



THE FIRST RECORD OF A MATERNITY COLONY OF KUHLMAN'S PIPISTRELLE *PIPISTRELLUS KUHLMANII* (CHIROPTERA) IN POLAND

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Abstract

For four decades, there have been changes in the ranges of many bat species in Europe, particularly shifts in their northern limits. This phenomenon is more spectacular for migratory species than sedentary ones, especially for representatives of the genera *Pipistrellus* and *Hypsugo*. Kuhl's pipistrelle *Pipistrellus kuhlii* (Kuhl, 1817) is the one of western Palaearctic bat species with conspicuous range expansion—in the last three decades, the species has rapidly expanded and colonised new territories both northwards and westwards. In Central Europe, two genetic lineages occur that are also quite different morphologically: *P. kuhlii kuhlii* (hereafter *P. kuhlii*) and *P. kuhlii lepidus* (hereafter *P. lepidus*). The contact zone between these two lineages passes through Hungary and Slovakia, although the real range of distinct lineages and/or morphotypes are still unclear. The first records of *P. kuhlii* from Poland (probably belonging to *P. lepidus*) come from Warszawa, central Poland (2004) and Zawiercie, southern Poland (2005): both specimens were males, found in December in buildings. Since then, there have been further reports of the presence of this species in Poland—occurring mostly in large cities along the valleys of large rivers such as the Wisła and Bug, from both periods of activity and hibernation. In subsequent years in Poland the occurrence of only *P. lepidus* has been confirmed, while *P. kuhlii* has been recorded from southern locations in the Carpathian Mountains in Slovakia. This paper describes the first record of this species from Poland, further indicating the existence of a maternity colony. In mid-July of 2020, a non-volant juvenile male was found in Kraków, Krowodrza district (50°04'11.7" N, 19°54'55.9" E). Initially poorly visible diagnostic features have become unambiguous with development and similar to those in *P. kuhlii*: narrow pale wing margin and orange penis colouration. After about two months in captivity, a mature individual capable of flying was released at the site where it was found. The presence of a maternity colony indicates that this species (i) has been part of the Polish fauna for several years, and (ii) its range in Poland possibly expands much further north.

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Перша реєстрація материнської колонії нетопира білосмугого *Pipistrellus kuhlii* (Chiroptera) у Польщі

Томаш Постава, Анна Мархевка

Резюме. За чотири десятиліття в Європі відбулися зміни в ареалах багатьох видів кажанів, особливо на їхніх північних межах. Це явище особливо вражає у випадку мігруючих видів, ніж осілих, особливо у представників родів *Pipistrellus* і *Hypsugo*. Нетопир білосмугий *Pipistrellus kuhlii* (Kuhl, 1817) є одним із видів кажанів західної Палеарктики з виразним розширенням ареалу — за останні три десятиліття цей вид швидко розширився та колонізував нові території як на північ, так і на захід. У Центральній Європі зустрічаються дві генетичні лінії, які також досить різні морфологічно: *P. kuhlii kuhlii* (далі *P. kuhlii*) і *P. kuhlii lepidus* (далі *P. lepidus*). Зона контакту цих двох ліній проходить через Угорщину та Словаччину, однак реальні ареали різних родинних ліній та/або морфотипів досі неясні. Перші згадки про *P. kuhlii* з Польщі (ймовірно, належні до *P. lepidus*), походять із Варшави, що в Центральній Польщі (2004), та Заверця, у Південній Польщі (2005): обидва екземпляри були самцями, знайденими в грудні у будівлях. Відтоді з'явилися нові повідомлення про присутність цього виду в Польщі — здебільшого у великих містах уздовж долин великих річок, таких як Вісла та Буг, з обох періодів їхнього життя — активного та зимоспячого. У наступні роки в Польщі підтверджено наявність лише *P. lepidus*, тоді як *P. kuhlii* був зафіксований з більш південних місць — у Карпатах у Словаччині. У цій статті описується перша знахідка цього виду з Польщі, яка додатково вказує на існування материнської (розродчої) колонії. У середині липня 2020 р. в Кракові, район Кроводжа (50°04'11.7"N 19°54'55.9"E) виявили нелітаючого ювенільного самця. Спочатку погано виразні діагностичні ознаки стали з ростом однозначно такими як ознаки *P. kuhlii*: вузький блідий край крил і помаранчеве забарвлення пеніса. Приблизно після двох місяців перебування у неволі цілком здатна до польоту особина була випущена на тому місці, де її знайшли. Наявність материнської колонії вказує на те, що цей вид: 1) є частиною польської фауни протягом кількох років, 2) що, можливо, його ареал у Польщі простягається значно далі на північ.

Ключові слова: кажани, материнська колонія, розширення ареалу, *Pipistrellus k. kuhlii*.

Introduction

Over the last 20 years, there has been a significant change in the ranges of many bat species in Europe, and the shifting of the northern limits of the ranges is particularly evident (Ancillotto *et al.* 2016). Range changes among sedentary species are rather small, while for migratory species they are much more spectacular probably due to their wide thermal tolerance [Ancillotto *et al.* 2018]. In some cases, migrations far beyond the previously known range are recorded [Zagorodniuk 2019]. For the Mediterranean bat fauna, the natural northern limit of occurrence was assumed to extend to the Outer Western and Eastern Carpathians.

The first species found outside its recognised range was the greater horseshoe bat *Rhinolophus ferrumequinum* (Schreber, 1774). Originally recorded in 1962 [Harmata & Wojtusiak 1963], followed by two findings in 1992 [Labocha & Postawa 1992; Mleczek 1992], and since then regularly wintering in the Łokietka cave (Ojców National Park [Grzywiński *et al.* 2020]), with potential breeding observed in 2003 in Beskidy Mts. [Szkudlarek *et al.* 2003] and in 2005 close to Ojców National Park [Kohyt & Postawa 2007]. The second species is the common bent-wing bat *Miniopterus schreibersii* (Kuhl, 1817), whose northerly site for this part of Europe was known from the Pieniny Mountains (Aksamitka cave, Slovakia) [Cel'uch 2014]. This species has been regularly recorded since 2015 in Rożnow Castle (Rożnowskie Foothills, Western Carpathians) during swarming and single individuals have also been recorded during hibernation [Piksa & Gubała 2021].

Both bat species belong to the so-called cave species group—they are found underground at least during part of their phenological cycle, so their observations are relatively easy and repeatable. Much more accidental findings concern species from genera that regularly migrate: *Pipistrellus*, *Hypsugo*, or *Nyctalus*. So far, of this group, only rare information on Savi's pipistrelle *Hypsugo savii* (Bonaparte, 1837) was noted from a location in southern Poland [Uhrin *et al.* 2016].

Considerably more widespread among them is Kuhl's pipistrelle *Pipistrellus kuhlii* (Kuhl, 1817), which is already known from eastern, southern and central Poland [Sachanowicz *et al.* 2017; Piskorski & Sachanowicz 2021].

Kuhl's pipistrelle *Pipistrellus kuhlii* sensu lato has a wide range that covers the entire Mediterranean basin both of Europe and Africa, extends through Asia Minor to Pakistan and northwards across the Caucasus to the Eurasian steppe [Juste & Paunovic 2016]. The species *P. kuhlii* is not homeogenic and several morphological and genetic forms with still unclear taxonomic status were described (see: [Andriollo *et al.* 2015; Sachanowicz *et al.* 2017]).

In Europe, three distinct lineages have been found: the western morphotypes (i) *P. kuhlii* sensu lato and (ii) *P. k. kuhlii*—reside throughout the Mediterranean basin; and the eastern morphotype (iii) *P. k. lepidus*—found mostly in Eastern Europe and Central Asia [Andriollo *et al.* 2015; Sachanowicz *et al.* 2017]. The eastern population of *P. kuhlii* (probably the lineage of *P. k. lepidus*), originally inhabited the dry zone of Central Asia [Strelkov *et al.* 1985; Strelkov & Il'in 1990] and the Southern Caucasus [Strelkov *et al.* 1985]. Until the end of the 1990s, the species' range expanded throughout/across the entirety of Ukraine [Kondratenko 1990; Zagorodniuk 2019], Belarus [Shpak & Larchenko 2016] and in European Russia [Prylutska & Vlaschenko 2013]. Therefore, this species has shown an extraordinary range expansion over the last 40 years, with the gradual appearance of overwintering populations [Hukov *et al.* 2020].

Both subspecies—*P. k. kuhlii* and *P. k. lepidus* (hereafter *P. kuhlii* and *P. lepidus*)—are sympatric and their current ranges overlap in eastern Slovakia and Hungary [Sachanowicz *et al.* 2017]. Until now, only *P. lepidus* has been found in Poland, and it indicates the presence of a sedentary population: single findings are either from hibernation (Puławy, Zawiercie) or breeding (eastern Poland) [Sachanowicz *et al.* 2006; Sachanowicz *et al.* 2017].

Material and Methods

During the chiropterological intervention, according to personal contact with the finder, a flightless bat was found that had left the maternity colony too early (probably due to overheating of the colony location: temperatures reached 30°C in those days). The juvenile male was found in Kraków, in the Krowdrza district (26.07.2020, Chocimska Street, 50°04'11.7" N, 19°54'55.9" E). The neighbourhood is built up with four- to six-storey blocks of flats, with a relatively high density of trees (small city parks, etc.). The bat was severely dehydrated and weakened, was fed and kept in conditions imitating natural conditions: a wooden bat box. It was initially fed with cat food (KiteKat Junior) and then its diet was gradually changed to *Tenebrio molitor* larvae. After two weeks, it started to fly autonomously. The bat (former name: Zeus) was released at the finding site in the second half of September. This allowed us to observe the final colouration features important for species diagnostics and to trace the formation of these features during growth and development, in particular the formation of a white stripe along the edge of the wing membrane.

Photographs were taken during the period of growth of the animal. According to Sachanowicz *et al.* [2017], three features were selected for species diagnostic: snout colouration, penis shape and colouration, and size of margin wing pale (Fig. 1, *a–c*). The distribution analysis was based on a map produced using data from various published sources mentioned above. The mapping data are shown in Figure 2.

Results and Discussion

Morphology. Diagnostic features were initially poorly visible and did not allow for species identification. Based on external morphology, those two morphotypes—*P. kuhlii* and *P. lepidus*—are clearly differentiated by body and penis colouration and the pale wing margin extent [Sachanowicz *et al.* 2017]. Around the middle of August, the white edge of the wings became clearly visible and enlarged to 1–2 mm wide (Fig. 1, *c*). The snout and ears were dark, with no bright orange and yellowish patterns (Fig. 1, *a*). The penis had pinkish-brown colouration (Fig. 1, *b*). These external features are fully consistent with those of *P. kuhlii* described by Sachanowicz *et al.* [2017].

Distribution. The presence of single individuals, especially found in spring and autumn, may indicate a migratory population. A sedentary population, on the other hand, is indicated by the presence of juveniles (confirmation of breeding) or overwintering individuals. According this assumption, our findings are the first record of *P. kuhlii* maternity colony in Poland.



Fig. 1. Kuhl's pipistrelle *Pipistrellus kuhlii* (Zeus): snout (a), penis (b), and narrow margin of wing pale (c) (photo taken at 14.08.2020).

Рис. 1. Нетопир білосмугий *Pipistrellus kuhlii* (Зевс): морда (a), пеніс (b) та вузька крайова смуга крилової підласості (c) (фото 14.08.2020).

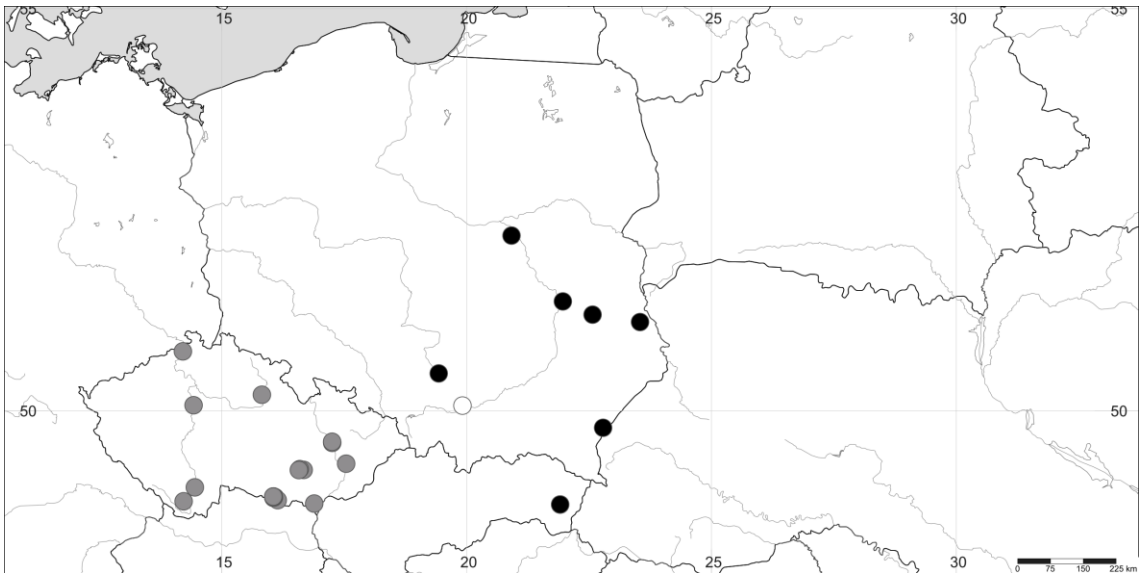


Fig. 2. Distribution of locations of *Pipistrellus lepidus* (black circles), *P. kuhlii* (white circles), and *P. kuhlii sensu lato* (grey circles) (after: [Cel'uch & Ševčík 2006; Sachanowicz et al. 2017; Lučan et al. 2020]).

Рис. 2. Розміщення місцезнаходжень *Pipistrellus lepidus* (чорні кола), *P. kuhlii* (білі кола) та *P. kuhlii sensu lato* (сірі кола) (за: [Cel'uch & Ševčík 2006; Sachanowicz et al. 2017; Lučan et al. 2020]).

To date, all individuals of *P. kuhlii* recorded from Poland concern specimens recognised as *P. lepidus*: in contrast to our finding, they were characterised by a broad, pale wing margin.

The nearest location for this species come from Zawiercie, 60 km to the north-west [Sachanowicz *et al.* 2006], followed by Puławy, 205 km to the north-east [Sachanowicz *et al.* 2017] and Warsaw, 255 km [Popczyk *et al.* 2008]. Currently, mating calls identified as those of *P. kuhlii*, were recorded from south-eastern Poland (Carpathians, Roztocze) [Piskorski & Sachanowicz 2021], although without morphological improvement.

Therefore, our findings are the first and, for the time being, the only certain record of the breeding of this species in Poland. Unexpectedly, this specimen belongs to *P. kuhlii*—the lineage occurring in western and southern Europe [Ancillotto *et al.* 2016; Sachanowicz *et al.* 2017]. Earlier finds come from the Carpathians and south of the Carpathians [Ceľuch & Ševčík 2006] and Sudetes [Lučan *et al.* 2020]. It should be noted, however, that identification is often restricted to *P. kuhlii* *sensu lato*, thus the real range of particular lineages and/or morphotypes is still unclear.

The range east of the Carpathians (Podolia plain, Ukraine) needs to be revised, especially as both species are also recorded in the Carpathians in Romania [Barti 2010]. The Mediterranean bat species differ both in their range and in their rate of migration: *R. ferrumequinum* and *M. schreibersii*, as species closely associated with the undergrounds, restrict their distribution to the southern edge of Poland [Ruprecht *et al.* 2008; Piksa & Gubała 2021], while the *Pipistrellus* species—as bat species independent from caves—seem to occupy new areas along the valleys of large rivers, as it was suggested by Zagrodniuk [2019].

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