BIOACOUSTIC STUDIES ON SOME CRICKET SPECIES
(INSECTA: ORTHOPTERA: GRYLLIDAE) FROM ROMANIA

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Abstract. There are 9 cricket species known from Romania belonging to the family Gryllidae. The ordinary stridulation of 7 species of those has been analyzed in this paper. The species belonging to the subfamily Gryllinae: Gryllus campestris, Acheta domestica, Melanogryllus desertus, Modicogryllus frontalis and Modicogryllus truncatus stridulate especially in the afternoon and in the evening, rarely during daytime, meanwhile the species Pteronomobius heydenii from the subfamily Nemobini was investigated only during daytime and especially on sunny weather, while the only species belonging to the subfamily Oecanthinae from our country fauna, Oecanthus pellucens, stridulates at night, very rarely during daytime (mostly in autumn). Details of the stridulatory vein and identification criteria for the studied cricket species are presented in this paper; also we have analyzed the spectrograms and the oscillograms for the ordinary stridulation of the 7 species. The species Modicogryllus truncatus, collected at Mărăşeşti, is a new report for Moldavia.

Keywords: crickets, bioacoustics, oscillogram, spectrogram.

Introduction
The stridulation is generally produced by rubbing a file across a membrane. The Orthoptera have two mechanisms for sound production: a file on one wing rubs across a roughened surface on the other wing (Ensifera) or a file on the foreleg is drawn across a special vein of the wing (Caelifera). The sound may be amplified by resonation in a wing or by causing a column of air to resonate in a chamber excavated for the purpose. That is why many cricket species stridulate at the borrow entrance. There are some types of stridulation, like the ordinary stridulation, the courtship song, the rivalry stridulation. In this paper we analysed the calling song (ordinary stridulation) for 7 cricket species from the eastern and south-eastern parts of our country.

Material and Methods
The recording of the calling songs were made using a Sony ICD SX56 recorder, in the field and laboratory conditions. Recording was made at 10 cm distance from the insect, at temperatures between 19-32°C. The electro-microscopy photos were taken with a Vega Tescan electronic microscope. The species identification and the calling song recording methods were made according to Kis (1976), Ragge & Reynolds (1998), Baur...
et al. (2006). The classification and nomenclature were used according to Eades & Otte (2008).

The species were recorded and collected from the following sites:
Subfamily Gryllinae

*Gryllus campestris*: 17♂♂ at Paşcani (May 2007, 19ºC), 8♂♂ at David’s Valley (Iaşi) (May 2007, 22ºC), 1♂ at Botanical Garden Iaşi (May 2007, 21ºC);
*Acheta domestica*: 3♂♂ at Paşcani (August 2007, 27ºC);
*Melanogryllus desertus*: 5♂♂ at Codrii Paşcanilor (July 2007, 29ºC), 7♂♂ at Bucharest (August 2007, 30ºC);
*Modicogryllus frontalis*: 13♂♂ at Paşcani (August 2007, 28ºC), 12♂♂ at Codrii Paşcanilor (July 2007, 30ºC), 2♂♂ at David’s Valley (Iaşi) (July 2007, 29ºC);
*Modicogryllus truncatus*: 2♂♂ at Mărăşeşti (August 2007, 29ºC), 21♂♂ at Bucharest (August 2007, 30ºC);
Subfamily Nemobiinae

*Pteronomobius heydenii*: 1♂♂ at Codrii Paşcanilor (June 2007, 24ºC), 10♂♂ at Botanical Garden Iaşi (June 2007, 26ºC), 3♂♂ at Botanical Garden Bucharest (June 2007, 27ºC);
Subfamily Oecanthinae

*Oecanthus pellucens*: 2♂♂ at Paşcani (August 2007, 28ºC), 1♂ at David’s Valley (Iaşi) (August 2007, 27ºC), 4♂♂ at Botanical Garden Iaşi (September 2007, 26ºC), 8♂♂ at Sulina (September 2007, 27ºC), 16♂♂ at Agigea (August 2006, 32ºC).

**Results and Discussion**

The seven cricket species we studied revealed, as an already known fact, that they can be easily recognized and determined only by listening to their specific calling song. An analysis of the stridulation is described below, completed with electromicroscopy photos of the stridulatory vein (pars stridens). Table 1 synthesizes the bioacoustic studies on the analyzed individuals from the 7 cricket species.

**Family Gryllidae**

Subfamily Gryllinae

*Gryllus campestris* (Linné, 1758) (Figs. 1; 8; 15; 22) - has one of the most known songs in the animal kingdom. This calling song is composed of echemes of 3 (rarely 4-5) hemisyllables, each echeme having 0.2 seconds. The song is in crescendo from the first to the last hemisyllable. The gaps between echemes are variable between 0.1 and 0.3 second at 20-22ºC. It stridulates from May to June, mostly in the evening and at night. The stridulation is very intense being heard from over 90-100 meters. The pars stridens has approximately 4.6 mm (the area with stridulatory pegs) and a number of 150 pegs.

*Acheta domestica* (Linné, 1758) (Figs. 2; 9; 16) - the calling song is composed from echemes of 2-3 hemisyllables, each echeme having 0.2 seconds. Gaps between echemes are variable between 0.8 and 1 second at 27ºC. The species stridulates especially in the summer, though adults can be found all year long. It stridulates at night and the stridulation can be heard from over 10-15 meters. The pars stridens has approximately 3.1 mm (area with stridulatory pegs) and 171 pegs.

*Melanogryllus desertus* (Pallas, 1771) (Figs. 3; 10; 17) - the species stridulates from June to September, in the evening and at night. The calling song is composed from echemes of 12-13 hemisyllables and the gaps between echemes are very variable, from 0.1 and 0.5 second at 30ºC and sometimes more than 1 second at a temperature below 20ºC. An echeme has 0.2 – 0.3 seconds.
The stridulation begins in the afternoon and lasts until late at night; it can be heard from more than 15 meters. The pars stridens has approximately 2,5 mm (the area with stridulatory pegs) and 136 pegs.

*Modicogryllus frontalis* (Fieber, 1845) (Figs. 4; 11; 18) - males can be heard stridulating from early July until late September. The echemes are composed of 18-20 hemisyllables and the gaps between those echemes are variable between 0.1 and 3 seconds, depending on the temperature. For example, at 29°C those gaps are 0.2-1.5 seconds. The echeme has 0.2-0.3 seconds. *Modicogryllus frontalis* begins its stridulation in the afternoon and at night, but not rarely we can hear this species singing at day time (especially in sunny days). Pars stridens is approximately 1,2 mm long (area with stridulatory pegs) and has 139 pegs.


*Modicogryllus truncatus* (Tarbinsky, 1940) (Figs. 5; 12; 19; 23) - 2 males from this species were captured in the southern part of Moldavia, at Marasesti, by following their stridulation which was emitted from the railway gravel. This species is a new report
for Moldavia, so far being known from Muntenia and south-western Dobroudgea. Song characteristics: echemes have 0.7-1 second; gaps between 2 consequent echemes: 0.2-2seconds; number of hemisyllables of an echeme: 5-6. This species stridulates between late June and late September, in the afternoon and at night. The song can be easily distinguished from the *Modicogryllus frontalis* stridulation, as the oscillogram shows. Both species stridulation can be heard from more than 20 meters, mentioning that the *Modicogryllus truncatus* song is a little louder. The stridulatory pegs area of the pars stridens has approximately 1.4 mm and 122 pegs.

**Subfamily Nemobiinae**

*Pteronemobius heydenii* (Fischer, 1853) (Figs. 6; 13; 20) - this species stridulates from May to July; stridulation being emitted all day long and sometimes at night. It can be heard from maximum 30 meters, but the individuals can hardly be located. The echeme has 1.5-3 seconds and each echeme is composed from more than 50-60 hemisyllables. Gaps between echemes can be from 1 to 5 seconds long, depending on the temperature: as higher the temperature, as shorter the gap is. The pars stridens has approximately 0.9 mm (the area with stridulatory pegs) and a number of 105 pegs.

**Subfamily Oecanthinae**

*Oecanthus pellucens* (Scopoli, 1763) (Figs. 7; 14; 21) - this species calling song is very common and well known because it can be heard everywhere with exception of the mountains. The species stridulates at night and very rarely we can hear it singing during day time, usually in late autumn. Each echeme has a number of 25-40 hemisyllables and a 0.8-1.2 seconds length. Gaps between two successive echemes are 0.4-1 second long. In the warm nights, the gaps have a very small length, meanwhile in the colder autumn nights the gaps have a bigger length, sometimes up to more minutes. The pars stridens has approximately 1.5 mm (area with stridulatory pegs) and only 46 pegs.

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**Figure 22.** *Gryllus campestris*, stridulating (Pașcani, 05.05.2007)(photos by I. Iorgu).

**Figure 23.** *Modicogryllus truncatus*, stridulating (București, 26.06.2007).
Table 1. Comparative analysis of the calling song and the pars stridens for the studied individuals.

<table>
<thead>
<tr>
<th>Species</th>
<th>Calling song characteristics</th>
<th>Pars stridens</th>
<th>Stridulatory pegs (pars stridens)</th>
<th>Studies made at temperature of (ºC)</th>
<th>Medium frequency (kHz)</th>
<th>Approximate acoustic intensity (dB)</th>
<th>Approximate scheme length (s)</th>
<th>Approximate gap length between schemes (s)</th>
<th>Number of hemisyllables of an scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gryllus campestris</td>
<td>4.6</td>
<td>150</td>
<td>19 - 22</td>
<td>4 - 12</td>
<td>-15 -- -50</td>
<td>0.2</td>
<td>0.1 – 0.3</td>
<td>3 - 5</td>
<td></td>
</tr>
<tr>
<td>Acheta domestica</td>
<td>3.1</td>
<td>171</td>
<td>27</td>
<td>3 - 13</td>
<td>-10 -- -45</td>
<td>0.2</td>
<td>0.8 - 1</td>
<td>2 - 3</td>
<td></td>
</tr>
<tr>
<td>Melanogryllus desertus</td>
<td>2.5</td>
<td>136</td>
<td>29 - 30</td>
<td>4 - 11</td>
<td>-10 -- -50</td>
<td>0.2 – 0.3</td>
<td>0.1 – 0.5</td>
<td>12 - 13</td>
<td></td>
</tr>
<tr>
<td>Modicogryllus frontalis</td>
<td>1.2</td>
<td>139</td>
<td>28 - 30</td>
<td>2 - 16</td>
<td>-5 -- -55</td>
<td>0.2 – 0.3</td>
<td>0.1 – 3</td>
<td>18 - 20</td>
<td></td>
</tr>
<tr>
<td>Modicogryllus truncatus</td>
<td>1.4</td>
<td>122</td>
<td>29 - 30</td>
<td>5 - 13</td>
<td>-15 -- -50</td>
<td>0.7 - 1</td>
<td>0.2 – 2</td>
<td>5 - 6</td>
<td></td>
</tr>
<tr>
<td>Pteronemobius heydenii</td>
<td>0.9</td>
<td>105</td>
<td>24 - 27</td>
<td>7 - 14</td>
<td>-20 -- -55</td>
<td>1.5 - 3</td>
<td>1 - 5</td>
<td>&gt; 50 - 60</td>
<td></td>
</tr>
<tr>
<td>Oecanthus pellucens</td>
<td>1.5</td>
<td>46</td>
<td>26 - 32</td>
<td>2 - 8</td>
<td>-10 -- -40</td>
<td>0.8 – 1.2</td>
<td>0.4 - 1</td>
<td>25 - 40</td>
<td></td>
</tr>
</tbody>
</table>

Conclusions

All the crickets are well known for their calling songs. Also they can be easily identified by listening to their stridulation, knowing that sometimes it is almost impossible to collect them because of their hidden way of life.

In this paper we analyzed the calling song and the stridulatory vein (pars stridens) for 7 cricket species from Romania, belonging to the subfamilies: Gryllinae (Gryllus campestris, Acheta domestica, Melanogryllus desertus, Modicogryllus frontalis and Modicogryllus truncatus), Nemobiinae (Pteronemobius heydenii) and Oecanthinae (Oecanthus pellucens).

The field cricket, Gryllus campestris, has a very well known callig song “tsri”, meanwhile the house cricket, Acheta domestica and the desert cricket, Melanogryllus desertus have short schemes, but high pitched. The two Modicogryllus species known from our country (M. frontalis – the eastern cricket and M. truncatus) can be easier identified by stridulation rather than by morphology. The species Modicogryllus truncatus, identified at Marasesti by its typical calling song is a new report for Moldavia, this site representing the northernmost record from our country. Among the crickets from our country, the marsh cricket, Pteronemobius heydenii, has the longest scheme, lasting about 3 seconds. The italian cricket (Oecanthus pellucens) has a loud calling song, heard in the evening and at night, being one of the most familiar insect sound in Europe.

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References
