

STUDIES ON *PODISMOPSIS INSULARIS* (ORTHOPTERA: ACRIDIDAE), ENDEMIC TO THE SHANTAR ISLANDS NATIONAL PARK IN THE SEA OF OKHOTSK, RUSSIA

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This paper aims to re-describe and illustrate the poorly known grasshopper *Podismopsis insularis* and to clarify the taxonomic status of its subspecies. This species occurs on all large islands of the Shantar Archipelago (Bolshoi Shantar Island, Feklistova Island, and Maly Shantar Island). The type specimens of both subspecies and additional material are examined. A new synonymy is established: *Podismopsis insularis* = *Podismopsis insularis shantariensis*, syn. nov. A thorough description of this species, photographs of male and female habitus and of male genitalia are also provided. The evolutionary radiation of grasshoppers of the genus *Podismopsis* over the islands of the Sea of Okhotsk basin during the last 8000–10 000 years is briefly discussed. The Shantar Islands National Park is important for conservation of endemic insect species.

Key words: Chrysochraontini, fauna, Gomphocerinae, grasshoppers, new synonymy, Palaearctic Region, Russian Far East, taxonomy

Introduction

Grasshoppers (Orthoptera: Acrididae) are among the most recognisable and familiar insects in terrestrial habitats around the world (Song et al., 2018). Grasshoppers can be excellent monitors of landscape use as they are ecologically sensitive and yet sufficiently mobile and abundant to serve as bioindicators (Sergeev, 2021). There are numerous endemic taxa of the insular grasshoppers in the Pacific Ocean but the majority of them are distributed in the tropical and subtropical regions (Tan et al., 2017, 2019; Storozhenko, 2018, 2020a,b; Yin & Yin, 2020), while the number of such taxa in boreal region is limited.

The Shantar Islands National Park covers both the terrestrial and maritime surroundings of the Shantar Islands, a group of 15 currently uninhabited islands situated in the Sea of Okhotsk in the neighbourhood of the continental coast of the Russian Far East. Most of the islands are moderately mountainous with rugged cliffs and covered by coniferous forests (taiga).

Two endemic species of grasshoppers were described from Shantar Islands by Mistshenko (1951), namely *Chorthippus shantariensis* Mistshenko, 1951 and *Podismopsis insularis* Mistshenko, 1951; the latter species was divided into two subspecies. The present paper aims to re-describe and illustrate *P. insularis* and to clarify the taxonomic status of its subspecies.

Material and Methods

The present paper is based on collections of the Zoological Institute RAS, St. Petersburg, Rus-

sia (ZIN) and Federal Scientific Center of the East Asia Terrestrial Biodiversity, Vladivostok, Russia (FSCB). Photographs were taken with an Olympus SZX16 stereomicroscope and an Olympus DP74 digital camera, and then stacked using Helicon Focus software. The final illustrations were post-processed for contrast and brightness using Adobe® Photoshop® software.

Results

The genus *Podismopsis* Zubowsky, 1899 (Gomphocerinae: Chrysochraontini) consists of 39 Palaearctic species, 12 of them are known from Russia (Cigliano et al., 2021). The acoustic signals of *Podismopsis* males are intensively investigated in Russia for the purpose of taxonomy (Tishechkin, 2008; Benediktov, 2017). The revision of the East Palaearctic species of *Podismopsis* has been published recently (Lu et al., 2011), while until now there are a lot of poorly known species in this genus. One of such species is *P. insularis* from the Shantar Islands. Both subspecies of this species were very briefly described by Mistshenko (1951) as follows: a) frontal ridge in male 1.5 times, in female 2 times narrower than vertex between eyes; length of body: ♂ 15.5, ♀ 16.1 mm, length of tegmen: ♂ 8.7, ♀ 5.1 mm ... *P. insularis insularis*; b) frontal ridge in ♂ 2 times narrower than vertex between eyes; length of body ♂ 16.7 mm, length of tegmen ♂ 8.8 mm; female unknown *P. insularis shantariensis*. Up to now no more information on these taxa is

available. The type material was examined by me. I found that really the frontal ridge in nominotypical subspecies 1.8 times and in *P. i. shantariensis* 2.2 times narrower than vertex. The study of additional material shows that there are not any differences between these subspecies. Therefore, a new synonymy is established here, as well as a thorough description of the species is given.

Re-description of *Podismopsis insularis* Mistshenko, 1951

Podismopsis (Podismacris) insularis insularis Mistshenko, 1951: 426, fig. 952.

Podismopsis (Podismacris) insularis shantariensis Mistshenko, 1951: 426, fig. 951; syn. nov.

Type material examined. *Podismopsis insularis insularis*: holotype – ♂, Russia: Bolshoi Shantar Island, River Amuka, 21.07.1925, leg. Dulkeit (ZIN); allotype – ♀, Russia: Bolshoi Shantar Island, 22.07.1911, leg. Soldatov (ZIN). *Podismopsis insularis shantariensis*: holotype – ♂, Russia: Maly Shantar Island, 18.07.1911, leg. Soldatov (ZIN). The photos of the original labels of the types in Russian are given here (Fig. 1).

Other material examined. Russia, Khabarovsk Krai, Maly Shantar Island, 15.08.2010, 1 ♀, leg. V.V. Bogatov (FSCB); Feklistova Island, Lisie Lake, 20.08.2010, 6 ♂, 6 ♀, 1 larva, leg. V.V. Bogatov (FSCB).

Male (Fig. 2). Body of small size for the genus *Podismopsis*. Head short; face in profile oblique. Frontal ridge almost parallel side, narrow, 1.8–2.4 times narrower than vertex between eyes. Depression of vertex with distinct median carinula. Foveolae absent. Vertical diameter of eyes 1.1 times larger than subocular furrow. Lower part of genae distinctly punctuated. Eyes oval; vertical diameter of eye 1.1 times as long as subocular furrow. Antennae filiform, 21–23-segmented, almost reaching the base of hind femora; mid segments of antennae 1.7–2.2 times as long as width. Pronotum crossed by main transverse furrow; prozona 1.4–1.6 times as long as metazona; anterior margin of prozona rounded; posterior margin of metazona weakly excised near median carina; lateral carinae in prozona almost parallel side. Lateral lobes of pronotum 1.2–1.3 times as long as height. Prosternal process absent. Mesosternal lobes 1.2–1.4 times as wide as mesosternal interspace. Mesosternal interspace transversal, 1.5–1.7 times as wide as long. Metasternal interspace square. Tegmina reaching the base of supra-anal plate or apex of abdomen, 2.8–3.0

times longer than pronotum and 2.5–2.8 times as long as wide; costal field 1.7–1.8 times as wide as subcostal field. Hind wings vestigial. Macropterous form unknown. Hind femora 4.9–5.0 times as long as their maximal width; inner lower keel with 90–115 stridulatory pegs. Hind tibiae with 10–12 outer and 10–11 inner dorsal spines. Arolium broad, reaching the apex of claws. Tympanum large, oval. 10th abdominal tergite without furculae. Supra-anal plate triangular with deep median longitudinal sulcus. Cerci conical, 2.7–3.0 times as long as their width near base; subgenital plate 1.7–1.9 times as long as its height near the base.



Fig. 1. The original labels of *Podismopsis insularis* types. Designations: a – *P. insularis insularis* holotype; b – *P. insularis insularis* allotype; c – *P. insularis shantariensis* holotype.

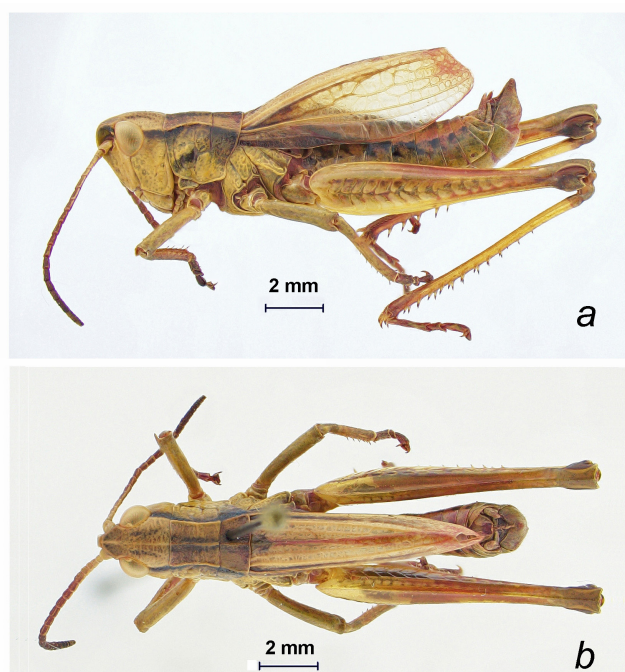


Fig. 2. Male of *Podismopsis insularis* from Feklistova Island. Designations: a – lateral view; b – dorsal view.

Male genitalia (Fig. 3). Epipallus bridge-shaped; bridge narrow, arch-like; ancorae almost reaching anterior projections; posterior projections triangular; lophi large; oval sclerites absent. Cingulum sclerotised, consisting of broad apodemes, zygomae, and rami; zygomae broadly rounded apically. Valves of cingulum narrow, divided, apically pointed. Apical valves of penis with pointed apex, as long as cingular valves; basal and apical penis valves connected by a narrow, strongly curved, and unbroken flexure.

The body is above olive green with black lateral stripe from eyes to apex of abdomen, below yellow. Antennae brown with blackish apex. Tegmina light brown with black precostal field and blackish stripe along cubitus anterior vein. Hind femora yellowish brown, lower side of femora yellow, inner side with longitudinal black stripe; knees black. Hind tibiae yellow with blackish base; spines yellow with black apex.

Female (Fig. 4). It is larger than the male. Head is as in male but frontal ridge 2.4–2.5 times narrower than vertex between eyes and vertical diameter of eyes 1.1–1.2 times larger than subocular furrow. Antennae filiform, 21–22-segmented; mid segments of antennae 1.5–1.6 times as long as width. Prozona 1.5–1.6 times as long as metazona; anterior margin of prozona rounded; posterior margin of metazona distinctly excised near median carina. Lateral lobes of pronotum 1.1–1.2 times as long as height; lower side of lobes broadly rounded. Epimerons of the meso- and metanotum rugose. Mesosternal lobes 1.0–1.2 times as wide as mesosternal interspace. Mesosternal interspace transversal, 2.0–2.1 times as wide as long. Metasternal interspace broad, 1.9–2.3 times as wide as long. Tegmina almost as long as pronotum, scale-like, 1.6–1.9 times as long as wide, with broadly rounded apex; hind wings absent. Hind femora 4.6–4.7 times as long as their maximal width. Hind tibiae with 11–13 outer and 10–11 inner dorsal spines. Arolium reaching the apex of claws. Tympanum large, oval. Supra-anal plate long triangular with wide median longitudinal sulcus. Cerci conical, 1.9–2.0 times as long as their width near base. Subgenital plate elongated, with distinctly triangular posterior margin, 2.2–2.3 times as long as wide. Basivalvular plates long. Ovipositor almost straight; upper margin of dorsal valves and lower margin of ventral valves finely serrated.

Body dorsally dark brown, ventrally yellow; laterally with black or blackish lateral stripe from vertex to apex of abdomen. Antennae brown with blackish apex. Tegmina light brown. Hind femora brown, lower side of femora yellow, inner side

with longitudinal black stripe near the base; knees blackish brown. Hind tibiae brown; spines yellow with black apex. Ovipositor brown.

Measurements. Body: ♂ 15.0–16.5 mm, ♀ 19.8–24.5 mm; pronotum: ♂ 2.9–3.2 mm, ♀ 4.0–4.4 mm; tegmen: ♂ 8.5–9.3 mm, ♀ 4.0–5.1 mm; hind femur: ♂ 10.0–11.6 mm, ♀ 11.7–13.4 mm; ovipositor 2.0–2.2 mm.



Fig. 3. Male genitalia of *Podismopsis insularis*. Designations: a – lateral view; b – dorsal view.

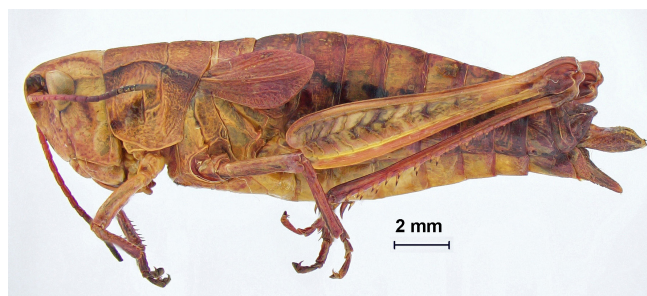


Fig. 4. Female of *Podismopsis insularis* from Feklistova Island, lateral view.

Habitat. The specimens examined were collected in the meadows on the lake shore or on the river bank.

Distribution. Russia: Khabarovsky Krai, Shantar Archipelago in the Sea of Okhotsk.

Conclusions

Podismopsis insularis inhabits all large islands of the Shantar Archipelago (Bolshoi Shantar Island, Feklistova Island, and Maly Shantar Island). This species is similar to *P. gelida* Miram, 1931 from Yakutia, Magadan Region, and north part of Khabarovsky Krai, *P. silvestris* Storozhenko, 1981 from Central and North Sakhalin, and *P. yurii* Storozhenko, 2006 from Moneron Island (Miram, 1931; Storozhenko, 1981, 2006). The current shape and ecosystems of the islands of the Sea of Okhotsk were basically formed during the course of the Late Würm regressions and subsequent Holocene transgressions. The sea level in the Late Würm climatic minimum fell some 130 m, resulting in land bridges between Shantars, Sakhalin, Moneron, and Hokkaido, with connection as well to continental part of Asia (Pietsch et al., 2012). At the end of Würm and especially in Holocene, the climate warmed once again, resulting in a rise in the sea level, so that the islands of the Sea of Okhotsk were separated again from the continent (ca. 8000–10 000 yr BP). The divergence of four species of the genus *Podismopsis* seems to be a sample of rapid evolution of the no flying grasshoppers on the isolated islands of the North Pacific region. Such neo-endemic species are in need of protection. Therefore, the Shantar Islands National Park is important for conservation of the endemic species of insects.

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ИССЛЕДОВАНИЕ *PODISMOPSIS INSULARIS* (ORTHOPTERA: ACRIDIDAE), ЭНДЕМИКА НАЦИОНАЛЬНОГО ПАРКА ШАНТАРСКИЕ ОСТРОВА В ОХОТСКОМ МОРЕ, РОССИЯ

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Цель настоящей работы – дать детальное описание плохо изученного саранчового *Podismopsis insularis* и выяснить таксономический статус его подвигов. Этот вид обитает на всех крупных Шантарских островах (Большой Шантар, Феклистова, Малый Шантар). Были изучены типы обоих подвигов и дополнительный материал. Установлена новая синонимия: *Podismopsis insularis* = *Podismopsis insularis shantariensis*, sup. nov. Впервые приведены детальные описания самцов и самок, а также фотографии имаго и гениталий самца этого вида. Кратко обсуждается дивергенция саранчовых рода *Podismopsis* на островах бассейна Охотского моря в течение последних 8000–10 000 лет. Показано, что национальный парк Шантарские острова важен для сохранения эндемичных видов насекомых.

Ключевые слова: Chrysochaontini, Gomphocerinae, Дальний Восток России, новая синонимия, Палеарктика, саранчовые, таксономия, фауна