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Levente Barti

FIRST RECORD OF *PIPISTRELLUS KUHLII* (CHIROPTERA: VESPERTILIONIDAE) FROM TRANSYLVANIA AND A MORPHOLOGICAL APPROACH TO THE *LEPIDUS* TAXON

I. Introduction

1. The international range of species complex:

Pipistrellus kuhlii (sensu lato, meaning the *Pipistrellus kuhlii – P. lepidus – P. maderensis – P. deserti group*) is a West-Palearctic and Afrotropical species-group. It apparently has a tropical origin, with a range that extends from North to South Africa along the eastern coast and from the Middle East and Caucasus to Uzbekistan, Turkestan, and Kashmir. In Europe, Kuhl's pipistrelle is distributed from the Atlantic coasts of Portugal and Spain throughout Southern Europe, including the Mediterranean and Atlantic Islands. Recently it has undergone a range expansion northwards in France, Switzerland, Southern Germany, Austria, Hungary, Western, Southern and Eastern Romania, the whole Ukraine and Southwestern Russia.[1] It has also been occasionally recorded in the United Kingdom.[2]

2. The range of the species complex in Romania:

In Romania, the first valid record of *Pipistrellus kuhlii* (sensu lato) belongs to Limpens,[3] who in the summer of 2000 reported the presence of the species in Cefa, near the Hungarian border, using an ultrasound detector. The former data are all faulty based on misidentification and perpetual wrong citations.[4] In January 2005, a hibernating male was discovered on a balcony of an apartment in Iaşi, Moldova Region,[5] this was the first "in hand" specimen from Romania.

In May 2006 a specimen was caught in the staircase of a flat in Constanta city, Dobrogea Region.[6] In July 2006, a nursery colony of 50 individuals was found in the same city, in a building near the coast of the Black Sea, inhabiting a space between two balconies, confirming the breeding of this species on the territory of Romania. 23 living individuals were released, seven dead individuals (2 adults, 5 juveniles) were collected.[7]

In 2007 Dragu identified the species in Bucharest, three juvenils were captured in a building, and several pictures were taken about some hunting individuals between the panel flats[8]. In July, the same year, Pocora (Ifrim) captured two individuals belonging to the both subspecies along the Prut river in the Lunca Inferioară a Prutului Nature Parc. In August 2007, in January and November 2008 five individuals were found in Iaşi,[9] in August 2009 another one in the same city visited the headquarter of the police.[10] In September 2009 a specimen entered in the building of the Parliament in Bucharest.[11] In December, the same year, two specimen were found in a house in Rădăuți town, this capture beeng the northern limit of the range of species in Romania, and the former altitude record from the country (about 360 m a.s.l.).[12] The map of Romanian findings, in order of their date of appearance is represented on the *Fig. 1.*

[1] SZATYOR Miklós et alii 2003; CEL'UCH, Martin – ŠEVČIK, Martin 2006; Sachanowicz, Konrad et alii 2006; IFRIM, Irina – VALENCIUC, Niculai 2006; DRAGU, Anca et alii 2007; DIETZ, Christian et alii 2009.

[2] BOGDANOWICZ, Wieslaw 2004.

[3] LIMPENS, Herman J. G. A. 2000.

[4] DADAY Jenő 1885, made a confusion identifying the species from six localities in Transylvania. Later MÉHELY Lajos 1900, made a revision in Daday's collections and all of those specimen where reconsidered and identified as *P. pipistrellus*. Unfortunately the following Romanian chiropterological literature didn't realize the change. Another doubtful detection data was reported by GHEORGHIU, Victor – MURARIU, Dumitru 2002, from the village of Cloşani in the Oltenia District.

[5] IFRIM, Irina – VALENCIUC, Niculai. 2006.

[6] Pictures examined from courtesy of SZÉKELY, Paul (det. BARTI, Levente).

[7] DRAGU, Anca et alii 2007.

[8] DRAGU, Anca pers.com.

[9] POCORA, Irina 2009.

[10] Data from news, det. POCORA, Irina: http://telem.telem.ro/telem/stiri/eveniment/19587.html.

[11] Data from news, det. POCORA, Irina: http://www.realitatea.net/video_972022_batman-de-romania--un-liliac-a-acaparat-atentia-deputatilor--dupa-ce-a-intrat-pe-holul-camerei--vezi-video_621147.html.

[12] POCORA, Irina pers. com.: 400 m a.s.l.

3. The preliminary results of the species splitting trials:

The taxonomical status of the *lepidus* form is still subject of controversy. The species was created by Blyth in 1845, the type locality is Kandahar in Afganistan.[13]

Pipistrellus lepidus is generally considered to be a subspecies of *P. kuhlii.*[14]

Other studies regarded the *Pipistrellus lepidus* as a synonym of the *P. kuhlii* Kuhl 1817.[15] Later the eastern form of the species was regarded again as a distinct subspecies.[16] Mayer et al (2007) found several genetical differences between the West-European and Middle-East populations (Israel, Syria, Iran) and recommended the restoration of the Blyth's taxon, introducing *Pipistrellus* cf. *lepidus* Blyth, 1845.[17] Dietz and Dietz on their homepage revealed that the northern and southern populations of the eastern *lepidus* form present fur color differences like in the case of the western *P. kuhlii*. They recorded the *lepidus* form in Ukraine.[18] Dietz, von Helversen and Nill (2009) declared the high probability that eastwards from Ukraine the animals are belonging to the *lepidus* form and represent a separate species.[19] Unfortunately nobody published a definite species description until this date,[20] as a consequence I prefere to use the subspecies level, as the last recognized status of the *lepidus* form, to class the Romanian records.

II. Materials and methods

On 27th of April 2010, at 3.00 PM a schoolboy observed a low-flying bat between the flats of Domb (Dealului) street, Sepsiszentgyörgy (Sfântu Gheorghe), about 540 m above sea level, N 45º51.487' E 025º46.628'. The bat finally met an obstacle and landed on a bush, where it was captured and kept overnight in a box.

The day after the specimen (an adult female) was examined, but it presented a low level of vitality. It didn't accept food, next morning its apathy was followed by death. The body was conserved in ethyl-alcohol and can be found in the author's personal collection. Tissue samples were taken for genetic analysis and two minuscule acarians were collected for identification from the wing membrane of the bat.

Observing the morphological characters of this individual a few differences were noticed between the habitus of the main subspecies known from the literature,[21] and the *lepidus* form, which seems to occure more frequently in the eastern and southern part of Romania.

[13] BLYTH, Edward 1845.

[14] DEBLASE, Anthony F. 1980: BOBRINSKII et alii in 1965 listed *P. k. lepidus* as the form from the Caucasus and central Asia. GAISLER in 1970 listed *P. k. lepidus* from Iraq, Iran, Afghanistan, and Pakistan. HARRISON in 1964 considered all specimens of this species from the Arabian Peninsula, including those from Iraq, to be *Pipistrellus kuhlii ikhwanius* Cheesman and Hinton, 1924. GAISLER et alii in 1972 considered North Africa specimens to be *Pipistrellus kuhlii marginatus* Cretzschmar, 1830. Both of these latter forms are also distinguished from *P. k. kuhlii* on the basis of lighter color. Comparisons of the three light forms, *lepidus*, *ikhwanius*, and *marginatus*, are absent from the literature.

[15] KOOPMAN, Karl F. 1994; HORÁČEK, IVAN et alii 2000.

[16] WILSON, Don E. – REEDER, DeeAnn M. (eds) 2005.

[17] MAYER, Frieder et alii 2007: "*Pipistrellus* cf. *lepidus* Blyth, 1845: Individuals of *Pipistrellus kuhlii* that were collected in Israel, Syria and Iran differ on average by 5.2% from western representatives of *Pipistrellus kuhlii*. According to the geographic origin and morphological characters the eastern animals are likely representatives of *Pipistrellus lepidus* Blyth, 1845. This taxon was regarded as a synonym of *P. kuhlii* in the past".

[18] DIETZ, Izabel – DIETZ, Christian 2008: "Die Weißrandfledermaus *Pipistrellus kuhlii* hat eine weite Verbreitung im gesamten Mittelmeerraum. Dabei unterscheiden sich Populationen der Wüstengebiete und feuchterer Lebensräume deutlich in ihrer Fellfärbung und Größe. Genetisch sind sich Tiere vom Nordrand der Verbreitung und aus der Sahara (*deserti*) allerdings sehr ähnlich. Deutliche und große genetische Unterschiede gibt es aber zwischen west- und ostmediterranen Formen. So hat sich gezeigt, dass die östlichen Tiere (Ukraine, Osttürkei, Israel) vermutlich eine eigene Art darstellen: *Pipistrellus lepidus*. Innerhalb dieser genetisch gut abgrenzbaren Gruppe gibt es allerdings wie bei *Pipistrellus kuhlii* eine deutliche Abstufung der Fell- und Hautfärbung mit der Niederschlagsmenge. Tiere aus der Negev-Wüste sind fahl gefärbt, Tiere aus dem Marongebirge an der Grenze zum Libanon wesentlich dunkler".

[19] DIETZ, Christian et alii 2009, p.302: "In the geographical scope of this book only the nominate form is usually recognised, with a high probability that eastwards from Ukraine animals belong to the form *lepidus* and form a separate species. In the southern and eastern Mediterranean area the present taxonomic classification of the *kuhlii* group is, however, very unsatisfactory; a comprehensive revision with genetical and morphological methods, and if possible including the ecolocation calls, is urgently required. Genetical investigations revealed that *P. kuhlii* in the North African desert area usually regarded as a separate species *P. deserti*, *P. maderensis* of the Atlantic islands, Kuhl's Pipistrelles of the Canary Islands, and African *P. hesperidus* classified by Simmons, are very similar. The genetic differences cannot be reconciled with the morphologically justified species classification. Conversely, the east Mediterranean and Pontic forms (cf. lepidus) show very strong genetic deviations from the actual kuhlii-deserti-maderensis-group. In the future, extensive changes to the species allocation and nomenclature within the kuhlii-group should be taken into account".

[20] 30. 06. 2010.

[21] DIETZ, Christian – VON HLEVERSEN, Otto – NILL, Dietmar, 2004.

Since 2005 several individuals of the species complex were photographed in different places of Romania.[22] A striking similar character can be identified on these photos, the shape and width of the white stripe from the margin of the wing membrane, which suggest the existence of a whole wide-spread population showing this character and is not only an isolated fenotypical variation.

III. Results and discussion

1. Morphological observations on the first Transylvanian specimen of* Pipistrellus kuhlii lepidus *compared with other similar individuals from Romania

The external characters of the Transylvanian specimen show a lot of similarities with the other individuals from Moldova, Dobrogea and Bucharest. The dorsal pelage consists of bicolored hair, which is dark-brown at the base with yellowish-brown tips. *(Fig. 2, 3.)* The color of the ventral side of the body is a little bit lighter *(Fig. 4, 7)*. The ears and the nose are light-brown. *(Fig. 5.)* The posterior margin of the ear presents a sharp indentation *(Fig. 6.)* and the length of the tragus is 6,5 mm. The length of the forearm is 36,1 mm and the length of fifth digit is 45 mm.

A well defined yellowish-white stripe is present along the margin of the dactylopatagium, plagiopatagium and uropatagium. *(Fig. 7, 4.)*

In the early version of the Illustrated identification key to the bats of Europe[23] Dietz and von Helversen did not differentiate the subspecies of *Pipistrellus kuhlii*, declaring that the white stripe along the wing membrane is about 1-2 mm wide but up to 5 mm wide in animals from the south of the range. Later nobody published a study on this matter, but regarding the verbal discussions with other bat workers on this field,[24] the width and the shape of this white stripe may be the most important morphological differences between these subspecies.

In the case of subspecies *lepidus* this stripe is wider between the fifth finger and the hind foot, measuring up to 5-6 mm and forming a big white semicircular extension. In the case of the Transylvanian individual the largest width on this semicircular extension is 5,6 mm. *(Fig. 7, 8.)*

The subspecies *kuhlii* can be recognized by the existence of an 1-2 mm wide white stripe all along the margin of the membrane.

Another whitish-depigmented area can be found on the wing membrane along the fifth finger and between the proximal endings of the metacarps of the fourth and fifth fingers. *(Fig. 7.)*

The pattern of wing venation between the elbow and the 5th finger is one celled on both forms *(Fig. 7, 8.)*; we didn't found any difference regarding this character.[25]

An other character which deserves to be examined, is the proportion of the first an second upper incisors.

On the *Pipistrellus kuhlii kuhlii* the upper incisors are very small, without magnifying lens it appears that the second one is not breaking trough the gums (a well illustrated character in the online determinator of Dietz and von Helversen.[26]

The upper incisors of *Pipistrellus kuhlii lepidus* seem to be stronger *(Fig. 9, 10.)* compared to the other neighbouring teeth.

On both of the subspecies the small second premolar (P3) is displaced from the median line of the toothrow. On *Pipistrellus kuhlii kuhlii* in the majority of the cases the last upper premolar (P4) is in contact with the canine, but on the Transylvanian individual the distance between the canine and the big premolar is bigger, and the small premolar is well visible from outside. *(Fig. 11.)*

Based on the width of the membran stripe, only one native record is known which can be identified as *Pipistrellus kuhlii kuhlii,* an adult male from the Lunca Inferioară a Prutului Nature Parc.[27] The other 16 known specimen which were examined, measured or photographed, seem to belong to the other form.

For data comparison some measurement values from other Romanian females: adult individual from Constanța, length of forearm (FA) 35,9 mm, length of fifth digit (5.D) 46,4 mm, maximum width of white stripe (WS) > 5 mm,[28] adult individual from Iași, FA 36,3, WS 4,2,[29] adult individual from Rădăuți, FA 35,4 mm, 5.D 45,5 mm, WS 5,5.[30]

2. The theory of the colonisation routes

Pipistrellus kuhlii (sensu lato) is a synanthropic species, characteristic to urban areas, roosting in tree hollows, slits and clefts in rocks and buildings, under roofs, and in other manmade structures,

[22] IFRIM Irina, POCORA, Irina, DRAGU, Anca.
[23] DIETZ, Christian – VON HEVERSEN, Otto 2004, 49.
[24] GÖRFÖL, Tamás; POCORA, Irina; DRAGU, Anca.
[25] The Romanian photos about the wide striped form were compared with Italian pictures about a narrow striped individual (photo: GRAZIOLI, Francesco, www.microvita.it).
[26] DIETZ, Christian – VON HEVERSEN, Otto 2004, 55, fig. 182.
[27] The individual described in POCORA, Irina 2009.
[28] DRAGU, Anca et alii 2007.
[29] POCORA, Irina 2009.
[30] Dead specimen from POCORA, Irina.

hunting typically over water and along street lights. It is known that females of Kuhl's pipistrelle usually give birth to twins in June or July, which offer a big advantage to the species to enlarge faster its effectives.

The rapidity of the northwards expansion of the Kuhl's pipistrelle is already known from neighbouring countries like Bulgaria, Serbia, Hungary, Ukraine,[31] and maybe a similar process is going on in Moldavia.

In Bulgaria the first individuals were captured in 1987 from Burgas area, near the Black Sea Coast. In 1995, based on a doubtful record, the species appeared on the Romanian border in Ruse.[32]

P. kuhlii was recorded as new for Serbia in 1994 from Beograd, where it became the most frequent bat species during the consecutive years.[33]

The first Hungarian specimen were found in 1993 in Keszthely near the Balaton lake, in the south-western part of the country.[34] In 1995 the species was caught in Sopron, one of the northernmost cities of the country, and in few years colonized the whole lowland to the line of Tisza river. In 1998 it was recorded from Szeged, in 2000 from Eger.[35] Until 2008 78 data of occurence were collected.[36]

Only two published records of *P. kuhlii* are known from the Republic of Moldova (2000, Tălmaza near the Dniester river; 2002, Tiraspol), where this species was probably overlooked due to low intensity of bat surveys.[37] Recently in 2010 another data of presence was recorded from Cimişlia.[38] Taking in account the high frequency of the species in the other side of Prut river.[39] Its very possible that this country is part of a broad route of colonisation which starts somewhere in the Middle East, and passes trough the southern part of Ukraine.

In Ukraine, *P. kuhlii* was regarded as one of the rarest bat species, limited to Crimea and the coast of the Azov Sea, until the 1990's. Supposedly, during last two decades, it has colonised almost the whole of eastern and probably central parts of Ukraine, reaching northernmost regions (54° latitude) already in 1998. First localities from western Ukraine northwards from the Carpathians (2005, Khotyn and Kutyshche, in the Dniester valley) extend the species' range and seem to confirm its continuous expansion.[40]

Some isolated captures were recorded in southern part of Poland as well (2004, Warsaw,[41] 2005, Zawierczie[42]) which may have the same origin, like the Ukrainian and Moldavian individuals, or may be coming from Slovakia, where the species was recorded at first time in 2006.[43]

The big river valleys like Dnieper, Dniester, Prut and maybe the Danube seem to drive the expansion of the species complex. In this way the Kuhl's pipistrelle reached every country around the Carpathians.

In view of the recent captures of hibernating, foraging and breeding individuals in Iaşi, Constanța, Bucureşti, Rădăuți and Galați County,[44] it was just a matter of time until the first individuals passed the Carpathians and reached the higher territories of the country (maybe the last not colonized plateau on this latitude in Central and Eastern Europe).

As we know, this is the first in-hand specimen captured in Transylvania.

The relative abundance of very similar individuals in Southern and Eastern Romania let us believe that this specimen or this specimen's ancestors are originary from there, its presence being a result of the expansion of the south-eastern form of the species complex. Unfortunately the hypotesis of artificial introduction of the species cannot be excluded, a medium sized trading company of building materials can be found in the same street, about 50 m distance from the finding place. Even the flying route was the same, from the direction of the company's entrance.

However, neither the natural way of species dispersion cannot be excluded, because the distance to the nearest known recording place is less than 190 km, trough a densely populated pass with the maximal altitude on 1040 m a.s.l..

A photo-comparison of the shape of white wing stripe extension is presented on the Fig. 12–15. using the known pictures of the other Romanian individuals.

[31] Godlevsky, Lena et alii 2000; PAUNOVIĆ, Milan – MARINKOVIĆ, Saša 1998; SZATYOR Miklós et alii 2003; BENDA, Peter et alii 2003; ZAGORODNIUK, Igor – NEGODA, Vadym 2001; SACHANOWICZ, Konrad et alii 2006.

[32] BENDA, Peter et alii 2003.

[33] PAUNOVIĆ, MILAN − MARINKOVIĆ, Saša 1998; SACHANOWICZ, Konrad et alii 2006.

[34] FEHÉR Csaba Endre 1995.

[35] SZATYOR Miklós et alii 2003.

[36] GÖRFÖL, Tamás et alii 2008.

[37] SACHANOWICZ, Konrad et alii 2006.

[38] Pictures examined from courtesy of CIOFLEC, Vlad.

[39] POCORA, Irina 2009.

[40] SACHANOWICZ, Konrad et alii 2006.

[41] POPCZYK, Bartolomiej et alii 2008.

[42] SACHANOWICZ, Konrad et alii 2006.

[43] CEĽUCH, Martin – ŠEVČIK, Martin 2006; DANKO, Štefan 2007.

[44] IFRIM, Irina – Valenciuc, Niculai 2006; DRAGU, Anca et alii 2007; POCORA, Irina 2009; POCORA, Irina pers. com.; DRAGU, Anca pers. com.

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Barti Levente – Sepsiszentgyörgy, Domb u. 11/B/16., RO-520060; bartilev@yahoo.com

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A fehérszélű törpedenevér (Pipistrellus kuhlii) első erdélyi adata és a lepidus taxon morfológiai megközelítése

(Kivonat)

A fehérszélű denevér (*Pipistrellus kuhlii*) első erdélyi példánya került kézre 2010. április 27-én, Sepsiszentgyörgyön. Az illető nőstény egyed feltehetőleg a *lepidus* alfajhoz tartozik. Morfológiailag nagy hasonlóságot mutat a Kárpátok ívén kívül, Dél- és Kelet-Romániában élő alak ismert egyedeivel, ami arra enged következtetni, hogy egy délről vagy keletről történő recens kolonizációs kísérletnek lehettünk tanúi. Néhány, alfaj szintű megkülönböztetésre alkalmas morfológiai bélyeg is tárgyalásra kerül, mint a fehér szárnyszegélysáv szélessége és félköríves kiszélesedése, valamint a felső metszőfogak méretaránya a többi fogakhoz képest.

Pipistrellus kuhlii capturat pentru prima dată în Transilvania; câteva observaţii morfologice asupra taxonului lepidus

(Rezumat)

Pipistrellus kuhlii a fost capturat pentru prima dată în Transilvania, în municipiul Sfântu Gheorghe, la data de 27 aprilie 2010. Femela respectivă aparţine cu mare probabilitate subspeciei *lepidus,* fiind similară exemplarelor cunoscute din sudul şi estul României. Tindem să credem că am fost martori la o încercare de colonizare recentă a speciei, care vizează extinderea arealului în Transilvania. Sunt prezentate şi câteva aspecte morfologice care pot fi utile în delimitarea subspeciilor, cum ar fi lăţimea benzii de la marginea membranei aripii şi lărgirea semicirculară a acesteia, precum şi proporţia dimensiunii incisivilor superiori comparativ cu dimensiunea altor dinţi.

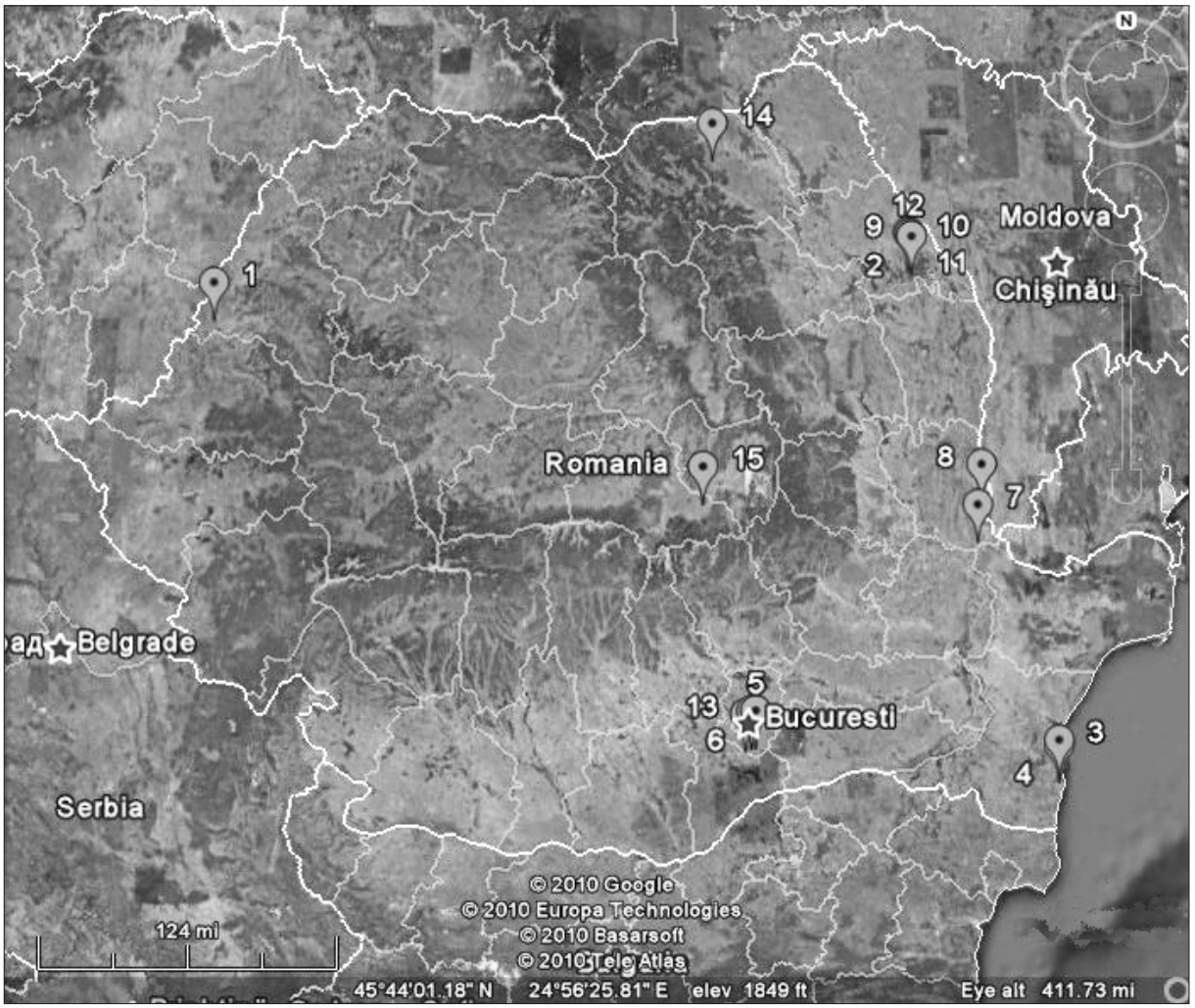

Figure 1.
The map of Romanian findings, in order of their date of appearance:
1. Cefa, Bihor county, 2000 (Limpens, Herman J. G. A. 2000);
2. Iaşi, Iaşi County, 2005 (Ifrim, Irina − Valenciuc, Niculai 2006);
3. Constanța, Constanța County, 2006 (photo by Székely, Paul);
4. Constanța, Constanța County, 2006 (Dragu, Anca et alii 2007);
5–6. Bucharest, 2007 (Dragu, Anca pers. com);
7–8. Lunca Inferioară a Prutului Nature Parc, Galați County, 2007 (Pocora, Irina 2009);
10–11. Iaşi, Iaşi County, 2008 (Pocora, Irina 2009);
12. Iaşi, Iaşi County, 2009 (data from news, det. Pocora, Irina);
13. Bucharest, 2009 (data from news, det. Pocora, Irina);
14. Rădăuți, Suceava County, 2009 (Pocora, Irina pers. com.);
15. Sfântu Gheorghe (Sepsiszentgyörgy), Covasna County, 2010 (present paper)

Figure 2. The female *Pipistrellus kuhlii lepidus* from Sepsiszentgyörgy (Sfântu Gheorghe), Transylvania, with yellowish fur (photo: Levente Barti)

Figure 3. The light dorsal pelage with bicolored hair and the wing with depigmented areas along the fingers (photo: Levente Barti)

Figure 4. The ventral side of the individual and the broad yellowish-white stripe on the folded wing (photo: Levente Barti)

Figure 5. The head of the same *Pipistrellus kuhlii lepidus* (photo: Levente Barti)

Figure 6. The ear and tragus. The posterior margin of the ear with a sharp indentation (photo: Levente Barti)

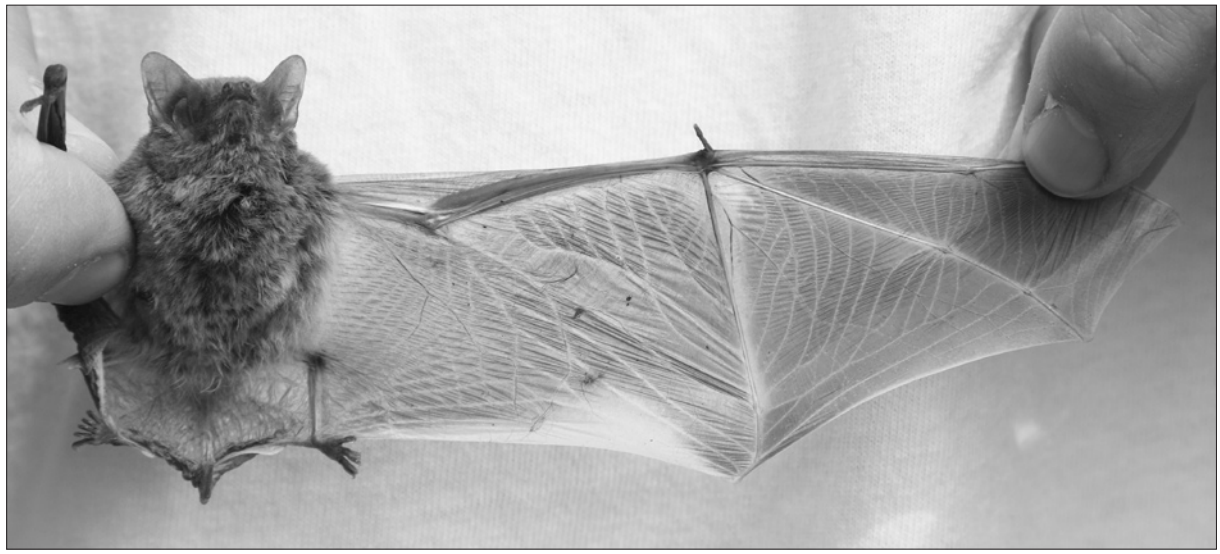

Figure 7. The yellowish-white stripe on the opened wing; the semicircular extension between the hind leg and the 5th finger; the marks on the wing membrane without pigment along the 5th finger and between the metacarps (photo: Levente Barti)

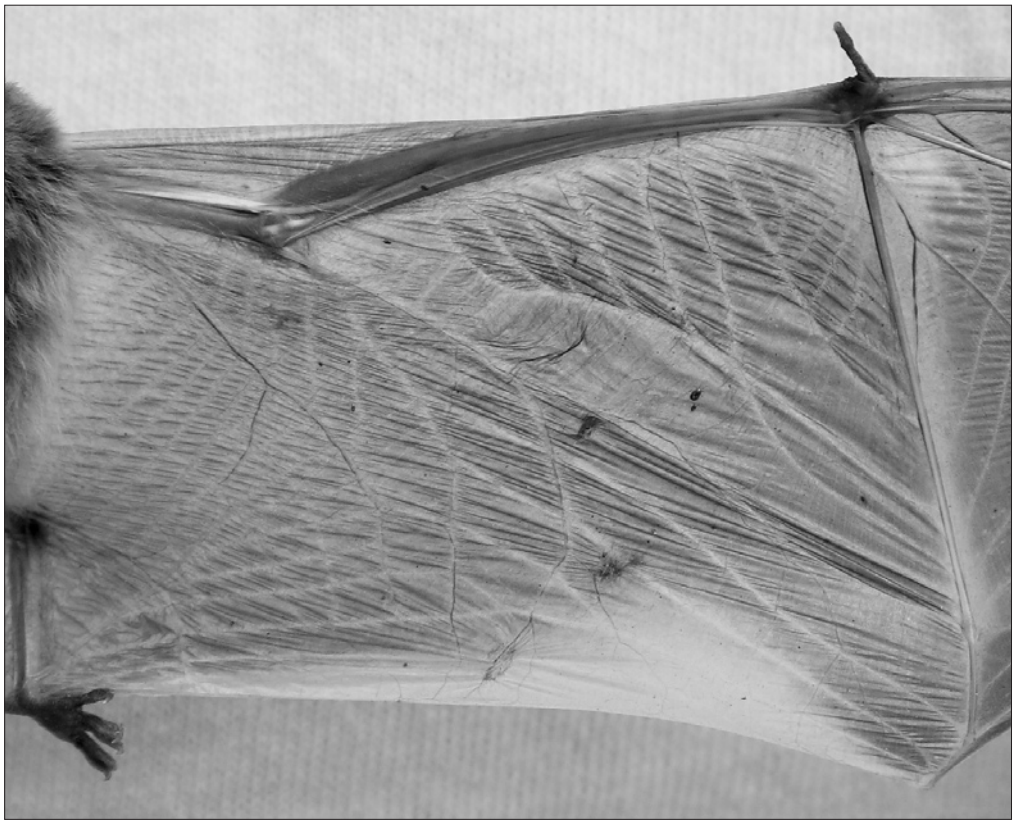

Figure 8. The semicircular extension of the wing stripe between the hind leg and the 5th finger; the one celled pattern of wing venation between the elbow and the 5th finger (photo: Levente Barti)

Figure 9. The upper incisors of *Pipistrellus kuhlii lepidus* (photo: Levente Barti)

Figure 10. The upper incisors of *Pipistrellus kuhlii lepidus* (photo: Levente Barti)

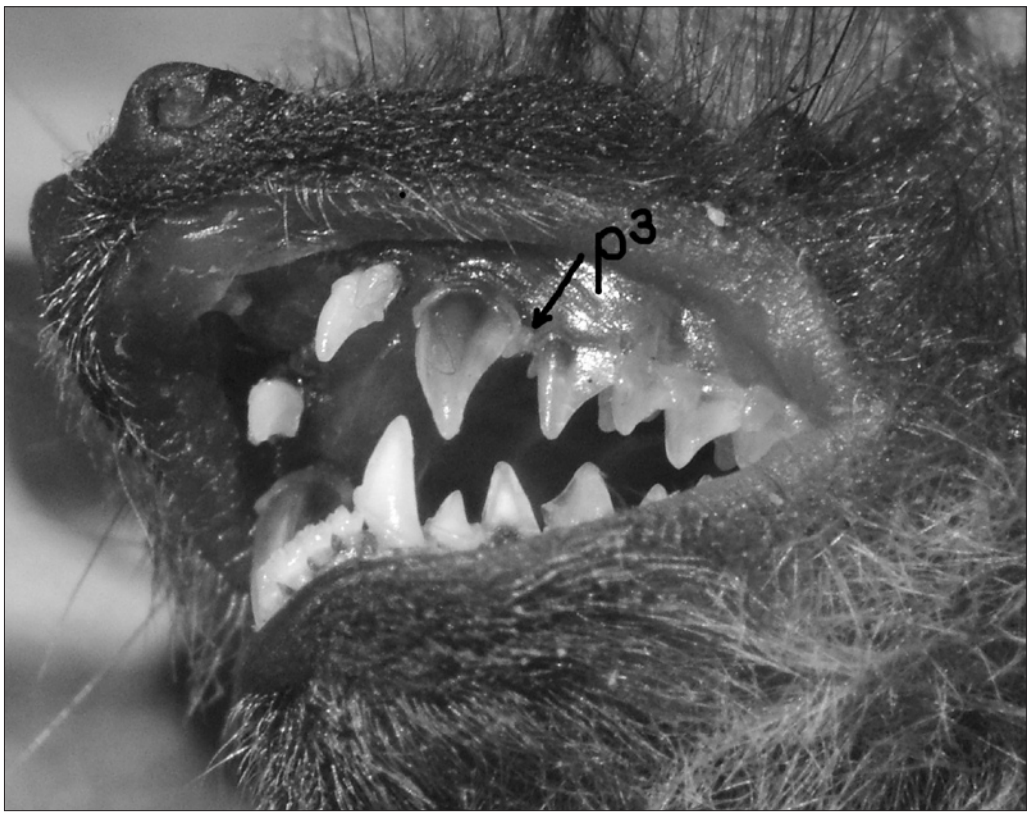

Figure 11. The position of the small second premolar (P3) in the toothrow (photo: Levente Barti)

Figure 12. The semicircular extension of the wing stripe between the hind leg and the 5th finger on a *Pipistrellus kuhlii lepidus* (?) from Iaşi, 2005 (photo from courtesy of Irina Pocora)

Figure 13. The semicircular extension of the wing stripe between the hind leg and the 5th finger on a *Pipistrellus kuhlii lepidus* (?) from Constanţa, 2006 (photo: Vlad Olteanu, Anca Dragu et al. 2007)

Figure 14. The semicircular extension of the wing stripe between the hind leg and the 5th finger on a juvenile *Pipistrellus kuhlii lepidus* (?) from București, 2007 (photo: Anca Dragu)

Figure 15. The semicircular extension of the wing stripe between the hind leg and the 5th finger on a *Pipistrellus kuhlii lepidus* (?) from "Lunca Inferioară a Prutului" Nature Parc, 2007 (photo from courtesy of Irina Pocora)