Scientific contributions

Note on the echolocation call frequency of *Hipposideros beatus* Andersen, 1906

Klaus-Gerhard HELLER[1] and Marianne VOLLETH[1,2]

[1]Grillenstieg 18, 39120 Magdeburg, Germany
[2]Department of Human Genetics, Otto-von-Guericke University, Leipziger Str. 44, 39120 Magdeburg, Germany

heller.volleth@t-online.de

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Echolocation sounds of rhinolophid and hipposiderid bats typically contain a long **c**onstant **f**requency part followed by a short **f**requency-**m**odulated part (cf/fm bats). In these species, the flying animal changes the frequency of the constant-frequency part in such a way that the frequency of the returning echo remains constant (Doppler effect compensation). The echo arrives in the auditory fovea of the bat, enabling flutter detection of moving prey (SCHNITZLER and DENZINGER, 2011). The frequency of the cf component is species specific, in hipposiderids often with a larger variation than in rhinolophids. For example, SCHNITZLER and DENZINGER (2011) report 81.0 to 84.2 kHz in 24 individuals of *Rhinolophus ferrumequinum* from one population, and 111 to 124 kHz in 18 individuals from the hipposiderid species *Asellia tridens*.

Here we present data on the echolocation frequency of *Hipposideros beatus* Andersen, 1906, which confirm the results reported by NOVICK (1958) and thus the unusually high frequency variation in this taxon (see below). *H. beatus* is considered to be a member of the *Hipposideros caffer/ruber* complex *s. l.* (MONADJEM *et al*., 2013), for which some echolocation data are available (e.g., HELLER, 1992; GUILLEN *et al*., 2000; HAPPOLD, 2013a).

Material and Methods

The bats were captured (but not collected) with mist-nets in Irangi, Democratic Republic of the Congo (DRC; formerly Zaire; 1.90°S 28.45°E) on 15th of March 1990 at about the same place, where we have made some other bat observations (HELLER, 1992; HELLER *et al.*, 1994). The echolocation sounds of hand-held animals were recorded with a custom-made condenser microphone (similar to e.g., QMC SM1) and amplifier on a videorecorder converted to monitor sound (bandwidth up to 300 kHz). For evaluation, calls were re-recorded with a RACAL store DS tape recorder and after appropriate slow down (mostly 32x) analysed with a MOSIP-FFT-processor (Fa. MEDAV, D-91080 Uttenreuth).

Results

Hipposideros beatus is a small member of the *caffer/ruber* complex with two lateral leaflets at the nose-leaf (Figure 1) as in most other members of the group (HAPPOLD, 2013a). In our two animals (data on sex and size not available) the frequencies of the cf-part were 109.2 and 111.6 kHz. Both specimens were captured from a group of four resting under a broken tree after disturbance during day-time.

Table 1. Echolocation frequencies of *Hipposideros beatus*

Country	Locality	Frequency	Publication
Côte d'Ivoire		139-147 kHz (n=?)	HAPPOLD, 2013b, based on FAHR and EBIGBO, *pers. comm*.
Liberia/Guinea	Mt. Nimba 7.60°N, 8.39°W	129 kHz (n=1) Anabat SD2 bat detector	MONADJEM *et al*., 2013
Congo	Lac Tumba 0.77°S, 18.01°E	129 kHz (n=1) pulse detector microphone 108 kHz (n=1) solid dielectric microphone	NOVICK, 1958
Congo	Irangi 1.90°S, 28.45°E	109.2 kHz, 111.6 kHz (n=2) custom-made condensor microphone	this paper

Discussion

At the time we made the recordings, the results for *H. beatus* were not very surprising, since NOVICK (1958) had already found this species calling at 108 kHz from Lac Tumba in northwestern DRC. He had also reported another individual at the same site calling much higher, at 128 kHz. This specimen was recorded with another type of microphone, so that we could not exclude recording artefacts in these early days of ultrasound recording. In addition, this observation was not mentioned in HAPPOLD (2013b). However, recent recordings in West Africa confirm the high frequency or indicate even higher call frequencies in *H. beatus* (up to 147 kHz; see Table 1). In the light of these new findings our results become more remarkable because a range of nearly 40 kHz (see Table 1) in the echolocation frequencies in a single species, even recorded at different localities, is quite unusual. From the distribution, our animals clearly belong to the subspecies *H. beatus maximus* Verschuren, 1957 (type locality DRC, Garamba National Park, 4°N, 29.25°E). Interestingly, Novick's recordings are also assumed to be *H. beatus maximus* (Happold, 2013b), but they were made close to the proposed border between the presently recognized subspecies *H. b. beatus* (type locality Equatorial Guinea, Rio Muni, Benito River, *fide* HAPPOLD, 2013b; about 1.52°N, 9.92°E [wikipedia]) and *H. b. maximus*. From the call frequencies (see Table 1) one could assume that Novick had by chance recorded one specimen from each subspecies at the same spot, thus indicating the existence of two full species. In *H. ruber*, the variation in call frequency (standard deviation) within one population is at maximum around 6 kHz (GUILLEN *et al.,* 2000), sex specific differences included, thus being much smaller than the 20 kHz difference between both of Novick's measurements. On the other hand, a difference of 20 kHz can be observed between closely related sympatric *Hipposideros* species. At our study site in Irangi, besides *H. beatus*, two other species of the group were recorded, assumed to be *H. ruber* (Noack, 1893) and *H. caffer* (Sundevall, 1846) (HELLER, 1992). The echolocation frequencies of these three species were clearly separated by around 20 kHz each: *H. beatus* 109-112 kHz, *H. ruber* 132-138 kHz and *H. caffer* 155-158 kHz, surprisingly the largest species having the highest calls and the smallest the lowest.

At present, it may be premature to change the status of the two *beatus* subspecies, but our data draw attention to this question. *H. beatus* is a taxonomically poorly known species with fascinating social behaviour: contrasting to the other members of the *caffer/ruber* complex, it seems to be one of the few monogamous bats (BROSSET, 1982).

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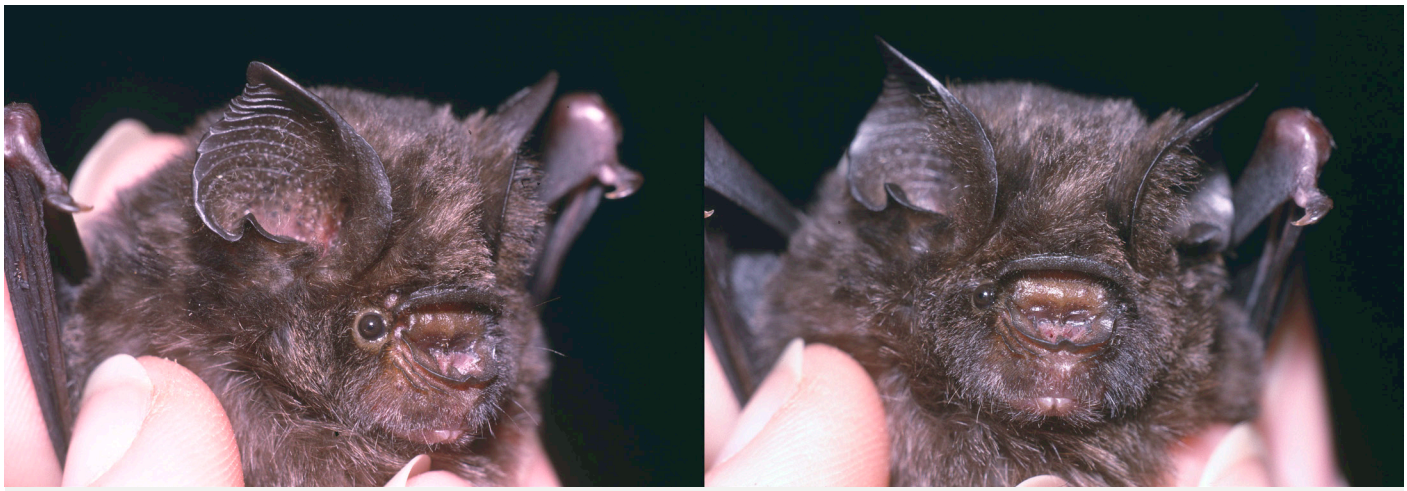

Figure 1. *Hipposideros beatus* (one individual) at Irangi, Congo (Democratic Republic).

from the Kivu region Central Africa Mammalia Chiroptera/links/575d3f1308aec91374ae8350.pdf?origin=publication_detail

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