



Short Note

Acoustic identification of free-flying Schreiber's bat *Miniopterus schreibersii* by social calls

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Abstract

Despite the recent advances in the identification of bat echolocation calls, some species are still difficult or impossible to distinguish at least under certain habitat conditions. Social calls are generally species-specific and may be successfully used to tell species apart. Echolocation calls of *Miniopterus schreibersii* can be distinguished from those of *Pipistrellus pipistrellus* and *P. pygmaeus* in many cases, especially when a multivariate approach to call identification is used, but call variables of these species still show a certain degree of overlap. In this study we provide a description of *M. schreibersii* social calls. They can be recorded both in roosting and foraging areas and their structure differs greatly from that known for social calls of the above-mentioned pipistrelles. Recording social calls from this species may lead to unambiguous identification and help assess its distribution when echolocation calls alone do not suffice.

Acoustic surveys are nowadays the most popular approach to detect bat presence and activity. They are not invasive and make it possible to record species that often evade capture. Several species can be identified confidently from their echolocation calls (e.g. Parsons and Jones, 2000; Russo and Jones, 2002; Preatoni et al., 2005; Papadatou et al., 2008). However, for some species reliable identification is not possible because call structural features overlap. Factors such as habitat structure, geographical area, colony membership, sex, age and presence of conspecifics may all generate within-species call variation (Russo and Jones, 2002) and in some cases make species identification a difficult, or impossible task. Echolocation call design may also be similar across species due to phylogenetic relatedness or adaptive convergence (Parsons and Jones, 2000).

Besides broadcasting echolocation calls for orientation and target detection, bats also emit social calls whose only function is communication (Fenton, 1985). Unlike echolocation call structure, whose variation is largely connected with the specific sensorial task faced by the bat (Obrist, 1995), social call structure is highly stereotyped and generally species-specific to ensure unambiguous communication (Fenton, 1985; but see Russo et al., 2009).

In some cases, social calls may greatly aid bat species identification and may be successfully employed to survey species distribution (Georgiakakis and Russo, 2012). For example, although *Pipistrellus kuhlii* and *P. nathusii* emit similar echolocation calls, their distinct social calls are most effective for species recognition (Russo and Jones, 1999; Jahelková et al., 2008).

The two cryptic pipistrelles *Pipistrellus pipistrellus* and *Pipistrellus pygmaeus* and Schreiber's bat *Miniopterus schreibersii* are largely sympatric across Europe, particularly in the Mediterranean region and several Eastern European countries (Dietz, 2013). They all emit echolocation calls showing an FM-QCF structure, i.e. made of a frequency modulated component followed by a constant frequency tract (e.g. Russo and Jones, 2002). Although such calls may be useful to distinguish

these species, especially when a multivariate approach to identification is adopted (Russo and Jones, 2002; Papadatou et al., 2008), call variables still show a certain degree of overlap so that in several circumstances confident species separation is impossible.

Both *M. schreibersii* and the above-mentioned pipistrelles may forage in urban areas, including in artificially illuminated sites (Russo and Jones, 2003; Vincent et al., 2011). In the latter or when natural light is available, the narrow-winged flight silhouette and higher speed of *M. schreibersii* are often sufficient to distinguish it from pipistrelles. However, such features are useless when bats are not visible (e.g. in dark sites), have been insufficiently observed, or when only audio recordings are available to the analyst (e.g. recordings made by surveyors others than the analyst not supported by field notes, or made by unattended automatic loggers).

In this study, we offer a novel solution to *M. schreibersii* identification based on previously unknown social calls.

We used calls recorded in Italy and in Greece in 2000–2012. Social calls were mostly recorded in or near the caves where they were emitted by bats emerging or flying near the entrance. We further attributed the social calls to *M. schreibersii* when they were included in echolocation call sequences and hence produced by bats emitting FM-QCF calls with an end frequency of 49 kHz to 53 kHz. As we had a thorough knowledge of the species occurring in such roosts, we are sure that only *Rhinolophus* spp. or *Myotis* spp. calls (producing echolocation calls totally different from those of *M. schreibersii*) may have been present in these recordings, ruling out all risk of confusion with other species. The presence of the species was also confirmed through harp-trapping and mistnetting over the recording occasions. These calls sometimes resemble feeding buzzes or insect ultrasound and may thus go unattended in call sequences recorded at feeding locations. Recording them in or near caves during chasing behaviour ensures that they were produced by *M. schreibersii*. Having been described at such sites, then their use can be extended to and applied at foraging sites.

We used (time-expansion) D980X, D240X and (direct sampling) D1000X bat detectors (Pettersson Elektronik AB, Uppsala). When a D240X or a D980X was used, recordings were made with a Roland R-

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Table 1 – Social call variables of 41 *Miniopterus schreibersii* recorded in Italy and Greece. TOTD = Total duration; Fmin = minimum frequency; Fmax = maximum frequency; FMAXE = frequency of maximum energy averaged across all call components; NOCOMP = number of call components.

Variable	Mean \pm SD	Range
TOTD (ms)	50.9 \pm 26.6	17.2–112.2
Fmin (kHz)	21.7 \pm 1.7	19.0–26.0
Fmax (kHz)	49.5 \pm 6.5	38.0–63.3
FMAXE (kHz)	30.3 \pm 1.5	27.3–33.8
NOCOMP	8.5 \pm 5.3	3–24

05 digital recorder. Sampling frequencies were 307 kHz and 384 kHz respectively for D980X/D240X and D1000X. Recordings were analyzed with the BatSound software ver. 4.1 (Pettersson Elektronik AB, Uppsala). We generated spectrograms with a 512-Hanning FFT window. For each social call, we measured the number of components to the call (NCOMP), the total duration of the call (TOTD), the minimum (Fmin) and maximum (Fmax) frequencies of the call, and the mean frequency of maximum energy (FMAXE) obtained by taking the frequency of maximum energy of each component and calculating the average. Frequency variables were expressed in kHz, time variables in ms. Only one social call per echolocation call sequence was used to ensure that those used for analysis were emitted by different bats.

We analyzed 41 social calls, each from a different bat. Calls consisted of a batch of short (< 5 ms) frequency-modulated (FM) pulses (Fig. 1). The number of pulses was highly variable, ranging between 3 to 24 components (Tab. 1).

Miniopterus schreibersii social calls were completely different from those broadcast by *P. pipistrellus* and *P. pygmaeus* (Barlow and Jones, 1997a; Russo and Jones, 2000) so the distinction among these species is clear and implies no risk of error. The social calls we describe are similar to type B calls described as “trills” in Pfalzer and Kusch (2003). As for their possible role, we suggest they can be employed in agonistic contexts because we often recorded them when bats chased each other. Such calls were also recorded from bats in free-flight in Italy (Lazio and Abruzzo, D. Russo, *pers. obs.*; Tuscany: T. Campedelli, *pers. comm.*) and Slovakia (M. Cefuch, *pers. comm.*), so we are sure that they are also broadcast away from roosts in situations where their occurrence may be most useful for identification. In Lazio and Abruzzo we recorded such calls in foraging sites (above riparian vegetation and near street lamps respectively), perhaps emitted by bats competing for prey or foraging patch. In these situations they may play a role similar to that of agonistic pipistrelle social calls (Barlow and Jones, 1997b).

Given the resemblance of these social calls with feeding buzzes, there might be some risk to misidentify feeding pipistrelles as *M. schreibersii* so care is needed into distinguishing the former from the latter.

It is unknown how frequently *M. schreibersii* broadcasts such calls. The fact that they have been so far overlooked by bat specialists suggests they are infrequent yet in some cases they may have been mistaken as feeding buzzes given the above-mentioned similarity with the latter.

Unlike *P. pipistrellus* and *P. pygmaeus*, featuring in Annex IV only of the EC/92/43 Habitats Directive, *M. schreibersii* is a species of community importance also included in Annex II, thus its protection requires designating Special Areas of Conservation. Therefore, misclassifying this bat as a pipistrelle may have significant consequences for habitat protection. Our study has considerable implications for bat conservation and habitat management as the observation of social calls greatly reduces misidentification risks. ☞

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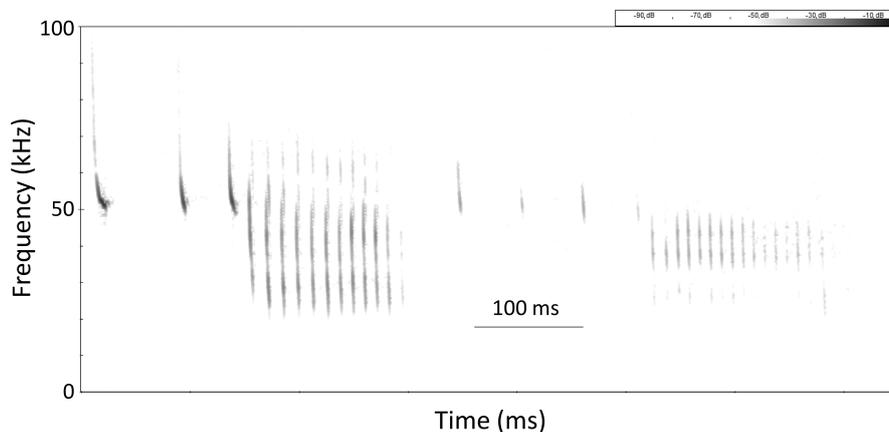


Figure 1 – Spectrogram of typical *Miniopterus schreibersii* social calls (buzz-like sequences of brief frequency modulated sweeps) associated with FM-QCF echolocation calls. The recording was made in July 2000 in the Benevento Province (southern Italy).