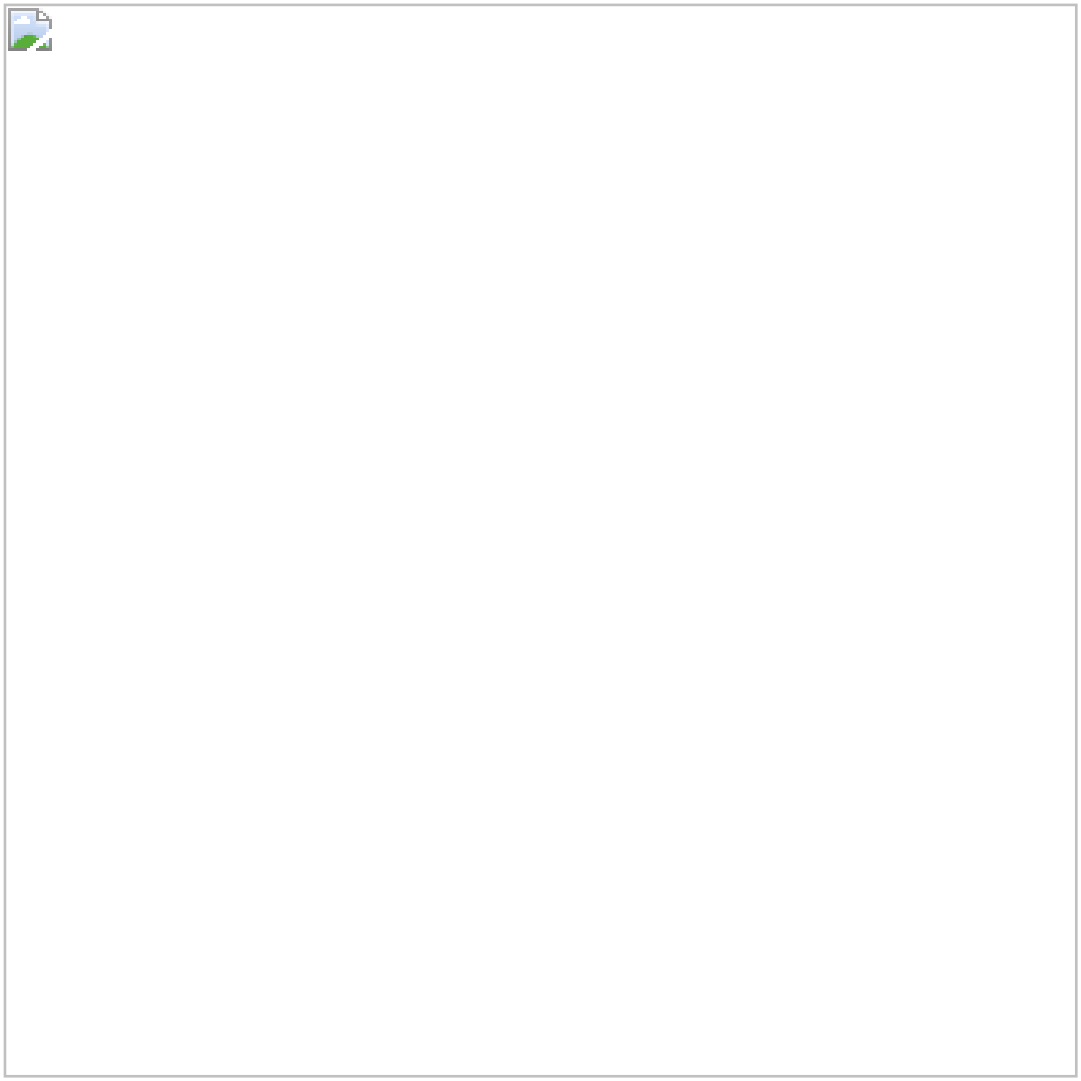

A New Species of Mongolotmethis from the Gobi Region of Mongolia (Orthoptera: Pamphagidae)

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A new species of *Mongolotmethis* from the Gobi region of Mongolia (Orthoptera: Pamphagidae)

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Abstract

A new species of grasshopper (Orthoptera: Pamphagidae, subfamily Thrinchinae) from the western edge of the Alashan plateau semi-desert in Southern Mongolia is described. The morphological characters of *Mongolotmethis michidi* new species and some characters of *Mongolotmethis gobiensis*, the most closely related species, are described.

Key words

new species, Orthoptera, Pamphagidae, *Mongolotmethis*, Alashan plateau, Mongolia

Introduction

During August 2012, staff of the Plant Protection Research Institute of Mongolia (PPRI) and the Zoological Institute of the Academy of Science (ZIAS), China, carried out a joint expedition through the Mongolian part of the Alashan plateau semi-desert, during which grasshoppers and other insects were collected.

Identification and or verification of species were completed with support from Dr. Batkhuyag, currently working at the WWF Mongolia office. A new species of *Mongolotmethis* was identified among the grasshoppers collected in the desert steppe ecosystems around Gurvantes and Noyon soums of Omnogobi province.

Materials and methods

During the joint expedition carried out by the Plant Protection Research Institute of Mongolia (PPRI) and Zoological Institute of the Academy of Science (ZIAS), China, over 23 grasshopper specimens from the Pamphagidae family were collected.

All collections, including the holotype and allotype of new species are added to the Pamphagidae grasshoppers section of the orthopteran insect collections kept at the PPRI of Mongolia.

Key books "Locusts of USSR and its neighboring countries" (Bey-Bienko *et al.* 1951), "Locusts of Kazakhstan, Central Asia and it neighboring countries" (Latchininsky *et al.* 2002), "Fauna Sinica: Insecta Vol 4" (Kailing 1994), "The phallic complex in Acridoidea (Orthoptera) in relation to taxanomy" (Dirsh 1956), as well as all records concerning new distributions of grasshoppers published in "Insects of Mongolia" (Chogsomzhav 1971, 1974, 1975) were used for identification and comparative review.

The male genitalia of *M. gobiensis* and *M. michidi* were extracted by lifting the epiproct and the epiphallus. Epiphallic sclerites, cingulum and phallic complex were extracted using a surgery knife and forceps. A 10% NaOH solution was used to clear the attached muscles from the epiphallus and aedeagus. Photos of epiphallus were made using a binocular with a grid eyepiece and edited using Photoshop CS Extended version 6.0, Lightroom version 3.3. Digital cameras Panasonic Ultra Zoom, AF Zoom 5.9-59 mm 1:2.8 - 3.5, (for taking photos via binocular lenses) and Canon Rebel AF Zoom 5.9-59 mm 1:2.8 - 3.5 (for taking photos of wings and other macro objects) were used.

Results

Orthopteran insects in the Gobi desert of Mongolia were comprehensively studied during 1970-1980 within the framework of Russian-Mongolian joint expeditions. One species of cockroach (Blattodea), four species of mantis (Mantidae), and 110 species of grasshoppers (Acridoidea) and long-horned grasshoppers (Tettigonioidea) were recorded in the region, and they account for 60% of total orthopteran insect species recorded in Mongolia (Chosomzhav 1977). Among the orthopteran insects recorded in the region, endemic species account for almost 30%. It shows that the desert and Gobi in Mongolia contain abundant terrestrial islands — patchy ecosystems that form its own unique assemblage of biodiversity.

Grasshoppers from the family Pamphagidae are, in general, characterized by relatively medium to large sized grasshoppers with rough, sculptured cuticles, giving them a stone or twig-like appearance. They inhabit low bushes or areas of sparse vegetation and are often geophilous (Centre for Overseas Pest Research, 1982).Out of 18 species from the Pamphagidae family recorded in northern Asia (Sergeev 1986), Mongolia has 6 species recorded as of today. These 6 species belong to two subfamilies, namely Pamphaginae and Thrinchinae. The Pampaginae in Mongolia is represented by a single species *Haplotropis brunneriana* Sauss., recorded in Khyangan mountains only (Chogsomzhav 1989), although its distribution area covers northeastern China to Baikal Lake (Bey-Bienko *et al.* 1951). However, in 2010, one female of *H. brunneriana* Sauss. was collected at the edge of pine forest in Dadal soum center (Batkhuyag pers. comm.), which shows that the distribution area of the species in Mongolia covers at least the Eastern Khentii mountain part of the Daurian forest steppe.

The subfamily Thrinchinae is represented in Mongolia by four genera: *Asiotmethis* Uvarov, *Beybienkia* Tsyplenkov, *Mongolotmethis* Bey-Bienko, *Rhinotmethis* Sjöstedt, all of which are considered as endemic to the Central Asian Gobi desert region. Among those four genera, *Mongolotmethis* Bey-Bienko has the highest number of species, consisting of 2 species and one subspecies. The genus is considered as an endemic to Mongolia and is widely distributed in desert ecosystems and dry steppes (Chogsomzhav 1989). In

addition, Chogsomzhav (1975) noted that the specimen from the Khuld soums of Dundgobi province identified as *M. kozlovi* has some distinctive characters different from the nominal species. He also noted that one male of *Mongolotmethis* sp. collected from the Matad soum of Dornod province should be considered as a new species due to its distinctive characters. However, there were no other attempts to collect additional specimen from these areas and review these specimen in detail.

The expeditions carried out by specialists from PPRI during August-September 2012 and 2014 collected 17 and 6 specimens from Pamphagidae family respectively.

2012 Expedition:

Rhinotmethis beybienkoi Chogsomzhav

Dornogobi provice, 50kms E Khovsgol soum, 2012.09.02, 1♂; Khar tsav of Ulaanbadrakh soum 2012.09.03, 3♀♀; Omnogobi province, 10 kms SE Tsogt-tsetsgii soum, 2012.08.30, 1 ♀.

Rhinotmethis hummeli Sjöst.

Dornogobi provice, 50kms E Khovsgol soum, 2012.09.02, 1♂, 1♀.

Mongolotmethis gobiensis gobiensis Bey-Bienko

Omnogobi, 5 kms NW Gurvantes soum, 2012.08.28, 1 ♀; Omnogobi, 5 kms SE Tsogt-tsetsgii soum, 2012.08.30, 2♂♂, 2 ♀♀.

Mongolotmethis michidi sp.n.

Omnogobi, Noyon Uul, Noyon soum, 2012.08.28, 2 ♂♂ (holotype), 1♀(allotype); Bayanzag, Bulgan soum, 2012.08.26, 1♀ (paratype); 5 kms NW Gurvantes soum, 2012.08.26, 1♂(paratype).

2014 Expedition:

Rhinotmethis beybienkoi Chogsomzhav

Dundgobi provice, 20kms NW of Gurvansaikhan soum, 2014.08.30, 1♂ and 1♀.

Mongolotmethis gobiensis gobiensis Bey-Bienko

Dundgobi provice, 15 kms S Delgerkhangai soum, 2014.09.01, 2♂♂ and 2♀♀.

Description of new species

Mongolotmethis michidi n. sp.

The morphology of the newly identified species *Mongolotmethis michidi* sp. n. has similar appearance to its closest relative *Mongolotmethis gobiensis* Bey-Bienko. Both species were collected from the same areas, which also draws a conclusion that both occupy a similar niche in the ecosystem.

Diagnosis.— The new species can easily be distinguished from *M. kozlovi* Bey-Bienko by a much smaller body size and the flash coloring on the inner lower margin of the femur. *M. kozlovi* is known to have a large body (♂ 35.0-38.5, ♀ 48 – 55mm) and hind femora with dark blue inside; it has orange-red ventral margin and ventral genicular lobe and ventral aspects with a narrow reddish edge along the margin: this is exactly the same as *M. gobiensis* (Bey-Bienko *et al.* 1951). Review of the geographical distribution of *M. kozlovi* also showed that the species is bound to the dry-steppe zone of the country, while *M. gobiensis* and *M. michidi* are more common in desert and semi-desert habitats. The 2014 expedition that covered known distribution areas of *M. kozlovi* did not result in any specimen that had the morphological characters of *M. kozlovi*. A paratype specimen of *M. kozlovi* stored at PPRI in Mongolia was externally morphologically similar to *M. gobiensis*, but the genitalia of the paratype specimen were not allowed to be removed for comparative review.

Etymology.— The new species was named after Michid, the daughter of Mr. Dorjderem S. who had collected most of the specimens of the new species and carried out all photographing and preparation of samples.

Description.—Ventral lower marginal area of the hind femur of both sexes has a weak narrow dark reddish band that starts at its base then disappears less than half way to its tip (Fig. 1), whereas *M. gobiensis* has a wide bright orange-red band that frames the entire ventral lower marginal area of the femur and goes into the knee and the proximal part of the tibia (Fig. 2).

Tegmen is elongated towards its tip and, in male, the length to width ratio of the tegmen is around 2.8, with widest part of tegmen located at 1/3 from the base. The tegmen also has a slight curve at the point where sub-costal vein meets the costal margin and where the cubital-posterior vein meets the posterior margin of the tegmen (Fig. 3). Male of *M. gobiensis* has oval shaped tegmen with length to width ratio less than 2.5 and widest part of the tegmen located closer to the middle of the tegmen (Fig. 4).

Hind-wing of the male has gradually fading dark fascia that reaches the last disk of hind wing (Fig. 5), whereas in *M. gobiensis* the dark fascia begins to dissolve starting from third disk of the hind-wing; the last disk of wing does not have dark coloring (Fig. 6).

Epiphallus of the male *M. michidi* has arching lateral sides and the bridge of the epiphallus has clearly defined parallel edged sides because posterior side of the bridge is slightly curved and the anterior side of the bridge has deep rectangular concavities. The lophi of the epiphallus has 18-19 spikes in each lophus, which are spread out irregularly (Fig. 7).

Aedeagus of the male *M. michidi* has much wider and shorter ventral and dorsal arms of apodeme than *M. gobiensis*, and gradually narrows towards the rami cingulum; the opening of the genital orifice is located in a concavity (Fig. 8).

Since there has been no previous work describing the epiphallus and aedeagus of *M. gobiensis gobiensis*, during the identification process we also extracted the genitalia of *M. gobiensis* and have compared both epiphallus and aedeagus with the new species.

The ephiphallus of *M. gobiensis* differs from *M. michidi* with its parallel lateral sides and a very broad bridge between the lophi. The posterior side of the bridge is curved very little and could almost be considered straight with small depressions at the edges. The anterior side of the bridge is concave. The left lophus has 18-19 spikes while the right lophus has 15-17 spikes; a linear pattern can be seen in spike positions (Fig. 9). The ventral and dorsal arms of apodeme on the aedeagus of the male M. gobiensis are more elongated and the rami of cingulum is much wider; the opening of the genital orifice is located in the middle of a wide depression (Fig. 10).

Male.—Body length 23.0-26.0 mm, pronotum length 8.5 mm, tegmen length 14.0 mm, femur length 13.3 mm (Figs 11, 12).

Head.—Antennae slightly flat, filiform with 18-19 segments, with longer segments toward the tip. Compound eyes are slightly oval, hemispheric, with diameter less than length of subocular sulcus. There are no lateral foveolae. Fastigium meets with frontal costa in wide angle and frontal costa in profile is slightly concave just below the median ocellus (Fig.11).

Fig. 1. M. michidi sp.n. Holotype, ♂. Inner side of femur.

Fig. 2. *M. gobiensis* B-Bien. ♂. Inner side of femur.

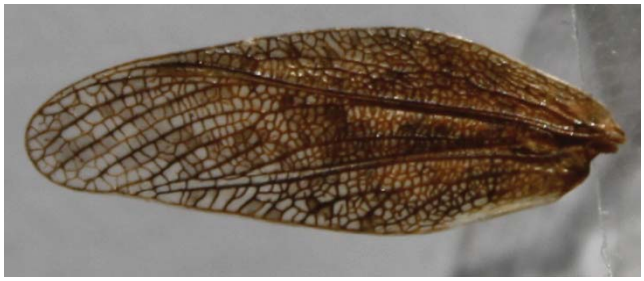

Fig. 3. *M. michidi* sp.n., Holotype♂. Left tegmina.

Fig. 4. *M. gobiensis* B-Bien.♂. Left tegmina.

Fig. 5. *M. michidi* sp.n. Holotype♂. Hind-wing.

Fig. 6. *M. gobiensis* B-Bien. ♂.Hind-wing.

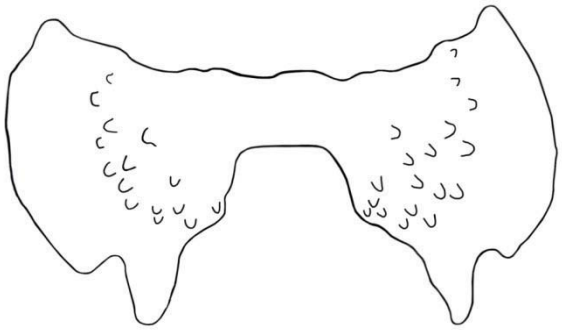

Fig. 7. *M. michidi* sp.n. Holotype, ♂. Epiphallus.

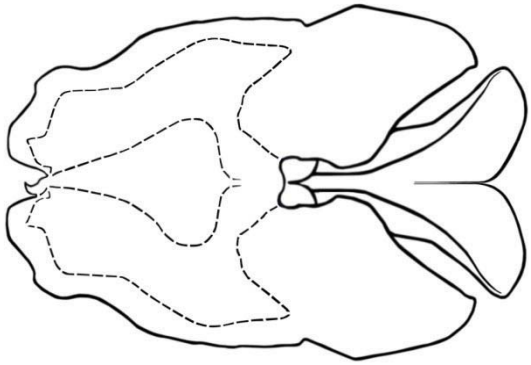

Fig. 8. *M. michidi* sp.n. Holotype, ♂. Aedeagus.

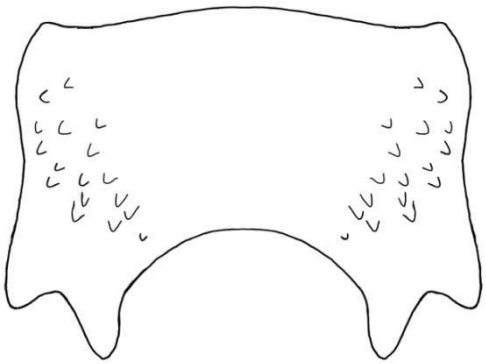

Fig. 9. *M. gobiensis* B-Bien. ♂. Epiphallus.

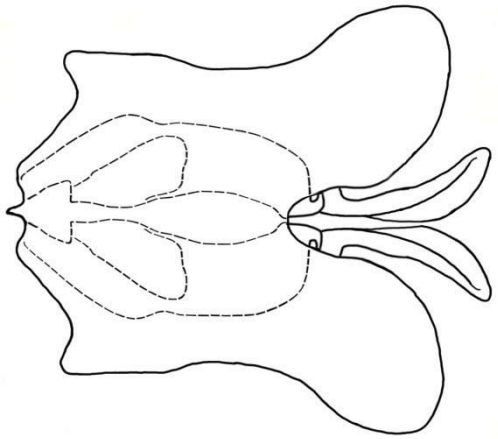

Fig. 10. *M. gobiensis* B-Bien. ♂. Aedeagus.

Fig. 11. *M. michidi* sp.n. paratype, ♂. Lateral view.

Fig. 12. *M. michidi* sp.n. paratype, ♂. Dorsal view.

Fig. 13. *M. michidi* sp.n. allotype, ♀. Lateral view.

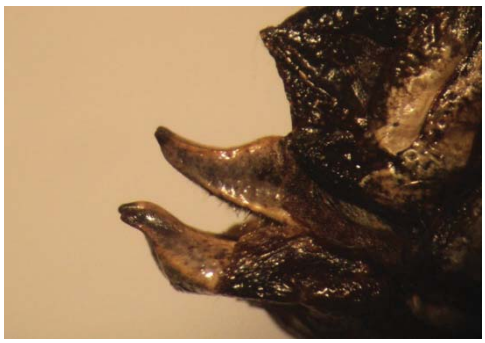

Fig. 14. *M. michidi* sp.n. allotype, ♀. Ovipositor dorsal view.

Thorax.—Median carina of the pronotum is high-crested and slightly arched in lateral view. Median carina is deeply cut by principal transverse sulcus that divides pronotum into equally long prozona and metazona. Prozona cut by two sulci that form three distinct crests. Median carina of metazona is clearly arched (Fig. 11). Entire pronotum is covered with small conical spikes that are more prominent on the metazona, especially along the hind edge of shoulder disk (Fig. 12).

Tegmina are around 13.5 - 19.5 mm long and do not reach the knee. Compared to other *Mongolotmethis* species, *M. michidi* has more elongated tegmina with slight curves towards its tip. Wing is well developed and has a dark band that gradually dissolves but still reaches the last disk of the wing.

Abdomen.—Tympanum on first segment of abdomen is well developed and has semi-vertical oval shape. Tympanic flap is relatively small and covers less than one quarter of tympanum membrane. The second abdominal segment also has well developed Krauss organ. Subgenital plate is normal, conically shaped; cerci are slightly flattened and pointed apically.

Hind leg.—Femur is short and wide. Inner lower marginal area of hind femur has reddish orange strip that starts at its base but disappears before half way to its tip. Inner side of tibia is dark blue with orange spots in upper and lower parts. Tibia has 9 inner spines and 7 to 8 outer spines and is covered with thick white long hairs between the spines.

Genitalia.—Epiphallus has arching lateral sides. The bridge of the epiphallus has clearly defined parallel edged sides because the posterior side of the bridge is slightly curved and the anterior side of the bridge has deep rectangular concavities. The lophi of the epiphallus have 18-19 spikes in each lophus, which are spread out irregularly. The ventral and dorsal arms of aedeagus are wide and

short, the dorsal arm gradually narrows towards the apodeme, and the opening of genital orifice is located in a narrow cavity.

Female.—Body length 32.0-37.0 mm, pronotum length 11.0 mm, tegmen length 8.5 mm, femur length 15.5 mm (Figs 13, 14).

Head.—Same as male (Fig.13).

Thorax.—Pronotum is same as male (Fig.13). Tegmina are around 8.5-9.5 mm long and do not reach the middle of extended tibia. Compared to other *Mongolotmethis* species, *M. michidi* has a more elongated tegmina.

Abdomen.—Tympanum in first segment of abdomen is well developed; tympanic flap is relatively big and covers lower quarter of tympanum membrane giving the tympanum a semi-vertical dome shape. The second abdominal segment also has well developed Krauss organ.

Dorsal valves of ovipositor are simple, slightly curved up and with no specialized appendices. Lower parts of the ventral valves are bulged in the middle with apexes slightly down curved (Fig. 14).

Hind leg.—Femur is short and wide. The reddish band in inner lower marginal area of hind femur is less visible and disappears before half way to its tip. Inner side of tibia is dark blue with orange spots in upper and lower parts. It has 9 inner spines and 7 to 8 outer spines and is covered with thick white long hairs between spines.

Discussion

The distribution of *Mongolotmethis michidi* sp.n. overlaps with *M. gobiensis* at least in the western edge of the Alashan plateau. This made review of materials take a substantial amount of time to make sure that the *M. michidi* was indeed a new species and not a subspecies of *M. gobiensis*. A morphological review of newly identified *Mongolotmethis michidi* compared with *M. gobiensis* show that *M. michidi* is a separate species that differs significantly in body size and color markings on hind-wing fascia and inner side of hind femur. These differences are specific to species as the colored hind-wing and hind leg are used for flash visual messages between members of the same species for attracting and recognizing mates (Pfadt 2002), especially among specialized geophilous grasshoppers (Kopaneva *et al.* 1985). The epiphalli and aedeagus of the two species differ considerably, further confirming their distinctness — in insects whose external morphology is similar, differences in male genitalia often become the only reliable species diagnostic characters (Song 2009).

Acknowledgement

The Sino-Mongolia joint field expeditions carried out during 2009-2012 made possible the collection of the new species from the Alashan plateau in Southern Mongolia. We would like to thank professor Nonaizhav from the Inner Mongolian Normal University, who was the key co-organizer of the joint expeditions.

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