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A new record of *Zatypota albicoxa* (Hymenoptera: Ichneumonidae) from Indonesia, with description of a new species of its host spider (Araneae: Theridiidae)

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Abstract

Zatypota albicoxa (Walker) is newly recorded from Mt. Merapi, Java Is., Indonesia. This is the first record of *Z. albicoxa* from this part of the Oriental region and from the Southern Hemisphere, and the first record of the genus *Zatypota* from Southeast Asia. The Indonesian population of *Z. albicoxa* attacks a theridiid spider of the genus *Parasteatoda*, as do populations of *Z. albicoxa* in other regions. The spider is a new species, and is described under the name of *Parasteatoda merapiensis*.

Key words: irregular three-dimensional web, host-shift, Java, koinobiont, parasitism, *Parasteatoda*, *Polysphincta*-group

Introduction

Zatypota albicoxa (Walker) belongs to the *Polysphincta* group of genera (Ichneumonidae, Pimplinae), which are exclusively koinobiont ectoparasitoids of spiders. As far as known each species of the group utilizes a very narrow range of spiders as hosts, usually one or a few closely related species. The genus *Zatypota* Förster, parasitizing mainly theridiid spiders, is the largest genus among the group (Gauld & Dubois 2006) and has an almost worldwide distribution (Fitton *et al.* 1987). *Zatypota albicoxa* utilizes several species of spider but exclusively those of the genus *Parasteatoda* Archer, three species in Japan and two species in Europe. Although the parasitoid is widely distributed in the Eastern and Western Palearctic areas and in the Oriental part of China (see Yu *et al.* 2005) and Japan (Matsumoto & Takasuka 2010), it had been never recorded from Southeast Asia.

During our ongoing investigation of polysphinctine wasps in Indonesia, we found theridiid spiders parasitized by *Z. albicoxa* at Mt. Merapi, Java Is., Indonesia. The spider belongs to the genus *Parasteatoda* which consists of about 40 species, mainly from East to Southeast Asia (Chrysanthus 1963, 1975; Levi *et al.* 1982; Yoshida 2008, 2009; Zhu 1998), and is recognized as new to science.

Material and methods

The study site is about 250,000 m^2 extent and located at an altitude of 1,100 m (S 07º 34' 46.8" E 110º 26' 49.0", Kaliurang, Province of Yogyakarta) of Mt. Merapi (alt. 2,914 m, an active volcano), Central Java, Indonesia. Sampling was carried out on 13th and 15th August 2009, 27-28th February 2010 and 17th August 2010. This area is covered with volcanic ash soil and dominated by *Albizia falcataria* (Fabales, Mimosaceae). We checked as many as

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possible of the host spiders inhabiting the study area for immature parasitoids in February 2010 (rainy season) and in August 2010 (dry season). The spiders bearing immature parasitoids were brought to the laboratory and fed to rear adult wasps. We also collected cocoons of the parasitoid on the webs.

All specimens of *Z. albicoxa* examined in this paper are deposited in the collection of Ehime University Museum (EUM). Holotype, allotype and paratypes of the new species (spider) described in this paper are deposited in the collection of the Department of Zoology, National Museum of Nature and Science, Tokyo (NSMT).

For the description of the spider in this paper the following abbreviations are used: ALE, anterior lateral eye; AME, anterior median eye; AME-ALE, distance between AME and ALE; AME-AME, distance between AMEs; MOA, median ocular area; PLE, posterior lateral eye; PME, posterior median eye; PME-PLE, distance between PME and PLE; PME-PME, distance between PMEs. Terms for web structure are based on Benjamin & Zschokke (2003).

Results

Zatypota albicoxa (Walker)

Zatypota albicoxa: Matsumoto & Takasuka (2010): 5 [redescribed].

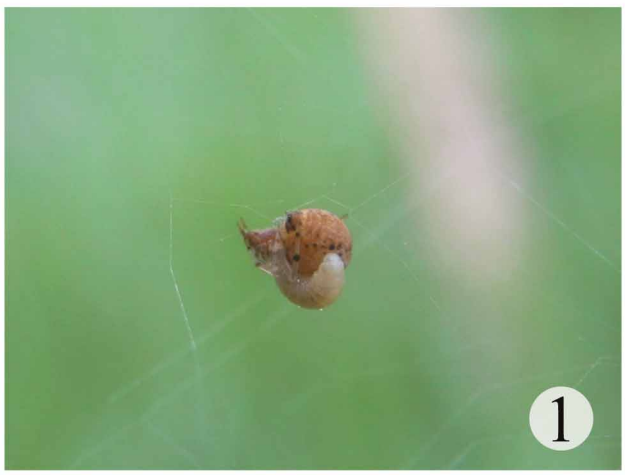
Specimens examined. All specimens were collected at Mt. Merapi, 1,100 m alt., Yogyakarta, Java, Indonesia, K. Takasuka leg. [13.Aug.2009] 2♂♂3♀♀ (cocoon, emer. Aug.2009); [15.Aug.2009] 3♂♂2♀♀ (cocoon, emer. Aug.2009), 1♀ (larva on host, cocooned and emer. Aug.2009); [27-28.Feb.2010] 1♀ (adult), 4♂♂6♀♀ (cocoon, emer. Mar.2010), 13 larvae on hosts preserved in 80% ethanol; [17.Aug.2010] 2♂♂1♀ (cocoon, emer. 18.Aug.2010), 1♂1♀ (cocoon, emer. 19.Aug.2010), 1♀ (cocoon, emer. 20.Aug.2010), 1♂2♀♀ (cocoon, emer. 22.Aug.2010), 1♀ (cocoon, emer. 23.Aug.2010), two pupae dead inside cocoons, 1♂1♀ (final instar larva hanging from web, cocooned 18.Aug., emer. 23.Aug.2010), 1♂ (larva on host, cocooned 18.Aug.2010, emer. 24.Aug.), 1♀ (larva on host, cocooned 18.Aug.2010, emer. 25.Aug.), 1♀ (larva on host, cocooned 19.Aug.2010, emer. 26.Aug.), 1♂ (larva on host, cocooned 20.Aug.2010, emer. 27.Aug.), 1♂ (larva on host, cocooned 22.Aug.2010, emer. 29.Aug.), 2♀♀ (larva and egg on host, cocooned 9.Sep.2010, emer. 17.Sep.), 1♀ (egg on host, cocooned 12.Sep.2010, emer. Sep.), five larvae on hosts preserved in 80% ethanol.

Biological notes. Eggs and larvae of *Z. albicoxa* were exclusively parasitic on juvenile spiders (Fig. 1). They were usually located on the dorso-lateral to lateral face, near the base of the abdomen, as were those of Japanese populations. The cocoon hung from the centre of the irregular three-dimensional web and was sustained by several horizontal frame threads (Fig. 2). Table 1 shows the numbers of the spiders and the parasitoids found in the study area in the rainy and dry season. The spider was more abundant in the dry season. Populations of the parasitoid wasp in both rainy and dry seasons were similar; thus the percentage parasitism in the rainy season was higher than in the dry season. The spiders, as well as the parasitoids at a variety of developmental stages, were recognized in both seasons (note that egg sacs of the spider existed in both seasons although we did not count them). The fact that eggs of the parasitoid wasp existed indicates that adult wasps are actively ovipositing regardless of season.

Distribution. Japan, Russian Far East, Sakhalin, Kuril Islands, China, India, Europe, Indonesia (new record).

TABLE 1. Population of *P. merapiensis* **sp. nov.** and *Z. albicoxa* in rainy and dry seasons. All eggs and larvae were found only on juvenile host spiders. Percentage parasitism was calculated by dividing number of parasitoid eggs and larvae by number of juvenile spiders.

	P. merapiensis **sp. nov.** (host spider)		*Z. albicoxa* (parasitoid)				percentage parasitism (%)
	juvenile	adult	egg	larva	pupa	adult	
27–28th Feb 2010 (rainy season)	55 (♀39, ♂14, unknown 2)	46 (♀21, ♂25)	3	10	10	1	23.6
17th Aug 2010 (dry season)	216 (♀185, ♂31)	107 (♀89, ♂18)	3	13	11	0	7.4



FIGURES 1–2. A larva of *Z. albicoxa* on a juvenile *P. merapiensis* **sp. nov.** (1); A cocoon hanging from web of *P. merapiensis* **sp. nov.** (2).

Description of host spider

Parasteatoda merapiensis Yoshida & Takasuka, sp. nov.

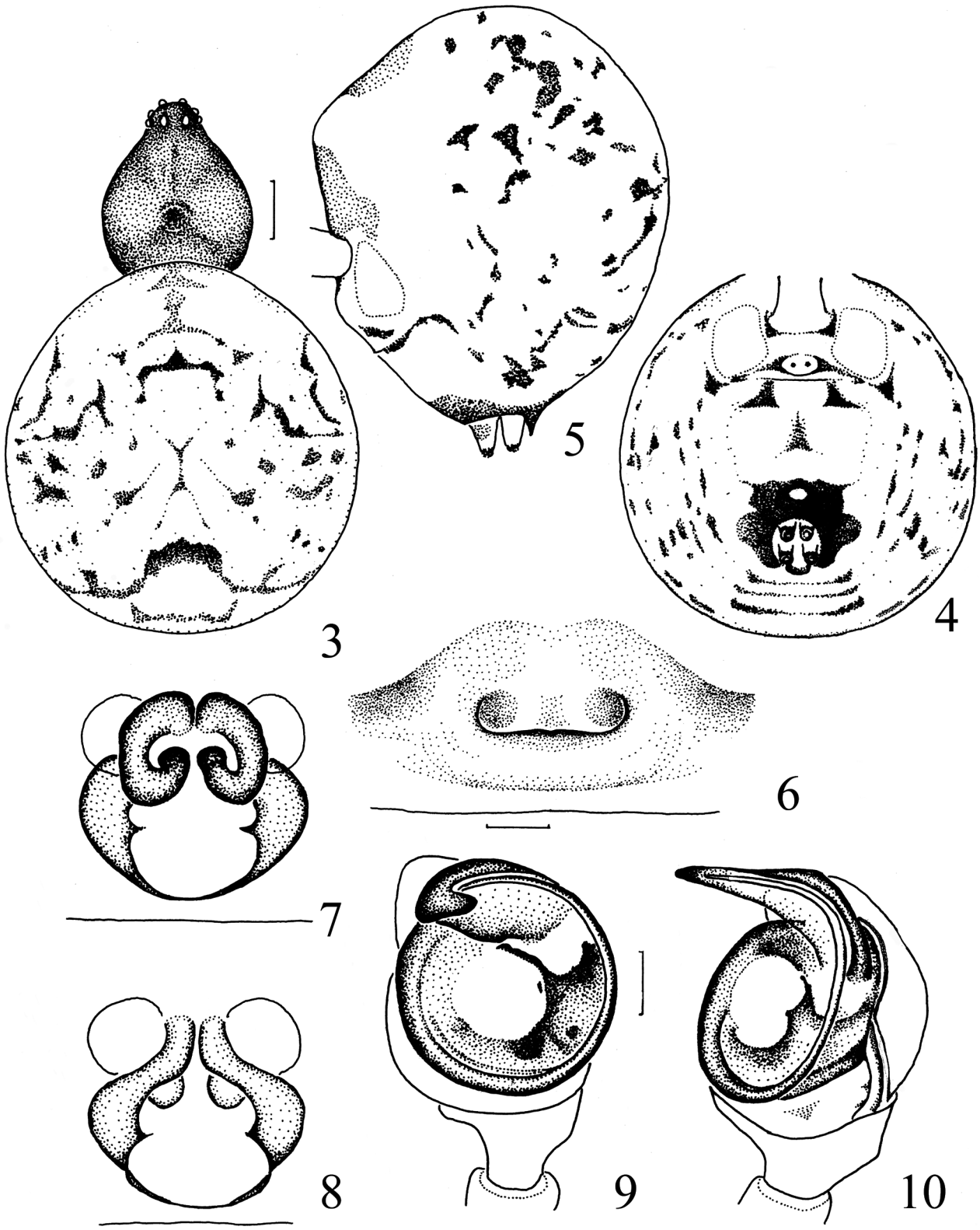
Diagnosis. This species is similar to *Parasteatoda wau* (Levi *et al.* 1982), *P. kaindi* (Levi *et al.* 1982) and *P. vervoorti* (Chrysanthus 1975), described from New Guinea, in general appearance and genital organs, but is distinguished from them by thick ducts and membranous seminal receptacles of female internal genitalia and coloration of the carapace and abdomen. It is also distinguished from *P. wau* by the absence of the anterior edge of the epygynal depression, from *P. kaindi* by the annulated color pattern of the legs, and from *P. vervoorti* by the short distance between the PMEs.

Female. Carapace oval with large round cervical groove (Fig. 3). AMEs and PMEs separated by distance equal to their diameter. Diameters in ratio, AME: ALE: PME: PLE = 11: 7: 11: 13. MOA wider than long. Chelicera with basal large tooth and distal small one on anterior margin of fang furrow. Leg formula, 1, 4, 2, 3. First patella and tibia 1.3 times carapace length. Abdomen higher than long, longer than wide (Figs 3–5). Genital organ as shown in Figs 6–8: epigynum swelling with depression, anterior edge indistinct; two openings in both sides of depression; ducts thick and black, forming circle; seminal receptacles globular and membranous.

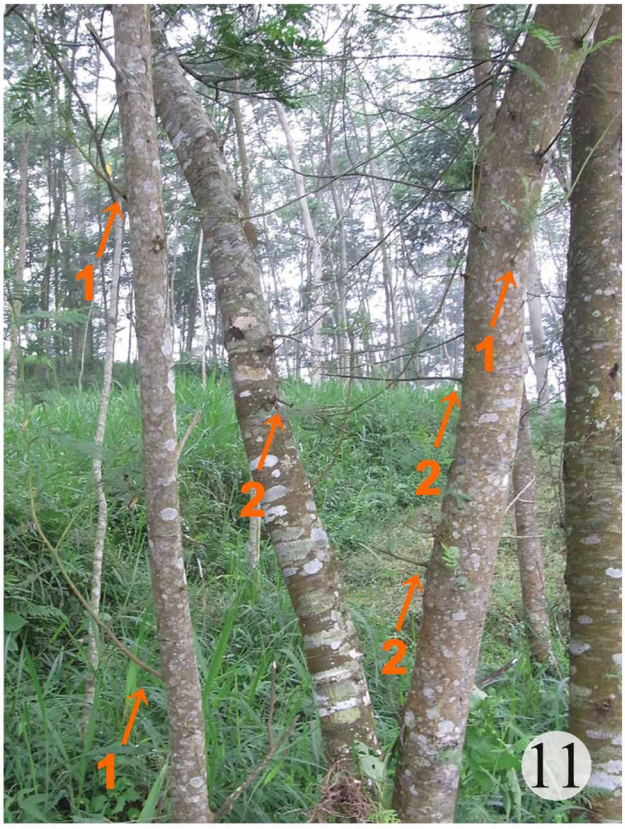
Coloration (Figs 3–5). Carapace almost black. Chelicerae, maxillae, and labium blackish brown. Sternum brown with posterior black line between fourth coxae. Palpus: femora and patellae dusky brown with black flecks; tibiae and tarsi almost black. Legs dusky brown with black flecks: femora, patellae, tibiae and tarsi each with distal, and metatarsi with distal and median black rings; longitudinal ventral dusky line on first femora, but that of second and third femora indistinct. Abdomen dusky brown with many black flecks, linear median transverse and lateral downward white patches distinct; venter with pair of large white patches between epigynum and spinnerets, and with large black fleck anterior to spinnerets.

Male. Ground color brown with black flecks. Abdomen without distinct white marks. AMEs half their diameter apart. Diameters in ratio, AME: ALE: PME: PLE = 16: 8: 11: 11. Leg formula, 1, 2, 4, 3. First patella and tibia 1.8 times carapace length. Palpal organ as shown in Figs 9–10: conductor long, ventrally projecting and tapering to apex; embolus thin and long, forming circle. Other characteristics as in female.

Measurements (in mm, ♀ holotype/ ♂ allotype). Body length 4.74/ 2.63. Carapace length 1.63/ 1.21; width 1.26/ 1.11. Abdomen length 3.16/ 1.53; width 2.68/ 1.16; height 3.63/ 1.58. Length of legs [total (femur + patella and tibia + metatarsus + tarsus)]: I 7.37/ 6.85 (2.16/ 2.00 + 2.16/ 2.16 + 2.16/ 1.95 + 0.89/ 0.74); II 4.96/ 4.58 (1.37/ 1.32 + 1.37/ 1.47 + 1.21/ 1.21 + 0.68/ 0.58); III 3.69/ 3.26 (1.11/ 1.00 + 1.05/ 0.95 + 0.95/ 0.84 + 0.58/ 0.47); IV 5.58/ 4.15 (1.68/ 1.26 + 1.74/ 1.26 + 1.42/ 1.05 + 0.74/ 0.58). Diameters: AME 0.11/ 0.16; ALE 0.07/ 0.02; PME 0.11/ 0.11; PLE 0.13/ 0.11. Distances: AME-AME 0.11/ 0.08; AME-ALE 0.05/ 0.08; PME-PME 0.11/ 0.13; PME-PLE 0.09/ 0.11. MOA, anterior width 0.30/ 0.34; posterior width 0.30/ 0.26; length 0.26/ 0.29.



FIGURES 3–10. *Parasteatoda merapiensis* **sp. nov.**, female holotype (3–8) and male allotype (9–10) – 3, carapace and abdomen, dorsal view; 4–5, abdomen, ventral (4) and lateral (5) views; 6, epigynum, ventral view; 7–8, internal genitalia, dorsal (7) and ventral (8) views; 9–10, palpus, ventral (9) and retrolateral (10) views. Scales: 0.5 mm (3–5) and 0.1 mm (6–10).



FIGURES 11–12. Habitat of *P. merapiensis* **sp. nov.** Web(s) of *P. merapiensis* **sp. nov.** under twigs (arrow 1) and dead branches (arrow 2) (11), and between tree trunks with a shelter (12) of *Albizia falcataria*.

Variation. The ground color of females is variable; some specimens are almost blackish brown, and some are yellowish brown. In dark specimens, flecks on the abdomen and legs are indistinct and the sternum has a pair of lateral, large dark flecks. In pale specimens, the longitudinal dusky flecks on the legs are indistinct. The ground color of males is not so variable. Measurements (in mm, ♀/ ♂): Body length 4.5-6.7/ 2.5–3.1; carapace length 1.9–2.3/ 1.2–1.5; abdomen length 2.5–4.8/ 1.4–1.7.

Type series. Holotype: ♀, and allotype: ♂, Mt. Merapi, 1,100 m alt, Yogyakarta, Java, Indonesia, 15.Aug.2009, K. Takasuka leg. (NSMT-Ar 8714-8715). Paratypes: 6♀ and 6♂, 27-28.Feb.2010, same locality and collector as for holotype (NSMT-Ar 8716).

Other specimens examined. 15♀ and 19♂, same data as for paratypes. Three juveniles were collected with holotype and 55 juveniles with paratypes.

Biological notes. This species constructs irregular, three-dimensional webs exclusively on *A. falcataria*, under twigs or dead branches or between tree trunks (Fig. 11–12). Adult spiders usually hang a dead leaf at the centre of the web as a refuge, in which they hide themselves (Fig. 12). Preys captured in the web are mainly ants, caterpillars and rarely beetles.

Comments. The web construction of this species is similar to that of *P. tepidariorum* (*Achaearanea*-type, *sensu* Benjamin & Zschokke (2003)). It consists of gumfooted lines (GF), a retreat (R) and supporting structures (SSt).

Distribution. Indonesia: Java (known only from type locality).

Etymology. The specific name is derived from Mt. Merapi, Java, the type locality.

Discussion

Zatypota albicoxa has a wide distribution and utilizes several species of spider as hosts, which seems to be exceptional for a member of the *Polysphincta* group, but the recorded hosts are exclusively of the genus *Parasteatoda*; *P. tepidariorum* (Koch) (Uchida 1940; Iwata 1942; Matsumoto & Takasuka 2010), *P. tabulata* (Levi) and *P. oculip-*

rominens (Saito) (Matsumoto & Takasuka 2010) in Japan and *P. lunata* (Clerck) (Nielsen 1923; Fitton *et al.* 1987; Bordoni 2003) and *P. simulans* (Thorell) (Fitton *et al.* 1987) in Europe. We added a new host spider, *P. merapiensis* **sp. nov.**, herein. The webs of all these host spiders of *Z. albicoxa*, including *P. merapiensis* **sp. nov.**, are of the same construction, *Achaearanea*-type (Benjamin & Zschokke 2003; Shinkai 2006; although the web type of *P. simulans* is unclear). Because a recent study showed oviposition behaviour of *Z. albicoxa* to be highly adapted to the web construction of *P. tepidariorum*, consisting of gumfooted vertical threads and dried frame threads (Takasuka *et al.* 2009; ambush hanging from the vertical thread or climbing the frame thread to cope with the spider inside the complex web); the parasitoid is obviously able to successfully utilize several spider species with the same web construction.

Due to the large eruption of Mt Merapi in October 2010 (GVP 2010), all suitable habitats in the type locality have sadly been destroyed.

Acknowledgments

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