

# Far Eastern Entomologist

Дальневосточный энтомолог

Journal published by Far East Branch  
of the Russian Entomological Society  
and Laboratory of Entomology, Federal  
Scientific Center of the East Asia  
Terrestrial Biodiversity, Vladivostok

---

Number 546: 1-10

ISSN 1026-051X (print edition)  
ISSN 2713-2196 (online edition)

April 2026

---

<https://doi.org/10.25221/fee.546.1>

<https://elibrary.ru/hoftar>

<https://zoobank.org/References/B79DB20F-4E4D-4FD0-9980-BE4A2D77FE0C>

## ACOUSTIC SIGNALS OF SOME KATYDIDS AND CRICKETS (ORTHOPTERA: TETTIGONIIDAE, TRIGONIDIIDAE) FROM THE RUSSIAN FAR EAST

O. S. Korsunovskaya<sup>\*</sup>, R. D. Zhantiev

*Department of Entomology, Faculty of Biology, Lomonosov Moscow State University, Leninskie Gory st. 1 bldg 12, Moscow 119991, Russia. \*Corresponding author, E-mail: korsuno@mail.ru*

**Summary.** For the first time in the Russian Far East, data are provided on the acoustic signaling and sound producing apparatus of the bush-crickets *Elimaea fallax* Bey-Bienko, 1951, *Tettigonia ussuriana* Uvarov, 1939, *Eobiana japonica* (Bolivar, 1890), *Sphagniana ussuriana* (Walker, 1869) and cricket *Pteronemobius gorochovi* Storozhenko, 2004.

**Key words:** Orthoptera, Ensifera, acoustic signaling, Primorsky krai, Sakhalin Island, Russia.

**О. С. Корсуновская, Р. Д. Жантиев. Акустические сигналы некоторых кузнечиков и сверчков (Orthoptera: Tettigoniidae, Trigonidiidae) с российского Дальнего Востока // Дальневосточный энтомолог. 2026. N 546. С. 1-10.**

**Резюме.** Впервые для Дальнего Востока России приводятся данные об акустической сигнализации и строении звукового аппарата кузнечиков *Elimaea fallax* Bey-Bienko, 1951, *Tettigonia ussuriana* Uvarov, 1939, *Eobiana japonica* (Bolivar, 1890), *Sphagniana ussuriana* (Walker, 1869) и сверчка *Pteronemobius gorochovi* Storozhenko, 2004.

## INTRODUCTION

The long-horned Orthoptera (Ensifera) of the Far East include species both widespread in the Palaearctic and endemic to areas of the Sea of Japan basin. The acoustic signaling of these insects is currently understudied, both due to the inaccessibility of some regions and the use of acoustic equipment that does not allow recording sounds across the entire frequency range corresponding to the acoustic signal spectrum of the studied objects (especially bush-crickets). Bioacoustic data have been published for only a few species of Ensifera from the tribes Gampsocleidini and Drymadusini (Korsunovskaya *et al.*, 2002; Zhantiev & Korsunovskaya, 2019). This article adds to the existing knowledge on the acoustic signaling of the Far Eastern species.

## MATERIAL AND METHODS

Insects for song recordings were collected in the following localities: Sakhalin Island (Yuzhno-Sakhalinsk), Primorsky krai (Sikhote-Alinsky and “Kedrovaya Pad” Nature Reserves, Ryazanovka village, Tigrovoy station, and Kema River valley). These specimens are kept in the Department of Entomology, Lomonosov Moscow State University (DEMSU).

Acoustic signals were recorded by use of microphone Bruel&Kjaer 4135 (frequency response flat up to 100 kHz), with amplifier Bruel & Kjaer 2604, modified studio tape recorder M3-23 with speed 762 mm/s (unflatness  $\pm 2$  dB in the range 2–50 kHz) and ultrasound tape recorder modified in lab (Yupiter-202 S) (up to 70 kHz). Besides portative tape recorder Sony with his own microphone was used. The sound signals were digitized by use of analogue-to-digital converter E-14 440 (L-Card, Russia) with sampling rate of 30303, 100000 or 142857 Hz. Oscillograms, frequency spectra and sonograms were obtained using CoolEditPro 2.1, Turbolab 4.2 and PowerGraph 3.3 softwares. Averaged data are presented with standard error, calculated over at least 20 measurements. The notation “n” is the number of specimens studied.

Scanning electron micrographs (SEMs) of stridulatory files (pars stridens) were made with a JEOL/EO scanning electron microscope (Japan) (in the Electron Microscopy Laboratory, Faculty of Biology, Lomonosov Moscow State University).

At description of sound signals we follow bioacoustic terminology used by Baker & Chesmore (2020) and Heller *et al.* (2021).

## RESULTS AND DISCUSSION

### Family Tettigoniidae

### Subfamily Phaneropterinae

### Tribe Elimaeini

***Elimaea fallax* Bey-Bienko, 1951**

Figs 1A,B, 2A, 3A

MATERIAL. Russia: Primorsky krai, Hasan district, near Ryazanovka village, 42°47'50" N, 131°14'40" E), 21 IX.2001, 4 ♂, A. Polilov & A. Moseyko leg. (DEMSU).

DISTRIBUTION. Russia: Khabarovskiy krai, Primorsky krai; NW, N, NE, E, SW China, Korea (Jin & Xia, 1994; Storozhenko *et al.*, 2015; Sergeev & Dubatolov, 2022; Baturina *et al.*, 2024).

SONG. Recordist O. Korsunovskaya. The calling song of male *E. fallax* is a sequence of syllables lasting 50-60 ms at 17°C (Fig. 1A,B). The repetition rate is unstable and low. The pauses between syllables in our experiments were quite long: 6-10 sec. However, under natural conditions, at higher temperatures and/or acoustic contact with other individuals, the repetition rate, as evidenced by our observations of other phaneropterine species with aperiodic calls (e.g., *Phaneroptera*), can increase significantly.

The frequency spectrum (Fig. 2A) is relatively narrow, located primarily in the audio region, with a maximum in the 10-25 kHz range. The dominant components are located in the 18 kHz region.

The STRIDULATORY FILE (part of the sound producing apparatus) of investigated male contains 43 bead-shaped teeth (Fig. 3A). Their size increases toward the end of the stridulatory file from the side of the anal edge of the tegmen, and their density decreases there. The largest teeth in the middle of the pars stridens are almost identical in size and density to those at its end on the side of the costal margin of the tegmen.

**Subfamily Tettigoniinae**

**Tribe Tettigoniini**

***Tettigonia ussuriana* Uvarov, 1939**

Figs 1C,E, 2B, 3B

MATERIAL. Russia: Primorsky krai, "Kedrovaya Pad" Nature Reserve, VIII 1969, 2 ♂; Hasan district, Ryazanovka village, 42°47'50" N, 131°14'40" E, 21. IX 2001 1 ♂, A. Polilov & A. Moseyko leg.; same locality, VIII 2014, 1 ♂, T. Galinskaya & I. Gomyranov leg. (DEMSU).

DISTRIBUTION. Primorsky krai, S Khabarovskiy krai, NE China, Korea, Japan (Tsushima) (Storozhenko *et al.*, 2015).

SONG. (n=4). Recordists O. Korsunovskaya and N. Dubrovin. Males produce a trilling call consisting of identical syllables (Fig 1C-E). The duration of the closing hemisyllable at 20°C is 31.0±0.5 ms, and the opening hemisyllable is 12-14 ms. The repetition rate of closing hemisyllables is 17.8±0.2 s<sup>-1</sup>. The tooth-impact frequency in this hemisyllable is 1000-2000 Hz at its beginning, decreasing to 500 Hz at the end, and in some individuals to 200 Hz. The tooth-impacts at the beginning of the

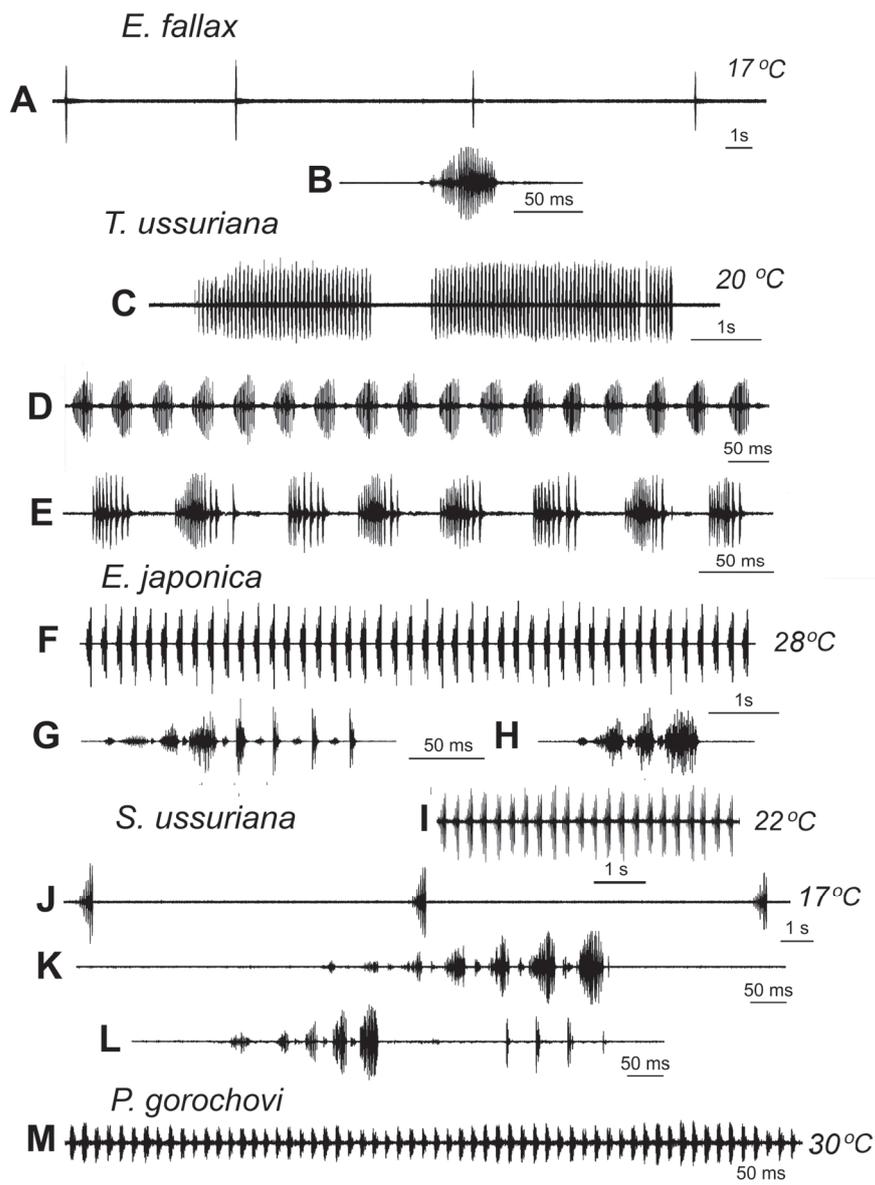


Fig. 1. Oscillograms of calling songs of Far Eastern Orthoptera. A, B – *Elimaea fallax*; C–E – *Tettigonia ussuriana*; F–H – *Eobiana japonica*; (I–L) – *Sphagniana ussuriana*; M – *Pteronemobius gorochovi* at different speeds. Temperature indicated when recording acoustic signals.

hemisyllable are single, paired, or triple, with a minimum duration (0.1 ms), while at the end of the hemisyllable, their duration increases tenfold (Fig. 1E).

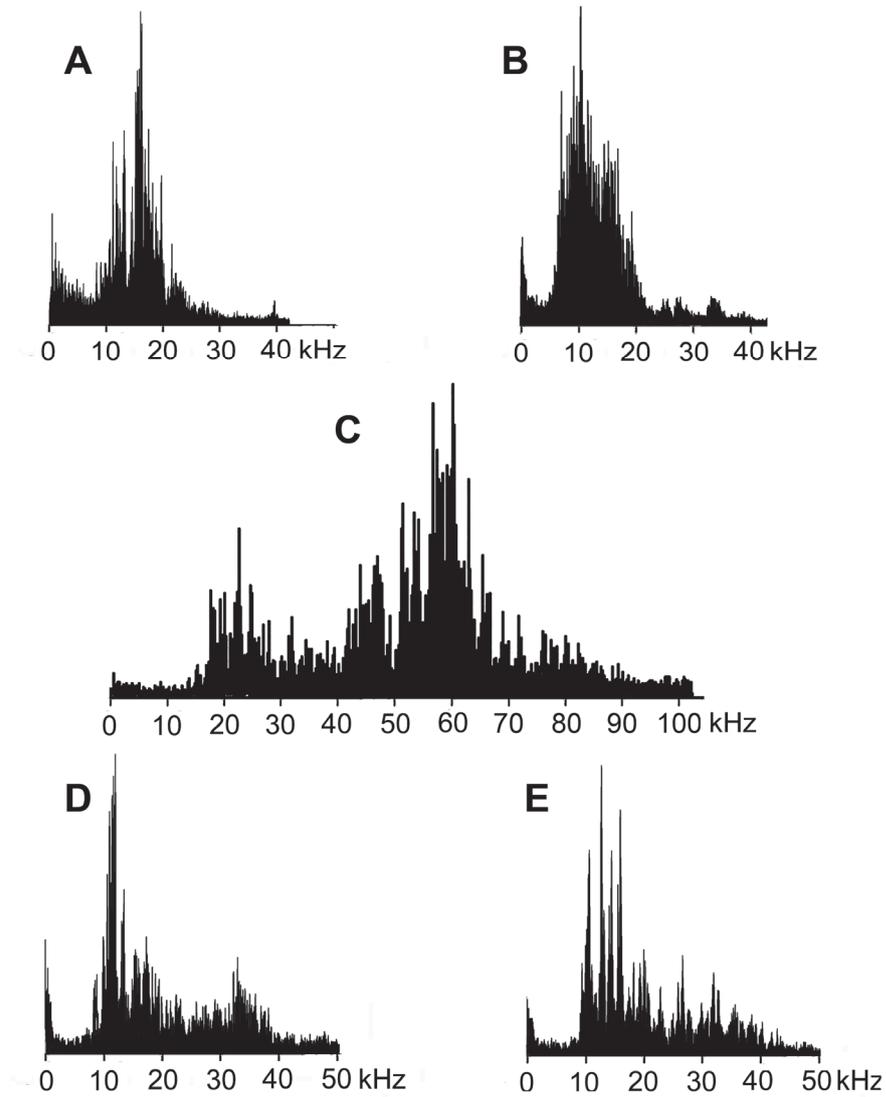


Fig. 2. Frequency spectra (on a linear scale) of calling songs of bush-crickets. A – *Elimaea fallax*; B – *Tettigonia ussuriana*; C – *Eobiana japonica*; D, E – *Sphagniana ussuriana*.

The frequency spectrum occupies a band from 6 to 45–50 kHz (Fig. 2B). In the 6–25 range, there are two peaks with dominant frequencies in the 8–10 kHz and 16 kHz bands. At certain positions of the insect relative to the microphone, these peaks merge into a single peak occupying the 6–25 kHz band with dominant frequencies in the 8–10 kHz range. In addition to these peaks, the spectrum contains another relatively low-amplitude peak with dominant components in the 32 kHz region. In different individuals, the dominant frequencies of the second and third peaks may shift by 2–3 kHz toward higher frequencies. For example, in males from the “Kedrovaya Pad” Nature Reserve, they are 22 and 38 kHz, respectively (Dubrovin, 1977). The main peak remains unchanged.

The STRIDULATORY FILE of the examined male contains 102 teeth (Fig. 3B). The 15 smallest teeth form an irregular row along the stridulatory file near the anal margin of the tegmen. The density of teeth decreases toward the middle of the pars stridens, then increases again toward the costal margin of the tegmen. The largest teeth are located in the middle of the pars stridens. According to other authors (Kim, 2010), the pars stridens can contain from 79 to 84 teeth.

### Tribe Platycleidini

#### *Eobiana japonica* (Bolívar, 1890)

Figs 1F,H, 2C, 3C

MATERIAL. Russia: Sakhalin, Yuzhno-Sakhalinsk, 46°57'39" N, 142°45'24" E, 2.VIII 2014, 4 ♂, T. Galinskaya & I. Gomyranov leg. (DEMSU).

DISTRIBUTION. Russia: S Sakhalin, Kuril Islands (Shikotan, Kunashir, Iturup), Japan: Hokkaido, Honshu (Storozhenko, 2004).

SONG. Recordist O. Korsunovskaya. At 28°C, males produce a calling song consisting of a series consisting of three syllables (Fig. 1F,H). Each series lasts 124.9±0.6 ms. The duration of the 1<sup>st</sup> closing hemisyllable is 19.3±0.3 ms, the 2<sup>nd</sup> one is 15.5±0.2 ms, and the 3<sup>rd</sup> one is 30.5±0.4 ms. The syllable repetition rate increases toward the end of the series from 30–32 to 37–42 s<sup>-1</sup> due to a decrease in the interval between the 2<sup>nd</sup> and 3<sup>rd</sup> closing hemisyllable. The duration of the 1<sup>st</sup> and 2<sup>nd</sup> opening hemisyllables is 10.6±0.4, 5.9±0.2, and 5.6±0.2 ms, respectively. The repetition rate of the series is approximately 3 s<sup>-1</sup>. Occasionally, long sequences of series begin with a series containing clicks similar to those in the songs of some bush-crickets of the genus *Platycleis* (Fig. 1G).

The frequency spectrum (Fig. 2C) is located in the range of 14–100 kHz and has two maxima in the band of 20 and 60 kHz. The amplitude is greatest at the second maximum.

The STRIDULATORY FILE (n=1) contains 68 teeth (Fig. 3C). The largest of these are located in the middle quarter of the stridulatory file, while the smallest teeth occupy approximately a quarter of the file from the anal margin of the elytron.

***Sphagniana ussuriana* (Walker, 1869)**

Figs 1I,L, 2D,E, 3D

**MATERIAL.** Russia: Primorsky krai, Sikhote-Alin Nature Reserve, Terneysky area, valley of Kema River, h=350 m, 15.IX 2000, 1 ♂, A. Polilov & A. Moseyko leg.; Partisansky distr., near Tigrovoy station, 43°11'N, 132°54' E, 23–25.VII 2000, 3 ♂, D. Schigel leg. (DEMSU).

**DISTRIBUTION.** Russia: S Khabarovskiy krai, Primorsky krai; NE China, N Korea (Storozhenko, 2004; Storozhenko *et al.*, 2015).

**SONG.** Recordist O. Korsunovskaya. Males produce calling songs in the form of a sequence of series, each of which typically consists of seven syllables of increasing amplitude (Fig. 1I–L). Their duration ranges from 178 to 300 ms, depending on the number of syllables comprising them. The series are repeated at a relatively unstable rate of approximately  $1.5 \text{ s}^{-1}$  (at 17–22 °C) or less frequently. During continuous stridulation, the repetition rate increases, but remains unstable. Thus, over the course of 10 seconds of such a song, it fluctuates between 2.6 and  $4.5 \text{ s}^{-1}$ . Each syllable is formed by hemisyllables: a low-amplitude opening one (duration approximately 10 ms) and a high-amplitude hemisyllable accompanying the closing of the tegmina. The duration of the closing hemisyllable in one of the males studied increases from  $15.0 \pm 0.4$  to  $22.8 \pm 0.4$  ms by the end of the series. Occasionally, the series ends with several high-amplitude short syllables (clicks) lasting approximately 10 ms at closing hemisyllables (Fig. 1L). The repetition rate of long and short syllables in the series is the same –  $16\text{--}18 \text{ sec}^{-1}$ .

The frequency spectra of long (Fig. 2D) and short (Fig. 2E) syllables differ from each other. The dominant frequencies of the former are approximately 12 kHz, while the high-frequency components form several low-amplitude maxima in the range of 13–24 kHz and approximately 32 kHz. The frequency spectrum of fast syllables differs from that described above by the presence of similar-amplitude maxima not only in the 10–11 kHz range, but also at 13, 14, and 16 kHz.

The STRIDULATORY FILE of the studied male (Fig. 3D) consists of 123 teeth. The first 15 teeth from the side of the anal edge of the tegmen form a randomly organized group, which then continues with a row of teeth gradually increasing in size. 2/3 of the stridulatory file, from the side of the costal edge of the tegmen, is formed by tightly located teeth of approximately equal size.

**REMARKS.** The temporal pattern of the calling song of *S. ussuriana* is similar to that of many species of the genus *Platycleis*. However, unlike *S. ussuriana*, representatives of the genus *Platycleis* can produce a series of short clicks at the beginning of a song, at its end, or even as an independent signal, which apparently functions as a territorial signal. In *S. sphagnorum*, the song pattern also includes two types of syllables, which differ from each other not only in amplitude but also in frequency content. Low-frequency syllables play an important role in courtship behavior. When near a female, the male produces a song consisting solely of low-frequency syllables, and this trill begins to function as a precopulatory signal (Morris *et al.*, 1975). The functional significance of the final clicks in some series of *S. ussuriana* appears to be the same as in a number of *Platycleis* species.

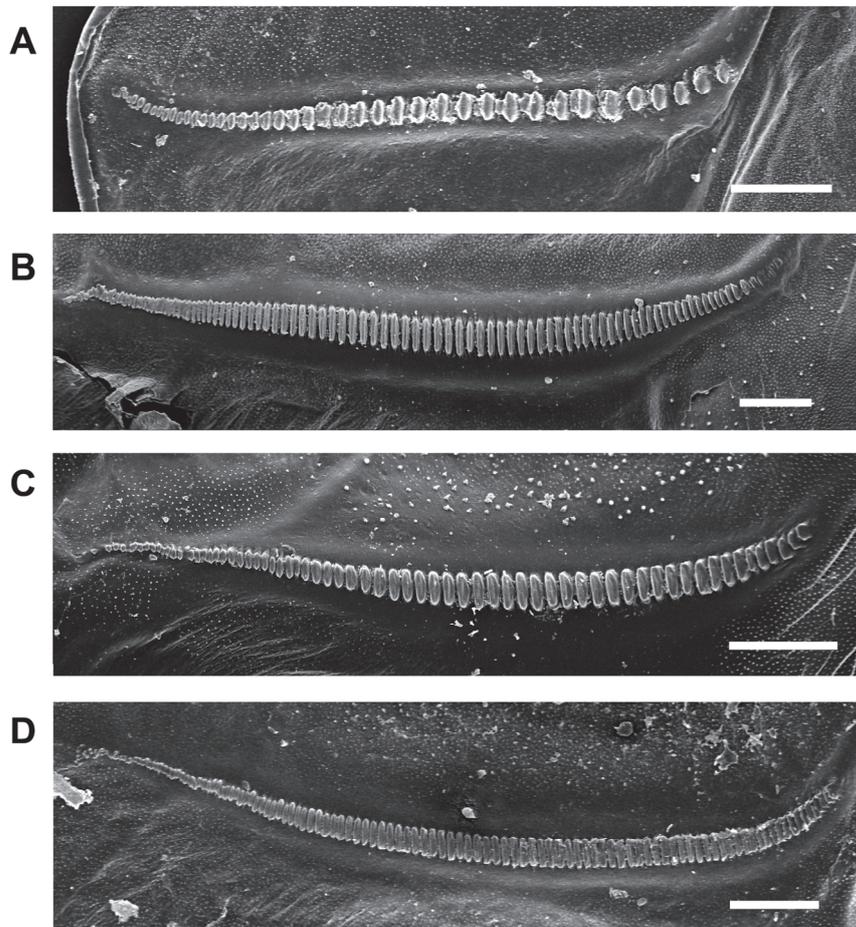


Fig. 3. SEMs of stridulatory files of Far Eastern bush-crickets. A – *Elimaea fallax*; B – *Tettigonia ussuriiana*; C – *Eobiana japonica*; D – *Sphagniana ussuriiana*. Scale bars: 300  $\mu$ m.

**Family Trigonidiidae**

**Subfamily Nemobiinae**

**Tribe Pteronemobiini**

***Pteronemobius gorochovi* Storozhenko, 2004**

Fig. 1M

MATERIAL. Russia: Primorsky krai, “Kedrovaya Pad” Nature Reserve, IX 1970, 8 ♂, 6 ♀, Noskov leg. (DEMSU).

DISTRUBUTION. Russia: S Amurskaya oblast, S Khabarovsky krai, Primorsky krai (Storozhenko, 2004), Korea, Japan (Honshu, Kyushu) (Storozhenko *et al.*, 2015).

SONG. Recordist N. Dubrovin. Males produce calling, aggression, and precopulatory signals. The calling signal consists of prolonged (up to several seconds) series of identical syllables lasting  $3.2 \pm 0.2$  ms (Fig. 1M). The number of syllables in a series, as well as the syllable repetition rate, varies significantly. However, the temporal pattern of the calling song is constant: it is not a continuous trill, but a sequence of series. The syllable repetition rate at  $30^\circ\text{C}$  reaches  $123 \text{ s}^{-1}$ . In the frequency spectrum of these signals, obtained by N. Dubrovin, in addition to the dominant frequency of 6.7 kHz and several low-amplitude harmonics, contains a small maximum at approximately 35–36 kHz.

REMARKS. According to N. Dubrovin (1977), aggression signal and calling song are trills, frequency spectrum of calling song contains high frequency components. Courtship sounds are characterized by a reduced signal intensity compared to calling song and by specific frequency spectra: the amplitude of the high-frequency component is comparable to the dominant frequency. Toward the end of courtship, the male begins to emit increasingly shorter signal series. Male courtship lasts approximately two hours. Initially, cricket produces long trills, similar in timing to a calling song, then transitions to precopulatory sounds, rocking back and forth on his legs. The subsequent copulation lasts approximately 10 minutes. The female in copula, vibrating her antennae like the male, licks the male's hind tibia and the top of his hind femur. The male bends his hind leg at the knee and brings it toward to the female's head.

#### ACKNOWLEDGEMENTS

We are very grateful to D. Schigel, A. Polilov, A. Moseyko, T. Galinskaya, and I. Gomyranov for orthopterans collecting.

Investigations were carried out as a part of the scientific project of the state order of the Government of Russian Federation to Lomonosov Moscow State University No. 121032300064-0.

#### REFERENCES

- Baker, E. & Chesmore, D. 2020. Standardization of bioacoustic terminology for insects. *Biodiversity Data Journal*, 8: e54222. DOI: 10.3897/BDJ.8.e54222
- Baturina, N.S., Molodtsov, V.V., Sergeev, M.G. & Storozhenko, S.Yu. 2024. Distribution of the leaf katydid *Elimaia fallax* (Orthoptera: Tettigoniidae: Phaneropterinae) in the countries of the Japan Sea basin. P. 70–75. In: *A. I. Kurentsov's Annual Memorial Meetings. Issue 35*. Vladivostok. 220 pp. [In Russian with English summary]
- Dubrovin, N.N. 1977. *Sound signaling of the long-horned orthopterans*. Candidate of science dissertation. Lomonosov Moscow State University, Moscow. [In Russian]
- Heller, K.-G., Baker, E., Ingrisch, S., Korsunovskaya, O.S., Liu, C.-X., Riede, K. & Warchałowska-Sliwa, E. 2021. Bioacoustics and systematics of *Mecopoda* (and related forms) from South East Asia and adjacent areas (Orthoptera, Tettigoniodea, Mecopodinae) including some chromosome data. *Zootaxa*, 5005(2): 101–144. DOI: 10.11646/zootaxa.5005.2.1

- Jin, X.-B. & Xia, K.-L. 1994. An index-catalogue of Chinese Tettigoniodea (Orthopteroidea: Grylloptera). *Journal of Orthoptera Research*, 3: 15–41. DOI: 10.2307/3503405
- Kim, T.W. 2010. *A Sound guide to Korean Tettigoniidae (Orthoptera: Ensifera)*. 136 pp. [In Korean]
- Korsunovskaya, O.S., Zhantiev, R.D & Savitsky, V.Yu. 2002. The songs of the Palearctic bush crickets of the tribe Drymadusini (Orthoptera, Tettigoniidae). *Russian Entomological Journal*, 11(3): 1–16.
- Morris, G.K., Kerr, G.E., & Gwynne, D.T. 1975. Calling song function in the bog katydid, *Metrioptera sphagnorum* (F. Walker) (Orthoptera, Tettigoniidae): female phonotaxis to normal and altered song. *Zeitschrift fuer Tierpsychologie*, 37: 502–514. DOI: 10.1111/j.1439-0310.1975.tb00891.x
- Sergeev, M.G. & Dubatolov, V.V. 2022. New data on Orthoptera distribution in the southern part of the Russian Far East. *Far Eastern Entomologist*, 450: 15–20. DOI: 10.25221/fee.450.4
- Storozhenko, S.Yu. 2004. *Long-horned orthopterans (Orthoptera: Ensifera) of the Asiatic part of Russia*. Dalnauka, Vladivostok. 280 pp. [In Russian]
- Storozhenko, S.Yu., Kim, T.W. & Jeon, M.J. 2015. *Monograph of Korean Orthoptera*. National Institute of Biological Resources, Incheon, 377 pp.
- Zhantiev, R. D. & Korsunovskaya, O. S. 2019. Acoustic signals of katydids of the tribe Gampsocleidini (Orthoptera, Tettigoniidae) in Russia. *Entomological Review*, 99(6): 705–710. DOI: 10.1134/S0013873819060010