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# A third species of the rare ant genus *Rotastruma* (Hymenoptera, Formicidae) from Cambodia, with illustrated generic diagnoses and key to species

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## Abstract

The myrmicine genus *Rotastruma* is a rarely collected arboreal ant group and only two species, *R. recava* Bolton and *R. stenocephs* Bolton, are known from the Oriental Region. A new species, *R. epispina* sp. nov., is described from Cambodia based on the worker and queen castes. The new species is distinguished from *R. recava* and *R. stenocephs* by having the propodeal spine directed upwards and elongated peduncle of the petiole. Herein, we provide an update to the identification key and diagnostic characters for the genus *Rotastruma*.

## Key Words

arboreal ant, nest series, new species

## Introduction

The genus *Rotastruma* Bolton, 1991 was established with the type-species *R. recava* Bolton, 1991 and was assigned to the tribe Crematogastrini by Ward et al. (2015). It is a rarely collected arboreal ant group (Luo and Guénard 2016). Bolton (1991) provided a diagnosis of the worker caste and a key to species, based on the worker caste. Two species are currently recognised: *R. recava* from Singapore and Borneo and *R. stenocephs* Bolton, 1991 from China (Bolton 1991, 2020). Luo and Guénard (2016) discovered a single queen in Hong Kong, which is less than 200 kilometres southeast from the type locality of *R. stenocephs* and identified it as being conspecific to *R. stenocephs*.

*Rotastruma* is known from China, Vietnam, Cambodia, Singapore and Malaysia (Borneo) (Bolton 1991;

Zryanin 2011; Hosoishi et al. 2015; Luo and Guénard 2016). Despite the extensive field surveys in Vietnam (Eguchi et al. 2011), Laos (Jaitrong et al. 2016) and Thailand (Khachonpisitsak et al. 2020), the nest series including sexual forms has not been recorded from the Indochinese Peninsula, probably due to the rarity of the genus. During a survey of the ant fauna of Cambodia (Hosoishi et al. 2015), a nest series of an undetermined species of this genus was collected in a regrowth forest in Kampong Thom.

In this paper, we describe the undetermined species as the third *Rotastruma* species, based on the nest series including the queen and propose a minor definition change to the genus, with illustrations of diagnostic characters for the genus. A revised key to the species, based on the worker caste, is also provided.

## Methods

### Sources of material

Specimens used in this study were collected during expeditions in Cambodia under the Memorandum of Understanding (MOU) between Japan and Cambodia, Kyushu University, Japan and the Forestry Administration, Cambodia, on cooperation concerning biological resources and information. The materials are shared between Cambodia and Japan, but the present materials are deposited in Japan, on indefinite loan from Cambodia. Type specimens were examined and/or deposited in the collections listed below.

- BMNH** The Natural History Museum, London, UK;  
**KUEC** Institute of Tropical Agriculture, Kyushu University, Fukuoka, Japan;  
**MCZC** Museum of Comparative Zoology, Harvard University, Cambridge, MA, USA;  
**SBSHKU** Insect Biodiversity and Biogeography Laboratory, School of Biological Sciences, The University of Hong Kong, Hong Kong SAR.

### Observations

Most observations were made on a Leica M205C (Leica Microsystems, Wetzlar, Germany) stereomicroscope. Images were taken using a Canon EOS 50D with a Canon MP-E 65 mm 1–5× Macro lens, then processed using Combine ZM (Hadley 2010). The scanning electron micrographs (SEM) were prepared with a JSM-5600LV (JEOL, Tokyo, Japan) scanning electron microscope. The samples were sputter-coated with gold (Ion Sputter JFC-1100, JEOL, Tokyo, Japan).

### Measurements and indices

Measurements were made under a Leica M205C stereomicroscope using micrometers. All measurements are expressed in millimetres, recorded to the second decimal place. The measurements and indices follow Fischer et al. (2014) and Luo and Guénard (2016).

**Head Width (HW):** Maximum width of head in full-face view, excluding the eyes.

**Head Length (HL):** Maximum length of head from the anterior median clypeal margin to the median posterior margin of the cephalic capsule measured along the midline as a straight line.

**Mandible length (MaL):** Maximum length of mandible from the anterior margin of clypeus at outer side of mandibular insertion to mandibular apex.

**Scape Length (SL):** Maximum length of scape, from the proximal point of scape shaft, not including the condyle, to the distal end of scape.

**Eye Length (EL):** Maximum diameter of eye measured in lateral view.

**Total length (TL):** Maximum length of specimen measured from the tip of the mandible to the tip of the last abdominal segment, not including sting. Due to the position of the specimen, total length was measured as the sum of head length + thorax, petiole and postpetiole length + gaster length.

**Weber's length of mesosoma (WL):** Maximum diagonal distance in lateral view, from base of anterior slope of pronotum to the posterior margin of the propodeal lobe.

**Pronotum height (PNH):** Maximum height of pronotum, measured in profile from the posterior base of the lateral sides of pronotum, where procoxa is attached, to the highest point of the pronotum.

**Pronotal width (PNW):** Maximum width of pronotum measured in dorsal view.

**Propodeal spine length (SPL):** Measured from the tip of the propodeal spine to the closest point on the outer rim of the propodeal spiracle.

**Petiole length (PTL):** Maximum diagonal length of petiole, measured in lateral view, from the most antero-ventral point of the peduncle, at or below the propodeal lobe, to the most posterodorsal point at the junction with helcial tergite.

**Petiole height (PTH):** Maximum height of petiole, measured in lateral view from the highest (median) point of the node, orthogonally to the ventral outline of the node.

**Petiole width (PTW):** Maximum width of the petiole in dorsal view.

**Postpetiole length (PPL):** Maximum length of postpetiole, measured in lateral view.

**Postpetiole height (PPH):** Maximum height of postpetiole, measured in lateral view from the highest point of the node.

**Postpetiole width (PPW):** Maximum width of the postpetiole in dorsal view.

**Cephalic index (CI):** Calculated as:  $HW/HL \times 100$ .

**Scape index (SI):** Calculated as:  $SL/HW \times 100$ .

**Mandibular index (MaI):** Calculated as:  $MaL/HW \times 100$ .

**Petiolar index (PI):** Calculated as:  $PTW/PTL \times 100$ .

**Postpetiolar index (PPI):** Calculated as:  $PPW/PPL \times 100$ .

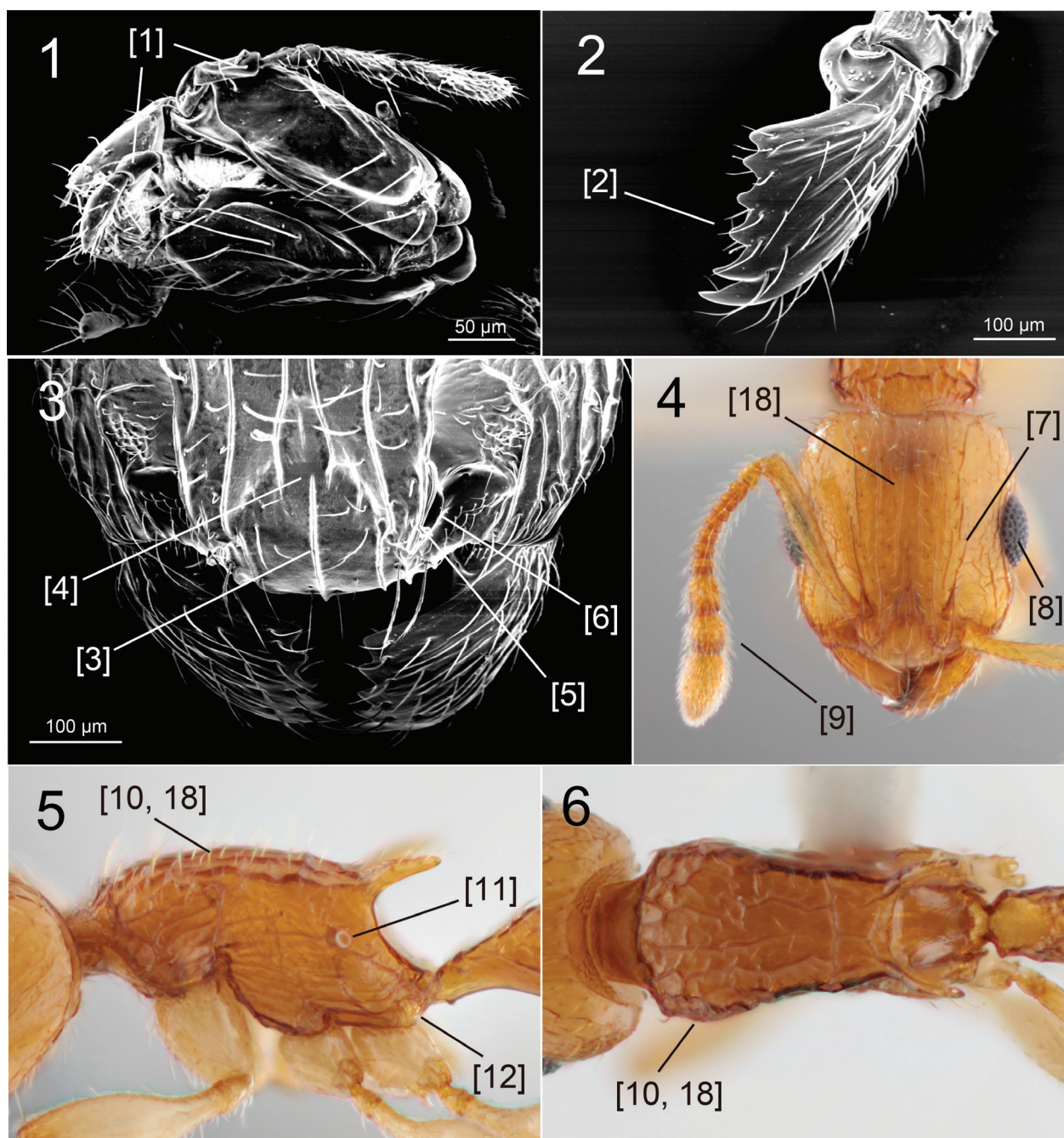
## Results

### Taxonomy

#### Diagnosis of worker caste of *Rotastruma*

Bolton (1991) provided 18 diagnostic characters for the genus *Rotastruma*, which were based on the only two species known from the genus at that time: *R. recava* Bolton, 1991 and *R. stenocephs* Bolton, 1991. The diagnosis provided for the genus is morphologically restrictive due to the limited material. The addition of a new species to *Rotastruma* allows for a slight modification. The following definition is taken from his study. The character [15] in the diagnosis is slightly modified, based on the present study as below (in italics). The number in brackets (Figs 1–11) corresponds to each of the diagnoses presented by Bolton (1991) (Appendix 1).





**Figures 1–6.** *Rotastruma epispinga* sp. nov., worker. **1**, Mouthparts [1]; **2**, Left mandible [2]; **3**, Clypeus [3, 4, 5, 6]; **4**, Full-face view of head [7, 8, 9, 18]; **5**, Mesosoma in profile view [10, 11, 12, 18]; **6**, Mesosoma in dorsal view [10, 18]. Figures in brackets correspond to diagnostic characters (Appendix 1).

[15]. *Petiole nodiform to pedunculate, with an anterior peduncle; petiolar spiracle located at the mid-length of the peduncle* (Fig. 10)

**Remarks.** Bolton (2003) mentioned that “a curved transverse crest is present on the stipes of the maxilla in all but *Rotastruma*” in his *Romblonella* genus group (*Poecilomyrma*, *Romblonella*, *Rotastruma*, *Vombisidris*). Our observation supports his view; the curved transverse crest was also not found in *R. epispinga* sp. nov. (Fig. 1).

In *R. epispinga* sp. nov., the term ‘peduncle of petiole’ is used to refer to an anteriorly narrow region of the petiole that extends from the anterior proximity to the curving point of the ventral outline (Fig. 10).

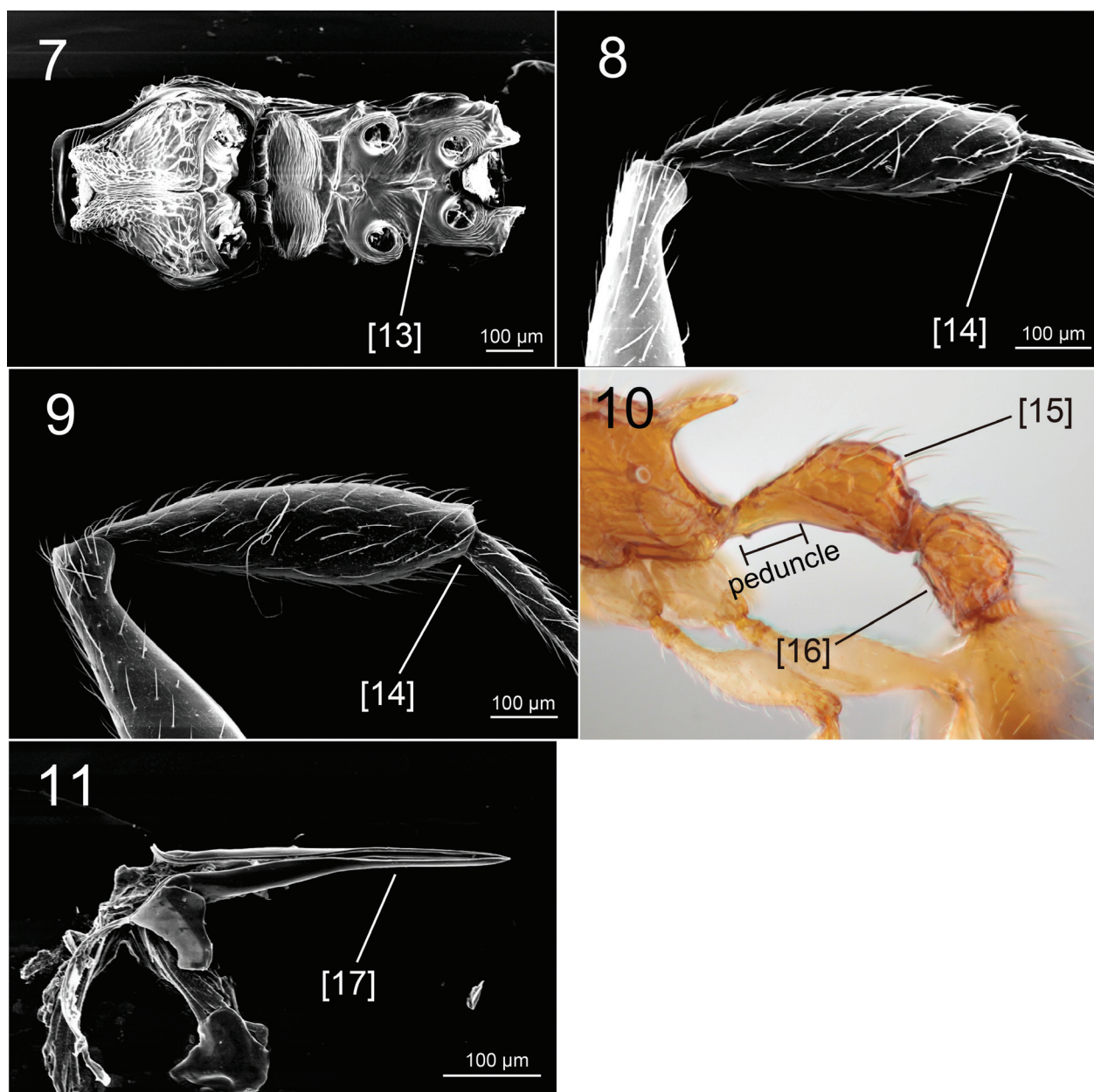
## Species accounts

### *Rotastruma epispinga* Hosoishi & Yamane, sp. nov.

<http://zoobank.org/F1B26A56-24A1-41E0-A356-3D7118AEF351>

Figs 1–17

**Type material examined.** *Holotype*: CAMBODIA • worker; Kampong Thom Province, regrowth forest; 12°38'N, 105°16'E; 24 Dec 2010; S. Hosoishi leg.; colony SH10-Cam-172; KUEC. *Paratypes*: CAMBODIA • 3 workers; Kampong Thom Province, regrowth forest; 12°38'N, 105°16'E; 24 Dec 2010; S. Hosoishi leg.; colony SH10-Cam-172; KUEC; 2 dealate queens;



**Figures 7–11.** *Rotastruma epispina* sp. nov., worker. **7**, Mesosoma in ventral view [13]; **8**, Middle tibia [14]; **9**, Hind tibia [14]; **10**, Petiole and postpetiole in profile view [15, 16]; **11**, Sting in profile view [17]. Figures in brackets correspond to diagnostic characters (Appendix 1).

Kampong Thom Province, regrowth forest; 12°38'N, 105°16'E; 24 Dec 2010; S. Hosoishi leg.; colony SH10-Cam-172; KUEC.

**Non-type material examined.** CAMBODIA • 2 pale-coloured workers; Kampong Thom Province, regrowth forest; 12°38'N, 105°16'E; 24 Dec 2010; S. Hosoishi leg.; colony SH10-Cam-172; KUEC.

**Diagnosis of worker.** Posterior margin of head almost straight. Lateral margin of head slightly convex. Propodeal spine curving upwards. Petiole pedunculate, peduncle longer than high. Two suberect hairs present around posterolateral corner of head.

**Measurements (in mm) and indices of holotype worker.** HW 0.62; HL 0.73; MaL 0.37; SL 0.50; EL 0.21;

TL 3.32; WL 0.84; PNH 0.30; PNW 0.44; MW 0.31; SPL 0.30; PTL 0.45; PTH 0.22; PTW 0.20; PPL 0.25; PPH 0.23; PPW 0.26; CI 84; SI 81; MaI 61; PI 46; PPI 106.

**Measurements (in mm) and indices of paratype worker (n = 3).** HW 0.62–0.63; HL 0.75; MaL 0.35–0.37; SL 0.51–0.53; EL 0.20–0.21; TL 3.25–3.40; WL 0.84–0.86; PNH 0.28–0.29; PNW 0.45–0.46; MW 0.30–0.32; SPL 0.28–0.30; PTL 0.44–0.46; PTH 0.22–0.24; PTW 0.20–0.21; PPL 0.23–0.25; PPH 0.22–0.23; PPW 0.27–0.28; CI 82–84; SI 81–86; MaI 57–59; PI 44–46; PPI 110–120.

**Description of worker.** Head rectangular in full-face view, longer than broad (CI 82–84), with posterior margin almost straight, lateral margin slightly convex and posterolateral corner rounded. Eye large, in the longest dimension





**Figures 12–14.** *Rotastruma epispina* sp. nov., holotype worker (KUEC) from Cambodia (HW 0.62; WL 0.84). **12**, Body in profile view; **13**, Full-face view of head; **14**, Dorsal view of body.

with 11–13 ommatidia. Frontal carina irregularly extending to posterior margin of head. Mandible with 6 teeth; two apical teeth large. Antenna 12-segmented, with 3-segmented club; scape not reaching posterolateral corner of head.

With mesosoma in dorsal view, lateral margins converging posteriad; anterolateral corner of pronotum rounded; mesonotum and propodeum laterally marginate; metanotal groove indistinct. In lateral view, pronotum, mesonotum and anterior propodeum forming a slightly convex dorsal outline. Mesopleuron marginated anteriorly in lower half, demarcated from pronotum and metapleuron. Propodeum with steeply sloping declivity that is laterally marginated with carinae; spine long, directed diagonally upwards, with apical 2/3 slightly down-curved; spiracle very close to apex of metapleural gland bulla.

In dorsal view, petiole rectangular with almost parallel sides. Petiole pedunculate in profile view; peduncle

longer than high, dorsally almost continuous to anterior slope of node. Petiolar spiracle located at mid-length of peduncle (measured from anterior extremity of peduncle). Subpetiolar process small and triangular. Postpetiole globular and distinctly wider than petiole in dorsal view, as high as petiolar node in lateral view (PTH 0.22–0.24; PPH 0.22–0.23).

Frons with two to three pairs of longitudinal rugulae; irregular rugulae in several specimens. Dorsum of head between frontal carina and eye reticulate-rugose. Clypeus with median longitudinal rugula and one or two rugulae laterally. Pronotum dorsally reticulate with smooth interspaces, laterally with rugulae running anteroposteriorly. Mesonotum sparse with irregular rugae interrupted by transverse rugulae posteriorly. Mesopleuron, metapleuron and lateral surface of propodeum shiny, with sparse anteroposteriorly running rugulae. Dorsum of propodeum



**Figures 15–17.** *Rotastruma epispina* sp. nov., paratype queen (KUEC) from Cambodia (HW 0.68; WL 1.10). **15**, Body in profile view; **16**, Full-face view of head; **17**, Dorsal view of body.

generally smooth, with weak irregular sculpture. Petiole and postpetiole reticulate-rugulose in dorsal and lateral view; dorsum of petiolar peduncle, anterior slope of petiolar node and petiolar sternite only superficially sculptured. First gastral tergite smooth, with short basigastral costulae.

Sparse standing setae present on dorsal surfaces of head, mesosoma, petiole, postpetiole and first gastral tergite; those on gastral sternites shorter. Two standing setae present around posterolateral corner of head. Clypeus

bearing a pair of setae medially at anterior margin. Scape and flagellum with suberect setae.

Colour yellowish-brown; first gastral tergite with broad brown band.

**Measurements (in mm) and indices of paratype queen (n = 2).** HW 0.64–0.68; HL 0.79–0.82; MaL 0.41–0.42; SL 0.53–0.54; EL 0.24–0.25; TL 3.88–4.01; WL 1.05–1.10; PNH 0.30; PNW 0.56; MW 0.59–0.60; SPL 0.35–0.36; PTL 0.54–0.55; PTH 0.26–0.27; PTW 0.25–



0.26; PPL 0.25–0.27; PPH 0.25–0.26; PPW 0.32–0.34; CI 81–83; SI 80–83; MaI 62–64; PI 46–49; PPI 126–128.

**Description of queen.** Head rectangular in full-face view, longer than broad (CI 81–83), with posterior margin almost straight (slightly concave medially), lateral margin slightly convex and posterolateral corner rounded. Eye large, in the longest dimension with 12–13 ommatidia. Median ocellus at the level with posterior margin of eye. Frontal carinae extending to anterior margin of lateral ocellus and diverging towards posterior margin of head. Mandible with 6 teeth; two apical teeth large. Antenna 12-segmented with 3-segmented club; scape not reaching posterolateral corner of head.

In dorsal view, mesosoma longer than wide, wider anteriorly, gradually narrowed posteriorly; pronotum demarcated from mesonotum, with evenly convex anterior margin and weakly convex lateral margin; metanotal groove distinct. In lateral view, dorsum of mesonotum slightly convex. Propodeal spiracle round and close to anterior margin of metapleural gland bulla. Wing scars clearly visible. Propodeal spines directed diagonally upwards, almost straight, apically blunt.

In dorsal view, petiole rectangular with almost parallel lateral margins. In lateral view, petiole pedunculate, with an ill-defined node; peduncle longer than high, with dorsal surface almost flat; dorsum of node convex. Subpetiolar process small and triangular, located near propodeum. Petiolar spiracle located at mid-length of peduncle. Postpetiole globular and distinctly wider than petiole, as high as petiolar node in lateral view.

Frons with two to three pairs of longitudinal rugulae; irregular rugulae in several specimens. Dorsum of head between frontal carina and eye reticulate-rugose. Clypeus with one median longitudinal rugula and one or two rugulae laterally. Pronotum dorsally reticulate with shiny interspaces, laterally with reticulate or longitudinal rugulae. Dorsum of mesoscutum and mesoscutellar disc with longitudinal rugulae. Mesopleuron, metapleuron and lateral propodeum with longitudinal rugae. Dorsum of propodeum with rugulae; declivity smooth and shiny. Dorsal surface of petiolar peduncle smooth and shiny; dorsal and lateral surfaces of node reticulate-rugose. Postpetiole reticulate-rugose. First gastral tergite smooth, with some short basigastral costulae.

Dorsal surface of head with suberect setae. Two standing setae present around posterolateral corner of head. Scape with suberect setae. Outer margin of mandible with decumbent setae. Pronotum and mesonotum with long suberect setae and short suberect to decumbent setae. Dorsal surface of propodeal spine with decumbent setae. Petiolar peduncle with decumbent setae; node with longer decumbent setae. Postpetiole with decumbent setae; subpostpetiolar process with suberect setae. Gaster with decumbent to suberect setae.

Colour yellowish-brown; first gastral tergite with broad brown band.

**Etymology.** The species name refers to the upwardly directed propodeal spine of the species.



**Figure 18.** Forest habitats on secondary forest, Kampong Thom Province, Cambodia, type locality of *R. epispina* sp. nov. (S. Hosoiishi).

**Distribution and biology.** This species is known only from the type locality of Cambodia. The nest series was collected from a dead twig on lower vegetation (Fig. 18). As Bolton (1991) suggested that *R. recava* appeared to be polygynous, the colony of *R. epispina* found inside the dead twig also involved two dealate queens.

**Remarks.** This species is similar to *R. stenoceps*, but can be distinguished by the propodeal spine directed upwards and the long peduncle of the petiole.

#### *Rotastruma recava* Bolton, 1991

**Type material examined.** Holotype and one paratype worker images examined. Holotype: MALAYSIA • worker; Sarawak, 4<sup>th</sup> Division G. Mulu NP; 22 May 1978; N. M. Collins leg.; type image CASENT0901995 of AntWeb (<http://www.antweb.org/>); BMNH. paratype: SINGAPORE • one worker; Bukit Timah Forest; 15 Mar 1973; D. H. Murphy leg.; type image CASENT0178523 of AntWeb (<http://www.antweb.org/>); MCZC.

**Remarks.** This species is easily distinguished from *R. epispina* sp. nov. and *R. stenoceps* by the concave occipital margin, convex lateral margin of head and sides of head not having hairs in the worker caste.

#### *Rotastruma stenoceps* Bolton, 1991

**Type material examined.** Holotype worker image examined. Holotype: CHINA • worker; Guangdong, Ding-Hu, Mts. 60 km W. of Guangzhou; Jun 1983; Z. Boucek leg.; type image CASENT0901994 of AntWeb (<http://www.antweb.org/>); BMNH.

**Non-type material examined.** CHINA • one dealate queen; Hong Kong, Lung Fu Shan Country Park, at 22.279139°N, 114.136755°E, elevation 273 m; 21 Apr 2016; Y. Y. Luo leg.; colour image ANTWEB1009015; SBSHKU.



**Remarks.** This species is similar to *R. epispina* sp. nov., but can be distinguished by the posteriorly directed propodeal spines and short petiolar peduncle.

Luo and Guénard (2016) mentioned that “*In full face view, head rectangular in shape, slightly wider than long*

(CI 85)” in the description of a single queen. However, the CI index and their image (fig. 10B) suggest that the queen has a longer head. The *R. stenoceps* queen is similar to the *R. epispina* sp. nov. queen, but can be distinguished by the downcurved propodeal spine and short petiolar peduncle.

## Updated key to *Rotastruma* species, based on the worker caste

The key is constructed basically after Bolton (1991), but slightly modified and updated, based on our observation.

- 1 With head in full-face view the posterior margin conspicuously concave and lateral margin convex..... *R. recava*
- With head in full-face view the posterior margin more or less flat and lateral margin straight to slightly convex..... 2
- 2 Propodeal spines directed upwards in profile view, curved at mid-length in dorsal view. Petiole with a distinct anterior peduncle; peduncle longer than high ..... *R. epispina* sp. nov.
- Propodeal spines directed backwards in profile view, straight in dorsal view. Petiole nodiform, with a short anterior peduncle; peduncle shorter than high ..... *R. stenoceps*

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## Appendix 1

Diagnosis of the worker caste of the genus *Rotastruma* (slightly modified from Bolton 1991).

- [1] Palp formula 5, 3 (Fig. 1).
- [2] Mandible triangular, with 6 teeth which decrease in size from apical to basal (Fig. 2).
- [3] Clypeus with a median longitudinal carina (Fig. 3); anterior clypeal margin with a pair of hairs which straddle the mid-point (Fig. 3).
- [4] Median portion of clypeus broad posteriorly, broadly inserted between the frontal lobes (Fig. 3).
- [5] Frontal lobes narrow; each lobe distinctly narrower than the portion of the clypeus that is inserted between them (Fig. 3).
- [6] Torulus not freely projecting (Fig. 3).
- [7] Frontal carinae very weakly present; antennal scrobes represented only by extremely shallowly depressed areas running above the eyes (Fig. 4).
- [8] Eyes large, situated at or just behind the mid-length of the sides (Fig. 4).

- [9] Antennae 12-segmented; the 3 apical segments forming a strongly defined club (Fig. 4).
  - [10] Mesosoma low in profile and with a shallowly evenly convex dorsum (Fig. 5); promesonotum not domed-convex (Fig. 5); metanotal groove absent (Figs 5, 6); propodeum bispinose (Fig. 6); sides of mesosoma marginate, especially on mesonotum and propodeum (Fig. 6).
  - [11] Propodeal spiracle set low on the side at about the mid-length of the sclerite, very close to the most dorsal point of the metapleural gland bulla (Fig. 5).
  - [12] Propodeal lobes present, small and rounded (Fig. 5).
  - [13] Metasternal process absent; cuticle between anterior halves of metacoxal cavities depressed (Fig. 7).
  - [14] Tibial spurs absent from middle and hind legs (Figs 8, 9).
  - [15] Petiole nodiform to pedunculate, with an anterior peduncle; petiolar spiracle located at the mid-length of the peduncle (Fig. 10)
  - [16] Postpetiolar sternite reduced, small in lateral view (Fig. 10).
  - [17] Sting functional, strong and simple (Fig. 11).
  - [18] Cuticle thick and armoured (Figs 4–6, 10). Pilosity present.
-