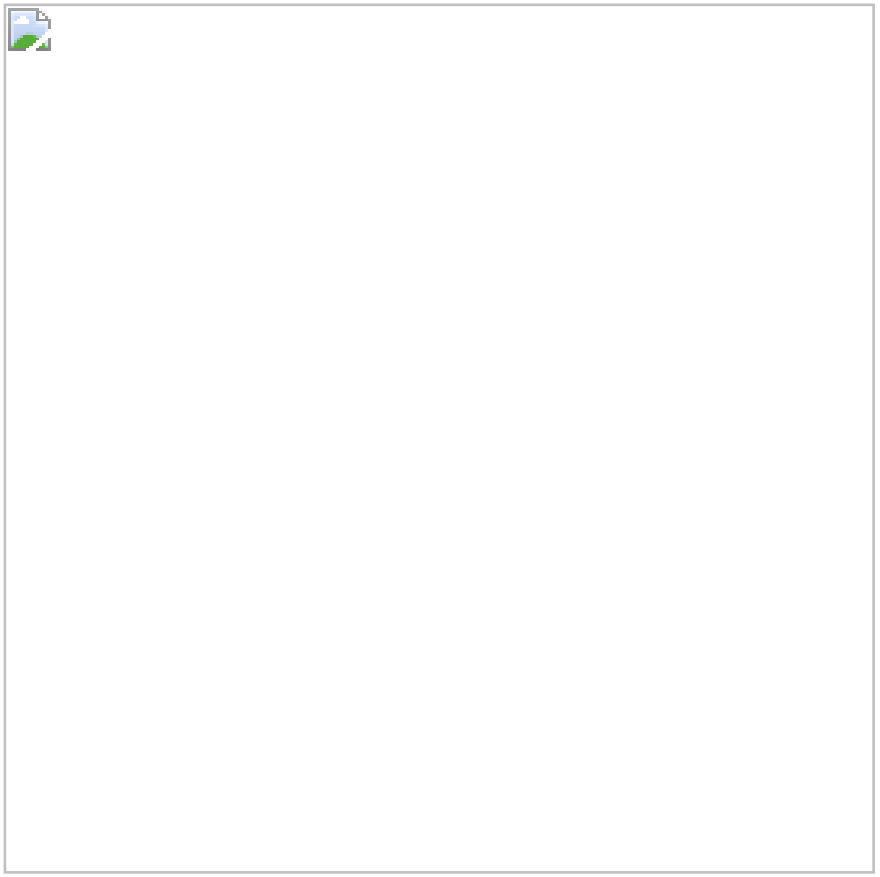

Discovery of the Bartica Bat Glyphonycteris daviesi (Chiroptera: Phyllostomidae) in Trinidad, West Indies

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SHORT NOTES

Discovery of the Bartica bat *Glyphonycteris daviesi* (Chiroptera: Phyllostomidae) in Trinidad, West Indies

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Key words: Chiroptera, Phyllostomidae, *Glyphonycteris daviesi*, new record, Trinidad

INTRODUCTION

After the description of *Glyphonycteris* by Thomas, 1896, this taxon was considered, by subsequent authors (e.g., Sanborn, 1949; Handley, 1976; Koopman, 1993), as a subgenus of *Micronycteris*; however, recently Simmons and Voss (1998) restored it to the rank of genus based on morphological differentiation with other related taxa (*Micronycteris, Trinycteris,* and *Lampronycteris*). Currently three congener species are recognised: *Glyphonycteris behnii* Peters, 1865, known only from Brazil; *G. daviesi* (Hill, 1964), recorded from Honduras south to Bolivia, the Guianas, and Brazil; and *G. sylvestris* (the type species) Thomas, 1896, whose distribution ranges from Peru and SE Brazil north to Mexico, including Trinidad (Simmons, In press). All these species are considered rare. *Glyphonycteris behnii* is known only from three specimens. However, Simmons (1996) suggests that *behnii* is probably a synonym of *sylvestris. Glyphonycteris daviesi*, formerly included in the monotypic genus *Barticonycteris* (see Simmons, 1996), is known only from 35 specimens (Pine *et al*., 1996; Anderson, 1997; Simmons and Voss, 1998; Solari *et al*., 1999; Ochoa, 2000), not including the new records reported here. The type specimen was collected in Guyana, Essequibo province, near Bartica (Hill, 1964).

The island of Trinidad lies only 11 km from the east coast of Venezuela. For a tropical country, the bat fauna of Trinidad has been unusually well documented due to extensive collecting in the late 1950s and 1960s by Goodwin and Greenhall (1961), and continued through to the present day by many other bat researchers. Nevertheless, despite these extensive surveys, the bat fauna in the southern part of the island has received little attention (Clarke and Downie, 2001). This situation has recently been rectified during a research project examining the effect of natural forest management on the bat community of the Victoria-Mayaro Forest Reserve (VMFR) in southeast Trinidad (authors' unpubl. data). During this research the first author captured two specimens of *G. daviesi*, which represent the first record for this bat in Trinidad.

Collecting Data and Morphological Description

On the 5th March 2002, at 21:00 h, an adult, parous female *G. daviesi* was caught in the Victoria-Mayaro Forest Reserve, Ward of Mayaro (10°08'N, 61°08'W). This specimen, deposited at the Zoology Museum, University of West Indies (UWI), St. Augustine, Republic of Trinidad and Tobago (catalogue No. UWI.02.07), was captured in a mist net set at 0 to 3 m above ground level in primary *Mora excelsa* forest. Dorsal and ventral pelage was dark brown and frosted, respectively. The dorsal fur was long, dense, woolly and uni-coloured. The individual had a well-developed throat gland and emitted a pungent musky odour. The stomach contained insect remains.

On 3rd April 2002, at 20:00 h, a second female *G. daviesi* was captured in a mist net set at ground level in primary Mora forest. This individual was trapped only 0.5 km from the site at which the first individual was taken. The female was nulliparous and juvenile. Dorsally it was dark grey with a uni-coloured pelage. The ventral fur was frosted, particularly around the throat and chest. It weighted 19.0 g and had a forearm length of 56.1 mm. This individual was released soon after being measured and photographed. As with the first individual, the throat gland in this female was obvious.

Taxonomic Comments

Our specimens exhibited the characteristic external diagnostic features of the genus *Glyphonycteris* (Simmons and Voss, 1998). The ears were not connected by a band of skin, the chin had a pair of dermal pads arranged in a 'V' with no central papilla, the ventral margin of the narial horseshoe graded gradually into the upper lip, the fifth metacarpal was longest and the fourth shortest, and the calcar was much shorter than the hindfoot. The upper incisors were greatly enlarged and almost equal in length to the canines. It fitted the craniodental description of *G. daviesi* given by Hill (1964) and the measurements were similar. Both specimens were easily distinguished from the congener *G. sylvestris* due to their large size (*sylvestris* < 10 g), uni-coloured dorsal fur (tricoloured in *sylvestris*), absent upper outer incisors, and lower incisors with crown height approximately twice the crown width (crown height approximately equal to crown width in *sylvestris* — see Simmons and Voss, 1998).

Glyphonycteris behnii may be synonymous with *G. sylvestris*, and is much smaller than *G. daviesi* (*G. behnii*: forearm length = 45–47 mm). The measurements of our voucher specimen fall within the range for *G. daviesi* in the Guianan subregion (Table 1) and elsewhere in its range (Pine *et al*., 1996). No subspecies are currently recognised for this taxon. Pine *et al*. (1996) provide a comprehensive review of *G. daviesi*, including measurements of specimens throughout its known range.

Ecology and Conservation

Both individuals were caught in lowland moist tropical forest of *Carapa-Eschweilera* association, where the canopy is dominated by the abundant *Mora excelsa* (Beard, 1946). Primary forests in the VMFR are located within a matrix of forest managed under different systems of timber extraction. The topography is typically undulating with many small ridges. Elevation in the VMFR is less than 200 m. A characteristic feature of the Bartica bat appears to be the strength of its odour and on approaching the mist net, and from a distance of over 10 m, the first author realised that a second individual of *G. daviesi* had been captured from the

TABLE 1. Measurements of *Glyphonycteris daviesi* from Trinidad and neighbouring localities in northern South America (Guianan subregion). Measurements are given in mm (body mass in g) and follow Simmons and Voss (1998). Measurements of greatest length of skull of specimens from Guyana and Venezuela may be inclusive of incisors. The ear length given by Hill (1964) for the holotype may be erroneous as it is significantly smaller than the measurement reported for all other specimens. It is possible that Hill (1964) measured the pinna from the crown rather than the notch. ‡ Simmons and Voss (1998); * Hill's (1964) holotype at NHM, UK; † McCarthy and Ochoa (1991)

Character	Trinidad	French Guiana‡		Guyana*	Venezuela†	
	♀	♀	♂	♀	♂	♂
Body mass	22.0	20.0	17.4	–	20.0	23.0
Total length	83.8	83.0	80.0	79.4	–	–
Tail length	8.7	10.0	10.0	10.4	–	–
Hindfoot length	15.0	17.0	17.0	16.8	–	–
Calcar length	7.8	–	–	8.0	–	–
Ear length	26.5	28.0	27.0	17.0	–	–
Forearm length	56.4	57.0	52.5	57.5	53.6	54.0
Greatest length of skull	24.36	24.56	–	27.2	26.3	26.1
Condyloincisive length	25.32	24.58	–	24.7	25.2	24.9
Postorbital length	6.36	5.97	–	6.5	6.1	5.9
Braincase breadth	12.00	10.27	–	10.9	10.3	10.8
Zygomatic breadth	12.68	12.68	–	13.3	11.5	11.2
Maxillary toothrow length	11.70	10.27	–	11.1	10.5	10.7
Breadth across molars	9.20	8.98	–	9.3	8.5	9.0

pungent odour coming from the vicinity of the mist net. Very little is known regarding the diet and roosting requirements of *G. daviesi*. Stomach contents have contained unidentified insects, a moth larva, and what may have been the remains of a small frog (Pine *et al.*, 1996; Solari *et al*., 1999). The morphology of *G. daviesi* and its diet indicates that this species may be a gleaning animalivore. The only recorded roosts were in Peru. Three individuals were collected from one hollow tree, and five from another (Tuttle, 1970; Solari *et al*., 1999). The colony of five individuals appeared to represent a family group consisting of an adult male, two adult females (one lactating), one subadult male and one young female (Solari *et al*., 1999).

Glyphonycteris daviesi is currently listed as low risk, near threatened (Hutson *et al*., 2001). Specimens recorded here were trapped only in primary forest. This species appears to be restricted to primary lowland moist tropical forest throughout its range (Pine *et al*., 1996; Simmons and Voss, 1998; Ochoa, 2000). Primary Mora forest in Trinidad is largely restricted to the VMFR, though a smaller area remains in Matura in the northeast of the island (M. Oatham, pers. comm.). Other fragments are likely to consist of scattered patches of up to a few hundred hectares in area. This species may therefore be particularly threatened as its primary forest habitat increasingly disappears from Trinidad due to unsustainable logging, fire, and fragmentation. Species extinction in tropical forest appears to be deterministic: the same species disappear in forests throughout their range so despite the wide geographical range of *G. daviesi* it may still be under threat as logging activities gather momentum throughout tropical America. On a positive note, though sawmillers in Trinidad are demanding more primary forest in the VMFR for logging, the forestry department aim to keep large areas unexploited.

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The occurrence of hibernating *Pipistrellus pipistrellus* (Schreber, 1774) in caves of The Carpathian Basin

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Key words: Carpathian Basin, distribution, *Pipistrellus pipistrellus*, Romania, underground hibernacula

INTRODUCTION

The pipistrelle *Pipistrellus pipistrellus* (Schreber, 1774) is one of the most widespread and abundant bat species in Europe (Mitchell-Jones *et al.*, 1999). Some studies have even inferred recent population increases or expansions in some Central and Western European countries (Arlettaz *et al.*, 2000). *Pipistrellus pipistrellus* forms large nursery colonies in summer, sometimes up to several hundred females, typically located in houses, tree holes or bat boxes (Gerell and Lundberg, 1985). In winter both sexes congregate, forming large hibernating colonies. They have been reported from tree holes (Kepka, 1976), underground cavities (Haensel, 1992; Lustrat and Julien, 1993; Kretzschmar and Heinz, 1995), church and house attics (Racey, 1973; Gjerde, 1994), and caves (Dumitrescu and Orghidan, 1963; Uhrin, 1995).

Dumitrescu and Orghidan (1963) reported the first large hibernating colony in Sura Mare cave (Sebes Mountains, Southern Carpathians), Romania, numbering up to 60,000 individuals. Individuals and sporadic colonies were also found in Liliecilor and Meziad caves (Dumitrescu *et al*., 1963). One group of *P. pipistrellus* was located hibernating in deep and dry crevices in the Drienovec cave in former Czechoslovakia (Gaisler and Hanák, 1962; see also Matis, 2000). Uhrin (1995) reviewed the winter distribution of *P. pipistrellus* in underground shelters in the Slovak Republic, remarking on the presence in three caves in South Slovakia, one of which contained ca. 10,000 individuals. In addition, 2,100 *P. pipistrellus* were found hibernating together with a large number of *Barbastella barbastellus* in mine gallery in the Muranska Plain Protected Landscape Area. In France 800–900 *P. pipistrellus* were reported during the winter of 1990 in a 600 metre tunnel near Paris (Lustrat and Julien, 1993) and in South West Germany about 1,000 *P. pipistrellus* were also discovered in a mine (Kretzschmar and Heinz, 1995).

Other records in European countries during the winter months show a sporadic occurrence of *P. pipistrellus* in underground shelters, including caves in Spain (Alcalde and Escala, 1999), Austria (Bernd, 1994), Hungary (Paulovics *et al*., 1996), Poland (Krzanowski, 1959; Bagrowska-Urbańczyk and Urbańczyk, 1983), Ukraine (Krochko, 1964), Bulgaria (Pandruska and Beshkov, 1998) and Switzerland (Aellen, 1965).

In view of the fact that the Sura Mare cave was reported to contain the largest number of hibernating *P. pipistrellus* throughout the range of this species, it was of interest to repeat and extend the original survey of Dumitrescu *et al*. (1963) 40 years later.

MATERIAL AND METHODS

From 1999–2002 we mapped the location and size of winter and summer colonies of *P. pipistrellus* in 50 caves in the Western and Southern Carpathians, and Dobrogea, Romania. In addition, potential roosts, i.e., those displaying adequate habitat parameters but not known to harbour *P. pipistrellus*, were also

investigated. We censused *P. pipistrellus* in hibernacula visually, sometimes with the help of binoculars. Inside caves we used bat detectors (Pettersson D200). The biopsy punch technique was used to sample wing tissue of 24 pipistrelles from Huda lui Papara cave according to Worthington Wilmer and Barratt (1996). Mitochondrial DNA analysis carried out at The University of Aberdeen indicated that all the sampled individuals were *P. pipistrellus*. Juveniles were distinguished from adults by the lack of ossification in the plates in the joints of finger bones (Anthony, 1988). Microclimatic measurements (temperature and humidity, using Checktemp 1, Hygrocheck, Hanna Instruments) were taken as near as possible to hibernating individuals. The winter sampling of sites was carried out each season between 20 December and 1 March. In order to estimate colony size, we counted bats in compact clusters in 10 cm^2 areas ($n = 7$, range = 29–35 bats/10 cm^2, $\bar{x} = 31.57$ bats/10 cm^2). The area occupied by bats was estimated or measured where possible. Lone individuals were counted separately. In addition to *P. pipistrellus*, we counted the number of individuals of other species sharing the roost. Other species within the genus *Pipistrellus* are rare in Romania. *Pipistrellus kuhlii* was recorded only by bat detector in 2000 (H. Limpens, pers. comm.), and *P. nathusii* were described in three localities within the country (Dumitrescu *et al.*, 1963; Barbu, 1968; Dobrosi and Gulyás, 1997). *Pipistrellus pygmaeus* was observed since 2000 in the western part of Romania, in the Cris River valley, and in the Danube Delta (H. Limpens, pers. comm.). The probability of the occurrence of any other *Pipistrellus* species in large winter aggregations, where individual identification was not possible, is therefore low.

The six studied caves housing *P. pipistrellus* were located in the Southern and Western Carpathian Mountains in Romania at an altitude of 62–567 m a.s.l., in limestone areas rich in underground formations. Those containing the largest number of bats have large entrances (16 m high by 10 m wide to 37 m high by 8–12 m wide), corridors up to 25 m high, large chambers, and a maximum length of 4,750 m. All caves, with the exception of the Grota Haiducilor and Magura cave, had a constant water flow in winter.

Results

Individuals of *P. pipistrellus* were observed in six caves during winter, frequently together with other species (Table 1). In Sura Mare cave (Southern Carpathians), they were hanging free from the roof and inside large crevices on corridor walls, 300–350 m from the entrance, forming compact clusters and aggregations. A large number of smaller groups were also located deep in crevices where they could not be counted. The total number of pipistrelles in this cave was estimated to be about 32,000–34,000. In contrast only 33, individuals of the second most common species *B. barbastellus* were found. In the two other caves, Grota Haiducilor and Gura Ponicoavei, which are also located in the Southern Carpathians, pipistrelles were hidden in crevices, with no distinct clusters at the roof or walls. In Groata Haiducilor, only eight individuals were counted, and an exact estimate was not possible. In Gura Ponicoavei the presence of about 1,000 *P. pipistrellus* was confirmed in 17 crevices.

In the Western Carpathians, the Huda lui Papara cave housed the second major aggregation of *P. pipistrellus* in Romania. In the winter of 2001, 16,000–17,000 *P. pipistrellus* were estimated to hibernate there. These bats were seen in the same locations during three consecutive years. They formed free hanging groups on the roof and walls, and were also present in wide horizontal and vertical fissures. In a few cases, they formed clusters together with *Nyctalus noctula*. The percentage of males to females in one randomly chosen group was 41.7 : 58.3 ($n = 24$). Solitarily hibernating pipistrelles were quite rare. The site, estimated to contain up to 55,000 individuals of 10 species (Table 1) probably constitutes the largest bat hibernaculum in Europe.

The Meziad cave contained large aggregations of *Rhinolophus ferrumequinum* together with small numbers of *P. pipistrellus* and some other species (Table 1). In February 2000, more than 200 pipistrelles were found in fissures of an artificial wall near the entrance. In January 2001, even larger number of pipistrelles were present in the same place. A few individuals were also

TABLE 1. Name and location of the caves, containing hibernating *Pipistrellus pipistrellus*. Temperature and humidity recorded under colonies of pipistrelles

Cave name	Geographic coordinates	Date of census	No. of pipistrelles	Location of pipistrelles	Temperature (°C) and humidity (%)	Other species
Meziad	46°45'N, 22°28'E	2000.02.15 2001.01.22 2002.01.19	> 250	crevices free hanging	-1.2–3.7 81.1	*Rhinolophus ferrumequinum, R. hipposideros, R. euryale, Miniopterus schreibersii, Myotis myotis, M. blythii, Nyctalus noctula, Barbastella barbastellus*
Magura	46°31'N, 22°32'E	2002.01.20	200	free hanging	0.6 83.2	*R. ferrumequinum, R. hipposideros, B. barbastellus, Plecotus auritus*
Huda lui Papara	46°23'N, 23°17'E	2000.02.20 2001.01.20 2001.02.03 2002.01.22	16,000–17,000	crevices free hanging	-0.5–4.7 82–96	*R. ferrumequinum, R. hipposideros, M. myotis, M. blythii, M. daubentonii, B. barbastellus, Vespertilio murinus, M. schreibersii, Nyctalus noctula*
Gura Ponicoavei	44°34'N, 22°14'E	2000.02.03	≤ 1,000	crevices	6.7 82.4	*R. ferrumequinum, R. hipposideros, R. euryale, P. auritus, M. daubentonii*
Grota Haiducilor	44°52'N, 22°24'E	2000.02.03	8	crevices	6.8 87.3	*R. ferrumequinum, M. daubentonii*
Sura Mare	45°32'N, 23°08'E	2000.02.06	32,000–34,000	crevices free hanging	4.8 95	*B. barbastellus*

recorded in the summer of 2000. In the Magura cave, after several years of winter monitoring, about 200 pipistrelles were discovered in January 2002. The bats formed a compact cluster in one niche of the roof, near to the entrance.

DISCUSSION

Pipistrellus pipistrellus was formerly considered to be primarily a house and tree-cavity dwelling bat, which occasionally occurred in caves during winter, primarily in Eastern Europe (Schober and Grimmberger, 1997). For a long time, the only available data regarding significant underground hibernacula in Europe for *P. pipistrellus* were those in the Sura Mare cave (Dumitrescu and Orghidan, 1963). Data from this locality have been incorrectly cited many times, with respect to the geographic position of the cave and the number of bats hibernating there. Schober and Grimmberger (1997) erroneously reported that 100,000 individuals constituted the aggregation, while Stebbings (1988) placed the hibernaculum in Dobrogea, where *Pipistrellus* spp. had not been reported previously in underground shelters.

The largest clusters of *P. pipistrellus* in underground hibernacula of Europe are found in the Carpathian Basin, in the mountains of Slovakia and Romania (Dumitrescu and Orghidan, 1963; Uhrin, 1995; this paper). Much smaller aggregations (< 10 individuals) of hibernating *P. pipistrellus* occur in caves in other European countries. There are some records of these bats present in the same caves during summer, but it appears that in such instances, the caves are being used as temporary resting places during migration.

The temperature of a church hibernaculum used by *P. pipistrellus* in England recorded throughout the hibernation period ranged from -5° to 12°C (Racey, 1974).

It thus seems that these bats can occur in varying types of habitats, including caves (albeit not in England). The median temperature recorded in our study (4.2°C; range: -1.2–6.7°C) was close to the median (3.4°C) described by Racey (1974), but circumscribed within a narrower range of values, which may be the result of the relatively stable microclimatic environment within caves. In all caves occupied by bats, there was a high level of relative humidity, nearing saturation (81.1–96%). Climatic factors do not seem to affect the beginning of hibernation in bats, but they do affect its duration. Grimmberger (1979) noted that if the average daily temperature is under 0°C, the activity of bats is very reduced within hibernacula.

The distribution of *P. pipistrellus* in caves does not seem to be affected by elevation (range: 62–567 m in Romania), and individual *P. pipistrellus* have been observed at altitudes of up to 2,000 m (Schober and Grimmberger, 1997). These bats do not appear to display any marked preference relative to cave topography or structural complexity, and are found near the entrance in the diffuse light zone, as well as deep within the caves. It was observed, however, that they hibernate in the same region within the cave for many consecutive years.

There is an extensive record of subfossils of *P. pipistrellus* in cave deposits in the Carpathian Basin area, documented especially well for Southern Poland (e.g., Kowalski, 1967; Nadachowski, 1976; Madeyska, 1981; Alexandrowicz *et al.*, 1985; Nadachowski *et al.*, 1989; Ochman and Wołoszyn, 2000). In Romania, subfossil remains of this species were found in the Huda lui Papara and Meresti caves in the Persani Mountains in Southern Carpathians (L. Barti, pers. comm.). All these findings strongly suggest that cave dwelling is not a recent occurrence in this region.

The decline in population sizes evident in the colony at Sura Mare cave seems to be the result of human perturbation. As in the rest of Europe, cave dwelling bats have shown dramatic declines in the last decades (Stebbings, 1988). This phenomenon may be a consequence of the increasing popularity of cave tourism. Similar, but more drastic, is the case of the Manastirea Bistrita cave, which 40 years ago held aggregations of more than 10,000 individuals of a few species, including small aggregations of *P. pipistrellus* (Dumitrescu *et al.*, 1963). At present, all these aggregations are extinct, and the cave is used daily as a place of cultic or religious worship. In the case of the other caves used by pipistrelles, it is not possible to document declines, due to the lack of earlier data.

These recent records of large aggregations of pipistrelles within the Carpathians suggest that this area is particularly important for these bats during hibernation. The diversity of bats in the underground sites of the Carpathian Basin also reveals the importance of the area for other cave dwelling bat species. At present caves in Romania are not protected as important bat roosts. The lack of legal and practical conservation measures makes the long-term existence of these unique places particularly vulnerable. Developing an action plan for the conservation of the cave dwelling bat species at a national and international level is clearly a high priority.

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