

Calling songs of grasshoppers of the genus *Podismopsis* (Orthoptera: Acrididae: Gomphocerinae) and potentialities of use of acoustic characters for discrimination between species of the genus

Призывные сигналы саранчовых рода *Podismopsis* (Orthoptera: Acrididae: Gomphocerinae) и возможности использования акустических признаков для различения видов этого рода

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KEY WORDS: grasshoppers, Acrididae, Gomphocerinae, *Podismopsis*, songs, signals, variability, bioacoustics, taxonomy, Russia.

КЛЮЧЕВЫЕ СЛОВА: саранчовые, Acrididae, Gomphocerinae, *Podismopsis*, сигналы, изменчивость, биоакустика, систематика, Россия.

ABSTRACT. Calling signals of *Podismopsis poppiusi*, *P. genicularibus* and *P. ussuriensis* from several localities in Southern Siberia, Amur Area, Khabarovsk and Maritime Provinces are described. Different types of variability of signals are investigated. Signals of all species studied have similar temporal pattern and are the echeme-sequences. The shape of syllables in first two species can vary due to the presence or absence of the gaps. Syllable repetition period (SRP) remains constant over many hundreds of kilometres of the range in all species studied. Signals of conspecific males from the same locality usually overlap in SRP fully or partially, but differ significantly from each other in this parameter. In the signals of sympatric species the values of SRP can overlap only to a small extent, whereas in allopatric ones they sometimes occupy almost the same range. *P. ussuriensis ussuriensis* and *P. ussuriensis micra* have the same pattern of songs, whereas populations of *P. genicularibus* from the western regions of the Russian Far East and from the Southern Maritime Province differ from each other in the number of syllables per echeme. Successful use of acoustic characters in taxonomy of *Podismopsis* is possible only with due account of their variation. Formal comparison of several selected recordings can lead to erroneous conclusions.

РЕЗЮМЕ. Описаны призывные сигналы *Podismopsis poppiusi*, *P. genicularibus* и *P. ussuriensis* из нескольких местонахождений в Южной Сибири, Амурской области, Хабаровском и Приморском краях. Исследованы разные типы изменчивости сигналов. Сигналы всех изученных видов имеют сход-

ный временной рисунок и состоят из регулярно повторяющихся фраз. У первых двух видов временной рисунок серий может варьировать за счёт наличия или отсутствия в них пауз. Период повторения серий (ППС) у всех изученных видов остаётся постоянным на протяжении многих сотен километров ареала. Сигналы конспецифических самцов из одной точки обычно частично или полностью перекрываются по значениям ППС, статистически достоверно различаясь по этому параметру. Значения ППС в сигналах симпатрических видов могут перекрываться лишь в незначительной степени, в то время как у аллопатрических они иногда занимают почти один и тот же диапазон. *P. ussuriensis ussuriensis* и *P. ussuriensis micra* имеют одинаковый временной рисунок сигналов, в то время как популяции *P. genicularibus* из западных регионов Дальнего Востока России и из Южного Приморья различаются по числу серий во фразах. В систематике *Podismopsis* успешное использование акустических признаков возможно только с учётом их изменчивости, формальное сравнение нескольких случайно выбранных записей может привести к ошибочным заключениям.

Comparative analysis of calling sounds (signals) of Gomphocerinae (Orthoptera: Acrididae) is widely used in taxonomy for discrimination of cryptic species and for elucidation of status of closely related forms. Still, there is increasing evidence that sometimes temporal pattern of songs in different species is quite similar; occasionally, this phenomenon is observed even in non-related forms from different genera [Bukhvalova, 2006].

The aim of the present study is to investigate the variability of signals in representatives of *Podismopsis* Zubowsky, 1900 and potentialities of use of acoustic analysis in taxonomy of the genus.

At present the genus includes in Palaearctic about 30 described species [Storozhenko & Paik, 2007]. The most part of species occur in the eastern part of the region, namely, in Eastern Siberia, the Russian Far East, China and Korea. A number of species are endemics of the Sakhalin, Kurile Islands and Shantarskie Islands; recently one species was described from the small Island of Moneron [Storozhenko, 2006]. Oscillograms of signals of *P. poppiusi* (Miram, 1907) from Irkutsk Area are presented in the paper by Bukhvalova and Vedenina [1998], signals of eight species from the northeast of China are described by Cao et al. [1995].

In the present paper signals of three most abundant representatives of the genus from the territory of Russia are described. Data on localities, the number of specimens investigated and the temperature during recordings are given in the Table 1. Recordings of songs were made under natural conditions from caged or freely-moving insects with microphone MD-382 (upper frequency limit 12.5 kHz) and cassette recorder Elektronika-302-1 (upper frequency limit 10 kHz) or minidisk recorder Sony Walkman MZ-NH900 (sampling fre-

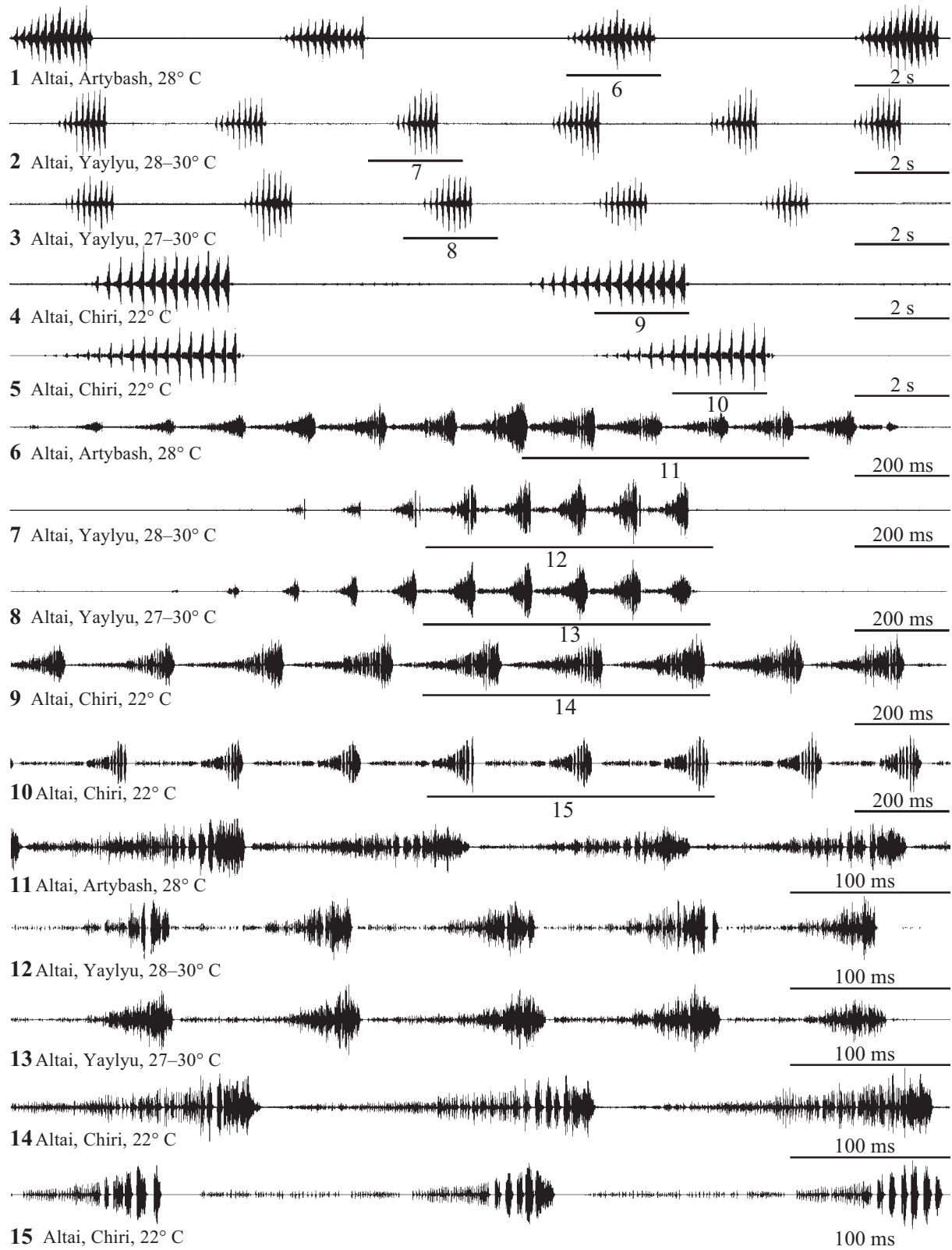
quency 44.1 kHz). In all cases manual mode of recording level control was used. Air temperature was measured during or immediately after recording on the place where the singing insect was sitting. For estimation of probability of identity of syllables repetition period in different songs Wilcoxon test was used. The specimens whose signals were recorded are deposited in the collection of the Zoological Museum of Moscow State University. Song terminology used in the present paper is accepted after Ragge [1987].

In contrast to most other Gomphocerinae, the studied species of *Podismopsis* are forest-dwelling insects. Singing males usually can be found on the soil among dry leaves or on the broad-leaved grasses either under the canopy of the forest or on the glades with dense and high vegetation. Similarly to other grasshoppers, *Podismopsis* males readily sing during the daytime. In the Southern Maritime Province, where the nights are rather warm, they can also keep on singing long after dusk, when all other grasshoppers normally are silent. The male, if not disturbed, can sing unceasingly for more than 10–15 minutes.

General schemes of temporal pattern of songs of three species studied are quite similar (Figs 1–71). Signals are echeme-sequences; each echeme begins quietly, but rapidly reaches maximum intensity.

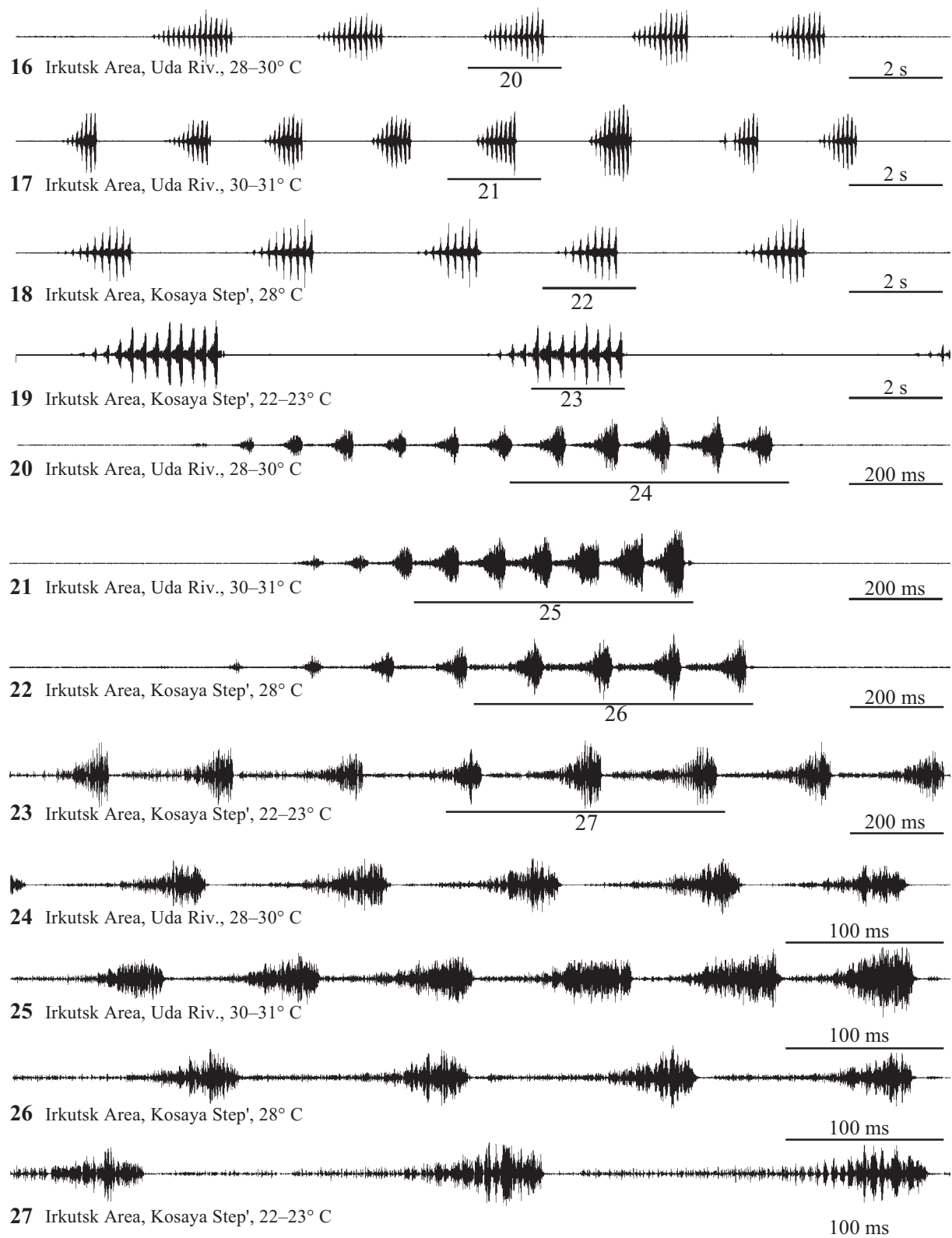
Table 1. Data for recordings of calling signals of the studied species of *Podismopsis*.
Таблица 1. Данные о записях призывных сигналов изученных видов *Podismopsis*.

| Species | Locality and number of specimens | Air temperature during recording, °C |
|---|--|--------------------------------------|
| <i>P. poppiusi</i> (Miram, 1907) | 1. Altai Mts., Teletskoe Lake: (a) Artybash village at the northern end of the lake, 1 ♂ (b) Yaylyu village at the northern end of the lake, 5 ♂♂ (c) Chiri village at the southern end of the lake, 2 ♂♂ | 28 27–30 22 |
| | 2. Irkutsk Area: (a) the valley of Uda Riv. 10–12 km N of Nizhneudinsk, 4 ♂♂ (b) env. Kosaya Step' village, 50 km SE of Bayanday along the road to Elantsy, 1 ♂ | 28–31 22–23 and 28 |
| <i>P. genicularibus</i> (Shiraki, 1910) | 1. Amur Area, about 30 km W of Svobodny, env. Kostyukovka village, 2 ♂♂ | 25 and 32 |
| | 2. SW of Khabarovsk Prov., about 7 km N of Obluchye, 2 ♂♂ | 30 and 32–35 |
| | 3. Maritime Prov.: (a) 30 km N of Chuguevka, env. Zametnoe village, 4 ♂♂ | 26–28 |
| | (b) Partizansky Region, env. Tigrovoy, 2 ♂♂ | 25–27 |
| | (c) Pogranichny Region, env. Barabash-Levada village, 1 ♂ | 26–27 |
| (d) NW bank of Khanka Lake, 10 km S of Turiy Rog, 1 ♂ | 27–28 | |
| (e) Khasan Region, env. Andreevka, 2 ♂♂ | 25 and 29 | |
| <i>P. ussuriensis micra</i> Bey-Bienko, 1932 | 1. Amur Area, about 30 km W of Svobodny, env. Kostyukovka village, 3 ♂♂ | 25–27 and 30 |
| | 2. SW of Khabarovsk Prov., about 7 km N of Obluchye, 3 ♂♂ | 22, 25–27 and 33–35 |
| <i>P. ussuriensis ussuriensis</i> Ikonnikov, 1911 | 3. Maritime Prov.: (a) Partizansky Region, env. Tigrovoy, 1 ♂ | 25–27 |
| | (b) Pogranichny Region, env. Barabash-Levada village, 5 ♂♂ | 27 and 30–32 |
| | (c) NW bank of Khanka Lake, 10 km S of Turiy Rog, 3 ♂♂ | 25 |



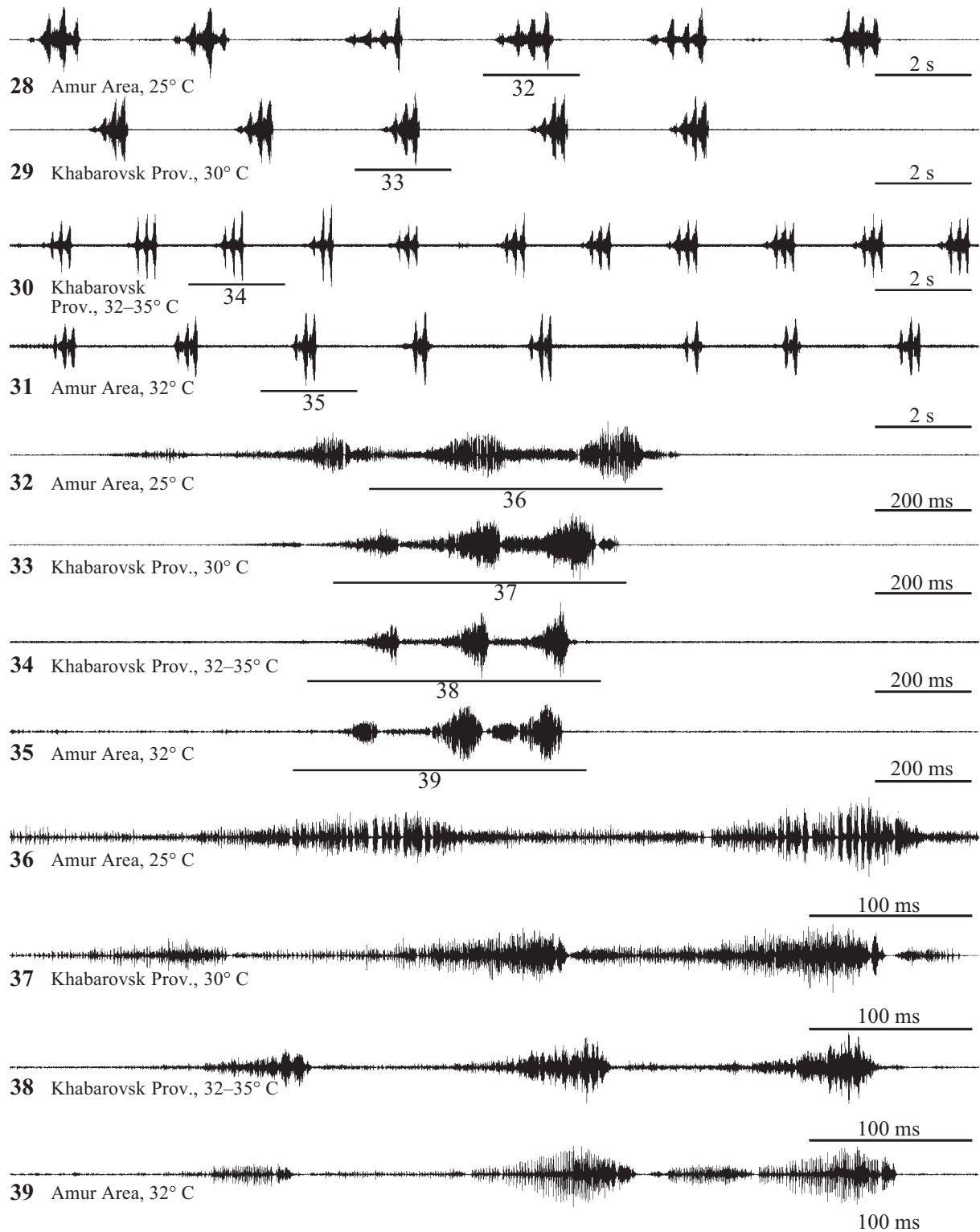
Figs 1–15. Oscillograms of calling songs of *Podismopsis poppiusi* (Miram): 5, 10, 15 — the male with one hind leg. Faster oscillograms of the parts of songs indicated as “6–15” are given under the same numbers.

Рис. 1–15. Осциллограммы призывных сигналов *Podismopsis poppiusi* (Miram): 5, 10, 15 — самец с одной задней ногой. Фрагменты сигналов, помеченные цифрами “6–15”, представлены при большей скорости развёртки на осциллограммах под такими же номерами.



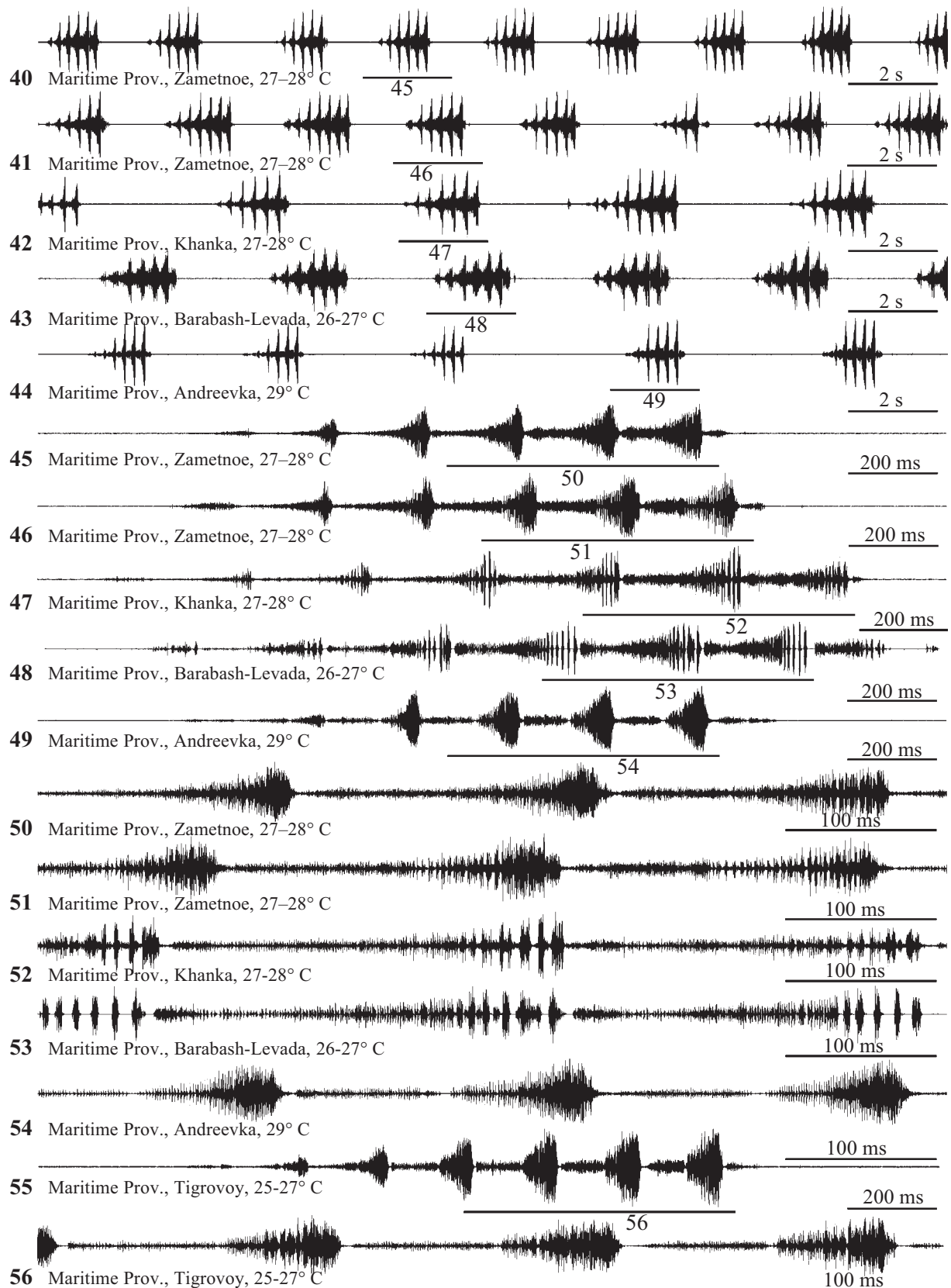
Figs 16–27. Oscillograms of calling songs of *Podismopsis poppiusi* (Miram): 18, 22, 26 and 19, 23, 27 — two signals of the same male. Faster oscillograms of the parts of songs indicated as “20–27” are given under the same numbers.

Рис. 16–27. Осциллограммы призывных сигналов *Podismopsis poppiusi* (Мирам): 18, 22, 26 и 19, 23, 27 — два сигнала одного самца. Фрагменты сигналов, помеченные цифрами “20–27”, представлены при большей скорости развёртки на осциллограммах под такими же номерами.



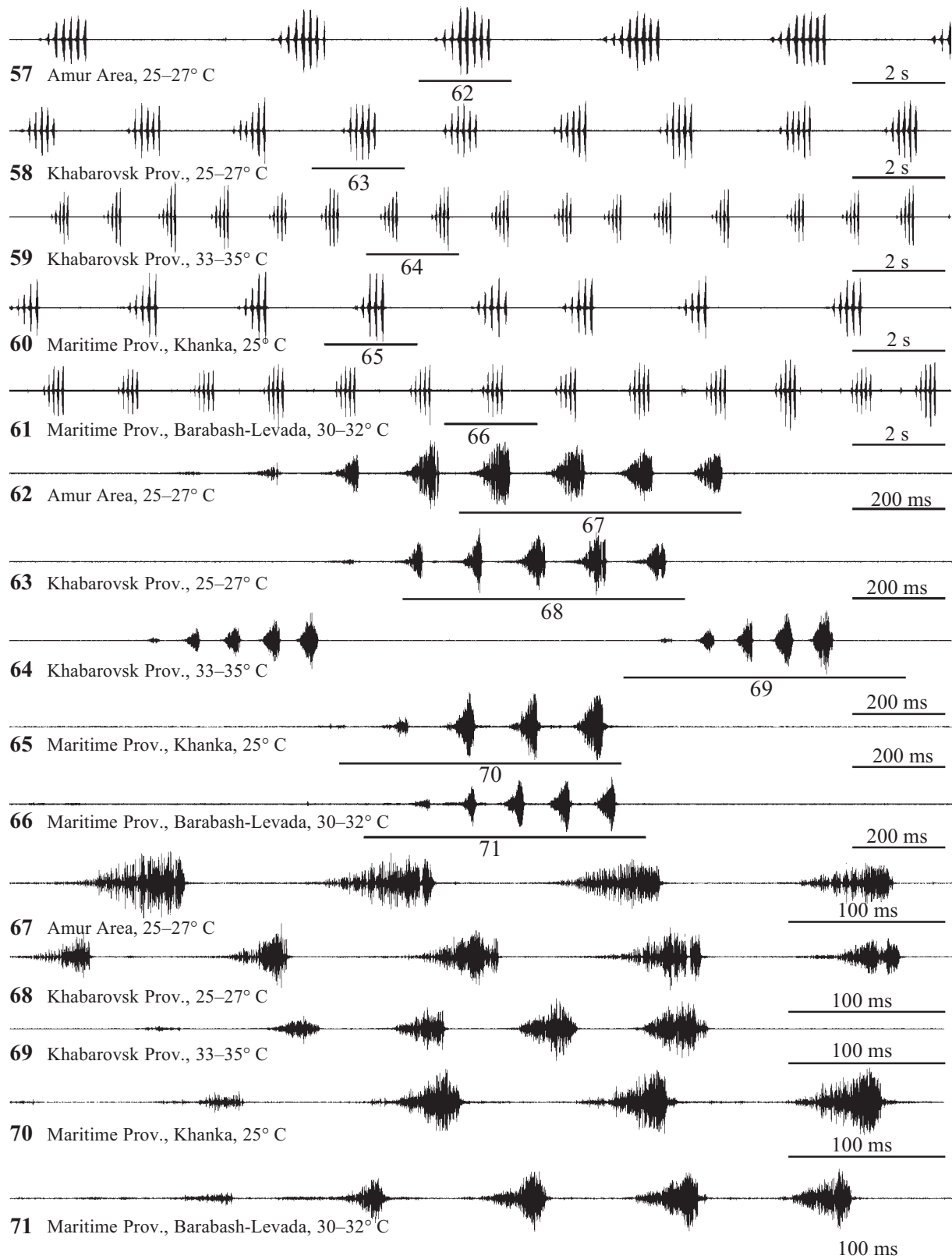
Figs 28–39. Oscillograms of calling songs of *Podismopsis genicularibus* (Shiraki) from Amur Area and Khabarovsk Prov. Faster oscillograms of the parts of songs indicated as “32–39” are given under the same numbers.

Рис. 28–39. Осциллограммы призывных сигналов *Podismopsis genicularibus* (Shiraki) из Амурской обл. и Хабаровского края. Фрагменты сигналов, помеченные цифрами “32–39”, представлены при большей скорости развёртки на осциллограммах под такими же номерами.



Figs 40–56. Oscillograms of calling songs of *Podismopsis genicularibus* (Shiraki) from the southern Maritime Province: 44, 49, 54 — the male with one hind leg. Faster oscillograms of the parts of songs indicated as “45–54” and “56” are given under the same numbers.

Рис. 40–56. Осциллограммы призывных сигналов *Podismopsis genicularibus* (Shiraki) из Южного Приморья: 44, 49, 54 — самец с одной задней ногой. Фрагменты сигналов, помеченные цифрами “45–54” и “56”, представлены при большей скорости развёртки на осциллограммах под такими же номерами.



Figs 57–71. Oscillograms of calling songs of *Podismopsis ussuriensis* Ikonnikov. Faster oscillograms of the parts of songs indicated as “62–71” are given under the same numbers.

Рис. 57–71. Осциллограммы призывных сигналов *Podismopsis ussuriensis* Иконников. Фрагменты сигналов, помеченные цифрами “62–71”, представлены при большей скорости развёртки на осциллограммах под такими же номерами.

In the songs of *P. poppiusi* syllables follow each other almost without pauses (Figs 6–15, 20–27). Each syllable begins quietly and gradually reaches its maximum towards the end. Quite often clicks in the high-amplitude part of syllable are united in groups separated by gaps (Figs 14–15, 27). In the male with one hind leg the gaps both in and between syllables are more distinct (Figs 5, 10, 15). We have not found any constant differences between the songs of males from Altai Mts. (Teletskoe Lake) and Irkutsk Area (Figs 1–15 and 16–27 respectively).

The songs of *P. genicularibus* (Shiraki, 1910) are quite similar with these of the previous species in the structure of syllables (Figs 28–56). The gaps in syllables can be almost entirely absent (Figs 37–38, 50–51) or, on the contrary, are quite distinct (Figs 36, 52–53). In the songs of certain males low- and high-amplitude parts of each syllable are separated by a gap. This is the case in the signals of males with one hind leg (Figs 44, 49, 54), but sometimes it was also observed in intact individuals (Figs 31, 35, 39 and 55–56). *P. genicularibus* does not form morphological subspecies. It can be subdivided into two distinct geographical forms basing in the structure of calling signals, however. In the form from the western regions of the Russian Far East (Amur Area and the south-west of Khabarovsk Province) each echeme includes 2–4 syllables only (Figs 28–35), whereas in the form occurring in the Southern Maritime Province the number of syllables per echeme averages 5–8 (Figs 40–49).

In the songs of *P. ussuriensis* Ikonnikov, 1911 syllables are separated by distinct pauses equal to or longer than syllable (Figs 57–71). Songs of different subspecies, *P. ussuriensis ussuriensis* Ikonnikov, 1911 and *P. ussuriensis micra* Bey-Bienko, 1932 are identical (Figs 57–59, 62–64, 67–69 and 60–61, 65–66, 70–71).

Therefore, as is seen from the oscillograms presented, differences between the songs of different species of *Podismopsis* are not always distinct. This is especially true in regard to *P. poppiusi* and *P. genicularibus* from the Southern Maritime Province (Figs 1–27 and 40–56). The ranges of variation of echeme duration in all forms (both species and subspecies) overlap to a greater or lesser extent (Table 2). Echeme repetition period also varies within more or less the same range (Table 2); in

addition, duration of pauses between echemes becomes more variable if the singing male was disturbed. Certain forms differ from each other in the number of syllables per echeme, still the songs of *P. genicularibus* from the Southern Maritime Province and *P. ussuriensis* overlap almost completely in this parameter (Table 2).

For this reason the songs of different species often sound quite similar for human ear and sometimes are almost indistinguishable in nature. Comparison of oscillograms of individual signals also does not always allow revealing distinct interspecific differences. On the other hand, differences between geographical forms of the same species (Figs 28–39 and 40–56) or even between individuals from the same region (e.g. Figs 45, 50 and 48, 53) sometimes are pronounced quite well.

It is common knowledge that calling signal of each species must differ in at least one physical parameter from signals of all other sympatric simultaneously singing ones. Otherwise, recognition of conspecific signal against the chorus of other species by potential mate would be impossible. All the complex of the parameters of the signal determine for the song of each species its own “place” in the acoustic environment of the ecological community. In grasshoppers, one of the most important parameters in which similar songs of different species differ from each other is a syllable repetition period (SRP) [Bukhvalova, 2006].

In *P. poppiusi* the ranges of variability of SRP in individual males from the same region at constant temperature can differ distinctly from each other and occasionally do not overlap even in extreme values (Fig. 72, e.g. males 1 and 4, 3 and 6). Probability of identity (P) of different samples presented on histograms does not exceed 0.30 (between males 2 and 5); moreover, in most cases $P \leq 0.01$ (significant difference). Hence it follows that in the case under consideration the results of statistical processing of data must be interpreted with caution, because statistical significance does not always mean biological significance. All males studied were collected in a rather small region on the northern end of Teletskoe Lake. What is more, males 2–6 were found on the same small glade on the shore of the lake and undoubtedly belong to the same population.

Table 2. Temporal parameters of calling signals of the studied species of *Podismopsis* at the temperature 27–33° C. Таблица 2. Временные параметры призывных сигналов изученных видов *Podismopsis* при температуре 27–33° C.

| Species | Duration of echeme, s | Echeme repetition period, s | Number of syllables per echeme |
|---|-----------------------|-----------------------------|--------------------------------|
| <i>P. poppiusi</i> (Miram, 1907) from Altai Mts. | 0.7–1.7 | 3.0–7.7 | 9–15 |
| <i>P. poppiusi</i> (Miram, 1907) from Irkutsk Area | 1.1–2.6 | 1.8–4.0 | 8–11 |
| <i>P. genicularibus</i> (Shiraki, 1910) from Amur Area and SW of Khabarovsk Prov. | 0.4–1.2 | 1.8–2.9 | 2–4 |
| <i>P. genicularibus</i> (Shiraki, 1910) from Maritime Prov. | 0.9–1.9 | 2.2–4.7 | 5–8 |
| <i>P. ussuriensis micra</i> Bey-Bienko, 1932 | 0.3–1.2 | 1.0–5.0 | 4–8 |
| <i>P. ussuriensis ussuriensis</i> Ikonnikov, 1911 | 0.2–1.0 | 1.3–3.8 | 3–9 |

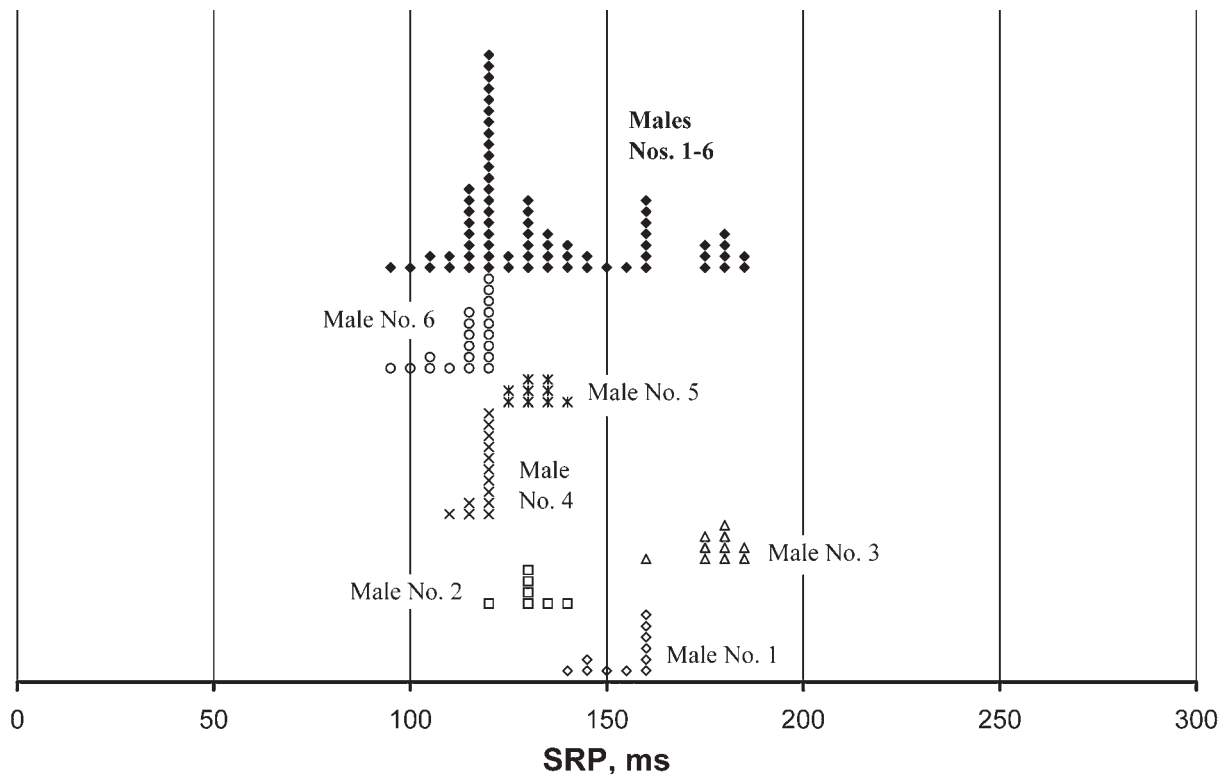


Fig. 72. Histograms of distribution of syllable repetition period (SRP) in the songs of different males of *Podismopsis poppiusi* (Miram) from the northern end of Teletskoe Lake (Altai Mts.) at the temperature 27–30° C. Probability of identity of SRP $P=0.02$ in the males Nos. 2 and 4; $P=0.30$ in the males Nos. 2 and 5; $P=0.06$ in the males Nos. 4 and 6, $P\leq 0.01$ in other cases.

Рис. 72. Гистограммы распределения периода повторения серий (ППС) в сигналах разных самцов *Podismopsis poppiusi* (Мирам) с северной оконечности Телецкого озера (Алтай) при температуре 27–30° C. Вероятность идентичности ППС $P=0,02$ у самцов №№ 2 и 4; $P=0,30$ у самцов №№ 2 и 5; $P=0,06$ у самцов №№ 4 и 6, $P\leq 0,01$ в остальных случаях.

As in other singing insects, SRP in *P. poppiusi* decreases with increasing temperature (Fig. 73). It is clearly visible even on oscillograms at low speed (Figs 1–3 and 4–5, 18 and 19; on last two oscillograms signals of the same male are presented). At the temperature difference of 5° C and more the ranges of SRP are fully separated. Also, the number of syllables per echeme in males singing at lower temperatures is somewhat higher. This peculiar phenomenon was observed in both regions, where the recordings of this species were made. Thus in individuals from Altai Mts. the number of syllables per echeme averages 9–15 and 14–16 at 27–30 and 22° C respectively (Figs 1–3 and 4–5). In the male from Irkutsk Area 9–11 and 12–13 syllables per echeme can be counted at 28 and 22–23° C respectively (Figs 18–19). Still, it should be noted, that syllables in the initial part of the echeme have very low amplitude and are almost indistinguishable on oscillograms. For this reason it is not always possible to count them with certainty.

In our recordings, SRP in signals of males from Altai Mts. and Irkutsk Area overlap to a great extent at the same temperatures (Fig. 73). In addition, at the temperature 22° C differences between males from different population are not significant (probability of identity $P=0.20$).

In *P. genicularibus* from the Southern Maritime Province the ranges of variability of SRP in the songs of different males for the most part overlap fully or partially, still the differences between signals were statistically significant in all cases but one: in the males 2 and 3 from Chuguevka probability of identity of SRP $P>0.01$ (Fig. 74). Males from the environs of Tigrovoy stand somewhat apart from other ones in this character. SRP in their signals is distinctly lower, than in individuals from other localities, still in other characters their songs are similar with these of other males (Figs 40–54 and 55–56).

Populations of *P. genicularibus* from the western regions of the Russian Far East (Amur Area and southwestern part of Khabarovsk Province) and from Maritime Province are quite similar in SRP (Fig. 75) in spite of distinct differences in the number of syllables per echeme (Figs 28–31 and 40–44). In males singing at 30–35° C SRP is distinctly lower than in one singing at 25° C (Fig. 75). In contrast to *P. poppiusi*, no temperature-related changes of number of syllables per echeme were observed.

In *P. ussuriensis ussuriensis*, the values of SRP in the songs of different individuals fall into the same range. Individual males differ significantly from each other in this character, however (Fig. 76). Only in

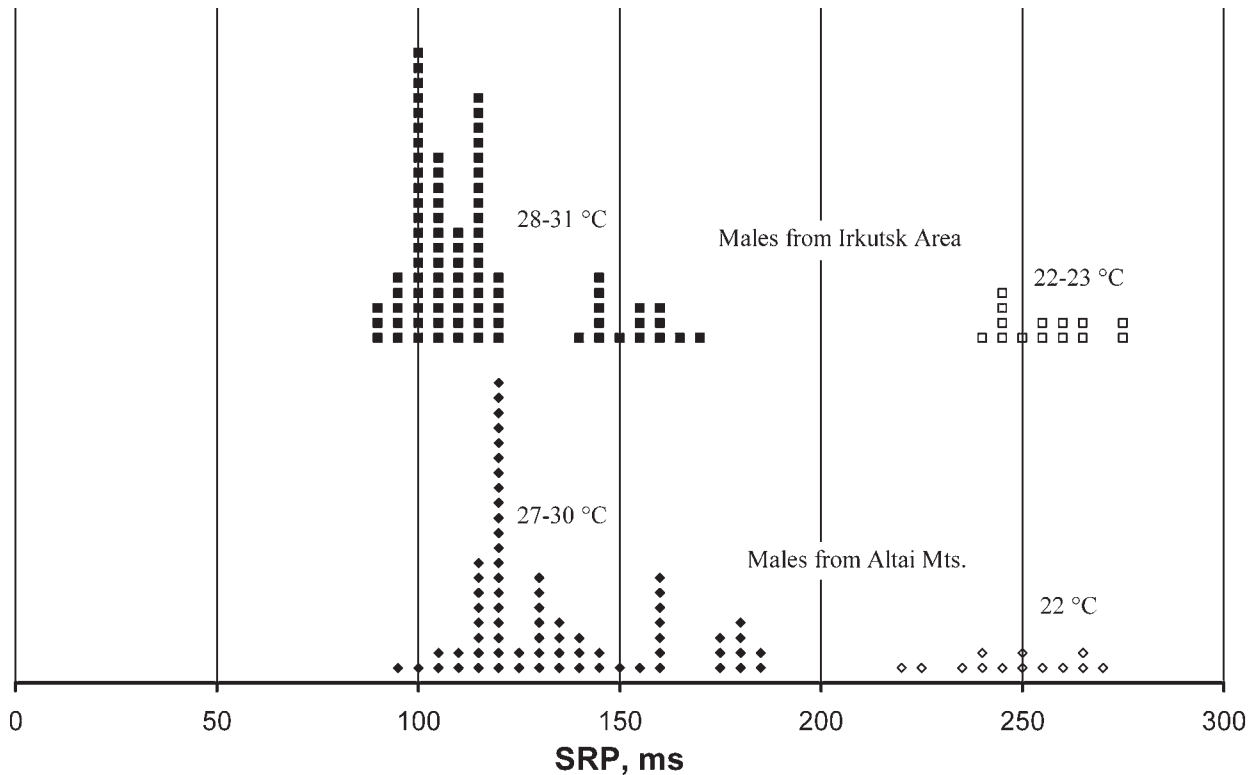


Fig. 73. Histograms of distribution of syllable repetition period (SRP) in the songs of *Podismopsis poppiusi* (Miram) from Altai Mts. and Irkutsk Area at the temperatures 27–31 and 22–23 °C. Probability of identity of SRP $P=0.20$ in the males singing at 22–23 °C; $P<0.01$ in the males singing at 27–31 °C.

Рис. 73. Гистограммы распределения периода повторения серий (ППС) в сигналах *Podismopsis poppiusi* (Мирам) с Алтая и из Иркутской обл. при температуре 27–31 и 22–23 °C. Вероятность идентичности ППС $P=0,20$ у самцов, певших при температуре 22–23 °C; $P<0,01$ у самцов, певших при температуре 27–31 °C.

males 1 and 2 from Khanka Lake probability of identity $P=0.24$. Differences between *P. ussuriensis ussuriensis* and *P. ussuriensis micra* are not pronounced (Fig. 77), moreover for signals of different subspecies recorded at 25–27 °C probability of identity $P=0.11$. Temperature-related changes of signals in this species are of the same order of magnitude as in *P. genicularibus* (Fig. 77).

Comparison of histograms of distribution of the values of SRP in different species shows, that in sympatric ones (*P. ussuriensis* and *P. genicularibus*) signals differ significantly in this parameter (Fig. 78). On the contrary, in allopatric forms the range of variability of SRP can overlap almost entirely (*P. ussuriensis* and *P. poppiusi*). These data are in good agreement with results obtained for other species of Gomphocerinae [Bukhvalova, 2006].

As a result, it must be admitted that only investigation of different kinds of variability of acoustic signals allows revealing reliable taxonomic characters for discrimination between different species of *Podismopsis*.

The shape of syllables in representatives of this genus can vary considerably due to the presence or absence of gaps. Moreover, differences between ex-

treme variants of syllable structure in the same species sometimes are as great as between different species in other groups of Gomphocerinae. Consequently, investigation of songs of a number of individuals is necessary for determination the limits of variation. Formal comparison of two selected recordings can lead to erroneous conclusions.

In the taxonomy on the subspecies level acoustic characters are in contradiction with morphological data. On the one hand, two subspecies of *P. ussuriensis* are indistinguishable in the shape of signals and on the other, *P. genicularibus*, which is uniform in morphology throughout all the range, forms two distinct geographical variations differing from each other in the song patterns.

SRP appeared to be one of the most reliable characters of the songs in representatives of the genus. In all species studied it remains constant over many hundreds of kilometres of the range. However, temperature has a profound effect on the SRP and, in the case with *P. poppiusi*, apparently also on the number of syllables per echeme. Besides, males of *Podismopsis* readily sing both on the open place and under the canopy of trees. Several individuals occurring at a distances of about 3–4 meters from each other quite

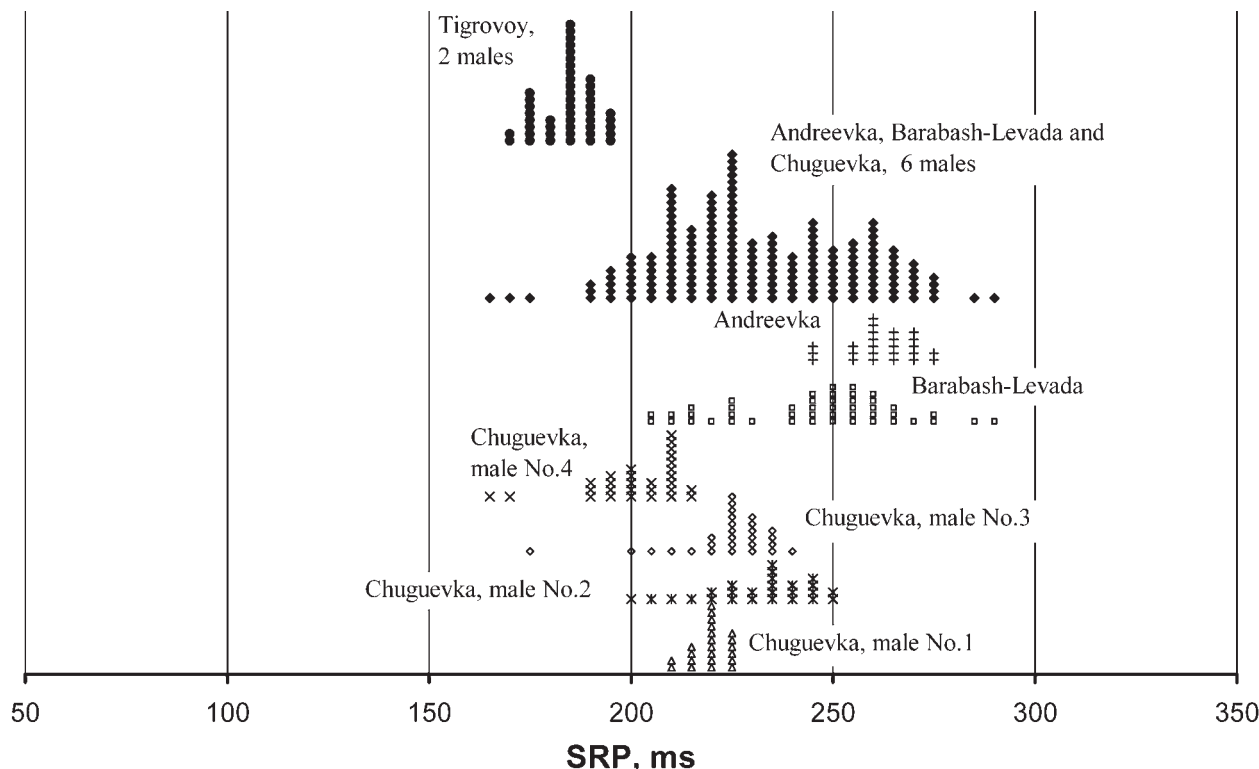


Fig. 74. Histograms of distribution of syllable repetition period (SRP) in the songs of different males of *Podismopsis genicularibus* (Shiraki) from the southern Maritime Province at the temperature 25–28° C. Probability of identity of SRP $P=0.02$ in the males Nos. 2 and 3 from Chuguevka; $P\leq 0.01$ in other cases.

Рис. 74. Гистограммы распределения периода повторения серий (ППС) в сигналах разных самцов *Podismopsis genicularibus* (Shiraki) из Южного Приморья при температуре 25–28° C. Вероятность идентичности ППС $P=0,02$ у самцов №№ 2 и 3 из Чугуевки; $P\leq 0,01$ в остальных случаях.

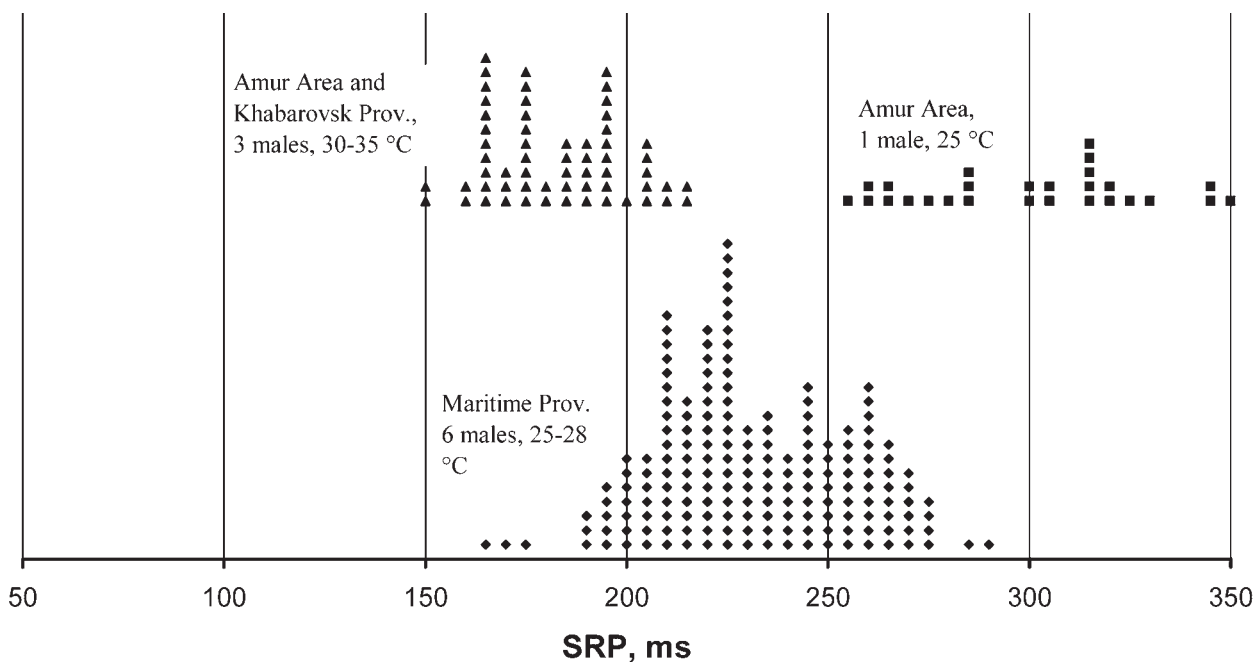


Fig. 75. Histograms of distribution of syllable repetition period (SRP) in the songs of *Podismopsis genicularibus* (Shiraki) from different regions. Probability of identity of SRP $P<0.01$ in all cases.

Рис. 75. Гистограммы распределения периода повторения серий (ППС) в сигналах *Podismopsis genicularibus* (Shiraki) из разных районов. Вероятность идентичности ППС $P<0,01$ во всех случаях.

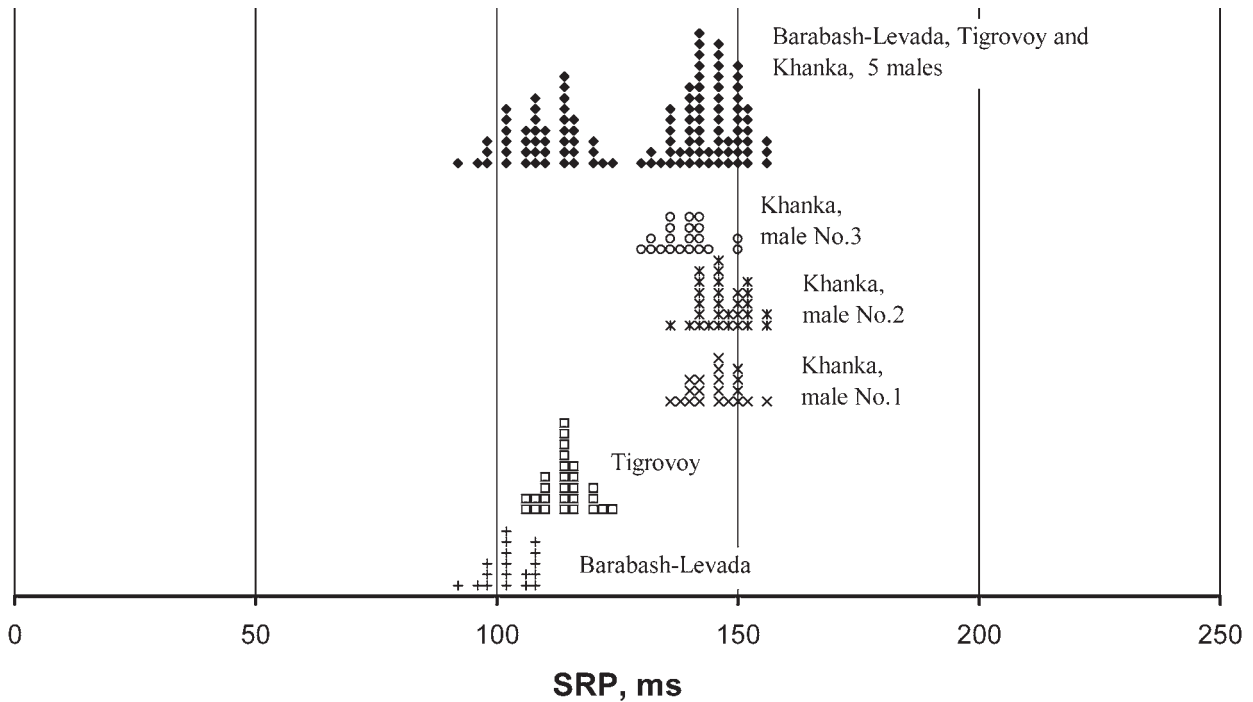


Fig. 76. Histograms of distribution of syllable repetition period (SRP) in the songs of different males of *Podismopsis ussuriensis* Ikonnikov from the southern Maritime Province at the temperature 25–27° C. Probability of identity of SRP $P=0.24$ in the males Nos. 1 and 2 from Khanka Lake; $P<0.01$ in other cases.

Рис. 76. Гистограммы распределения периода повторения серий (ППС) в сигналах разных самцов *Podismopsis ussuriensis* Ikonnikov из Южного Приморья при температуре 25–27° C. Вероятность идентичности ППС $P=0.24$ у самцов №№ 1 и 2 с озера Ханка; $P<0,01$ в остальных случаях.

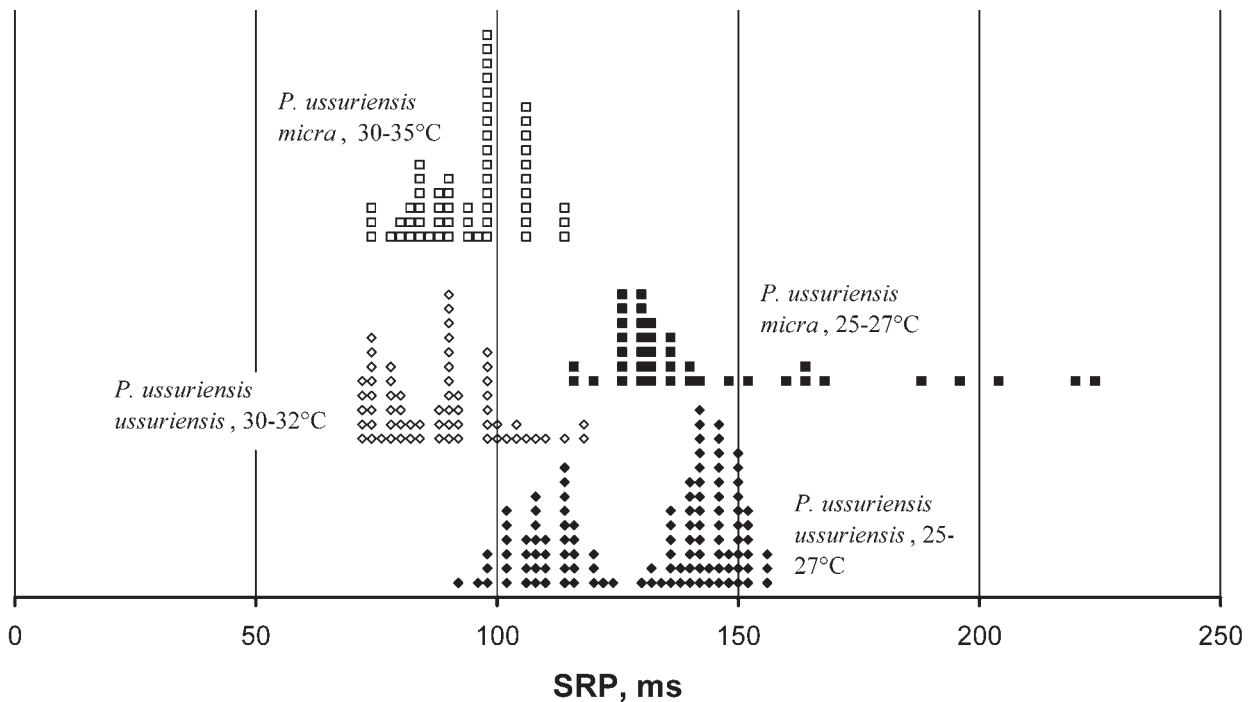


Fig. 77. Histograms of distribution of syllable repetition period (SRP) in the songs of two subspecies of *Podismopsis ussuriensis* Ikonnikov at the temperatures 25–27 and 30–35° C. Probability of identity of SRP in *P. ussuriensis ussuriensis* Ikonnikov and *P. ussuriensis micra* Bey-Bienko $P=0.11$ at the temperature 25–27° C; $P=0.01$ at the temperature 30–35° C.

Рис. 77. Гистограммы распределения периода повторения серий (ППС) в сигналах двух подвидов *Podismopsis ussuriensis* при температуре 25–27 и 30–35° C. Вероятность идентичности ППС у *P. ussuriensis ussuriensis* Ikonnikov и *P. ussuriensis micra* Bey-Bienko $P=0,11$ при температуре 25–27° C; $P=0,01$ при температуре 30–35° C.

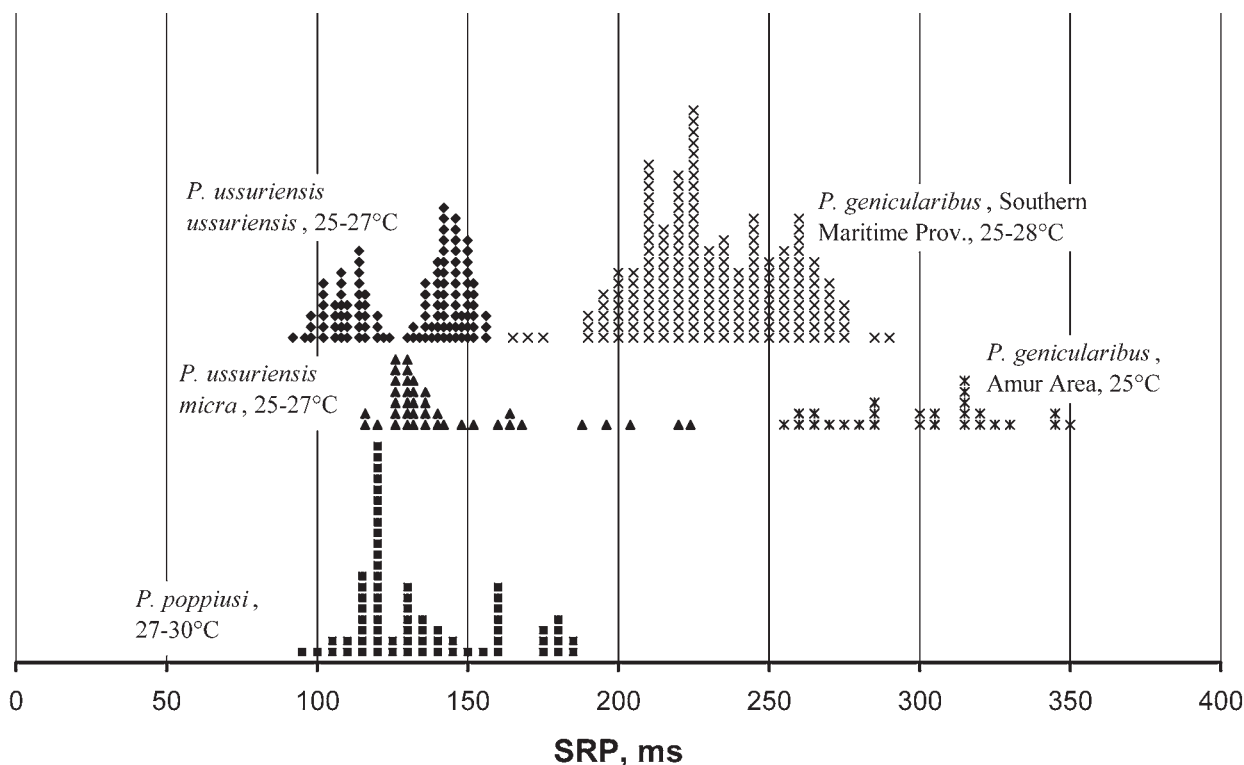


Fig. 78. Histograms of distribution of syllable repetition period (SRP) in the songs of different species and subspecies of *Podismopsis*. Probability of identity of SRP in different species $P < 0.01$ in all cases.

Рис. 78. Гистограммы распределения периода повторения серий (ППС) в сигналах разных видов и подвидов *Podismopsis*. Вероятность идентичности ППС в сигналах разных видов $P < 0,01$ во всех случаях.

often produce their signals at different temperatures, one sitting on the sunlit place and another in the shade. Differences in SRP in such a case sometimes are distinct even for human ear. For this reason only recordings made at more or less similar temperatures can be used for comparative analysis.

Also, acoustic analysis is of limited usefulness for elucidation of taxonomic status of allopatric forms. Among *Podismopsis* these are species from the islands of the Russian Far East and certain mountain forms such as a siberian *P. altaica* Zubowsky, 1900 or european *P. transsylvanica* Ramme, 1951. Clear differences between signals of allopatric forms indicate that they are good species, still the similarity of signals is not an evidence of their synonymy.

In the light of results obtained an attempt of comparative investigation of signals of eight species of *Podismopsis* from the northeast of China [Cao et al., 1995] seems to be unsuccessful. It should be noted, that all species studied are described from China and were not found outside its territory. On the basis of comparison of oscillograms and temporal parameters of songs the authors concluded that these species differ from each other in the structure of signals. However, judging from the oscillograms presented, there is no escape from the conclusion that in certain forms tem-

poral pattern of songs is identical. Quantitative data provided in the paper under consideration confirm this supposition. Intervals between syllables are identical in three forms (0.133 s) and have close values in two more ones (0.127 and 0.140 ms). In two other forms this parameter averages 0.053 and 0.067 s respectively. The number of syllables per echeme varies from 2 to 4 in all forms. We have no data on biology and distribution of chinese species, still if they are not allopatric, some of them evidently should be considered as synonyms. Moreover, neither *P. ussuriensis*, nor *P. genicularibus*, which are abundant and numerous in the adjacent regions of Maritime Province were not found in the northeast of China by the authors of the paper. Consequently, it is quite possible, that certain chinese forms are junior synonyms of species described from the Russian Far East.

ACKNOWLEDGEMENTS. I am greatly indebted to my friend and colleague Dr. K.A. Kolesnichenko (Botanical Garden of M.V. Lomonosov Moscow State University) for his invaluable help in expeditions to Southern Siberia and the Russian Far East. The study was supported by a grant of a State Program "Development of Scientific Potential of Higher School" (project "Biological Diversity: Structure, Stability, Evolution") and Russian Foundation for Basic Research (No. 07-04-00349-a).

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