 20–1960 m. Altogether 70% of the findings (80.6% of the individuals) were made less than 400 m from the watercourse (Fig. 1).

## Discussion

Until recently, 18 species of bats have been reported from the capital city of Prague (Hanák et al. 2009, Neckářová 2010). With the finding of Savi's pipistrelle (*Hypsugo savii*) in the winter 2013, the number of species known from Prague increases to 19. Natural roosts of this Mediterranean species include cracks in the rocks or even vertical crevices in a limestone pavement close to the sea, but these bats also inhabit roosts in the synanthropic environment (Horáček & Benda 2004, Kipson et al. 2013). Modern built-up areas in cities offer many roosting opportunities including crevices in prefab houses, which over years started to be used as new traditional roosts by some species, e.g. the noctule bat (*Nyctalus noctula*) and parti-coloured bat (*Vespertilio murinus*) (Hanák et al. 2009). In the future, if the expansion of Savi's pipistrelle continues in the Czech Republic (Reiter et al. 2010a), we can possibly expect development of a similar roosting tradition in this species. Tendency to synanthropic life along the northern borders of its distribution range was described also in the Nathusius' pipistrelle (*Pipistrellus nathusii*). In Russia, Il'in et al. (2003) described that below 53° N, 69% of the roosts were found in buildings and 31% in trees, whereas above 53° N, most of the individuals occupied tree roosts. Increased evidence of hibernating Nathusius' pipistrelles, including one record of a colony discovered during tree felling, has been recently reported also from Moravia, in the towns of Olomouc and Znojmo (E. Tošenovský, T. Bartonička, pers.comm.).

In Prague, only one Nathusius' pipistrelle was found during the winter months of 2003–2008 (Jahelková et al. 2008). Since that the number has increased to 30 individuals (recorded at 19 localities) including three small hibernating groups. The Stromovka city park can be considered a “traditional” hibernation place. This park with old trees is situated near the Vltava river and two individuals and two small hibernating groups were discovered there during tree cutting in January

2012 and February 2013. Majority of the findings were situated close to a water stream and 45% near the Vltava river, which seems to be a very important corridor in the north-south direction for long-distance migrants such as Nathusius' pipistrelle (Vierhaus 2004, Hutterer et al. 2005).

Shifts in distribution range or expansion of wintering grounds in these species could be connected with changing climatic conditions together with the loss of natural habitats, roosts and successive synantropization (Sachanowicz et al. 2006, Lundy et al. 2010, Uhrin et al. 2012). The increased evidence of records in Prague may also be a result of a high number of both renovations of buildings subsidized by governmental or EU grants and recultivations of old parks. When tree cutting or building reconstructions are carried out in the middle of winter, bats lose their original roosts and thus look for new ones. The increased number of records in the last decades can also be due to public awareness activities of the ZO ČSOP Nyctalus and the Czech Bat Conservation Trust (ČESON).

Unfortunately a certain proportion of data probably gets lost due to insufficient training of the staff of animal rescue centers. Majority of them do not distinguish among small species and classify all such findings as the "common pipistrelle". However, these may include not only the common pipistrelle (*Pipistrellus pipistrellus*), but also the soprano pipistrelle (*Pipistrellus pygmaeus*), Nathusius' pipistrelle (*Pipistrellus nathusii*), Kuhl's pipistrelle (*Pipistrellus kuhlii*), as well as Savi's pipistrelle (*Hypsugo savii*), and even the Alcaethoe bat (*Myotis alcathoe*), Brandt's bat (*Myotis brandtii*), and whiskered bat (*Myotis mystacinus*). Hence it is possible that the number of hibernating Nathusius' pipistrelles, Savi's pipistrelles and Kuhl's pipistrelles in the Czech Republic is much higher than we have ever expected.

## Acknowledgements

The ZO ČSOP Nyctalus would like to thank all caring people who noticed a bat in need and called us or brought the bat directly to the rescue center, and of course all our members who take care of bats, especially Marta Paduchová, Petra Schnitzerová, Markéta Jandová, Zuzana Jůzlová, Vladimír Hybner, Petr Starý. We are grateful to all donors who supported us via our account "SOS – netopýr" (SOS – Bat) and the Aves rescue center in Brandýsek u Kladna for long-term cooperation and support. General activities of the ZO ČSOP Nyctalus would not have been possible without financial support from grants of the Municipality of the Capital City of Prague, Czech Union of Nature Conservationists, Ministry of Environment, Animal Protection Trust and individual donors. Activities of the ZS LHMP animal rescue center would not have been possible without cooperation and financial support of the Municipality of the Capital City of Prague, Czech Union of Nature Conservationists and other donors. We would also like to thank the police of the capital city of Prague and the Prague animal first-aid. Both organisations are very grateful to the veterinarian Dr Pavlína Hájková who has been taking care of the injured and exhausted bats for more than ten years.

## Literature

- ARNOLD A., SCHOLZ A., STORCH V. & BRAUN M., 1996: The Nathusius' bats in flood plain forests in Nordbaden (SW Germany). *Carolinea*, **54**: 149–158.
- BARTONIČKA T. & KAŇUCH P., 2006: Savi's pipistrelle (*Hypsugo savii*): bat species breeding in the Czech Republic (Chiroptera: Vespertilionidae). *Lynx, n.s.*, **31**: 19–21.
- BENDA P. & HOTOVÝ J., 2004: Nález zimujícího netopýra parkového (*Pipistrellus nathusii*) na jižní Moravě [Hibernation record of *Pipistrellus nathusii* in southern Moravia (Czech Republic)]. *Vespertilio*, **8**: 135–137 (in Czech, with an abstract in English).
- BOGDANOWICZ W., 2004: *Pipistrellus kuhlii* (Kuhl, 1817) – Weißrandfledermaus. Pp.: 875–908. In: KRAPP F. (ed.): *Handbuch der Säugetiere Europas. Band 4: Fledertiere. Part II: Chiroptera II. Vespertilionidae 2, Molossidae, Nycteridae*. Aula-Verlag, Wiebelsheim, 1186 pp.

- BRAUN M., 2003: Rauhhauffledermaus *Pipistrellus nathusii* (Keyserling & Blasius, 1839). Pp.: 569–578. In: BRAUN M. & DIETERLEN F. (eds.): *Die Säugetiere Baden-Württembergs. Band 1. Fledermäuse (Chiroptera)*. Stuttgart, Ulmer-Verlag, 687 pp.
- CEUCH M. & ŠEVČÍK M., 2006: First record of *Pipistrellus kuhlii* (Chiroptera) from Slovakia. *Biológia, Bratislava*, **61**: 637–638.
- DANKO Š., 2007: Reprodukcia *Hypsugo savii* a *Pipistrellus kuhlii* na východnom Slovensku: ďalšie dôkazy o ich šírení na sever [Reproduction of *Hypsugo savii* and *Pipistrellus kuhlii* in eastern Slovakia: further evidence of their spreading northwards]. *Vespertilio*, **11**: 13–24 (in Slovak, with an abstract in English).
- GAISLER J., 2001: A mammal species new to the Czech Republic – Savi's pipistrelle *Hypsugo savii*. *Folia Zoologica*, **50**: 231–233.
- GAISLER J. & VLAŠÍN M., 2003: Second record of the Savi's pipistrelle *Hypsugo savii* in the Czech Republic. *Vespertilio*, **7**: 181–182.
- HANÁK V., NECKÁŘOVÁ J., BENDA P., HANZAL V., ANDĚRA M., HORÁČEK I., JAHELKOVÁ H., ZIEGLEROVÁ A. & ZIEGLEROVÁ D., 2009: Fauna netopýřů Prahy: přehled nálezů a poznámky k urbánním populacím netopýřů [Bat fauna of Prague: review of records with notes on the urban populations]. *Natura Pragensis*, **19**: 3–89 (in Czech, with an abstract in English).
- HORÁČEK I. & BENDA P., 2004: *Hypsugo savii* (Bonaparte, 1837) – Alpenfledermaus. Pp.: 911–941. In: KRAPP F. (ed.): *Handbuch der Säugetiere Europas. Band 4: Fledertiere. Teil II: Chiroptera II. Vespertilionidae 2, Molossididae, Nycteridae*. Aula-Verlag, Wiebelsheim, 1186 pp.
- HORÁČEK I. & UHRIN M. (eds.), 2010: *A Tribute to Bats*. Lesnická práce s.r.o., Kostelec na Černými Lesy, 400 pp.
- HUTTERER R., IVANOVA T., MEYER-CORDS C. & RODRIGUES L., 2005: Bat migration in Europe. A review of banding data and literature. *Naturschutz und Biologische Vielfalt*, **28**: 1–162.
- IL'IN Y. V., SMIRNOV D. G. & YANYAEVA N. M., 2003: Effects of the anthropogenic factor on bats (Chiroptera: Vespertilionidae) in the Volga Region. *Russian Journal of Ecology*, **34**: 122–126.
- JAHELKOVÁ H., NECKÁŘOVÁ J., ZIEGLEROVÁ A. & ZIEGLEROVÁ D., 2008: Nové nálezy zimujících netopýřů rodu *Pipistrellus* sp. v Praze a okolí [New records of pipistrelles in Prague and its surroundings (Czech Republic)]. *Vespertilio*, **12**: 27–32 (in Czech, with an abstract in English).
- KIPSON M., ŠÁLEK M., LUČAN R., JAHELKOVÁ H. & HORÁČEK I., 2013: Bats living beneath our feet: roosting strategy of Savi's pipistrelle (*Hypsugo savii*). Pp.: 110–111. In: BRYJA J., ŘEHÁK Z. & ZUKAL J. (eds.): *Zoologické dny Brno 2013. Sborník abstraktů z konference 7.–8. února 2013. Ústav biologie obratlovců AV ČR, Brno*, 283 pp.
- LEHOTSKÁ B. & LEHOTSKÝ R., 2006: First record of *Hypsugo savii* (Chiroptera) in Slovakia. *Biologia, Bratislava*, **61**: 192.
- LUNDY M., MONTGOMERY I. & RUSS J., 2010: Climate change-linked range expansion of Nathusius' pipistrelle bat, *Pipistrellus nathusii* (Keyserling & Blasius, 1839). *Journal of Biogeography*, **37**: 2232–2242.
- MARTINOLI A., PREATONI D. G. & TOSI G., 2000: Does Nathusius' pipistrelle *Pipistrellus nathusii* (Keyserling & Blasius, 1839) breed in northern Italy? *Journal of Zoology, London*, **250**: 217–220.
- NECKÁŘOVÁ J., 2010: Nález netopýra brvitého (*Myotis emarginatus*) v Praze [Record of Geoffroy's bat (*Myotis emarginatus*) in Prague (Czech Republic)]. *Vespertilio*, **13–14**: 151–152.
- ŘEHÁK Z. & FORAL M., 1992: The first winter record of *Pipistrellus nathusii* (Chiroptera: Vespertilionidae) in Czechoslovakia. *Myotis*, **30**: 119–122.
- REITER A., BENDA P. & HOTOVÝ J., 2007: First record of the Kuhl's pipistrelle, *Pipistrellus kuhlii* (Kuhl, 1817), in the Czech Republic. *Lynx, n.s.*, **38**: 47–54.
- REITER A., BARTONIČKA T., LUČAN R. K. & ŘEHÁK Z., 2010a: New records of *Hypsugo savii* in the Czech Republic. *Vespertilio*, **13–14**: 121–125.
- REITER G., WEGLEITNER S., HÜTTMEIR U. & POLLHEIMER M., 2010b: Die Alpenfledermaus, *Hypsugo savii* (Bonaparte 1837), in Mitteleuropa. *Nyctalus (N.F.)*, **15**: 158–170.



- RUSS J. M., O'NEILL J. K. & MONTGOMERY W. I., 1998: Nathusius' pipistrelle bats (*Pipistrellus nathusii*, Keyserling et Blasius 1839) breeding in Ireland. *Journal of Zoology, London*, **245**: 345–349.
- RUSS J. M., HUTSON A. M., MONGOMERY W. I., RACEY P. A. & SPAEAKMAN J. R., 2001: The status of Nathusius' pipistrelle (*Pipistrellus nathusii* Keyserling & Blasius, 1839) in British Isles. *Journal of Zoology, London*, **254**: 91–100.
- SACHANOWICZ K. & CIECHANOWSKI M., 2006: First winter record of the migratory bat *Pipistrellus nathusii* (Keyserling and Blasius 1839) (Chiroptera: Vespertilionidae) in Poland: Yet more evidence of global warming? *Mammalia*, **70**: 168–169.
- SACHANOWICZ K., WOWER A. & BASHTA T. A., 2006: Further range extension of *Pipistrellus kuhlii* (Kuhl, 1817) in Central and Eastern Europe. *Acta Chiropterologica*, **8**: 543–548.
- SPITZENBERGER F., 1997: Distribution and range expansion of Savi's bat (*Hypsugo savii*) in Austria. *Zeitschrift für Säugetierkunde*, **62**: 179–181.
- SPITZENBERGER F., 2001: *Die Säugetierfauna Österreichs*. Bundesministeriums für Land- und Forstwirtschaft, Umwelt und Wasserwirtschaft, Graz, 890 pp.
- UHRIN M., MIKOVÁ E., RENDOS M., LEHOTSKÁ B., LEHOTSKÝ R., ESTÓK P., DANKO Š., BUCS S., JÉRE C., CSÖSZ I., BARTI L., SZODORAY-PARADI F. & POCORA I., 2012: Patterns of *Hypsugo savii* (Mammalia: Chiroptera: Vespertilionidae) range changes in the frame of the Pannonian basin and the Carpathians. P.: 91. In: FLAQUER C. & PUIG-MONTSERRAT X. (eds.): *Proceedings of the International Symposium on the Importance of Bats as Bioindicators. Programme, Abstracts and List of Participants*. Museum of Natural Sciences Edicions, Granollers, 95 pp.
- VIERHAUS H., 2004: *Pipistrellus nathusii* (Keyserling & Blasius, 1839) – Rauhhauffledermaus. Pp.: 825–873. In: KRAPP F. (ed.): *Handbuch der Säugetiere Europas. Band 4: Fledertiere. Teil II: Chiroptera II. Vespertilionidae 2, Molossidae, Nycteridae*. Aula-Verlag, Wiebelsheim, 1186 pp.
- WAWROCKA K., BARTONIČKA T. & REITER A., 2012: *Pipistrellus kuhlii*, a bat species breeding and hibernating in the Czech Republic. *Vespertilio*, **16**: 351–356.

received on 26 November 2014