

ORIGINAL ARTICLE

First record of male drumming call of the genus *Capnioneura* Ris, 1905 (Plecoptera, Capniidae)

J. Manuel TIERNO DE FIGUEROA¹, Julio M. LUZÓN-ORTEGA² and Manuel J. LÓPEZ-RODRÍGUEZ¹

¹Departamento de Biología Animal, Facultad de Ciencias, Universidad de Granada, Campus Fuentenueva s/n; and ²Hydraena S. L. L. Plaza del Baño, Granada, Spain

Abstract

The male call of *Capnioneura mitis*, produced by drumming, is recorded and analyzed for the first time. It also represents the first known signal for the genus. It consists of a highly variable number of beats (2-32) with inter-beat duration approximately constant along the call, but inter-beat duration is temperature dependent. Thus, at 13°C the mean inter-beat duration is 1.397 s (SD = 0.050) while at 21°C it is 1.139 s (SD = 0.093). The call pattern exhibited by this species, as those of the majority of previously studied Capniidae species, can be catalogued as an ancestral or near-ancestral percussive monophasic signal.

Key words: Capnioneura mitis, Southern Iberian Peninsula, stonefly, vibrational communication.

INTRODUCTION

The family Capniidae includes approximately 315 species and 17 genera distributed mainly in North America, Europe and Asia, but also in Northern Africa and Central America (Fochetti & Tierno de Figueroa 2008). The genus *Capnioneura* Ris, 1905 shows a West Palearctic distribution, with a distribution area that spreads from the Caucasus to the Iberian Peninsula, including the Maghreb region. The genus includes 12 species, 11 of them present in Europe (Tierno de Figueroa 2006). The diversity of *Capnioneura* is not uniformly distributed: the Iberian Peninsula, with six species recorded, is one of the places in Europe where the genus is better represented.

The vibrational communication of Capniidae was cited for the first time in *Capnia bifrons* (Newman, 1838) by Brinck (1949), who heard the males "drum on the substratum by sticking it [the substratum] several times in rapid succession with the abdomen".

Correspondence: J. Manuel Tierno de Figueroa, Departamento de Biología Animal, Facultad de Ciencias, Universidad de Granada, Campus Fuentenueva s/n, 18071, Granada, Spain. Email: jmtdef@ugr.es *Received 5 March 2009; accepted 11 May 2009.*

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Afterwards, Rupprecht (1965, 1968, 1969, 1982) recorded, analyzed and described in detail the call of this species and also described the different signals presented by several European populations (Rupprecht 1982, 1997). Nevertheless, despite the differences, the call of the *C. bifrons* male could be described as a sequence of beats with a varied beat-interval.

In North America, the drumming calls of some species belonging to five genera of Capniidae have been studied: *Allocapnia* Claassen, 1928; *Bolshecapnia* Ricker, 1965; *Capnia* Pictet, 1841; *Isocapnia* Banks, 1938; *Mesocapnia* Raušer, 1968 (Stewart & Zeigler 1984; Stewart *et al.* 1991; Stewart & Maketon 1991; Abbott & Stewart 1997). The relatively simple monophasic signals of species studied belonging to the genera *Allocapnia*, *Bolshecapnia*, *Capnia* and *Isocapnia* suggested that drumming in the Capniidae had remained near-ancestral (Abbott & Stewart 1997). Nevertheless, the study of the communication of three species of *Mesocapnia* showed that two of these species presented more complex and derived calls composed of complex grouped signals (Abbott & Stewart 1997).

The aim of our study is to describe for the first time the male call of the genus *Capnioneura*, particularly the call of *Capnioneura mitis* Despax, 1932 (a species present in Western Europe and widely distributed on the Iberian Peninsula), recorded at two different temperatures.

MATERIALS AND METHODS

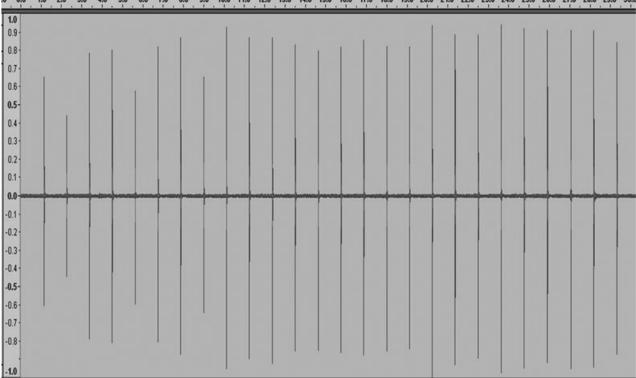
Groups of adults of *Capnioneura mitis* (both males and females) from the River Trevélez (Sierra Nevada, Southern Spain; 1470–1975 m a.s.l., 37°00'24.00"N, 3°15'31.14"W at 1470 m a.s.l., 37°03'43.71"N, 3°14'37.77"W at 1975 m a.s.l.), collected on 29 January 2009, were placed in different crystal pots with a piece of paper at the opening. Records were taken during the following two days in a light room at two different constant temperatures of 13 and 21°C.

The calls were recorded using a microphone (100– 16 000 Hz, 44 dB V/Pa) sited in light contact with the paper surface, and attached to a computer. Audacity v1.2.6 software (Free Software Foundation, Boston, MA, USA) was used for recording and analyzing the calls.

For each call, the number of beats and interval duration between beats (inter-beat duration) were analyzed. No female answers were detected. Calls from males recorded at different temperatures were compared using a non parametric Mann–Whitney *U*-test because normality assumptions were not achieved by the data (Kolmogorov–Smirnov d = 0.185, P < 0.05 for calls registered at 13°C, and d = 0.222, P < 0.05 for calls registered at 21°C).

RESULTS AND DISCUSSION

We obtained 14 calls from four males recorded at 13°C and 24 calls from eight males at 21°C (Fig. 1). Call overlapping between two different males occurred sometimes, but in all cases there was a clear differentiation between them (Fig. 2). Moreover, sometimes males were observed to produce a single beat. The male call is produced by drumming and it consists of a sequence of beats with an approximately constant inter-beat duration. The number of beats and, consequently, the total duration of the call, are highly variable (2-19 beats/call at 13°C, 2-32 beats/call at 21°C; means of 6.500 and 8.208 beats/call, respectively). The inter-beat duration is approximately constant among calls from males at the same temperature (1.311-1.741 s, mean = 1.397 s,SD = 0.050 at 13°C; 0.801–1.346 s, mean = 1.139 s, SD = 0.093 at 21°C). Nevertheless, this parameter significantly varies among calls recorded at different temperatures (Mann–Whitney U = 7.000, Z adjusted = -12.633; P < 0.05).



0 0.0 1.0 2.0 3.0 4.0 5.0 6.0 7.0 8.0 9.0 10.0 11.0 12.0 13.0 14.0 15.0 16.0 17.0 18.0 19.0 20.0 21.0 22.0 23.0 24.0 25.0 26.0 27.0 28.0 29.0 30.0

Figure 1 Sonogram of a long male drumming call of Capnioneura mitis at 21°C.

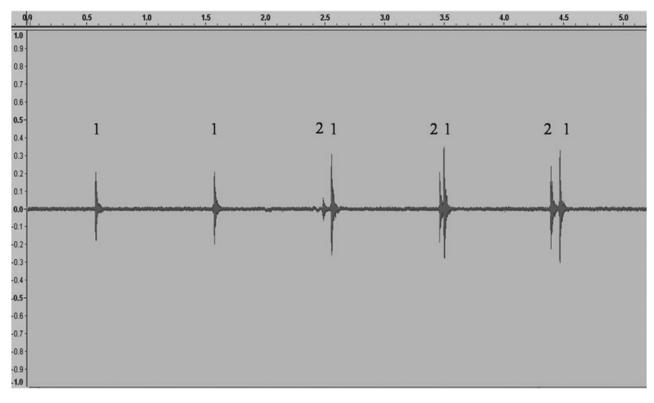


Figure 2 Sonogram of two overlapped male drumming calls (shown as 1 and 2) of Capnioneura mitis at 21°C.

Although no female answers were detected, in some cases a clear approach of the female to the male (in response to the male call) and posterior copulation were observed.

Thus, the male call of *C. mitis*, as those of other Capniidae except *Mesocapnia lapwae* (Baumann and Gaufin, 1970) and *M. yoloensis* (Baumann and Gaufin, 1970) (Abbott & Stewart 1997), is a relatively simple, monophasic signal, representing a near-ancestral pattern. It must be noted that the beat frequency has little variability, which is the main parameter of the male call that seems to be recognized by the females, while the total number of beats shows a large variation. Nevertheless, as previously pointed out by other authors since Zeigler and Stewart (1977) proved for the first time the temperature dependence of drumming signals, this parameter is influenced by the temperature, with increased beat frequency at higher temperatures.

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