

Three New Species of the Genus *Acanthomyrmex* Emery (Hymenoptera: Formicidae) from Indonesia, with Notes on the Reproductive Caste and Colony Composition

Mamoru TERAYAMA¹, Fuminori ITO² and Bruno GOBIN³

¹Department of Biology, College of Arts & Sciences, The University of Tokyo, Komaba, Meguro-ku, Tokyo, 153-8902 Japan

²Laboratory of Biology, Faculty of Agriculture, Kagawa University, Takamatsu, Kagawa, 760-8522 Japan

³Zoological Institute, K. U. Leuven, Naamsestraat 59, B-3000 Leuven, Belgium

Abstract. Three new species of the ant genus *Acanthomyrmex*, *A. padanensis*, *A. minus*, and *A. sulawesiensis*, are described from Indonesia. Ergatoid (wingless) queens are recorded in this genus for the first time. Colony compositions of these species are also noted.

Key words: Formicidae, *Acanthomyrmex*, new species, colony composition, ergatoid queen, Indonesia.

Introduction

The ant genus *Acanthomyrmex*, belonging to the subfamily Myrmicinae, is represented by 13 described species and restricted to the Oriental Region (Moffett, 1986; Terayama, 1995; Zhou & Zheng, 1997). All the *Acanthomyrmex* species are strongly dimorphic, presenting minor and major worker subcastes. The head length of majors is more than twice as long as that of minors. The majors serve roles in nest defense, and presumably also mill the seeds which form a large part of the diet of these omnivores (Moffett, 1985). The reproductive castes are known only for *A. ferox* Emery (alate queen and male) and *A. thailandensis* Terayama (alate queen).

Recently, we have examined ten colonies of the *Acanthomyrmex* ants from the various regions of Indonesia. After careful examinations, we have found three new species in the material. We never collected alate or dealate queens in these species, but each colony contained ergatoid (permanently wingless) queens. In this paper, we describe those species and provide information about reproductive caste and colony composition.

For diagnosis of *Acanthomyrmex*, see Moffett (1986). The following abbreviations are used: HL, head length; HW, head width; SL, scape length; CI, cephalic index ($HW \times 100 / HL$); SI, scape index ($SL \times 100 / HW$); WL, Weber's length of alitrunk; PL, petiole length; PH, petiole height; DPW, dorsal petiole width; PPL, postpetiole length; PPH, postpetiole

height; PPW, dorsal postpetiole width; TL, total body length (total length of outstretched individual, from the mandibular apex to the gastral apex in minor worker and ergatoid queen, and from the frons of head to the gastral apex in major worker).

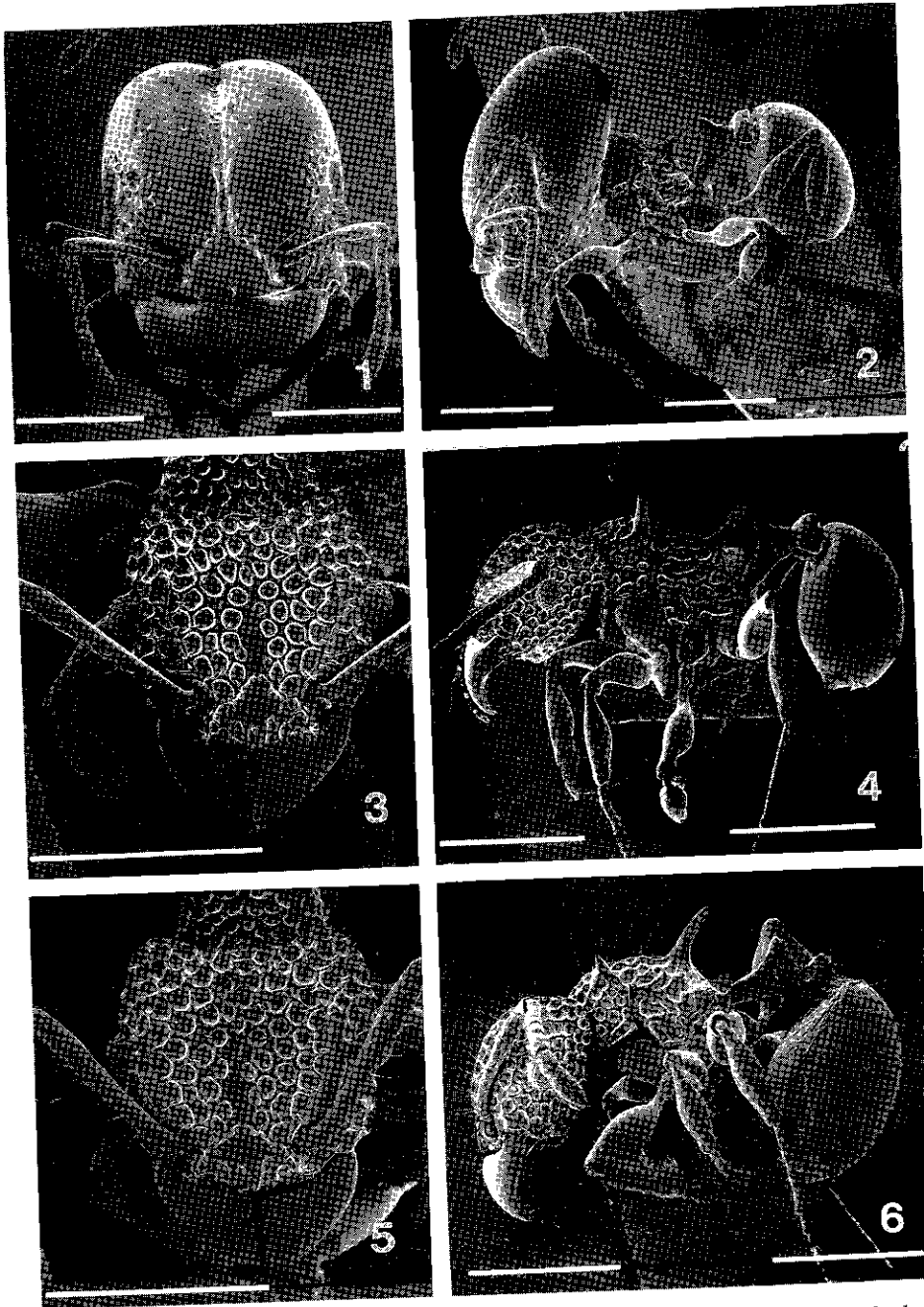
The holotype and some paratypes are preserved in the Zoological Museum, Bogor (LIPI), Indonesia, and the other paratypes are in the National Institute of Agro-Environmental Sciences, Tsukuba, and the Museum of Nature and Human Activities, Hyogo.

Descriptions

Acanthomyrmex padanensis sp. nov.
(Figs. 1-6, 19-21)

Major worker (holotype). HL 2.30 mm; HW 2.15 mm; SL 1.08 mm; CI 93; SI 50; WL 1.05 mm; PL 0.58 mm; PH 0.40 mm; DPW 0.28 mm; PPL 0.28 mm; PPH 0.45 mm; PPW 0.35 mm; TL ca. 6.0 mm.

Head slightly longer than wide, with parallel sides and strongly concave posterior margin in full face view; cephalic median furrow well developed, extending below to the frontal area; frons and vertex subopaque with shallow punctures sparsely, and without hairs. Mandible massive, subopaque, and with two blunt teeth near basal portion of masticatory margin. Anterior margin of clypeus almost straight, without a projecting median lobe. Antennal scape slightly longer than the funiculus, with more than 15 long erect hairs; 2nd segment $1.3 \times$ as long as wide; 3rd to 9th segments each wider than long. Antennal scrobe developed,



Figs. 1-6. *Acanthomyrmex padanensis* sp. nov. — 1, Head in full face view, major worker; 2, body in profile, major worker; 3, head in full face view, minor worker; 4, body in profile, minor worker; 5, head in full face view, ergatoid queen; 6, body in profile, ergatoid queen. Bar = 1 mm.

with a clearly demarcated funicular scrobe. Eye 0.23 mm in diameter.

Alitrunk short, smooth and shining; dorsum with several relatively long erect hairs. Propodeal spines long and straight, 0.35 mm long, and converging to the tip; propodeal declivitous surface microreticulate.

Petiole long, 1.45 × as long as high, largely smooth; a pair of posterodorsal hairs present; lateral petiolar hairs present; node with weakly convex anterior and posterior margins and obtusely angulate dorsum in profile; in posterior view, node reverse U-shaped as in

Fig. 19. Postpetiole 0.62 × as long as high, with 3 pairs of erect hairs; anterior and posterior margins straight; dorsal margin convex and highest at anterior 1/3 in profile; in dorsal view, postpetiole 3.0 × as wide as long.

Gaster subopaque, with erect hairs sparsely.

Head including mandibles castaneous; alitrunk, petiole, and postpetiole reddish brown; gaster dark brown; antennae and legs yellowish brown.

Minor worker. HL 0.95 mm; HW 1.15 mm; SL 1.00 mm; CI 121; SI 87; WL 1.08 mm; PL 0.50 mm; PH

0.33 mm; DPW 0.17 mm; PPL 0.21 mm; PPH 0.28 mm; PPW 0.28 mm; TL 3.8 mm.

Head wider than long, with convex posterior margin in full face view; frons and vertex coarsely punctate; punctures 0.07–0.10 mm in diameter. Mandible subopaque and impunctate. Clypeus with 2 longitudinal rugae; median clypeal lobes feebly developed; clypeal index 73. Eye 0.25 mm in diameter.

Pronotum coarsely punctate; punctures 0.07–0.09 mm in diameter; pronotal tooth 0.33 mm long; mesonotal dorsum straight in profile; lateral surfaces of mesonotum and propodeum with strong carinae. Propodeal spine long, 0.45 mm long.

Petiole $1.5\times$ as long as wide, with obtusely angulate dorsal margin of node in profile; a pair of posterodorsal hairs present; lateral petiolar hairs present; in posterior view, node reverse U-shaped as in Fig. 20. Postpetiole $0.75\times$ as long as high, with 2 pairs of dorsal and a pair of lateral hairs, highest in anterior portion in profile; in dorsal view, postpetiole $0.58\times$ as long as wide.

Gaster shining, with erect hairs moderately.

Body yellowish brown excepting the gaster dark brown.

Ergatoid queen. HL 1.25 mm; HW 1.00 mm; SL 0.93 mm; CI 80; SI 93; WL 1.08 mm; PL 0.50 mm; PH 0.38 mm; DPW 0.25 mm; PPL 0.20 mm; PPH 0.40 mm; PPW 0.38 mm; TL 4.2 mm.

General shape as in minor worker excepting the shorter pronotal teeth (0.10 mm long), and much higher postpetiole (PPH 0.40 mm).

Holotype. Major worker, Ulu Gadut, Padang, Sumatra, Indonesia, 28.III.1997, F. Ito leg.

Paratypes. Six minor workers, 2 ergatoid queens, same colony as holotype; 2 major workers, 9 minor workers, 4 ergatoid queens, same locality, 30.III.1997, F. Ito leg.; 3 major workers, 10 minor workers, 1 ergatoid queen, same data.

Etymology. The specific epithet refers to the type locality.

Remarks. This species is mostly resembles *A. dusun* Wheeler from Sarawak with clearly demarcated funicular scrobe in major worker. However, it is easily distinguished from the latter by the clypeus with straight anterior margin and lacking a median projecting lobe, the straight propodeal spines, and convex dorsal margin of petiolar node in posterior view.

Acanthomyrmex minus sp. nov.

(Figs. 7–12, 22–24)

Major worker (holotype). HL 1.58 mm; HW 1.60 mm; SL 0.63 mm; CI 101; SI 39; WL 0.65 mm; PL 0.35

mm; PH 0.28 mm; DPW 0.26 mm; PPL 0.20 mm; PPH 0.28 mm; PPW 0.25 mm; TL 2.8 mm.

Head as long as wide, with weakly convex posterior margin in full face view; posterior margin very slightly notched medially; median furrow shallow, and recognized in posterior $2/5$ of frons and vertex; frons and vertex smooth, without hairs; gena with shallow punctures moderately; shallow punctures also present near frontal carina. Mandible smooth, without any tooth. Anterior margin of clypeus straight, without a median projecting lobe. Antennal scape broadest at posterior $1/5$ of its length, with about 10 erect hairs; 2nd segment slightly longer than wide; 3rd to 9th segments each $0.5\times$ as long as wide. Antennal scrobe moderately developed, but without funicular scrobe. Eye 0.10 mm in diameter.

Pro- and mesonotum with large punctures which are ca. 0.05 mm. Propodeal spine 0.24 mm long, turned to the posterior portion; declivitous surface subopaque.

Petiole longer than high, with acute triangular node in profile; posterodorsal margin with a pair of erect hairs; lateral petiolar hairs absent; in posterior view, node rectangular, with parallel sides and straight dorsal margin. Postpetiole rectangular, $0.76\times$ as long as wide in profile; 2 pairs of dorsal hairs and a pair of lateral hairs present; in dorsal view, $0.70\times$ as long as wide, with slightly concave anterior and straight dorsal margins.

Gaster smooth and impunctate, without hairs.

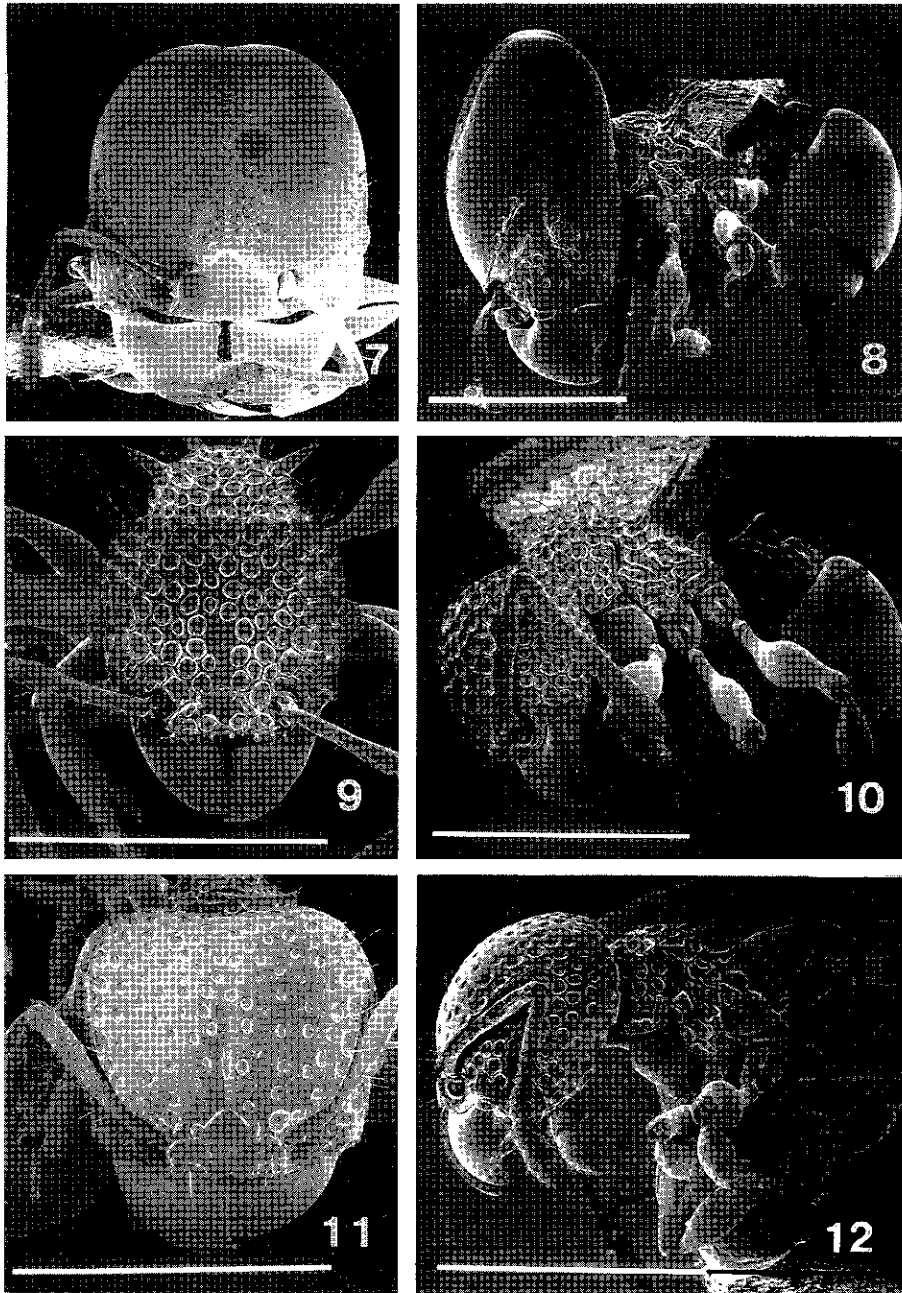
Body reddish brown; mandibles dark brown; antennae and legs yellowish brown.

Minor worker. HL 0.73 mm; HW 0.90 mm; SL 0.60 mm; CI 123; SI 67; WL 0.80 mm; PL 0.30 mm; PH 0.24 mm; DPW 0.18 mm; PPL 0.18 mm; PPH 0.23 mm; PPW 0.20 mm; TL 2.5 mm.

Head wider than long, with feebly concave posterior margin in full face view; frons and vertex with large coarse punctures which are ca. 0.06 mm in diameter. Mandible largely smooth. Antennal scape with about 10 erect hairs; 2nd segment slightly longer than wide; 3rd to 9th segments each $0.5\times$ as long as wide. Clypeus with 2 longitudinal rugae; median clypeal lobes feebly developed; clypeal index 84. Eye 0.11 mm in diameter.

Alitrunk with convex dorsal outline in profile; pro- and mesonotum punctate as in head; pronotal spine 0.13 mm long; propodeal spine thin and straight, 0.28 mm long.

Petiole $1.25\times$ as long as high, with a pair of posterodorsal hairs; lateral petiolar hairs absent; in posterior view, node with parallel sides and straight dorsal margin. Postpetiole $0.78\times$ as long as high,



Figs. 7–12. *Acanthomyrmex minus* sp. nov. — 7, Head in full face view, major worker; 8, body in profile, major worker; 9, head in full face view, minor worker; 10, body in profile, minor worker; 11, head in full face view, ergatoid queen; 12, body in profile, ergatoid queen. Bar = 1 mm.

with straight dorsal margin in profile; dorsum with 2 pairs of erect hairs; lateral postpetiolar hairs present; in dorsal view, $0.76\times$ as long as wide.

Gaster smooth and shining, without hairs.

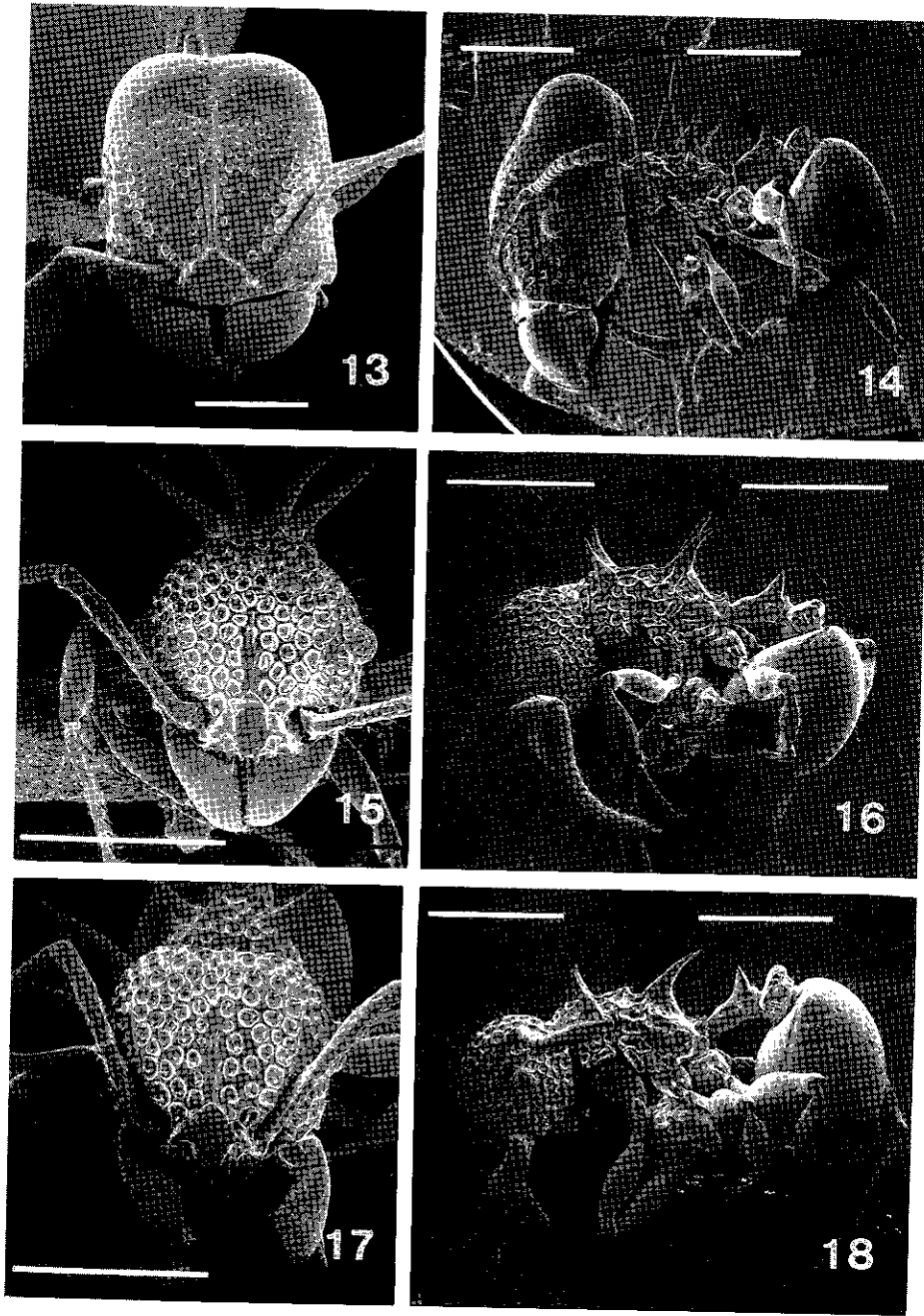
Body reddish brown, gaster slightly darker; antennae reddish brown; mandibles and legs brown.

Ergatoid queen. HL 0.90 mm; HW 1.08 mm; SL 0.65 mm; CI 119; SI 60; WL 0.83 mm; PL 0.35 mm; PH ; 0.26 mm; DPW 0.21 mm; PPL 0.18 mm; PPH 0.28 mm; PPW 0.24 mm; TL 2.5 mm.

Head wider than long, with concave posterior

margin in full face view; frons and vertex with shallow punctures sparsely; the punctures ca. 0.05 mm in diameter, and separated by $1.5\text{--}2.0\times$ their own diameters; interspaces smooth. Mandible large, without tooth as in major worker. Anterior margin of clypeus straight, without distinct teeth. Antennal scape with about 10 erect hairs; 2nd segment longer than wide; 3rd to 9th segments each wider than long. Eye 0.11 mm in diameter.

Alitrunk, petiole, postpetiole, and gaster as in major worker.



Figs. 13–18. *Acanthomyrmex sulawesiensis* sp. nov. — 13, Head in full face view, major worker; 14, body in profile, major worker; 15, head in full face view, minor worker; 16, body in profile, minor worker; 17, head in full face view, ergatoid queen; 18, body in profile, ergatoid queen. Bar = 1 mm.

Body reddish brown; mandibles, antennae and legs yellowish brown.

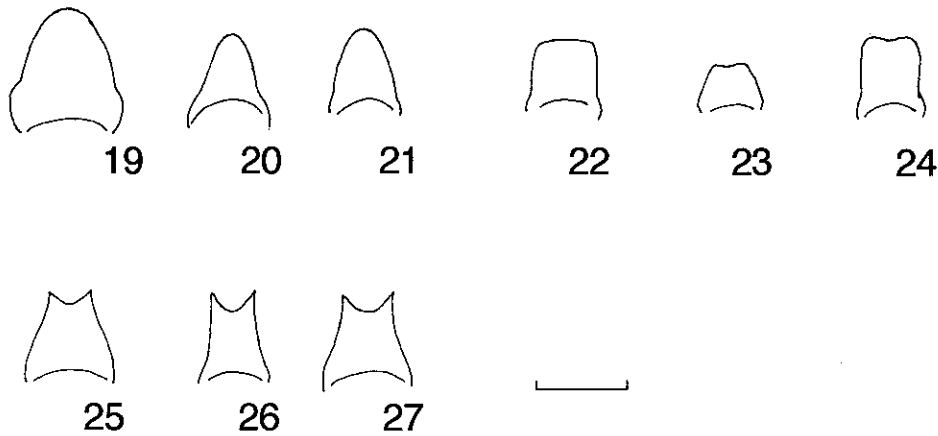
Holotype. Major worker, Ulu Gadut, Padang, Sumatra, Indonesia, 28. III. 1997, F. Ito leg.

Paratypes. 1 major worker, 17 minor workers, 1 ergatoid queen, same colony as holotype; 8 minor workers, 1 ergatoid queen, same data as holotype.

Etymology. The specific epithet is named after the small body size of major workers.

Remarks. This species belongs to the *notabilis* species group of Moffett (1986), which is characterized

by the convex and not bilobed posterior margin of head in major workers. Within the group, this new species is easily distinguished from the others by the smooth and impunctate frons and vertex, and smaller body size (HL 1.58 mm, HW 1.60 mm) of major workers, and straight dorsal margin of petiolar node in major and minor workers.



Figs. 19–27. Petiole, posterior view. — 19–21, *Acanthomyrmex padanensis* sp. nov.; 22–24, *A. minus* sp. nov.; 25–27, *A. sulawesiensis* sp. nov.; 19, 22, 25, major worker; 20, 23, 26, minor worker; 21, 24, 27, ergatoid queen. Bar=0.25 mm.

Acanthomyrmex sulawesiensis sp. nov.

(Figs. 13–18, 25–27)

Major worker (holotype). HL 2.48 mm; HW 2.40 mm; SL 1.10 mm; CI 97; SI 46; WL 1.13 mm; PL 0.53 mm; PH 0.45 mm; DPW 0.27 mm; PPL 0.29 mm; PPH 0.43 mm; PPW 0.45 mm; TL 5.0 mm.

Head as long as wide, with concave posterior margin in full face view; cephalic median furrow developed, but very weak on vertex; frons and vertex subopaque and moderately punctate, with short erect hairs sparsely; punctures shallow, 0.05–0.13 mm in diameter, and separated by 1.0–1.2× their diameters. Mandible subopaque, without distinct tooth. Anterior margin of clypeus weakly produced medially, and very weakly concave at midlength. Antennal scape with more than 15 erect hairs; 2nd segment longer than wide; 3rd and 4th segments each slightly longer than wide; 5th to 9th segments each as long as wide. Antennal scrobe shallow, without funicular scrobe. Eye 0.25 mm in diameter.

Pronotum with punctures which are 0.05–0.08 mm in diameter; propodeal spine in profile straight, with a wide basal portion relatively abruptly narrowing to shaft of spine; length 0.50 mm; propodeal declivitous surface smooth and shining.

Petiole 1.18× as long as high, with high and thin node; dorsum with 2 pairs of erect hairs; one near the top of node and the other in posterodorsal portion; lateral petiolar hairs present; in posterior view, dorsum with a pair of acute teeth as in Fig. 25. Postpetiole 0.67× as long as wide, with 3 pairs of relatively short erect hairs dorsally; 2 pairs of lateral postpetiolar hairs present; dorsal margin convex, and highest at anterior 1/3 of its length; in dorsal view, postpetiole 0.5× as long as wide and dorsal disc 0.41×

as long as wide.

Gaster subopaque and weakly shining excepting the anterior 1/3 of 1st tergite, with shallow sparse punctures, and scattered with erect hairs.

Body reddish brown, gaster darker; clypeus blackish brown; mandibles reddish brown excepting the masticatory and basal margins blackish brown; antennae and legs brown.

Minor worker. HL 1.01 mm; HW 1.28 mm; SL 1.08 mm; CI 127; SI 84; WL 1.15 mm; PL 0.45 mm; PH 0.38 mm; DPW 0.26 mm; PPL 0.23 mm; PPH 0.36 mm; PPW 0.38 mm; TL 4.0 mm.

Head wider than long, with almost straight, very weakly convex posterior margin in full face view; frons and vertex coarsely punctate; the punctures large, 0.09–0.10 mm in diameter. Mandible subopaque. Clypeus without 2 longitudinal rugae; medial clypeal lobes very weakly developed; clypeal index 83. Eye 0.20 mm in diameter.

Pronotum with coarse punctures which are 0.06–0.09 mm in diameter; pronotal spine long, 0.53 mm long; mesonotal dorsum straight in profile; propodeal spine long with a wide base, and subequal in length to pronotal teeth.

Petiole 1.18× as long as high, with high and thin node in profile; in posterior view, a pair of acute teeth present on posterolateral corners of node as in Fig. 26. Postpetiole 0.64× as long as high, with convex dorsal margin in profile; dorsum with 3 pairs of erect hairs; 2 lateral postpetiolar hairs present; in dorsal view, postpetiole 0.55× as long as wide, and dorsal disc 0.34× as long as wide.

Gaster shagreened, with erect hairs.

Body reddish brown, gaster even darker; mandibles, antennae, and legs brown, somewhat yellowish.

Ergatoid queen. HL 1.13 mm; HW 2.50 mm; SL 1.15 mm; CI 122; SI 84; WL 1.00 mm; PL 0.45 mm;

Table 1. Colony composition of two *Acanthomyrmex* species collected in Ulu Gadut, Padang, West Sumatra. Number of mated and egg-laying queens is shown in parenthesis.

Colony code	Ergatoid queens	Major workers	Minor workers	Males	Major pupae	Minor pupae
<i>A. padanensis</i>						
FI97-392	2 (2)	1	6	0	0	0
FI97-516	4 (2*)	2	9	0	—	—
FI97-518	1 (1)	3	10	3**	—	—
<i>A. minus</i>						
FI97-483	2 (1)	0	8	0	1	0
FI97-485	1 (1)	2	17	0	0	2

* only two queens were dissected.

** escaped after collection.

— not counted.

Table 2. Number of ovarioles per ovary in three castes of *Acanthomyrmex* spp.

Species	Ergatoid queens	Major workers	Minor workers
<i>A. minus</i>	1	1	1
<i>A. padanensis</i>	2	2	1
<i>A. sulawesiensis</i>	2	2	1

PH 0.43 mm; DPW 0.27 mm; PPL 0.23 mm; PPH 0.45 mm; PPW 0.43 mm; TL 4.0 mm.

General shape as in minor workers with the following differences: pronotal spines distinctly shorter than propodeal spines; mesonotal dorsum with a large transverse carina; propodeal spines with much broader base.

Holotype. Major worker, Karaenta, Kobupoke-Maros, Sulawesi, Indonesia, 18.III.1996, B. Gobin leg.

Paratypes. 5 minor workers, 5 ergatoid queens, same colony as holotype.

Etymology. The specific epithet refers to the type locality.

Remarks. This species is similar to *A. basispinosus* Moffett from Sulawesi, in having the propodeal spines with a wide basal portion. However, it is easily distinguished from the latter by the straight posterior margin of head in minors (strongly concave in *basispinosus*), the much broader head (CI > 120, whereas CI < 105 in *basispinosus*), and the higher petiolar node with acute spines at apex in minor and major workers (short and without spines in *basispinosus*).

Colony composition and ovariole numbers

All colonies of the three species nested in dead twigs fallen on the ground of forests. Colony composition of *A. padanensis* and *A. minus* is shown in Table 1. In both species, ergatoid queens reproduced. These were the only individuals in the colony that had a spermatheca. Two of three *A. padanensis* colonies were poly-

gynous, in which two or more ergatoid queens had mated and laid eggs. Two colonies of *A. minus* were monogynous, but in one of them additional virgin ergatoid queen was found. We did not count the number of mated ergatoid queens in the *A. sulawesiensis* colony. *A. minus* and *A. padanensis* colonies were small, with less than 20 minor workers and a few majors. One colony of *A. minus* had no majors, although the colony produced two major pupae in the laboratory. In *A. sulawesiensis*, the colony size was also around 30 workers, a few of which were majors. The number of ovarioles of each caste is shown in Table 2. In *A. minus*, ergatoid queens and both subcastes of workers had a single ovariole per ovary. The ergatoid queens and majors of *A. padanensis* and *A. sulawesiensis* had two ovarioles per ovary, while minors had only one.

Sexual calling behavior

The colonies of *A. sulawesiensis* and *A. padanensis* were kept in laboratory for a few months. The *A. padanensis* colony produced two ergatoid queens after removal of reproductive queens. In the laboratory, the colony of *A. sulawesiensis* also produced many ergatoid queens, up to 15 just after orphaning. In this orphaned colony, newborn ergatoid queens started to leave the nest to climb onto the top of elevated surfaces and perform sexual calling behavior. This is a posture in which the abdomen is lifted high in the air, with the sting slightly extruded. Unfortunately, no males were available to test the attractiveness of the queens.

Remarks

Ergatoid queens in ants have been regarded as a very specialized reproductive caste, because in all species of army ants and driver ants, highly fecund (revealed by their physogastric abdomen) ergatoid queens

reproduce. High fecundity allows enormous colony sizes, running into millions of workers (Gotwald, 1995; Peeters, 1991, 1997). Because of their high egg-laying potential, species with ergatoid queens were believed to be monogynous (Peeters, 1991, 1997). However, recent observations provide a new insight into the significance and evolution of ergatoid queens. In *Myrmecina* sp. A, belonging to the subfamily Myrmicinae, ergatoid queens have only two ovarioles per ovary while workers have one, and most of the colonies are polygynous (Ito, 1996). The ergatoid queens of the three studied species of *Acanthomyrmex* have smaller numbers of ovarioles than alate queens of congeneric *A. ferox*, which have 4 to 5 ovarioles per ovary (Ito, unpubl.). In *A. minus* especially, queens have only a single ovariole per ovary. Similar small ovariole numbers in the queen caste have so far been known only in three species of the ponerine genus *Probolomyrmex* (Ito, 1998). Colony sizes of all three *Acanthomyrmex* species are small and polygyny occurs in one species. Most ergatoid species of a ponerine genus, *Leptogenys*, also have small colony size (less than 30) and polygyny has been found in two of the ten Oriental species studied by Ito (1997). These facts suggest that evolution of winglessness is not always associated with ovary specialization for reproduction in queen caste. Theoretically, wingless reproductive females can evolve just under the condition where independent colony foundation is impossible. Queen specialization may be secondary trait in most ergatoid species.

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