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

Danilo Russo*a, Elena Papadatoub

*aWildlife Research Unit, Laboratorio di Ecologia Applicata, Sezione di Biologia e Protezione dei Sistemi Agrari e Forestali, Dipartimento di Agraria, Università degli Studi di Napoli Federico II, via Università, 100, 80055 Portici (Napoli), Italy
bVernardou 14, 15235 Vrilissia (Athens), Greece

Keywords:
Bat detector
communication
echolocation

Abstract

Despite the recent advances in the identification of bat echolocation calls, some species are still difficult or possible 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; Pretoni 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-
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 (Petersson 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 (Table 1).

**Table 1** — Social call variables of *Miniopterus schreibersii* recorded in Italy and Greece.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean ± SD</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTD (ms)</td>
<td>50.9 ± 26.6</td>
<td>17.2–112.2</td>
</tr>
<tr>
<td>Fmin (kHz)</td>
<td>21.7 ± 1.7</td>
<td>19.0–26.0</td>
</tr>
<tr>
<td>Fmax (kHz)</td>
<td>49.5 ± 6.5</td>
<td>38.0–63.3</td>
</tr>
<tr>
<td>FMAXE (kHz)</td>
<td>30.3 ± 1.5</td>
<td>27.3–33.8</td>
</tr>
<tr>
<td>NCOMP</td>
<td>8.5 ± 5.3</td>
<td>3–24</td>
</tr>
</tbody>
</table>

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.

**References**


Dietz C., 2013. Natürlicher Fledermaus Europa: Alle Arten erkennen und sicher bestimmen. Kosmos, Germany. [In German]


