

## A new grasshopper species of the genus *Podisma* BERTHOLD (*Orthoptera: Acrididae*) from the Southern Kuril Islands and its karyotypic features

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Received: 15 March 1996

Accepted for publication: 5 Oct. 1996

BUGROV A. G., SERGEEV M. G. 1997. A new grasshopper species of the genus *Podisma* BERTHOLD (*Orthoptera: Acrididae*) from the Southern Kuril Islands and its karyotypic features. *Acta zool. cracov.*, 40(1): 47-52.

Abstract: *Podisma tyatiensis*, sp.n., is described from the Southern Kuril Islands (Kunashir).

Key words: *Orthoptera, Acrididae*, grasshopper, taxonomy, karyotype, chromosome, Far East.

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### I. INTRODUCTION

More than 15 species of the grasshopper genus *Podisma* BERTHOLD 1827, are distributed in temperate Eurasia (DOVNAR-ZAPOLSKIJ 1932, MISTSHENKO 1952, HARZ 1975, SERGEEV 1986, 1993). Only *Podisma pedestris* (L.) is widely distributed in this region, from Europe to East Siberia. All other species are endemic in different parts of the Palaearctic Region: 8 species are distributed in the Mediterranean mountains, and 4 occur in the Caucasus. The Manchurian Subregion of the Palaearctic is inhabited by a specific group of this genus (STOROZHENKO 1983, 1986, 1993). This group includes at least four species: *P. aberrans* IKONNIKOV 1911 (Primorye, North East China), *P. sapporensis* SHIRAKI, 1910, (sensu STOROZHENKO 1983, 1993) (Hokkaido, Sakhalin, South Kuril Islands), *P. kanoi* STOROZHENKO 1993, (Japan) and the new one being described below. The holotype and some of the paratypes of the new species are deposited in the Zoological Museum of the Institute for Systematics and Ecology of Animals SB RAS (Novosibirsk), the remaining paratypes being at the Zoological Institute RAS (Saint-Petersburg), at the Institute of Systematics and Evolution of Animals PAN (Kraków), in the Department of General Biology, Novosibirsk State University, and at the Institute of Biology and Pedology FEB RAS (Vladivostok).

A c k n o w l e d g e m e n t s. The authors wish to express their sincere thanks to the Russian State Programme "Biological Diversity" (grant 1.19 to M.G.S.) and the Russian Founda-

tion for Basic Research (grant 94-04-11606 to A.G.B.) for partial financial support of this study. They are also very grateful to all the staff of the Kuril State Reserve for help and support.

## II. METHODS

**Cytogenetics.** 9 adult males and 16 embryos were studied. The males were injected with 0.1-0.2 ml of 0.1% for 1.5-2.0 hours. The testes were then fixed in acetic-alcohol 1:3, being washed and the fixed material kept in 70% ethanol. The eggs were dissected, and the embryos cultured in 1% hypotonic saline with 0.05% colchicine for about 2 hours. They were then fixed in ethanol:acetic acid. Air dried preparations were made by tissue squashing in 45% acetic acid and then freezing in liquid nitrogen. They were then stained by the barium hydroxide denaturation technique (GALLAGHER *et al.* 1972) of C-method differential staining.

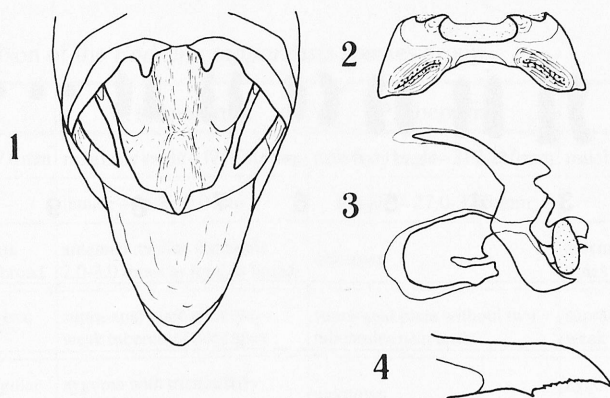
### *Podisma tyatiensis* BUGROV et SERGEEV, sp.n.

(Figs 1-5)

**Male.** Body medium sized, relatively slender. Width of vertex between the eyes 1.2-1.6 times greater than that of the frontal ridge between antennae. Eye medium, almost rounded. Antenna thin; its median segments 1.5-2 times as long as broad; antennal length usually slightly greater than that of head and pronotum combined. Pronotum subcylindrical; prozona long, about 1.2-1.5 times as long as metazona; its anterior margin slightly emarginate in the middle or straight; posterior margin of metazona emarginate in the middle. Tegmina narrow, suboval, sometimes with acute apex, reaching the posterior edge of the tympanum, about 2-3 times as long as broad. Mesosternal interspace transverse, its maximum width 1.6-1.7 times greater than its length. Width of the metasternum is 0.7-0.8 greater than the combined length of the mesosternum and metasternum. Fore and middle femorae relatively stout. Hind femora slender, about 4.3-5.0 times as long as broad. First abdominal tergum with oval tympanum. Last abdominal tergum with broadly separated, relatively small furculae (Fig. 1); top of furcula distinctly rounded or acute. Supra-anal plate trapezoidal, 1.1 times as wide as long, with two triangular tubercles on lateral margins near the middle, weak wide median groove and median tip. Cercus straight, conical, 2.8 times as long as wide. Subgenital plate conical; its apex acute or slightly notched. Body green, olive, olive-brown with black stripes behind eyes and along prosternal carinae. Furculae black, supra-anal plate with black spots. Tegmina unicolor, light brown. Hind femora light brown beneath; hind tibia blue, its spines creamy light with black apices.

Phallic complex (Figs 2, 3). Epiphallus bridge-shaped, with pointed ancorae; epiphallic bridge relatively narrow; lophus strong, viewed from rear with angular inner margin; anterior projection small, almost rectangular; posterior projection relatively short, slightly pointed. Cingulum with long curved apodems; ramus parallel-sided, angularly curved near the middle, relatively narrow; zygoma with small triangular apical projection; zygomal plate relatively small. Apex of cingular valve viewed from above broad. Basal and apical aedeagal valves connected by short, curved, unbroken flexure. Apex of apical aedeagal valve viewed from above broad, viewed laterally pointed. Gonopore process relatively short, broad and angular.

**Female.** Similar to male, but larger. Width of vertex between the eyes 1.4-1.5 times greater than width of frontal ridge between antennae. Eye small. Antennae thin, reaching posterior margin of pronotum. Pronotum subcylindrical; prozona long, about 1.1-1.2 times as long as metazona; its anterior margin slightly emarginate in the middle; posterior margin of metazona emarginate in the middle. Tegmina narrow, suboval, sometimes with acute apex, reaching posterior edge of tympanum, about 2.5-2.7 times as long as broad. Mesosternal interspace transverse, its maximum width 2.3 times greater than its length. Hind femora slender, about 4.4-4.7 times as long



Figs 1-4. *Podisma tyatiensis*, sp.n.: 1 – end of male abdomen, dorsal view; 2 – epiphallus, dorsal view; 3 – phallic complex (epiphallus and epiphallic membrane removed), lateral view; 4 – ventral valve of ovipositor, lateral view.

as broad. Supra-anal plate triangular, with very weak longitudinal median groove. Cercus straight, conical, as in male. Subgenital plate elongate; posterior margin distinctly triangular in the middle. Lower margin of ventral valve of ovipositor with row of small pointed teeth (Fig. 4). Body, tegmina, legs coloured as in the male.

**Karyotype.** The chromosome complement of *P. tyatiensis*, sp.n., consists of  $2n=23$  (sex determination is XO/XX). Autosomes may be divided into three size groups: 2 long ( $L_1$ – $L_2$ ), 6 medium ( $M_3$ – $M_8$ ), and 3 short ( $S_9$ – $S_{11}$ ) (Fig. 5 a,b). The chromosomes of the  $L_1$  pair can be considered as subacrocentric owing to the presence of small (mainly heterochromatic) second arms. The  $L_2$  pair is acrocentric with small paracentromeric C-blocks. Chromosomes of the  $M_3$ – $M_6$ ,  $M_8$ , and  $S_9$ – $S_{11}$  pairs are acrocentric with large paracentromeric C-heterochromatic blocks. Among them the chromosomes of the  $M_4$  and  $M_5$  pairs have C-heterochromatic blocks in the telomeric regions. The chromosomes of the  $M_7$  pair are submetacentric with a small paracentromeric block. The chromosomes of the  $M_8$  pair are acrocentric with small paracentromeric blocks and two interstitial blocks near the telomeric region (Fig. 5 b). The X-chromosome is approximately equal in length to the  $M_3$  pair. The morphology of the X-chromosome is similar to those of the  $L_1$  pair, but differs in having euchromatic very short second arm and telomeric C-block (Fig 5 a,b). Meiosis in *Podisma tyatiensis*, sp.n., is typical. In its prophase, the  $L_1$  bivalent usually form 3 chiasmata,  $L_2$  – 2, medium bivalents – 1 or 2, short – only one (Fig 5 c).

**Length.** Body of male 14.5–17 mm, female 18.5–19.8 mm; pronotum of male 3.5–3.9 mm, female 4.6–4.8 mm; tegmina of male 1.9–3.3 mm, female 2.5–4.3 mm; hind femora of male 8.5–9.9 mm, female 10.7–11.8 mm.

**Material.** Kuril Islands: Kunashir Is., Tyatya volcano, upper part of slope, 22.08.1994 (Bugrov, Tchernykh) 14 m (including holotype), 4 f.

**Etymology.** From the name of the principal type locality.

**Diagnosis.** *P. tyatiensis*, sp.n., resembles *P. sapporensis*, *P. aberrans* and *P. kanoi*. The diagnostic characteristics of these species are compared in the Table I.

The general morphology of the chromosomal complement of *P. tyatiensis*, sp. n., resembles that of most 23-chromosome grasshoppers belonging to the tribe *Melanoplini* (=Podismini)

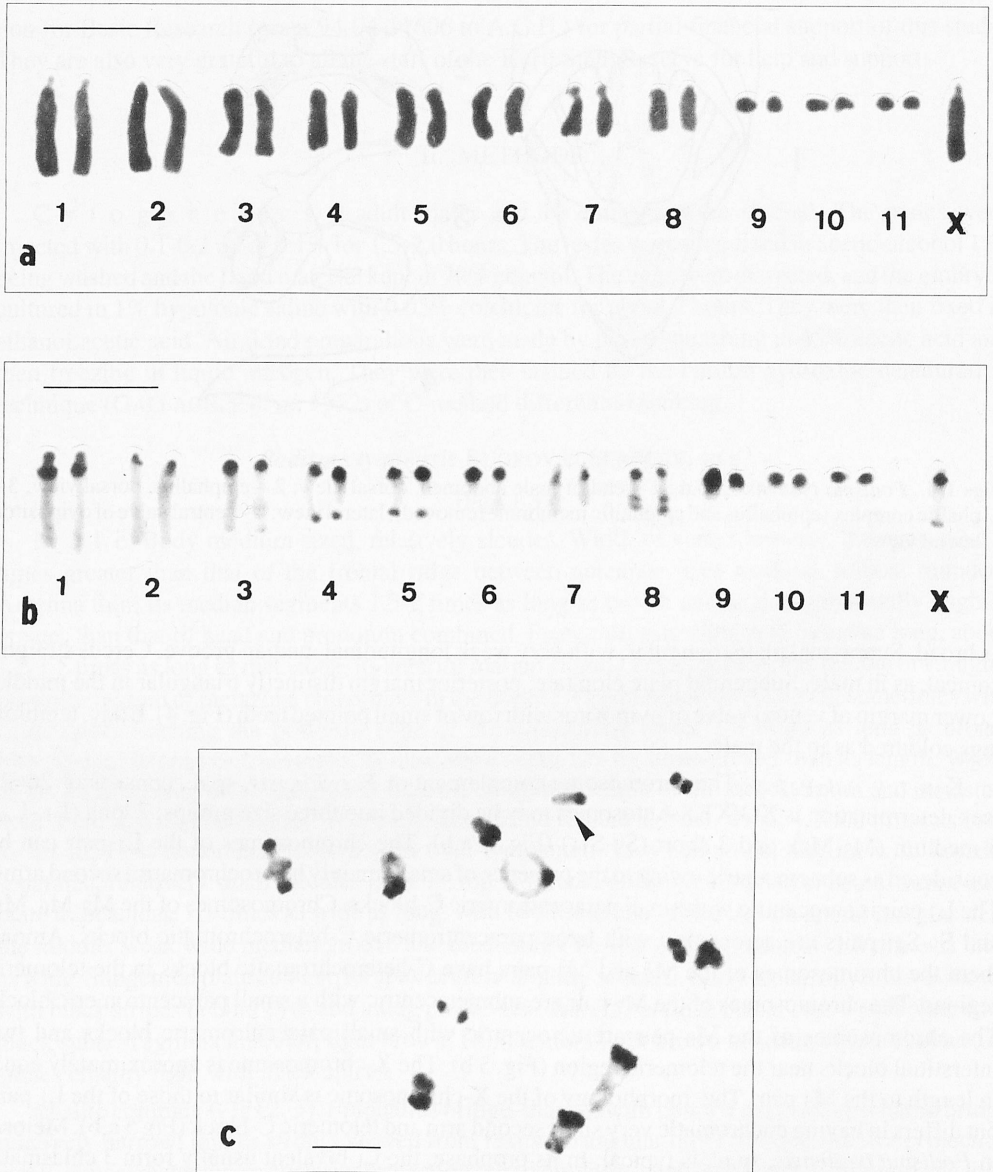


Fig. 5. Karyotype of *Podismatyatiensis*, sp.n.: a – male embryo mitotic metaphase; b – male embryo metaphase with C-bands; c – metaphase I with C-bands, arrow indicates the X-chromosome univalent. Bars equal 10  $\mu$ m.

(INOUE 1985, WESTERMAN, HEWITT 1985, BUGROV et al. 1994). Bivalent formation in the meiotic prophase is also typical. Some cytogenetic traits of the new species differ from the known karyotypes of the genus *Podisma*. The karyotype of *P. tyatiensis*, sp.n., includes the L<sub>1</sub> autosomes with the short second arms (mainly heterochromatic), the M<sub>7</sub> autosomes with the euchromatic second arms, and the X-chromosome with the small euchromatic second arm also. These arms are likely to be the result of pericentric inversions in formerly acrocentric chromosomes.



Table I

Comparison of the *Podisma sapporensis* species group

<i>P. tyatiensis</i>	<i>P. sapporensis</i>	<i>P. aberrans</i>	<i>P. kanoi</i>
male body length – 14.5-17.0 mm	male body length – 17.0-20.8 mm	male body length – 21.2-22.0 mm	male body length – 17.1-17.8 mm
female – 18.5-19.8 mm	female – 21.8-30.0 mm	female – 27.0-32.5 mm	female – 24.5 mm
antennal median segments 1.5-2.0 times as long as broad	antennal median segments 2.0-3.0 times as long as broad	unknown	antennal median segments 2.0 times as long as broad
supra-anal plate without two tubercles near apex	supra-anal plate with two weak tubercles near apex	supra-anal plate without two tubercles near apex	supra-anal plate with two weak tubercles near apex
zygoma with small triangular apical projection	zygoma with triangularly rounded apex	unknown	zygoma with broadly rounded apex
apex of apical aedigal valve viewed from above broad	apex of apical aedigal valve viewed from above narrow	unknown	apex of apical aedigal valve viewed from above broad

Two-arm autosomes similar to  $L_1$  and  $M_7$  of *P. tyatiensis*, sp.n., were not known for the genus *Podisma*. The subacrocentric X-chromosome was earlier found in the Sakhalin population of *Podisma sapporensis* only (BUGROV 1995). Thus, in *P. tyatiensis*, sp.n., the combination of pericentric inversions and heterochromatinization of the telomere regions of some chromosomes seems to be unique among the studied species of the genus *Podisma*.

**Ecological remarks.** The new species inhabits the elfin woodland altitudinal belt (1300-1500 m) of the Tyatya volcano where alder (*Alnus maximoviczii*) bushes and Siberian dwarf pine (*Pinus pumila*) are dominant.

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