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DESCRIPTION OF A WELL-KNOWN WESTERN PALEARCTIC SPECIES OF THE GENUS *REPTALUS* EMELJANOV 1971 (HOMOPTERA, AUCHENORRHYNCHA, FULGOROIDEA, CIXIIDAE) THAT HAS NO VALID NAME

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Reptalus salicinus sp. n., previously misinterpreted as *R. quinquecostatus*, is described and illustrated. Oscillograms of male calling signals with data on host plants and distribution of the new species that is closely related to *R. artemisiae* (Becker 1865) are provided. A neotype of *R. artemisiae* is designated. *R. salicinus* sp. n. and *R. artemisiae* are similar both in external morphology and male genitalic structure, but differ distinctly by male calling signal patterns and host plants, thus being two different biological species. The distribution of *R. salicinus* sp. n. covers southern European Russia, Kazakhstan and, apparently, the southern part of Western Europe. *R. artemisiae* is known so far only from the Lower Volga region and western Kazakhstan.

Keywords: planthoppers, male calling signals, cryptic species, new species, vibrational signals, host plant, neotype designation

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The genus *Replatus* with the type species *Reptalus quinquecostatus* (Dufour 1833) was erected by Emeljanov (1971) in the planthopper family Cixiidae to accommodate species of the tribe Pentastirini (Homoptera, Auchenorrhyncha, Fulgoroidea, Cixiidae) having styles with inner recurrent process.

For a long time many authors under the name *R. quinquecostatus* meant a widespread planthopper species which is in fact still undecribed. The drawings of the genitalia of this taxon were published by Logvinenko (1975), Holzinger et al. (2003), Emeljanov (2015), etc. However, recent examination of putative type specimens from Dufour's collection by Webb et al. (2013) showed that this species was misinterpreted at least since Fieber's work on European Auchenorrhyncha (Fieber, 1872) and it is a senior synonym of *R. melanochaetus* (Fieber 1872) sensu Logvinenko (1975) and subsequent authors. As a result, *R. quinquecostatus* auct. nec Dufour (1833) became nameless. Emeljanov (2020), after studying Fieber's drawings published by Webb et al. (2013), came to the conclusion that Fieber meant *R. artemisiae* (Becker 1865) under the name *R. quinquecostatus*. The first species was very briefly described from the Lower Volga region of Russia (Becker, 1865). However, since the original description with some data on its morphology, *R. artemisiae* becomes the valid name for *R. quinquecostatus* auct. nec Dufour (1833) and the type species of the genus *Replatus***.**

According to the original description by Becker (1865), *R. artemisiae* was collected from *Artemisia fragrans* Willd. (presently, *A. lercheana* Weber ex Stechm.) and *A. nutans* Willd. (Asteraceae) from the subgenus *Seriphidium*. Our study of male vibrational signals of Cixiidae in the Crimea, in the southern European Russia, Kazakhstan, and Kyrgyzstan revealed that *R. artemisiae* lives only on *Artemisia* from the subgenus *Seriphidium* and occurs only in the Lower Volga and Trans-Volga regions. This species was not found in southeastern Kazakhstan and Kyrgyzstan despite the fact that *Artemisia* subg. *Seriphidium* is abundant in the plains and low mountains in these parts.

In the course of these studies, we also found a cryptic species similar to *R. artemisiae* in external morphology and genitalia structure, but producing signals with a different temporal pattern and feeding on willows (*Salix* spp.). Apparently, the records of *R. quinquecostatus* auct. nec Dufour (1833) from many localities outside the Lower Volga region, especially from the

territories where *Artemisia* subg. *Seriphidium* does not occur (e.g., Nast, 1987), actually refer to this species. Since presently the name *R. quinquecostatus* is applied to another taxon, this widespread and well-known species does not have a valid name. For this reason, here we provide its description with data on its biology and distribution.

MATERIAL AND METHODS

Small Auchenorrhyncha used for intraspecific communication not air-borne sounds, but vibrational signals transmitted via a solid substrate, i. e. plant stems or leaves on which the insects occur. As shown by ethological experiments, it is the differences in the structure of the calling signals emitted by males to attract conspecific females that constitute the principal precopulatory reproductive barrier in many taxa. Therefore, when differentiating close forms by their signals, one can actually discriminate between biological species based on the very criterion of their reproductive isolation. Thus, acoustic analysis in taxonomy is a useful tool for elucidating the taxonomic status of morphologically similar forms, since the distinct differences in the signal patterns clearly indicate that the taxa under consideration are good species (see the review by Tishechkin (2013)).

Planthopper vibrational signals were recorded by means of portable recording equipment consisting of a piezocrystal gramophone cartridge GZP-311 connected to the microphone input of a cassette recorder Elektronika-302 (before 2005), minidisk recorder Sony Walkman MZ-NH900 (2005–2016), or Roland R-05 wave/mp3 recorder (since 2017) via a custom-made matching amplifier. For recording, a stem of the host plant about 10–15 cm in length was attached to the cartridge by a rubber ring with the cartridge needle slightly touching the stem. Then a nylon cage containing a male leafhopper was put on the twig. After some time, the male usually sat on the twig and started singing.

Oscillograms of signals were produced with Cool Edit Pro 2.1 software.

For elements of signal temporal pattern, the following terms are used. **Pulse** is a brief fragment of signal (or succession of sine waves) with rapid increase and subsequent decrease of amplitude, i.e. separated from similar fragments by amplitude minimums. Fragments with more or less constant temporal pattern consisting of pulses are referred to as **syllables**. Signal consisting of several syllables is referred to as a **phrase**.

Digital photographs of male genitalia were obtained with a Micromed 3 LED M microscope equipped with a MIchrome 5 Pro camera (Tucsen). The drawings of male genitalia were made by tracing the outlines of photographs on a glass table lighted from underneath. The map of signal recording localities was produced using free software from www.simplemappr.net.

Morphological terminology follows Emeljanov (2015).

Materials studied are deposited in the collections of the Zoological Museum of M.V. Lomonosov Moscow State University (ZMMU) and the Zoological Institute of Russian Academy of Sciences, St. Petersburg (ZIN).

Reptalus salicinus Tishechkin et Emeljanov sp. n. (Figs 1; 3; 4, *1–9*)

Type material. Holotype, ♂: Crimea, environs of Perevalnoe Village, halfway from Simferopol to Alushta, from *Salix* sp., 16.VI.1997, D. Tishechkin, male calling signals recorded at 28–30°C (ZIN). Paratypes: 1 ♂, same data, male calling signals recorded at 28–30°C (ZMMU); 1 ♂, southern European Russia, Volgograd Oblast, the Ilovlya River about 5 km from the mouth, from *Salix* sp., 8.VI.1996, D. Tishechkin, male calling signals recorded at 25°C (ZIN); 1 ♂, southeastern Kazakhstan, Urzharsky Region, 27 km south of Taskesken, from *Salix* sp., 23.VI.2022, D. Tishechkin, male calling signals recorded at 37°C (ZMMU).

Description. Coloration. Body black, carinae on head and pronotum yellowish, mesonotum entirely black. Forewings transparent with dark veins (fig. 1, *1–2*).

Male genitalia. Left paramere of phallotheca rather short, with three processes of different shape (fig. 1, *3–6*). Right paramere straight, more or less uniformly tapering distally, with apex usually somewhat bifurcated. Anal tube with truncated posterior process bent to right (fig. 1, *7–8*). Ventro-median process of pygofer elongated, incisions on back margin of pygofer on each side of it of approximately same width as process (fig. 1, *9*). Styles of almost same shape, apical lobe of right style somewhat shorter and wider than of left one (fig. 1, *10–11*).

Comparison. In the shape of the genitalia the new species does not differ from *R. artemisiae* (fig. 2, *1–10*). Since the shape of parameres and of the aedeagal processes is quite variable, small differences between individual specimens are the result of intraspecific variability and cannot be used to distinguish between *R. salicinus* sp. n. and *R. artemisiae*.

Male calling signals. Male calling signals of *R. salicinus* sp. n. from all three localities where the type material was collected were investigated (fig. 3). Calling signal consists of syllables lasting from about 0.7 up to 1.0 s (fig. 4, *1–9*). Male produces single syllables following each other with irregular intervals or short sequences of syllables separated by gaps lasting for ca 0.7–1.5 s. Pulse repetition rate in syllable increases with temperature and averages 70 pulses per second at 25°C, 85–90 pulses per second at 28–30°C, and 100 pulses per second at 37°C in our recordings.

Male calling signals of *R. artemisiae* from the following localities were investigated:

1. Russia, the Lower Volga region, Saratov Oblast, Dyakovka Village ca 35 km SSW of Krasny Kut Town,

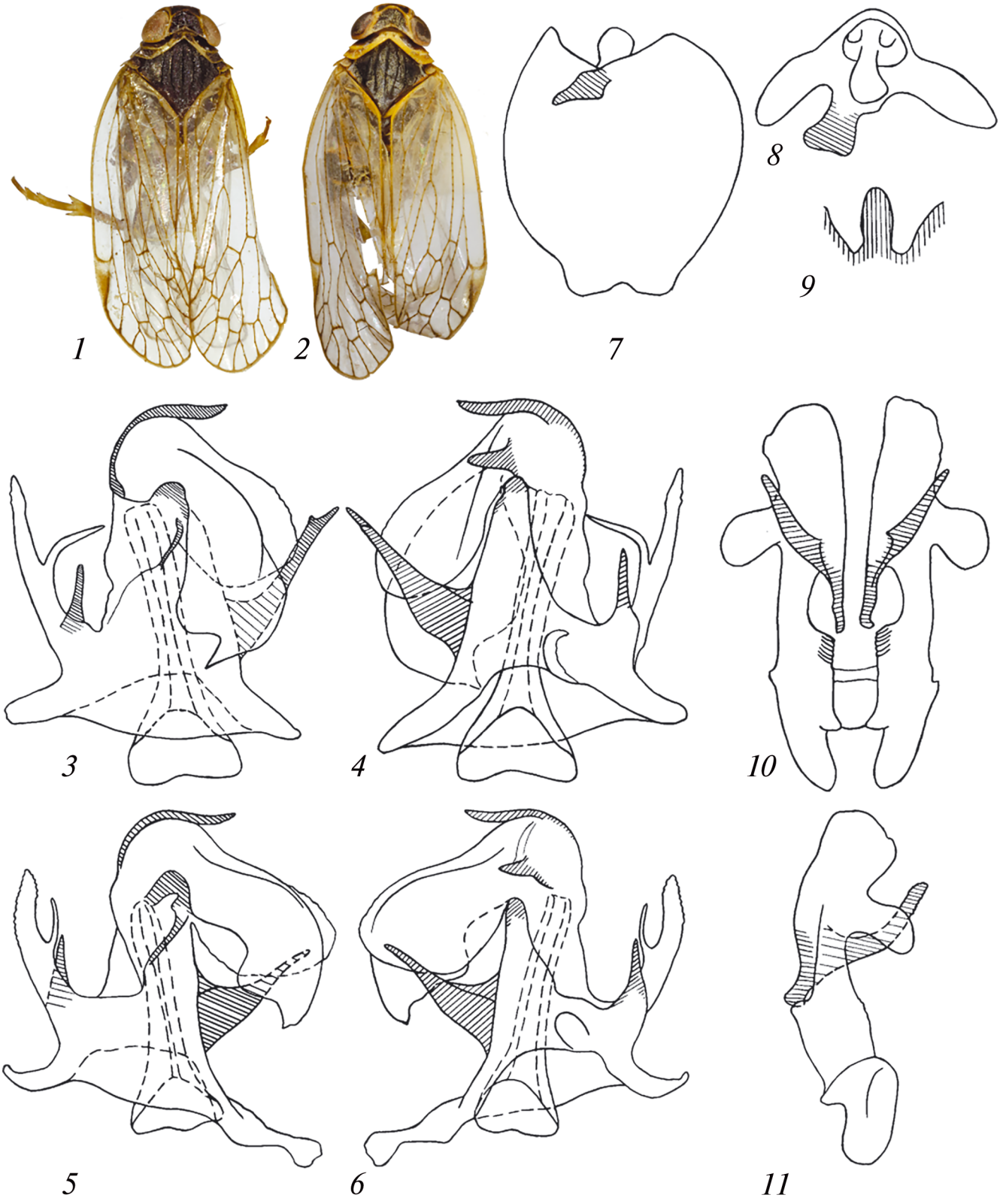

Fig. 1. *Reptalus salicinus* sp. n.: *1–2* – habitus dorsally, *3–6* – aedeagus (*3*, *5* – dorsal view; *4*, *6* – ventral view), *7* – anal tube, ventral view; *8* – same, caudal view; *9* – ventro-median process of male genital segment, ventral view; *10* – styles, dorsal view; *11* – right style, ventral and lateral view. *1*, *3–4*, *10–11* – male from Crimea; *2*, *5–8* – male from southeastern Kazakhstan; *9* – male from Volgograd Oblast.

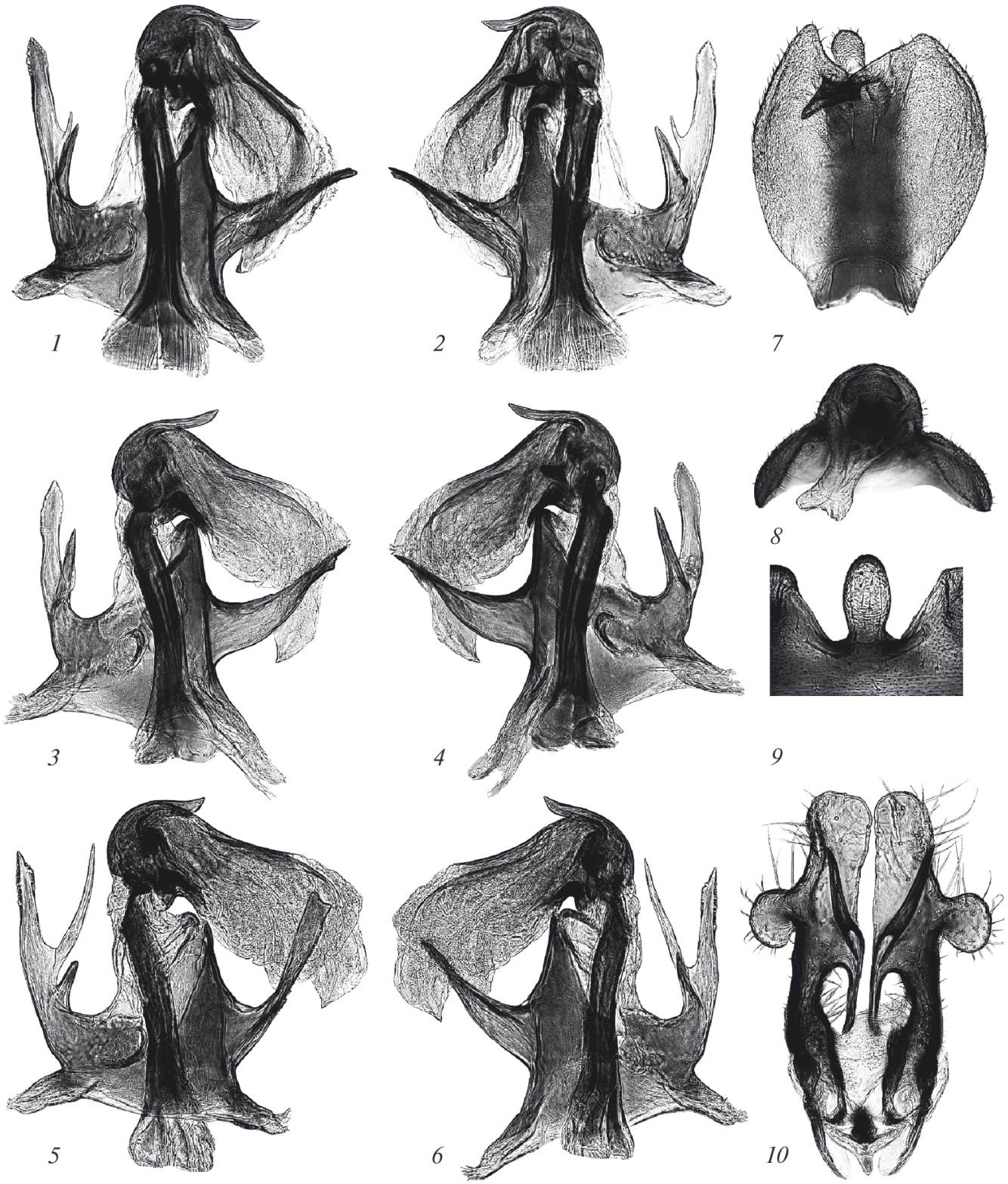

Fig. 2. *Reptalus artemisiae*: *1–6* – aedeagus (*1*, *3*, *5* – dorsal view; *2*, *4*, *6* – ventral view); *7* – anal tube, ventral view; *8* – same, caudal view; *9* – ventro-median process of male genital segment, ventral view; *10* – styles, dorsal view. *1–4*, *8*, *10* – male from Saratov Oblast; *5–7*, *9* – male from Astrakhan Oblast.

Fig. 3. Map of planthopper signal recording localities.

from *Artemisia* subg. *Seriphidium* on saline soil in the steppe, 9.VII.2004, signals of four males recorded at 22°C.

2. Russia, the Lower Volga region, Astrakhan Oblast, western shore of the Baskunchak Lake, near Bolshoy Bogdo Mtn., from *Artemisia* subg. *Seriphidium* in the semi-desert, 30.VI.2005, signals of one male recorded at 30–31°C.

In *R. artemisiae*, male calling signal is a phrase lasting for about 12–20 s and normally consisting of two shorter syllables followed by one longer syllable (fig. 4, *10–15*). The duration of shorter syllables averages 1–2 s, the duration of the longer syllable is 9–12 s. Pulse repetition rate in syllables is almost the same as in *R. salicinus* sp. n. and averages 60–70 pulses per second at 22°C and 70–90 pulses per second at 30–31°C. Occasionally, the male produces single shorter syllables lasting for 2–5 s.

Thus, the male calling signals of *R. salicinus* sp. n. and *R. artemisiae* are distinctly different, which proves that they are different biological species.

Biology. All studied specimens of *R. salicinus* sp. n. were collected from willows (*Salix* spp.), whereas *R. artemisiae* was found only on *Artemisia* subg. *Seriphidium*.

Willows, with rare exceptions, grow in humid habitats, while *Artemisia* subg. *Seriphidium* occur in the steppe and desert zones and often grow on saline soils. Therefore, it can be safely assumed that *R. salicinus* sp. n. and *R. artemisiae* are almost always spatially and, as a consequence, reproductively isolated not only due to differences in the signal patterns, but also due to different host specializations.

Distribution. Judging by the findings, confirmed by the calling signal analysis, the range of *R. salicinus* sp. n. includes southern European Russia and Kazakhstan (fig. 3). The record of *R. quinquecostatus* from willows in Germany by Biedermann and Niedringhaus (2009) also, apparently, belongs to *R. salicinus* sp. n. The records of *R. quinquecostatus* from other plants (e. g., Logvinenko (1975)) may refer to another species. In particular, Holzinger et al. (2003) previously suggested that *R. quinquecostatus* auct. nec Dufour (1833) may actually include several closely related species.

Reptalus artemisiae is known only from the steppes and semi-deserts of the Lower Volga and Trans-Volga regions; evidently, records of *R. quinquecostatus* from the saline lands of western Kazakhstan by Mityaev (2002) also refer to this species. It should be noted, that so far *R. artemisiae* was not found on *Artemisia* subg. *Seriphidium* in similar biotopes in southern and southeastern Kazakhstan and Kyrgyzstan.

Ethymology. The name of the species derives from the name of its host plant, *Salix*.

Remarks. We failed to find morphological traits for distinguishing between *R. salicinus* sp. n. and *R. artemisiae*. However, since these species are associated with different plants that differ distinctly in biotopic preferences, it is sufficient to have data on the biotope and sometimes only on the locality, to identify a species.

Due to the fact that the specimens, based on which Becker (1865) described the species *Flata artemisiae*

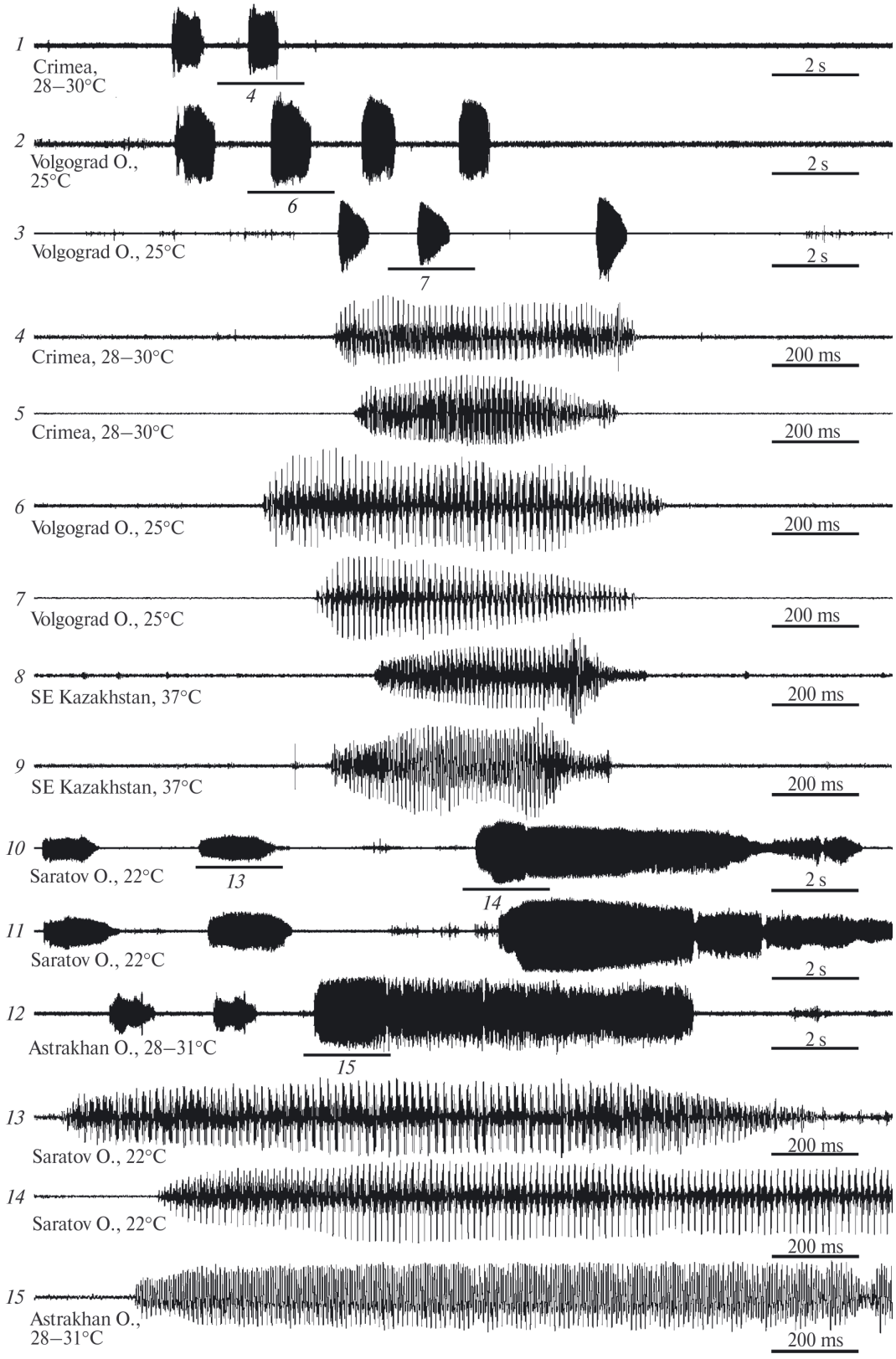

Fig. 4. *Reptalus* spp., male calling signal oscillograms: *1–9 – R. salicinus* sp. n.; *10–15 – R. artemisiae*. Faster oscillograms of the parts of signals indicated as "*4*", "*6–7*", and "*13–15*" are given under the same numbers, signal recording localities and temperature during recording are given under the oscillograms.

Becker 1865 = *R. artemisiae* (Becker 1865), were not found, and this name was applied to the cryptic species indistinguishable in morphological traits, we consider it necessary, in accordance with Article 75 of ICZN, to designate the male which calling signals were recorded and which was collected from the same host plant in the locality nearest to the original collection site (Sarepta = Krasnoarmeysk, now part of the city of Volgograd) as the neotype of *F. artemisiae* Becker 1865.

Neotype: ♂, Russia, Astrakhan Oblast, western shore of the Baskunchak Lake, near Bolshoy Bogdo Mtn., from *Artemisia* subg. *Seriphidium* in the semi-desert, 30.VI.2005, deposited in ZIN (fig. 2, *5–7*, *9*; 4, *12*, *15*).

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ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This work does not contain any studies involving human and animal subjects.

CONFLICT OF INTEREST

The authors of this work declare that they have no conflicts of interest.

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ОПИСАНИЕ ШИРОКО ИЗВЕСТНОГО ЗАПАДНОПАЛЕАРКТИЧЕСКОГО ВИДА РОДА *REPTALUS* EMELJANOV 1971 (HOMOPTERA, AUCHENORRHYNCHA, FULGOROIDEA, CIXIIDAE), НЕ ИМЕЮЩЕГО ВАЛИДНОГО НАЗВАНИЯ

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Приведено иллюстрированное описание *Reptalus salicinus* sp. n., ранее ошибочно интерпретированного как *R. quinquecostatus*. Приведены осциллограммы призывных сигналов самцов, а также данные о кормовых растениях и распространении нового вида и близкородственного *R. artemisiae*. Обозначен неотип *R. artemisiae*. *R. salicinus* sp. n. и *R. artemisiae* схожи по внешней морфологии и строению гениталий самца, но отчетливо различаются по временно́й структуре призывных сигналов и кормовой специализации и, таким образом, представляют собой разные биологические виды. Ареал *R. salicinus* sp. n. охватывает юг европейской части России, Казахстан и, по-видимому, южную часть Западной Европы. *R. artemisiae* до сих пор был найден только в Нижнем Поволжье и Западном Казахстане.

Ключевые слова: цикадовые, призывные сигналы самцов, криптические виды, новый вид, вибрационные сигналы, кормовые растения, обозначение неотипа