Vibrational communication in Tetrix ceperoi: description of male and female songs

Petr Kočárek

Faculty Science, University of Ostrava, CZ-710 00 Ostrava, Czech Republic; e-mail: petr.kocarek@osu.cz

UNIVERSITAS OSTRAVIENSIS

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INTRODUCTION

Traditionally, Tetrigidae have been considered to be voiceless orthopteroids (Ingrisch & Köhler 1998). Vibrational signals in the genus *Tetrix* were for the first time found by Benediktov (1998). Recently, vibratory signals of ten species of Tetrigidae from Russia, the Ukraine and Kirgizia have been described, but not all of them completely (Benediktov 2005; Pushkar 2009) The vibrations (produced as rhythmic contractions of muscles) are transmitted to the substrate through middle legs which do not produce any visible movements. The presented study describes the vibratory signalisation in the species *Tetrix ceperoi* (Bolívar, 1887) for the first time.

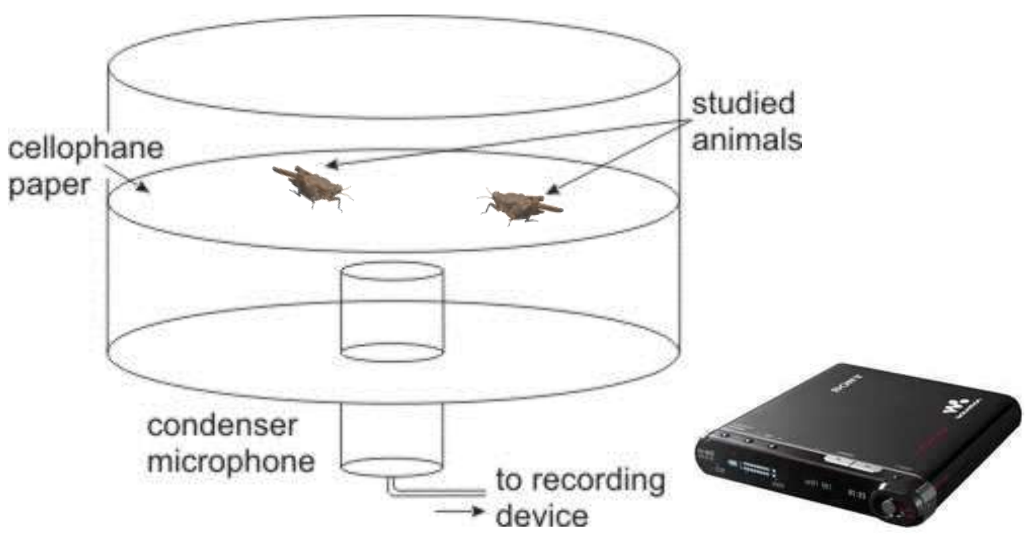


Fig 3: Scheme of apparatus used to recording of substrate transmitted vibrations of *Tetrix.*

Figs 1, 2: *Tetrix ceperoi* (Bolívar, 1887) is a West-Mediterranean species, which reaches the north-eastern edge of its range in Central Europe. In the Czech Republic, the species has been reported for the first time in 2002 and up to now we know only few localities in southern Moravia. *T. ceperoi* is restricted to damp, warm habitats, such as dune valleys, sand pits or heath ponds and it is prefers sand substratum. Fig. 1: female on typical substratum; Fig. 2: pair in copula feeding on *Atrichum undulatum*

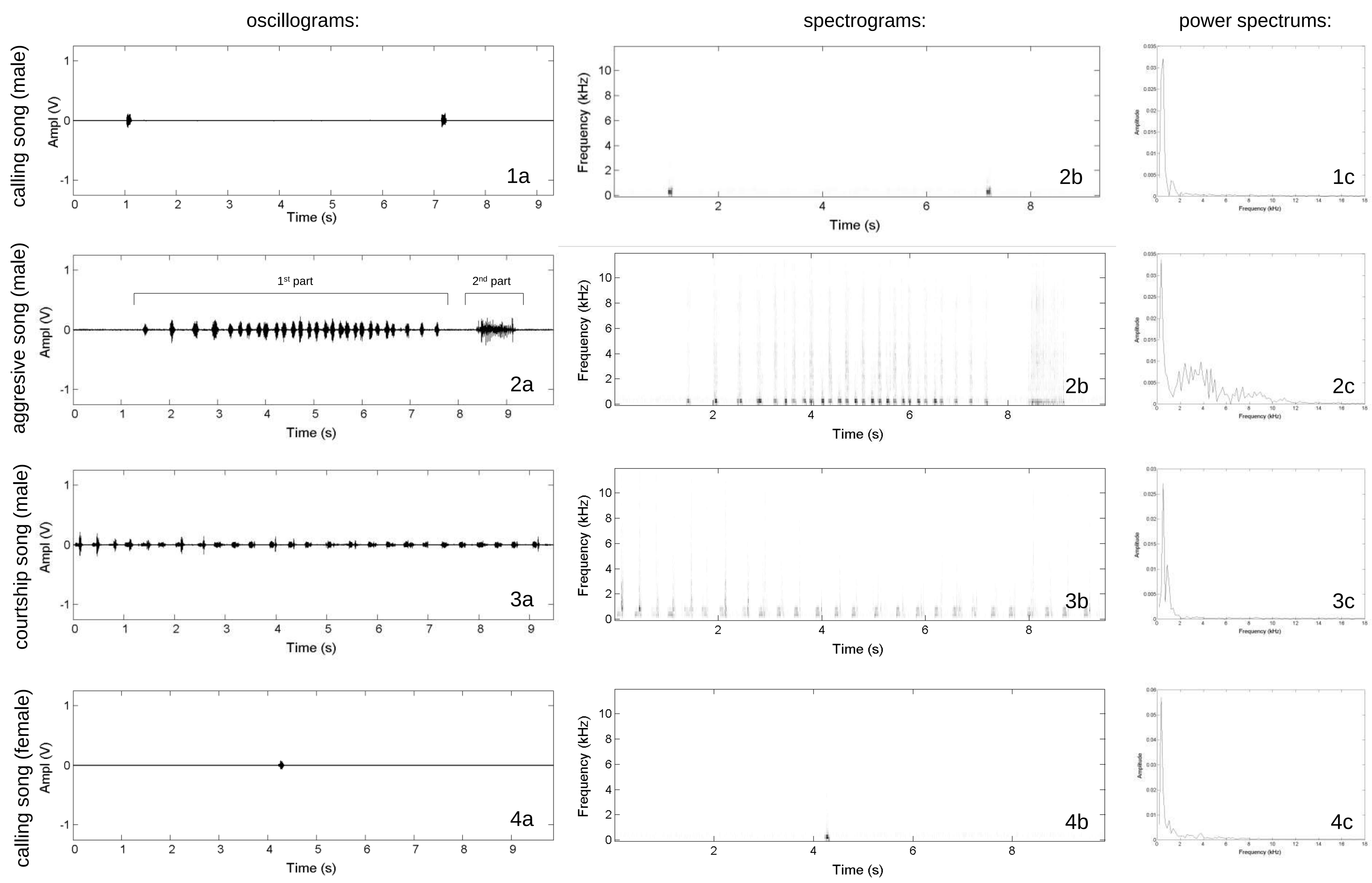
MATERIAL AND METHODS

The *Tetrix* vibrations produce very low intensity sounds not audible for humans, so the recordings need special technology. Methods for obtaining the recordings of such low intensity vibrations were proposed by Benediktov (2005) and Kanmyia (2006). In this study, the recordings was made by the modification of the both mentioned methods. The recordings were performed on the arena made from plastic circular half-opened container (10cm in diameter) with a sheet of cellophane paper fixed on the rim (Fig 3). The cellophane is used to pick up the substrate-born sounds produced by the insect through the contact with its surface. The sound pressure caused by *Tetrix* vibration produce standing waves in the cellophane, and the vibration of cellophane result in greatly amplified oscillation of the diaphragm of a condenser microphone fixed under the cellophane. The high sensitive condenser microphone microphone (type MCE-2500) was attached to recording device (mini-disc recorder SONY MZ-RH1). The obtained sound was processed on PC with help of the software Cool Edit Pro ver.2.0 and, filtered out and the temporal characteristics, oscillogram and spectrograms were analysed and compared by analytical instruments of this software. Presented graphs were generated by Sound Ruler ver. 0.941 (Gridy-Papp 2004).The measurements were performed under laboratory conditions at temperature between 25-27°C. The usage and significance of vibratory signals within the intraspecific interactions were studied by means of manipulated contacts of individual insects of each sex (male-male, male-female, female-female interactions).

RESULTS

The observed vibrational signals consist of more or less distinct pulses united into rhythmically repeated groups. Males of *T. ceperoi* produce signals of three functional types: calling, aggressive and courtship. (1) The calling signal is produced by males in order to attract conspecific females and it consists of simple irregularly repeated pulses (duration of pulse 100±10ms, frequency 0.05-0.8kHz). (2) The courtship signal is produced by males only in close proximity to a female and it is used for inducing females to mate. This signal is quieter and consists of more regularly and quickly repeated pulses (duration 85±15ms, interpulse intervals 260±50ms, carrier frequency 0.3-0.5kHz). (3) The aggressive signal is the most complicated one because it consists of two different parts and each part can be used separately or in the complex. These signals are produced by males usually during close contact with other conspecific male. The first part of the signal consists of 3-30 regularly repeated pulses (duration 95±20ms, interpulse intervals 125±80ms); the second part consists of 20-135 regularly repeated pulses (duration 18±3ms, interpulse intervals 40±25ms; carrier frequencies of both parts 0.05-0.3kHz). Production of vibrational signals (esp. calling and courtship) is accompanied by specific visual communication behaviour described by Hochkirch et al. (2006), but the production of vibrations and the above mentioned behaviour are not time synchronised.

Females of *T. ceperoi* are also able to produce vibrations, which are similar to male's calling vibration and are produced irregularly during contacts with other intra- or interspecific individuals (duration 90±10ms, frequency 0.05-0.3kHz).



Figs 1-4: Functional types of vibratory signales produced by *Tetrix ceperoi.* Fig 1: male calling signal, Fig 2: male aggressive signal, Fig 3: male courtship signal, Fig 4: female calling song. The first column (a) – oscillograms (relative amplitude vs. time in seconds); the second column (b) – spectrograms (frequency in kHz vs. time in seconds); the third column (c) – power spectrums (portion of a signal's power falling within given frequency bins). Laboratory conditions, temperature 25-27°C.

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