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WING POLYMORPHISM IN *NETOMOCERA RAMAKRISHNAI* SURESHAN, 2010 (HYMENOPTERA: PTEROMALIDAE) IN EAST ASIA, WITH THE FIRST DESCRIPTION OF A BRACHYPTEROUS MORPH

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ABSTRACT

Netomocera ramakrishnai Sureshan, 2010 is newly recorded from China (Taiwan), Japan (Honshu) and the Russian Far East (Sakhalin I. and Kamchatka Terr.). Females of the species also showed the first example of wing polymorphism in the genus *Netomocera* Bouček, 1954 and the second in the subfamily Diparinae Thomson, 1876. Female wings of *N. ramakrishnai* range from being fully macropterous in eastern India to macropterous or slightly brachypterous in Taiwan and fully brachypterous in Japan and eastern Russia. The previously unknown brachypterous morph of *N. ramakrishnai* is described and illustrated, and the distribution of the species is discussed.

Key words: Diparinae, distribution, new records, parasitoid, taxonomy, wing polymophism

КРЫЛОВОЙ ПОЛИМОРФИЗМ У *NETOMOCERA RAMAKRISHNAI* SURESHAN, 2010 (HYMENOPTERA: PTEROMALIDAE) В ВОСТОЧНОЙ АЗИИ С ПЕРВЫМ ОПИСАНИЕМ БЕСКРЫЛОЙ МОРФЫ

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РЕЗЮМЕ

Netomocera ramakrishnai Sureshan, 2010 впервые указывается для Китая (Тайвань), Японии (Хонсю) и Дальнего Востока России (о. Сахалин и Камчатский кр.). У этого вида и рода *Netomocera* Bouček, 1954 впервые обнаружен крыловой полиморфизм; это второй случай крылового полиморфизма в подсемействе Diparinae. Самки *N. ramakrishnai* характеризуются изменчивостью от полнокрылых морф в восточной Индии до короткокрылых на Тайване и бескрылых в Японии и на Дальнем Востоке России. Описана и иллюстрирована ранее неизвестная бескрылая морфа *N. ramakrishnai*, и обсуждается распространение данного вида.

Key words: Diparinae, распространение, новые находки, паразитоид, таксономия, крыловой полиморфизм

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INTRODUCTION

Many insect species exhibit wing polymorphism, i.e. variation in wing size, which affects their dispersal capabilities (e.g. Harrison 1980). Wing polymorphism can be caused by several factors such as different genotypes (genetic polymorphism), environments (environmental polyphenism), or a combination of the two (e.g. Zera 2003).

Only a few examples of species with different wing morphs are known among Pteromalidae, including *Nasonia vitripennis* (Walker, 1836), *Callitula pyrrhogaster* (Walker, 1833), and *Meraporus graminicola* Walker, 1834. No species of *Netomocera* Bouček, 1954 was known previously to be polymorphic in wing structure and among Diparinae only the females of *Dipara hyalinipennis* (Girault, 1915) were known to display the entire range of wing polymorphism, i.e. macropterous, brachypterous and apterous morphs (Bouček 1988).

The pteromalid genus *Netomocera* (type species *N. setifera* Bouček, 1954) belongs to the subfamily Diparinae and is composed of eight species distributed in all zoogeographic regions (Noyes 2013). *Netomocera* is easily identified by a strongly asymmetrical clava (in females), a short petiole (broader than long or quadrate), the presence of two pairs of scutellar bristles and the absence of a median clypeal tooth (Yoshimoto 1977; Desjardins 2007; Sureshan 2010).

Males are macropterous in all known *Netomocera* species, whereas females can be either macropterous or brachypterous. Wing-size variability within the same species in this genus has never been recorded previously. Sureshan (2010) described the male and the macropterous female of *N. ramakrishnai* from eastern India (Arunachal Pradesh) and provided a key to the world species of the genus (females), using the two states of wing development (fully winged or brachypterous) as the main feature for separating the species groups. However, the new data brought by our study indicate that this character is not reliable for all species.

During our study of Pteromalidae from China (Taiwan), Japan and the Russian Far East from the collections of the Zoological Institute of the Russian Academy of Sciences (Saint Petersburg, Russia; further ZIN) and the Canadian National Collection of Insects and Arachnids (Ottawa, Canada; further CNC), we discovered female specimens of what we first considered an apparently undescribed species having reduced wings. However, after carefully checking of the description and illustrations provided by Sureshan (2010), we came to the conclusion that these specimens represent the brachypterous morph of *N. ramakrishnai*. The aim of this paper is to describe this previously unknown morph, provide an update of the species distribution, and discuss the clinal variation observed in wing-size.

MATERIAL AND METHODS

This study is based on material from the collections of ZIN and CNC, as well as from the Natural History Museum London, U.K. (BMNH). All available records are indicated on the distribution map (Fig. 8).

Observations were made using MC-2 ZOOM, Micromed 3 and Krüss MSZ5400 stereomicroscopes. Illustrations were prepared using the following combinations of stereomicroscopes and digital cameras: Micromed 3 plus DCM 510, Leica MZ16 plus Leica DFC 290, and Leica M205A plus Leica DFC500. The acquired images were processed with Helicon Focus 6, Zerene Stacker and Adobe Photoshop CS3 software.

Morphological terminology, including sculpture and wing venation nomenclature, follows Gibson (1997). The following abbreviations are used: POL – posterior ocellar line, the minimum distance between the posterior ocelli; OOL – ocell-ocular line, the minimum distance between a posterior ocellus and compound eye.

RESULTS

Family Pteromalidae Dalman, 1820

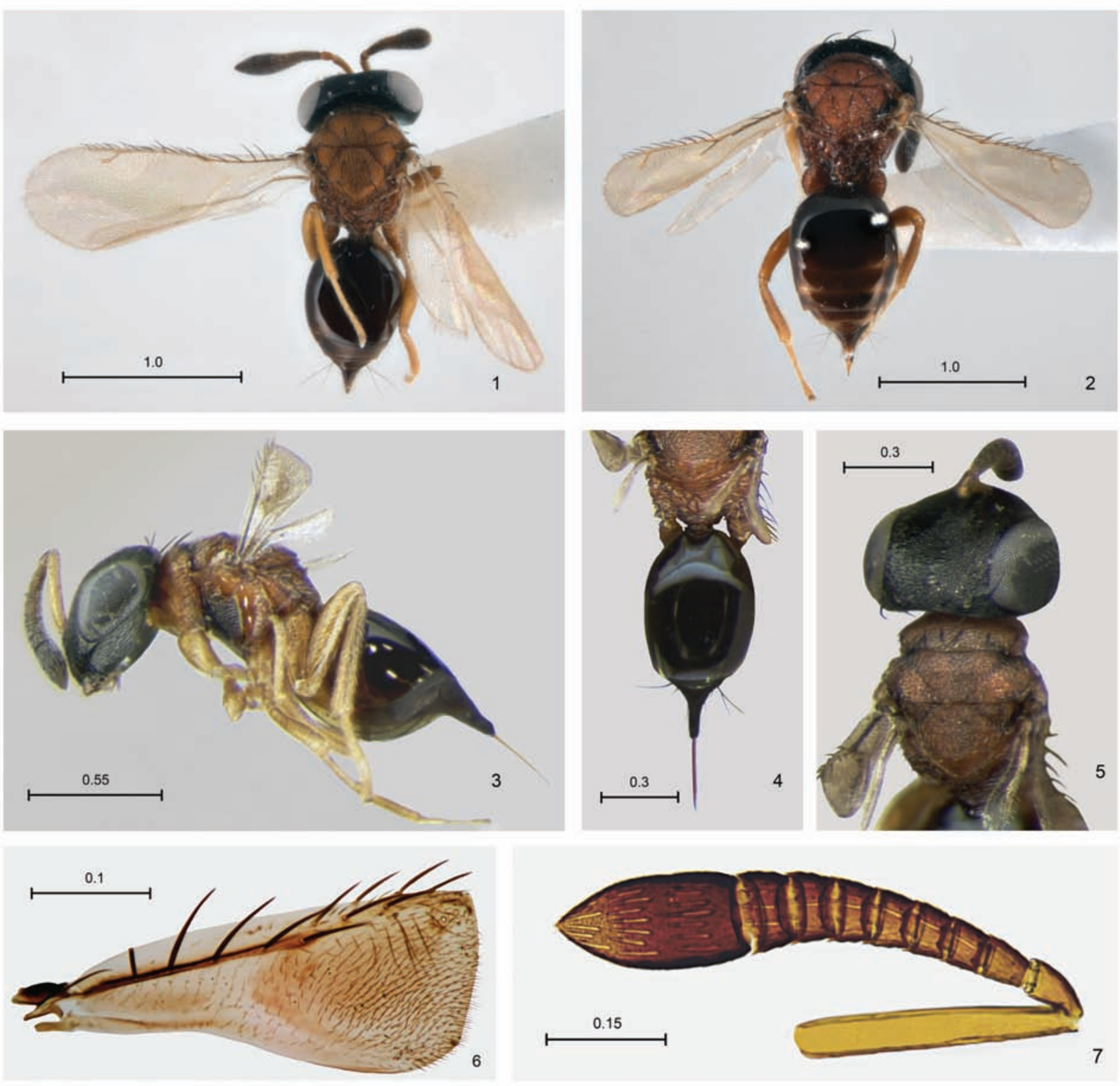
Subfamily Diparinae Thomson, 1876

Genus *Netomocera* Bouček, 1954

Type species: *Netomocera setifera* Bouček, 1954.

Netomocera ramakrishnai **Sureshan, 2010**
(Figs 1–7)

Material. JAPAN: 1 female (brachypterous), Honshu I., Ibaraki, Tsukuba Mountain, N 36°13.186´E 140°06.444´, 25 September 1999, S.A. Belokobylskij (ZIN); 2 female (brachypterous), 3 male, Iwate,



Figs 1–7. *Netomocera ramakrishnai*, macropterous (1), slightly brachypterous (2) and brachypterous (3–3) female. 1, 2 – habitus, dorsal view; 3 – habitus, lateral view; 4 – metasoma, dorsal view; 5 – head and mesosoma, dorsal view; 6 – fore wing; 7 – antennae.

Iwaizumi Hitsufori, 770 m, 11–17 August 1991, A. Smetana (J47) (CNC); 1 female (brachypterous), 1 male, Tochigi, Nishinasuno, 500 m, 10 August 1989, M.J. Sharkey, sweep (CNC); 1 male, Aichi, Toyone Misawa, 750 m, 15–17 July 1992, K. Yamagishi (CNC); 3 male, Iwate, Kawai, Yoshibezawa, 1050 m, 12–17 August 1991, A. Smetana (J50) (CNC); 2 male, Tochigi, Kuriyama, Nikkosawa, 1465 m, 20–22 August 1991, A. Smetana (CNC); 1 male, Kibune, Kyoto, 6 August 1980, C.M. Yoshimoto (CNC); 1 male, Aichi Pref., Mt Sanageyama, 25–31 July 1989, A. Takano, Malaise trap (CNC). RUSSIA**:** 2 female (brachypterous), Kamchatka Terr., Kronotsky Natural Reserve, 90 km S Lazo, forest margin near thermal pool “Kipelye”, N 55°08.165´ E 160°05.832´, 20 July 2013, E.V. Tselikh et D.V. Rachin (ZIN); 1 female (brachypterous), Sakhalin Prov., Sakhalin I., 17 km S Nevel’sk, forest margin, N 46°35.244´ E 141°50.071´, 17 July 2011, E.V. Tselikh et D.V. Rachin (ZIN). CHINA: 2 female (one macropterous and one slightly brachypterous), Taiwan, Shan-Lin Chi (Nanton Helen), 1600 m, 16 May 1990, L. Lesage (CNC).

Description of the brachypterous morph (female) (Figs 3–7)

Body length: 1.6–2.4 mm; fore wing length: 0.40–0.75 mm.

Colour. Head black. Mesosoma reddish, mesepisternum and sometimes pronotum darker. Metasoma dorsally dark brown to black, ventrally pale. Scape and pedicel reddish-yellow, pedicel sometimes darker dorsally; flagellum light brown, gradually becoming darker towards clava. Legs reddish-yellow. Wings evenly and moderately infuscate.

Head (Figs 3, 5) finely reticulate, in dorsal view 2.3 × broader than its length, 1.3–1.4 × broader than mesoscutum. POL 3.3–3.5 × OOL. Head in front view 1.1–1.2 × broader than high. Eye height 1.4–1.5 × longer than eye length and 2.3–2.4 × longer than malar space. Both mandibles with three teeth. Antennal scrobe wide and deep. Distance between antennal toruli and lower margin of clypeus about half the distance between antennal toruli and median ocellus. Clypeus smooth, lower margin slightly arched and without teeth. Antenna clavate (Fig. 7). Scape 0.8–0.9 × as long as eye height and 1.3 × longer than eye length. Pedicel 1.7–1.8 × longer than broad and 1.4–1.6 × longer than first funicular segment. Combined length of pedicel and flagellum subequal to breadth of head. All funicular segments transverse. Clava 1.8–2.0 × longer than broad, 0.6–0.7 × longer than combined length of all funicular segments. Apical claval segment with large area of micropilosity.

Mesosoma (Figs 3–5) about 1.3 × longer than broad. Pronotal collar medially 0.4–0.6 × as long as mesoscutum, its front margin rounded. Mesoscutum finely reticulate, 2.9–3.1 × broader than long. Scutellum finely reticulate, about as long as broad, with noticeable but shallow frenal line. Pronotum, mesosoma and mesoscutum with a few long dark setae. Propodeum with a network of large alveolae, medially 0.6–0.7 × as long as scutellum; median carina not complete; nucha small; spiracle small and circular. Fore and hind wings reduced and represented by stumps. Fore wing (Fig. 6) 2.6–3.0 × longer than its maximum width, usually with truncate apex. Basal cell pilose; speculum absent or very small. Fore wing with complete submarginal vein, reduced marginal vein and barely indicated postmarginal and stigmal veins. Upper surfaces of submarginal and marginal veins with numerous long dark setae.

Metasoma ovate (Figs 3, 4), 1.6–1.8 × longer than broad and 1.0–1.3 × longer than mesosoma. Gastral tergites smooth. First gastral tergite 1.4–1.5 × longer than broad (Fig. 4). Posterior margins of first and second gastral tergites more or less arched to slightly angulate. Ovipositor sheath slightly to distinctly projecting beyond apex of metasoma.

DISCUSSION

Many genera of Diparinae contain species with wingless or brachypterous females, such as *Dipara* Walker, 1833, *Bohpa* Darling, 1991, *Myrmicolelaps* Hedqvist, 1969 and *Neapterolelaps* Girault, 1913, but only one species is known from *Dipara* where females display the entire range of wing polymorphism from macropterous to brachypterous and apterous (Bouček 1988). Because of this, we initially considered that the brachypterous females discovered in ZIN and CNC belonged to an undescribed species of *Netomocera*. However, observed similarities with *N. ramakrishnai* prompted us to investigate their species status more closely and we now consider that the brachypterous morph is conspecific with the macropterous female described by Sureshan (2010) from India. Apart from similarities in relative measurements and colour pattern, we base our conclusion on the following:

(1) No significant differences could be found between the males described by Sureshan (2010) and the males we examined.

(2) Among the macropterous females of *Netomocera setifera* in BMNH there is one brachypterous female identified by Bouček himself (unpublished record). The specimen was collected in 1963, nine years after the description of *N. setifera* was published (Bouček 1954), and so no account on the wing polymorphism in *Netomocera* could be given at that time.

(3) According to Desjardins (2007), a reduced or absent posterior notal wing process is common in many apterous diparines. This character could be a good indication of the "potential" wing size of a taxon, i.e. taxa with both apterous and macropterous members would have complete posterior notal wing processes even in their apterous members. In the brachypterous morph of *N. ramakrishnai* the poste-

Fig. 8. Distribution of *N. ramakrishnai* (square = type locality; circle = new records).

rior notal wing process is as well developed as in the macropterous morph.

(4) In the CNC collection we discovered two females from China (Taiwan), one being slightly brachypterous (Fig. 2) and the other macropterous (Fig. 1). The relative measurements and other characters match those of the brachypterous specimens.

The specimens examined during this study were collected in China (Taiwan), Japan (Honshu) and the Russian Far East (Sakhalin I. and Kamchatka Terr.), and represent new records of *N. ramakrishnai* for these countries. Taking into account these new discoveries, the currently known distribution of *N. ramakrishnai* ranges from the easternmost part of India to Kamchatka (Fig. 8). This may not be as strange as it looks, because the distribution is largely confined to the Palaearctic region. In fact, the type locality of the species is right at the southernmost edge of the Palaearctic, at the border with the Oriental region. Thus, it is very likely that the species will be found in eastern China as well.

The macropterous morph is known only from the eastern part of India (Arunachal Pradesh). An intermediate female that is slightly brachypterous is known from China (Taiwan) from the same locality as a macropterous female, whereas the brachypterous morph appears to be more widely distributed from Japan (Honshu) to the Russian Far East (Sakhalin I. and Kamchatka Terr.). From the distributional and variability patterns presented above it appears that the macropterous morph is confined to the southern part of the distribution (India and China) and the brachypterous morph to the north (Japan to the Russian Far East), whereas the intermediate form is found between these regions (China: Taiwan). Wing polymorphism in *N. ramakrishnai* thus appears to be clinal, i.e. displaying a continuous variation along a latitudinal gradient. However, this apparent pattern could be an artifact resulting from insufficient material, especially from continental China. Further investigations are also necessary in order to explain whether this is a case of genetic polymorphism or environmental polyphenism.

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REFERENCES

Bouček Z. 1954. Chalcidologické poznámky I, Pteromalidae, Torymidae, Eurytomidae, Chalcididae (Hymenoptera). *Acta Entomologica Musei Nationalis Pragae,* **29**(426): 49–80.

Bouček Z. 1988. Australasian Chalcidoidea (Hymenoptera). A biosystematic revision of genera of fourteen families, with a reclassification of species. CAB International, Wallingford, Oxon, U.K.; Cambrian News Ltd, Aberystwyth, Wales, 832 p.

Desjardins C.A. 2007. Phylogenetics and classification of the world genera of Diparinae (Hymenoptera: Pteromalidae). *Zootaxa,* **1647**: 1–88.

Gibson G.A.P. 1997. Morphology and terminology. In: Gibson G.A.P., Huber J.T. et Woolley J.B. (Eds.). Annotated keys to the genera of Nearctic Chalcidoidea (Hymenoptera). NRC Research Press, Ottawa: 16–44.

Harrison R.G. 1980. Dispersal Polymorphisms in Insects. *Annual Review of Ecology and Systematics,* **11**: 95–118.

Noyes J.S. 2013. Universal Chalcidoidea Database, Natural History Museum London. Available from: http://www.nhm.ac.uk/entomology/chalcidoids/index.html (Accessed 20 Nov. 2013).

Sureshan P.M. 2010. Description of a new species of *Netomocera* Boииek (Hymenoptera: Chalcidoidea: Pteromalidae) from Arunachal Pradesh, India, with a key to world species. *Journal of Threatened Taxa,* **2**(12): 1309–1312.

Yoshimoto C.M. 1977. Revision of the Diparinae (Pteromalidae: Chalcidoidea) from America north of Mexico. *Canadian Entomologist,* **109**(8): 1044–1048.

Zera A.J. 2003. The endocrine regulation of wing polymorphism in insects: State of the Art, recent surprises, and future directions. *Integrative and Comparative Biology,* **43**(5): 607–616.

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