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**PRELIMINARY DATA CONCERNING CALLING SONGS  
OF SOME MOUNTAIN ORTHOPTERA SPECIES (INSECTA)  
FROM ROMANIA**

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Abstract. In this paper the calling songs for seven Orthoptera species are presented, recorded in the field on Rarău Mountain and near Agapia Monastery in the summer of 2005 and 2006. All seven species stridulate from early 10-11 A.M. until dawn; the sunlight, the humidity and the temperature are the main factors that condition the stridulatory activity of the mountain Orthoptera species. The seven mountain Orthoptera species can be easily recognized in the field by the stridulation presented. This is the first paper concerning Orthoptera stridulation from Romania.

Résumé. On présente les chansons appelantes pour sept espèces d'orthoptères, rapportées pour le Mont Rarău et le monastère Agapia au cours de l'été 2005 et de l'été 2006. Chacune de ces sept espèces stridule à partir de 10-11 a.m. jusqu'au soir; la lumière du soleil, l'humidité et la température sont les facteurs principaux qui conditionnent l'activité stridulatoire des espèces d'orthoptères de montagne. Ces sept espèces d'orthoptères de montagne peuvent être facilement identifiées dans la nature grâce à leur stridulation spécifique. C'est le premier travail concernant la stridulation des orthoptères effectué en Roumanie.

Key words: Orthoptera, stridulation, spectrogram, oscillogram.

*INTRODUCTION*

Stridulation is one of the most fascinating aspects of Orthoptera ethology. In most cases, only the male stridulates. The song of the Orthoptera species plays an important role in conspecific recognition (Gwynne & Morris, 1986). Also, it is being used in female attraction and intraspecific male competition (von Helversen & von Helversen, 1994). At the same time, it plays an important role in reproductive isolation between closely related species that are sympatric (Hill et al., 1972). There are different types of stridulation: ordinary stridulation or calling song, courtship song, rivalry stridulation. Calling song is defined as the song produced by the solitary male when it is not in a direct response to another male or female (Ragge & Reynolds, 1998). The calling song structure is species-specific and it is used as a taxonomic character in groups of sibling species with similar morphological traits (Ragge & Reynolds, 1988). In this paper we want to show how we can identify some mountain Orthoptera species in the field by listening to their stridulation as an alternative method of identification.

*MATERIAL AND METHOD*

The stridulatory organ of Orthoptera species has the highest morphological development. At Ensiferans, the majority of wing veins form the stridulatory apparatus at the base of the wing. The song is produced by rubbing the fore wings over each other. Caeliferans have their stridulatory organs located on their tegmina

and on the posterior femur. Their song is produced by rubbing the hind femora up and down against the flexed forewings.

Field recordings of the calling songs were made using a Sony RCS 900 recorder, at the field conditions. Recording was made at 10-15 cm from the insect. The species identification and the calling song recording methods were made according to Ragge & Reynolds (1998), Bellman & Luquet (1995) and Baur et al. (2006).

At Rarău Mountain the stridulation recordings were made at 19°C for four Orthoptera species: 7 ♂♂ *Tettigonia cantans*, 12 ♂♂ *Metrioptera brachyptera*, 3 ♂♂ *Decticus verrucivorus* and 16 ♂♂ *Pholidoptera transsylvanica*. At Agapia Monastery, the recordings were made at 23°C for three Orthoptera species: 3 ♂♂ *Pholidoptera frivaldskyi*, 5 ♂♂ *Gryllus campestris* and 9 ♂♂ *Chorthippus parallelus*. The stridulation investigation sites are presented in fig. 1.

The analysis of the sounds was made using Batsound v.3.3 for making the oscillograms and spectrograms.

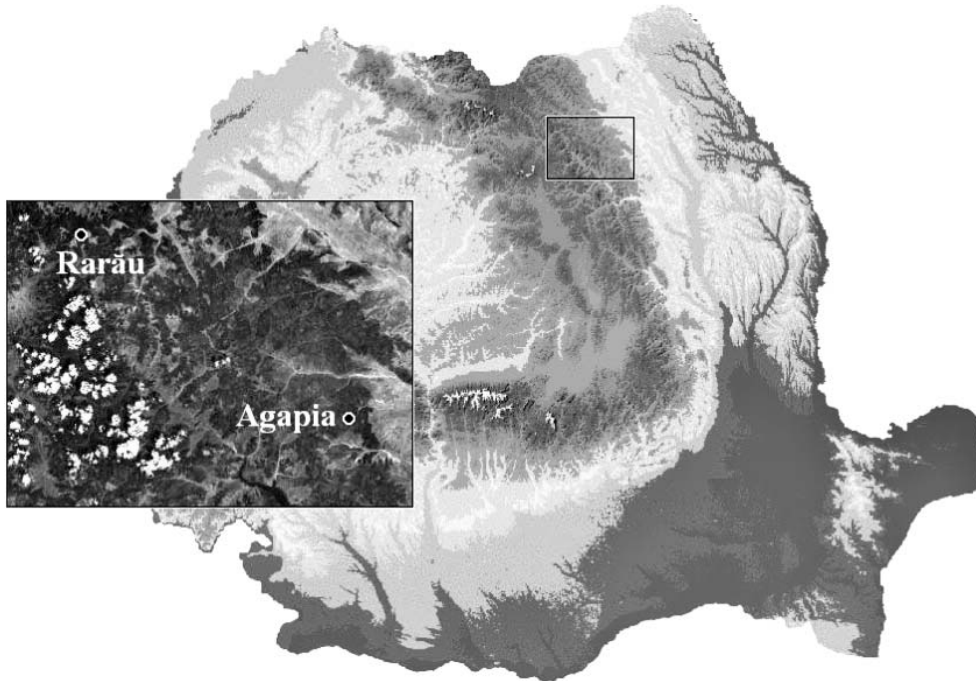


Fig. 1 – Stridulation recording sites at Agapia Monastery (Stânișoarei Mountain) and Rarău Mountain.

To describe better Orthoptera song presented in this paper we have adopted the following song terminology: syllable: the song produced by one to-and-fro movement of the stridulatory organ, a complete up and down stroke of the wings or femurs; hemisyllable: the song produced by one unidirectional movement of the wings or femurs; echeme: a first-order assemblage of syllables; echeme sequence is a first-order assemblage of echemes; gap: a pause between two echeme or echeme-sequences (Fig. 2).

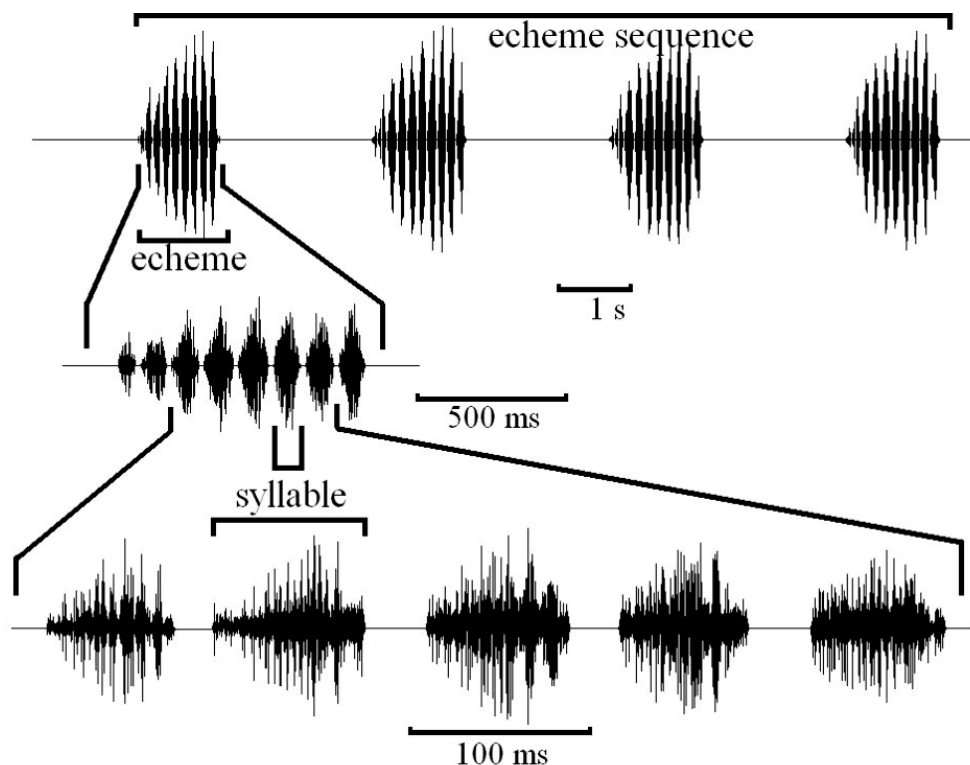


Fig. 2 – Song structure of Orthoptera species.

#### RESULTS AND DISCUSSION

##### *Tettigonia cantans* (Fuessli, 1775)

*Description:* body length is about 22-28 mm ♂, 24-31 mm ♀. The colour of the body is light green with a brown dorsal stripe. There are also yellow-orange individuals, but very rare. It is a meso-hygrophilous species characteristic to the mountains. It is an Eurosiberian species, very common in Northern and Central Europe and Siberia.

*Stridulation:* the intervals between syllables are very hard to distinguish, these belong to homogenous phrases of about 3-5 seconds. During the day, the gaps between the echemes are quite long, sometimes a few minutes long. In the evening these gaps tend to get shorter, and during the night the stridulation is realised almost without pause (Fig. 3). The stridulation has very high intensity and it can be heard as far as 70 meters. The mountain bushcricket sings starting at noon, and especially at sunset and at night (Fig. 10 A).

##### *Decticus verrucivorus* (Linné, 1758)

*Description:* body length is about 25-34 mm ♂, 25-38 mm ♀. The colour of the body is variable, the most common forms being green with brown spots on the tegminas. It is a mesophilous and xero-mesophilous species common in grasslands from sea level up to 1800 m altitude. It is an Eurosiberian species very common in Romania.

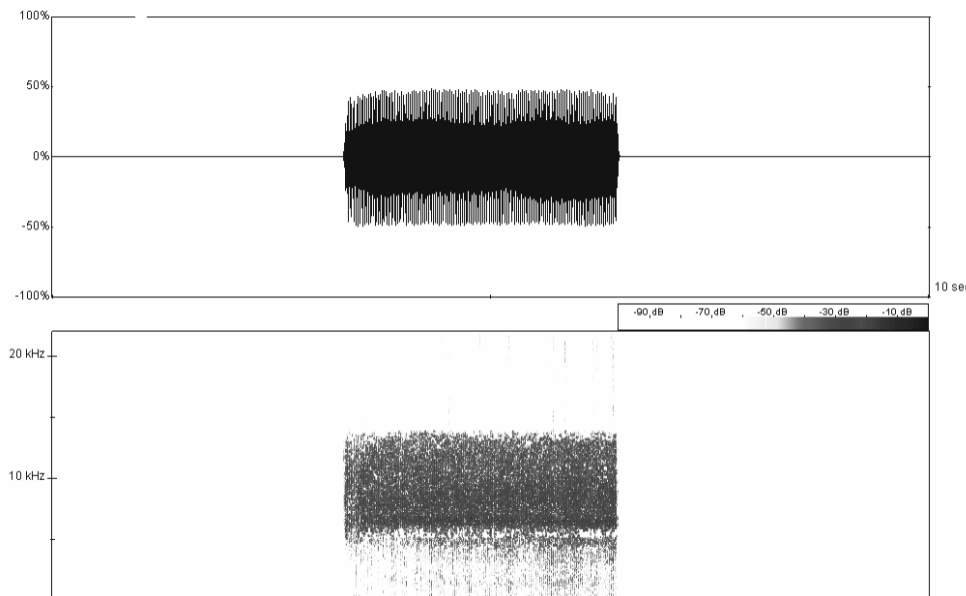


Fig. 3 – Oscillogram and spectrogram of the calling song of *Tettigonia cantans*.

*Stridulation*: the song consists of a continuous series of short echemes. The echeme sequence often lasts over one minute. The gaps between the echemes are about 0.1s (Fig. 4). The species stridulates mainly in sunlight. If it stridulates in cloudy sky, then the echemes are more isolated.

*Metriopectera brachyptera* (Linné, 1761)

*Description*: body length is about 14-16 mm ♂, 15-18 mm ♀. The colour of the body is brownish with the vertex, the pronotal disc and the anal border of the tegmina green. The posterior border of the pronotal lobes is white-grey. It is a species characteristic to the mountain grasslands, being a hygro-mesophilous species and praticolous. It is an Eurosiberian species, very common in the Carpathian Mountains.

*Stridulation*: the song consists of a series of short echemes, with low intensity, which are derulated with high speed. The duration of an echeme sequence varies very much, from a few seconds to almost a minute. The gaps between the echemes are about 0.1-0.2s (Fig. 5). The species stridulates during the day when the sun is shining and rarely in the evening.

*Pholidoptera frivaldskyi* (Herman, 1871)

*Description*: body length reaches 20-23 mm ♂, 22-25 mm ♀. The body is light green, with yellow-rusty tegminas. It is a species characteristic to the hygrophilous biotops from the hill and the mountain area. It is an European element, known from the Carpathians and the Balkans.

*Stridulation*: the syllables are grouped in short echemes, 3-4 seconds long, with a high intensity, repeated at long time intervals up to several minutes. The species stridulates all day, especially in daylight, from dawn till evening (Fig. 6).

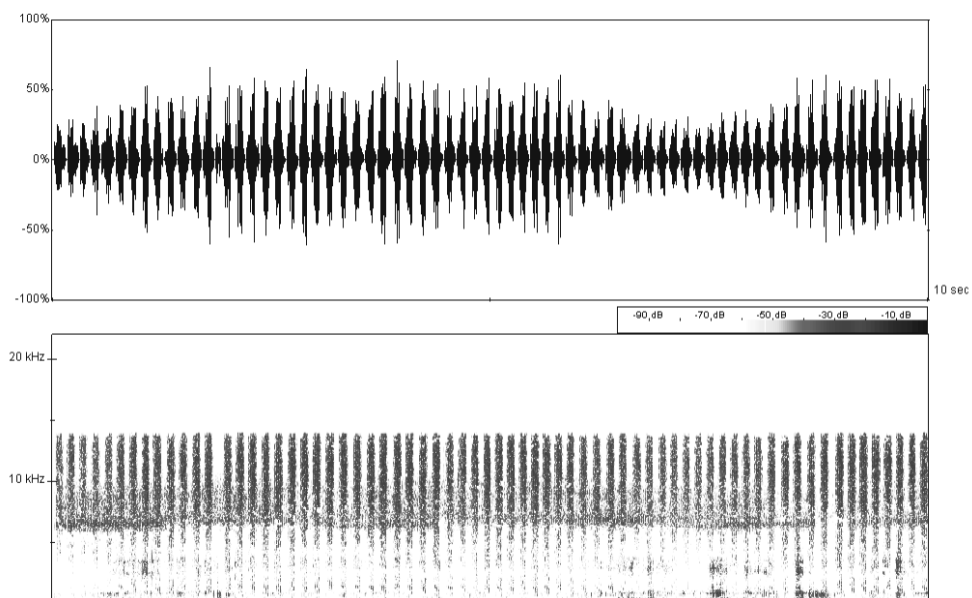


Fig. 4 – Oscillogram and spectrogram of the calling song of *Decticus verrucivorus*.

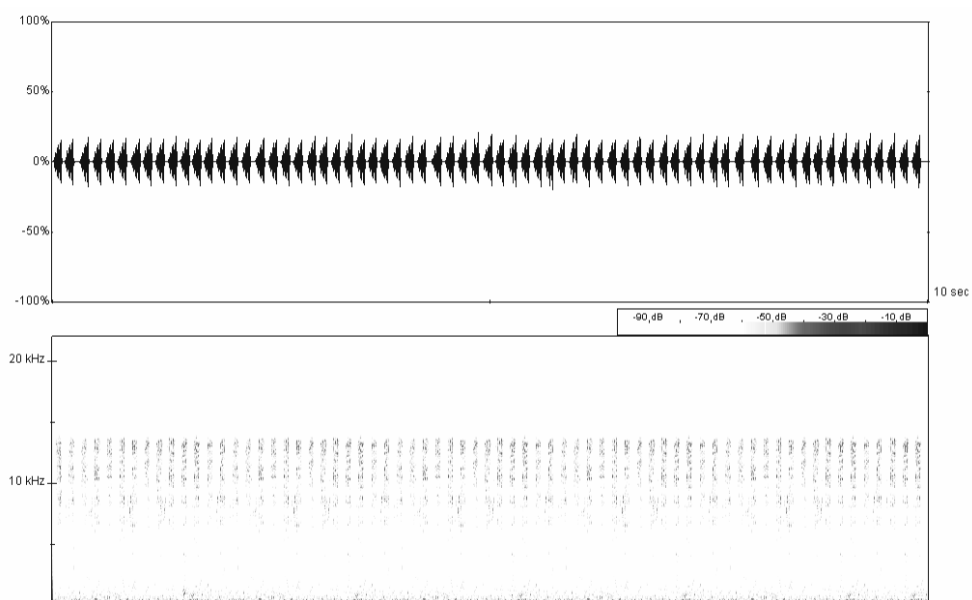


Fig. 5 – Oscillogram and spectrogram of the calling song of *Metrioptera brachyptera*.

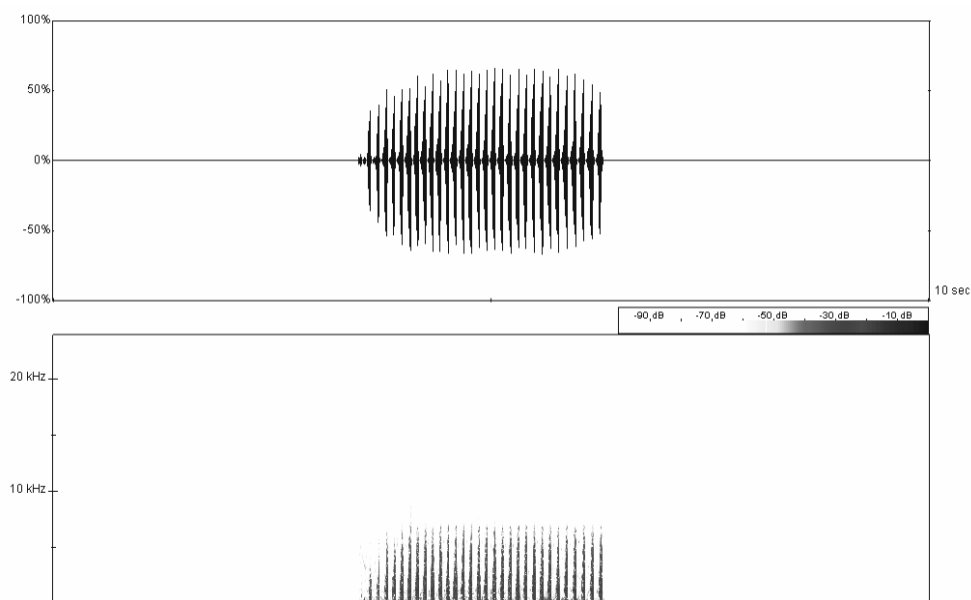


Fig. 6 – Oscillogram and spectrogram of the calling song of *Pholidoptera frivaldskyi*.

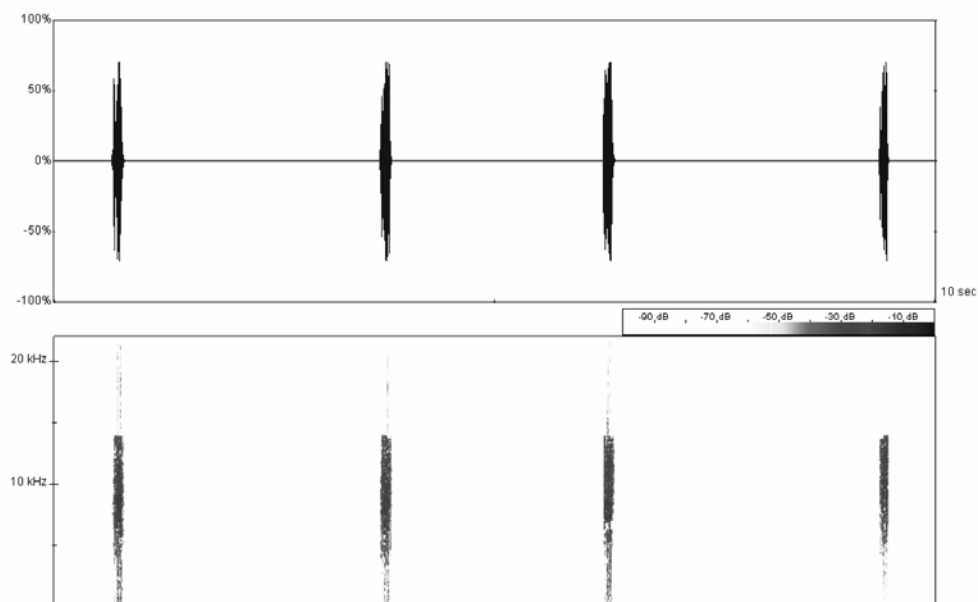


Fig. 7 – Oscillogram and spectrogram of the calling song of *Pholidoptera transsylvanica*.

*Pholidoptera transsylvanica* (Fischer, 1758)

*Description:* body length can reach 19-24 mm ♂, 21-29 mm ♀. The body colour is brownish with a white transversal stripe in the forehead. It is a mesophilous and hygrophilous species which can be found in alpine grasslands and the edge of forests. It is an endemic species to the Carpathian Mountains.

*Stridulation:* the syllables are quite strong in intensity, grouped in short echemes of 0.2-0.3 seconds. The gap between two successive echemes is approximately 3 seconds long. It stridulates during the day especially in the afternoon (Fig. 7).

*Gryllus campestris* (Linné, 1758)

*Description:* body length of about 19-28 mm ♂, 18-29 mm ♀. The colour of the body is black with the ventral side of the hind femurs red. It is a geophilous species which prefers meso-xerophilous grasslands with low vegetation. It is Holarctic species common in the mountain grasslands.

*Stridulation:* the song is composed from echemes of 3 syllables. The gaps between echemes are variable between 0.3 and 0.5 seconds. It stridulates from May to June, mostly in the evening and at night (Fig. 8). The stridulation is very intense being heard from over 50 meters.

*Chorthippus parallelus* (Zetterstedt, 1821)

*Description:* body length can reach 14-17 mm ♂, 19-25 mm ♀. The body colour is variable from green to brown and pink. It is an euribiont species living in hygro-mesophilous, mesophilous and meso-xerophilous biotops. It is a Palearctic species being the most frequent species from Romania.

*Stridulation:* the syllables are short and crescendo until the middle of the echeme, forming echemes of 8-10 syllables, 1-2 seconds long with gaps of 3-5 seconds between them (Fig. 9). The species stridulates from dawn to the evening (Fig. 10 B).

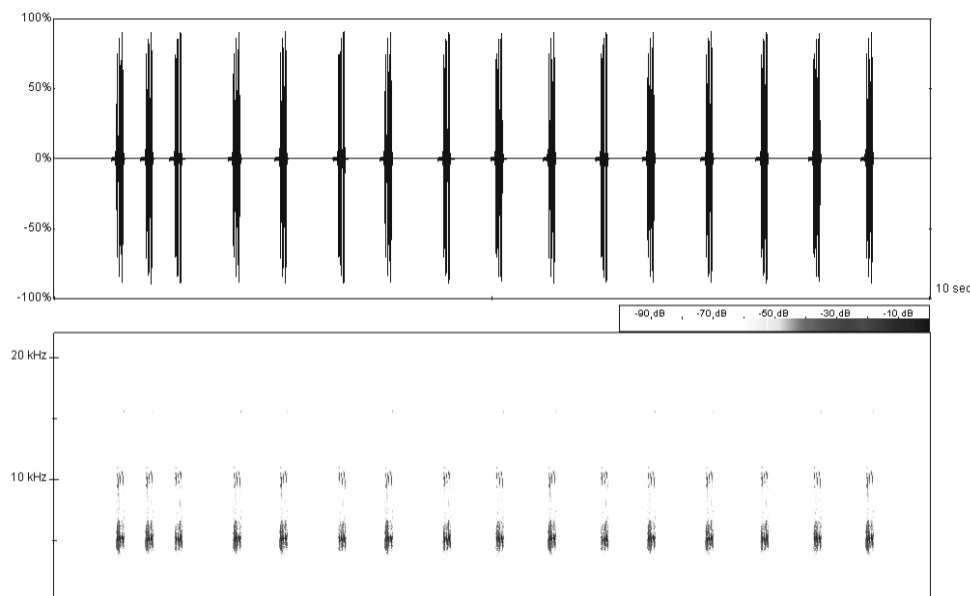


Fig. 8 – Oscillogram and spectrogram of the calling song of *Gryllus campestris*.

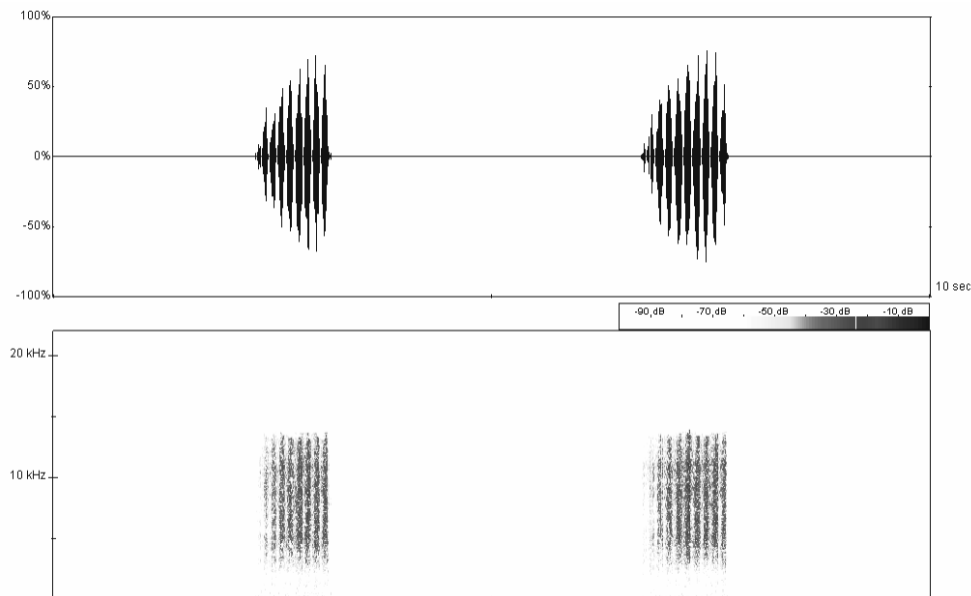


Fig. 9 – Oscillogram and spectrogram of the calling song of *Chorthippus parallelus*.

Table 1

Song characteristics of the studied mountain Orthoptera species.

Species	Medium frequency (kHz)	Acoustic intensity (dB)	Echeme length(s)	Gap length between echemes (s)	Number of syllables of an echeme
<i>Tettigonia cantans</i>	4-15	-13~ -45	3-5	2 - 60	>50
<i>Decticus verrucivorus</i>	3-14	-30~ -60	0.2-0.3	0.1	4
<i>Metrioptera brachyptera</i>	6-14	-40~ -55	0.2	0.1 - 0.2	3
<i>Pholidoptera frivaldskyi</i>	1-7	-25~ -55	2-2.5	20 - 60	25 - 40
<i>Pholidoptera transsylvanica</i>	1-23	-25~ -55	0.2-0.3	0.8 - 1	3
<i>Gryllus campestris</i>	3-16	-20~ -60	0.1	0.2 - 0.7	3
<i>Chorthippus parallelus</i>	0-14	-35~ -55	1-2	3-5	8-10

The study of stridulation to characterize and identify Orthoptera species is used for the first time in Romania. We have analysed the calling songs of seven Orthoptera species considered to be the most frequent species in the mountain grasslands from North-Western Moldova. From table 1 we can see that the medium frequency, the acoustic intensity, echeme length and the number of syllables from an echeme are all variable amongst Orthoptera and can be used as taxonomic criteria. The seven Orthoptera species can be easily recognized in the field by their stridulation.

The two *Pholidoptera* species have similar morphological traits but they can be very easy to identify by acoustic determination.

This paper can be considered the beginning of a key to mountain Orthoptera calling song. The seven mountain Orthoptera species can be easily recognized in the field by their stridulation.



Fig. 10 – A, male of *Tettigonia cantans* during stridulation; B, male of *Chorthippus parallelus* during stridulation.

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#### DATE PRELIMINARE PRIVIND STRIDULAȚIA UNOR ORTOPTERE MONTANE (INSECTA) DIN ROMÂNIA

##### REZUMAT

Sunt prezentate stridulațiile a șapte ortoptere montane înregistrate în teren, pe masivul Rarău și în apropierea mănăstirii Agapia, în vara anilor 2005 și 2006. Toate cele șapte specii stridulează începând cu orele 10-11 AM și până seara; lumina, precipitațiile și temperatura sunt principalii factori care condiționează activitatea stridulatorie a speciilor de ortoptere montane. Cele șapte ortoptere pot fi foarte ușor determinate în teren, pe baza stridulațiilor prezentate. Aceasta constituie prima lucrare ce tratează stridulația la ortoptere din România.

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