

Revision of the ant genus *Anillomyrma* EMERY, 1913 (Hymenoptera: Formicidae: Myrmicinae: Solenopsidini)

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Abstract

The ant genus *Anillomyrma* EMERY, 1913 is revised based on the type and new materials from Vietnam and the Philippines. *Anillomyrma decamera* ssp. *continentis* WHEELER, 1927 described from Vietnam is a junior synonym of *A. decamera* (EMERY, 1901) described from Sri Lanka. *Anillomyrma decamera* is newly recorded from the Philippines. *Anillomyrma tridens* BOLTON, 1987 has so far been known only from the type series, and it is morphologically very similar to *A. decamera*. The conspicuous morphological characters separating the two species are as follows: masticatory margin of mandible 3-toothed in *A. tridens* but 4-toothed in *A. decamera*; 3rd tooth much larger than the 2nd in *A. tridens* but almost as large as the 2nd in *A. decamera*; posterior slope of propodeum in lateral view expanded posterodorsad more strongly in *A. tridens* than in *A. decamera*; petiolar peduncle in lateral view more slender in *A. tridens* than in *A. decamera*. The genus is relatively well diagnosed from the other genera of the *Solenopsis* WESTWOOD, 1840 genus group by the shape of clypeus, condition of eye, antennal and palpal segmentations, shape of promesonotum, forecoxa and petiole, segmentation between postpetiole and 1st gastral segment, and condition of sting.

Key words: *Solenopsis* genus group, *Anillomyrma decamera*, *A. decamera* ssp. *continentis*, *A. tridens*, synonymy, Vietnam, Philippines.

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Introduction

The genus *Anillomyrma* EMERY, 1913 is one of the rare and mysterious taxa, containing two described species and one subspecies all of which are known from South, Southeast and East Asia: *A. decamera* ssp. *decamera* (EMERY, 1901) from Sri Lanka (the type locality) and India (BOLTON 1987); *A. decamera* ssp. *continentis* WHEELER, 1927 from Vietnam (the type locality) and China (WHEELER 1928); *A. tridens* BOLTON, 1987 from East Malaysia (the type locality). In a recent taxonomic treatment of the family Formicidae by BOLTON (2003), two units previously treated as separate entities, i.e., the *Solenopsis* WESTWOOD, 1840 genus group and the *Carebara* WESTWOOD, 1840 genus group, were combined in the tribe Solenopsidini, and the genus *Anillomyrma* was placed in the *Solenopsis* genus group together with *Allomerus* MAYR, 1878, *Bondroitia* FOREL, 1911, *Carebarella* EMERY, 1906, *Diplomorium* MAYR, 1901, *Epelysidris* BOLTON, 1987, *Megalomyrmex* FOREL, 1885, *Monomorium* MAYR, 1855, *Nothidris* ETTERSCHANK, 1966, *Oxyepoecus* SANTSCHI, 1926, *Phacota* ROGER, 1862 and *Solenopsis*. EGUCHI & BUI (2007) added *Parvimyrmex* EGUCHI & BUI, 2007 as a member of the *Solenopsis* genus group.

In Vietnam, this genus has not been seen since WHEELER (1927) described *A. decamera continentis* based on workers collected by F. Silvestri from Van Phu. Its morphological features (i.e., its depigmented, tiny, slender body and eyeless condition), and its behavior (i.e., the discovery that it creates a runway covered by a canopy of small soil particles, BOLTON 1987), suggest that the genus is subterranean. As a part of our inventory work on Vietnamese ants (see YAMANE & al. 2003, EGUCHI & al. 2005), we conducted a survey of subterranean ants, using the underground bait-trapping method, in Binh Chau - Phuoc Buu Nature Reserve of Ba Ria - Vung Tau Province, Vietnam (EGUCHI & BUI in press), and collected several hundred workers of a single colony which are referable to *A. decamera continentis*. Based on the examination of new material and the type material we here redefine the genus, and revise the status of *A. decamera continentis*.

Methods

In the present study, we examined two syntypes of *A. decamera*, three syntypes of *A. decamera* ssp. *continentis*, 48

non-type workers of *A. decamera* (Vietnam, China and Philippines), and 24 paratypes of *A. tridens*.

The following measurements and indices were used in the present article:

- CI Cephalic index = $HW / HL \times 100$.
HL Maximal length of head capsule, taken from mid-point of a transverse line spanning the anteriormost and posteriormost projecting points.
HW Maximal width of head capsule.
PW Maximum width of pronotum in dorsal view.
SI Scape index = $SL / HW \times 100$.
SL Length of scape excluding basal condylar bulb and radicle.
WL Diagonal length of mesosoma in profile from anteriormost point of pronotum to posteriormost point of metapleuron.

Measurements were made at 160× using Nikon AZ100 microscope. Multi-focused montage images were produced using Helicon Focus 30 Pro (MP) from a series of source images taken by a Nikon Coolpix 8400 digital camera attached to a Nikon AZ100 microscope (for dry-mounted specimens) or Nikon OPTIPHOT-2 (for slide-mounted specimens). When fine hairs and other parts which were not recognized automatically were found, the focused parts from the source images were copied to the montage image using the retouching function of Helicon Focus. Artifacts (ghost images) and unnecessary parts (unfocused appendages, etc.) surrounding or covering target objects were erased and cleaned up using the retouching function of Helicon Focus. Finally, the background was cleaned up, and the color balance, contrast and sharpness were adjusted using Adobe Photoshop CS2.

Abbreviations of the specimen depositories are:

ACEG, Ant Collection of Katsuyuki Eguchi (for a contact address, see the first page of this article); BMNH, Natural History Museum, London, UK; CASENT, Entomological Collection of the California Academy of Sciences, California, USA; DMGC, Ant Collection of David M. General (for a contact address, see the first page of this article); MCZC, Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, USA; MHNG, Muséum d'Histoire Naturelle, Geneva, Switzerland; MSNG, Museo Civico di Storia Naturale "Giacomo Doria", Genova, Italy; NHMW, Naturhistorisches Museum Wien, Austria; VNMN, Vietnam National Museum of Nature, 18 Hoang Quoc Viet, Cau Giay, Hanoi, Vietnam.

Anillomyrma EMERY, 1913 (Figs. 1 - 15)

Anillomyrma EMERY, 1913: 261 [as subgenus of *Monomorium*]. Type-species: *Monomorium decamerum* EMERY, 1901: 117; by monotypy.

Anillomyrma EMERY, 1913: ETTERS HANK (1966): 97 [Raised to genus].

Worker description. By the combination of the characteristics marked by blue asterisks, *Anillomyrma* is distinguished from the other genera of the *Solenopsis* genus group (sensu BOLTON 2003). Worker monomorphic. Body extensively depigmented, weakly sclerotized (easily shrunk when dry-mounted). Head longer than broad, without preoccipital carina; frontal lobe in full-face view only partially concealing torulus, not extending posteriorly as frontal carina; antennal scrobe absent; median portion of clypeus only weakly expanding anteriorly and distinctly raised

above the level of lateral portions, *not bicarinate laterally below antennal insertion, *narrowly inserted between frontal lobes; median clypeal seta well developed; 1st paracarinial seta well developed; lateral portions of clypeus not forming a raised rim or shield wall in front of antennal insertions; anterior tentorial pit located at the mid-point of antennal insertion and lateral margin of head in full-face view; mandible elongate-triangular, with 3 or 4 distinctly dark-colored teeth on masticatory margin but without any tooth / denticles on basal margin; a short diastema present between the preapical and 3rd teeth; trulleum small and closed; hypostoma without lateral tooth just mesal to each mandibular base; anterior margin of labrum broadly concave medially; *both maxillary and labial palps consisting of two completely separated segments (see "Remarks"); praementum with a pair of long and simple setae; *antenna 10-segmented, *with 3-segmented club; antennal segments III - VII each much shorter than broad; segment X much longer than segments VIII and IX combined; segments VIII, IX and X with several sensilla tricodea curvata (arrow in Fig. 7) which are long, thick, simple and appressed; segment X with several sensilla ampullacea (arrow in Fig. 8) [i.e., a peg contained in a bottle-shaped chamber (ampulla) which connects apically with a thin duct; the tube opening on the outer surface of the apex of segment X]; *eye completely absent. Mesosoma in dorsal view moderately constricted between promesonotum and propodeum; promesonotum in lateral view low, almost flat or very weakly convex, without conspicuous humerus; promesonotal suture completely absent dorsally; metanotal groove present dorsally as a weak transverse striation; propodeum neither armed posterodorsally nor carinate posterolaterally; propodeal lobe absent; both mesosternum and metasternum without conspicuous ventral tooth; *propodeal spiracle small, situated at or slightly behind midlength of sides of propodeum; metapleural gland relatively large. *Forecoxa robust, *and much longer than middle and hind coxa; meso- and metatibial spur absent. *Petiolar peduncle long, *without any anteroventral process; *petiolar node long, low and dorsally broadly convex in lateral view; postpetiole much shorter than petiole, in dorsal view almost as broad as or slightly broader than petiolar node, *in lateral view broadly attached to top of anterior face of first gastral segment. Gaster elongate; gastral shoulder absent; *sting strongly developed.

Remarks. ETTERS HANK (1966) and BOLTON (1987, 2003) mentioned that the labial palp consists of two semi-fused segments. The separation of the two segments, however, was recognized as a conspicuous notch in silhouette in slide-mounted specimens of both *A. decamera* (8 specimens from bait #16xii08-18) and *A. tridens* (3 paratypes donated by B. Bolton) (Figs. 5, 14).

In the present article we redefined the genus *Anillomyrma* based only on the two Asian species, i.e., *A. decamera* and *A. tridens*. An "*Anillomyrma*-like" *Monomorium* sp. was collected from Toliara, Madagascar, and housed in CASENT (CASENT 0006834; see <http://www.antweb.org/>). Brian Fisher tentatively determined the specimen as "*Anillomyrma* mad01", but later he concluded, based on molecular phylogenetic analysis, that it is a member of the genus *Monomorium* (B. Fisher, pers. comm.). His view is supported by our examination of the worker morphology. CASENT 0006834 is clearly differentiated from *A. decamera* and *A. tridens*: antenna 11-segmented; forecoxa not

massive; postpetiole narrowly articulated close to center of anterior face of first gastral segment; petiole with very short pedicel and with highly raised node. CASENT 0006834 lacks eyes and has an evenly convex median part of the clypeus without bicarination, which makes CASENT 000-6834 somewhat different from the majority of *Monomorium*. The eye, however, is reduced to a single ommatidium in the "*Monomorium fossulatum* group" and clypeal bicarination is reduced or lost in a few species of *Monomorium* (see BOLTON 1987, 2003, HETERICK 2006). Barry Bolton (pers. comm.) informed us that Hamish Robertson, of Iziko Museums of Cape Town, has discovered *Anillomyrma* species, from Tanzania. His species has only 9-segmented antennae. Unfortunately, we have not yet succeeded in coming in contact with H. Robertson. LIN & WU (2003) recorded an unnamed species from Taiwan, but, according to TERAYAMA (2009), the Taiwanese material has 11-segmented antennae. The identity has not yet been confirmed by us.

COVER & DEYRUP (2007) recently described *Dolopomyrmex* COVER & DEYRUP, 2007 from the US. The genus is morphologically very similar to *Anillomyrma* but lacks the median clypeal seta. As mentioned by them and also by EGUCHI & BUI (2007), the presence or absence of a median clypeal seta has been over-emphasized in the classification of myrmicine ants. However, for the moment, we follow BOLTON (2003), in which the two genus groups were recognized within the tribe Solenopsidini based on the condition of the median clypeal seta and the radial cell of forewing. On this basis, the genus *Anillomyrma* has been placed into the *Solenopsis* genus group.

Bionomics. K. Eguchi and V.T. Bui collected workers of *Anillomyrma decamera* in a well-developed dry forest in the southern coastal part of Vietnam, by underground bait-trapping; baits (pork sausage) were buried in sandy soil (for details see EGUCHI & BUI in press). On the other hand, J. Caceres, a colleague of D.M. General, collected *A. decamera* in abandoned agricultural land that had isolated stands of abaca plants (Musaceae: *Musa textilis* NÉE) and jackfruit trees (Moraceae: *Artocarpus heterophyllus* LAM.), and was overgrown with tall grasses, upright and creeping bamboos and tree ferns. Ant samples were obtained by sifting a soil core sample taken from a deep sandy loam of volcanic origin. BOLTON (1987) collected *A. tridens* on sandy ground in a lowland rain forest. These facts suggest that the distribution of this species may be affected by soil type. EMERY (1901) mentioned that the type material of *A. decamera* was collected from termite nest(s). *Anillomyrma* may actively hunt soil invertebrates, including termites, using its well-developed sting to envenomate prey, and it may also scavenge animal matter under the ground. BOLTON (1987) tentatively suggested that *A. tridens* is nomadic. These scattered observations may help us to develop collecting and observing methods for these mysterious ant species.

***Anillomyrma decamera* (EMERY, 1901)** (Figs. 1 - 10)

Monomorium decamerum EMERY, 1901: 117. Syntype workers, Sri Lanka: Anuradhapura, W. Horn leg., 1899, MSNG. Two syntypes examined.

Monomorium (Anillomyrma) decamerum EMERY, 1901: EMERY (1913): 261 (combination).

Anillomyrma decamera (EMERY, 1901): ETTERSCHANK (1966) (combination).

Anillomyrma decamera ssp. *continentis* WHEELER, 1927: 96-97. Syntype workers, Van Phu, Indochina [Vietnam?], leg. F. Silvestri, 16.II.1925 (MCZC). Three syntypes (35572) examined. **New synonymy.**

Non-type material examined. China: "Jungshan", 9 workers, leg. F. Silvestri (MCZC). Vietnam: Ba Ria – Vung Tau: Binh Chau – Phuoc Buu Nature Reserve, 10° 32' 49" N, 107° 29' 11" E, 44 m a.s.l., 33 workers captured in underground bait-trap # BTN16xii08-18, leg. K. Eguchi, 16.XII.2008 (ACEG, MCZC, MHNG, MSNG, NHMW, VNMN). Philippines: Luzon Island: Camarines Sur: Mt. Isarog, Naga City, Panicuason Village, 13° 40' 11" N, 123° 20' 05" E, 550 m a.s.l., 6 workers extracted from soil, leg. J. Caceres, 31.III.2008 (DMGC).

Worker diagnosis. (Also see "Worker description" under the genus description). Body sculpture absent except for hair-pits, which are most conspicuous on head and promesonotum; dorsum of head, promesonotum and gaster relatively densely covered with short suberect to decumbent hairs. Head in full-face view roughly rectangular, longer than broad; mandible with 4 distinct teeth of which basal one is smaller than the others and 3rd almost as large as 2nd (preapical tooth); antennal scape short, reaching only 7 / 10 - 3 / 4 of distance from anterior margin of clypeus to posterior margin of head; apical antennal segment more than 3 times as long as preapical segment. Dorsum of mesosoma in lateral view flat; posterior slope of propodeum in lateral view hardly expanding posterodorsad. Petiolar peduncle in lateral view gradually thickened toward node.

Worker measurements and indices. Type material (3 syntype workers of "*Anillomyrma decamera* ssp. *continentis*", but 2 measured for PW and WL): CI 79 - 82, HL 0.34 - 0.35 mm, HW 0.27 - 0.29 mm, PW 0.19 mm, SI 66 - 67, SL 0.18 - 0.19 mm, WL 0.46 - 0.48 mm; Vietnamese material (5 workers from BTN16xii08-18): CI 80 - 83, HL 0.37 - 0.38 mm, HW 0.30 - 0.32 mm, PW 0.21 - 0.23 mm, SI 67 - 72, SL 0.21 - 0.22 mm, WL 0.46 - 0.48 mm; Philippine material (3 workers from Isarog): CI 83 - 87, HL 0.33 - 0.37 mm, HW 0.28 - 0.32 mm, PW 0.19 - 0.22 mm, SI 61 - 65, SL 0.18 - 0.19 mm, WL 0.43 - 0.47 mm; Chinese material (3 workers from Jungshan, but 2 measured for WL): CI 85 - 86, HL 0.34 - 0.35 mm, HW 0.29 - 0.30 mm, PW 0.20 - 0.22 mm, SI 66 - 67, SL 0.20 mm, WL 0.47 mm.

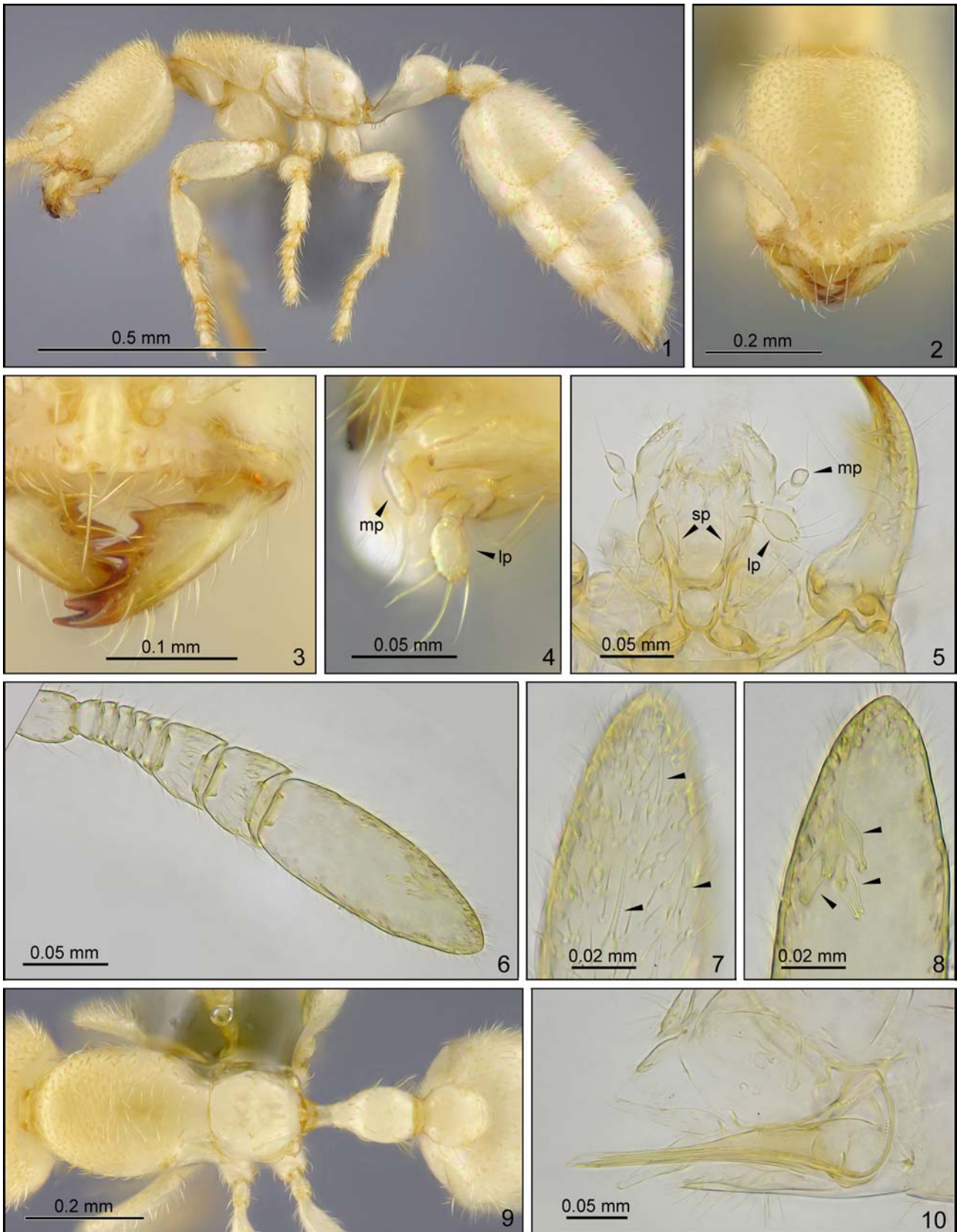
Distribution. India: Bihar (BOLTON 1987). Sri Lanka: Anuradhapura. Vietnam: Ba Ria – Vung Tau; "Van Phu". China: "Jungshan". Philippines: Luzon.

Remarks. CI is greater in the material from Isarog and Jungshan than in the material from Vietnam; SI is smaller in the material from Isarog than in the material from Vietnam and Jungshan.

***Anillomyrma tridens* BOLTON, 1987** (Figs. 11 - 15)

Anillomyrma tridens BOLTON, 1987: 274-275, 440. Holotype worker: East Malaysia: Sarawak, 4th Division, Gunong Mulu Nat. Park, RGS Exped., Long Pala, lowland rain forest in sandy soil, leg. B. Bolton, 11.X.1977 (BMNH); paratypes: workers with same data as holotype (BMNH, MCZ, MHN, NMB). Fifteen paratypes (personally donated to ACEG by B. Bolton) and 9 paratypes (MCZC) examined.

Worker diagnosis. Body sculpture absent except for hair-pits, which are most conspicuous on head and promesonotum; dorsum of head, promesonotum and gaster relatively densely covered with short suberect to decumbent



Figs. 1 - 10: *Anillomyrma decamera* (EMERY, 1901), non-type worker. (1) Body in lateral view; (2) head in full-face view; (3) mandible in full-face view; (4) left maxillary palp (mp) and left labial palp (lp) in lateral view; (5) mouthparts in ventral view: setae of praementum (sp), maxillary palp (mp), labial palp (lp); (6) right antenna in ventral view; (7) sensilla tricodea curvata (arrows) of ventral surface of antennal segment X; (8) sensilla ampullacea (arrows) of antennal segment X; (9) body in dorsal view; (10) sting in lateral view.



Figs. 11 - 15: *Anillomyrma tridens* BOLTON, 1987, paratype worker. (11) Body in lateral view; (12) head in full-face view; (13) mandible in full-face view; (14) mouthparts in ventral view: maxillary palp (mp), labial palp (lp); (15) body in dorsal view.

hairs. Head in full-face view roughly rectangular, longer than broad; mandible with three large sharp teeth. Apical and preapical teeth close together, separated by a diastema from 3rd tooth; 3rd much larger than 2nd; antennal scape short, reaching only 7 / 10 - 3 / 4 of distance from anterior margin of clypeus to posterior margin of head; apical antennal segment more than 3 times as long as preapical segment. Dorsum of mesosoma in lateral view flat. Dorsum and posterior slope of propodeum in lateral view forming rounded outline. Petiolar peduncle in lateral view relatively slender (as in Fig. 11).

Worker measurements and indices. Holotype and 10 paratype workers (cited from BOLTON 1987): CI 88 - 90, HL 0.37 - 0.39, HW 0.33 - 0.36, PW 0.24 - 0.25, SI 57 - 60, SL 0.21 - 0.23, WL 0.35 - 0.39.

Distribution. Malaysia: Sarawak.

Remarks. *Anillomyrma tridens* is morphologically very similar to *A. decamera*. The only conspicuous morphological characters separating the two species are as follows: head slightly longer than broad, masticatory margin of mandible of *A. tridens* having 3 distinct teeth as mentioned by BOLTON (1987) (but very small 4th tooth rarely present) (Fig. 13); the 3rd tooth of *A. tridens* much larger than 2nd (Fig. 13); posterior slope of propodeum in lateral view expanding posterodorsad more strongly in *A. tridens* (Fig. 11) than in *A. decamera* (Fig. 1); petiolar peduncle in lateral view more slender in *A. tridens* (Fig. 11) than in *A. decamera* (Fig. 1).

Anillomyrma sp.

Domingo Empeso collected 5 workers of *Anillomyrma* from Dumaguete, Negros Island, Philippines (MCZC). Because the specimens were, however, shrunk heavily and / or covered largely with glue, we were unable to see the basal part of masticatory margin of mandibles. Thus we refrained from determining them at the species level.

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Zusammenfassung

Die Ameisengattung *Anillomyrma* EMERY, 1913 wird auf der Basis von Typusmaterial und neuem Material aus Vietnam und von den Philippinen revidiert. *Anillomyrma decamera* ssp. *continentis* WHEELER, 1927, beschrieben aus Vietnam, ist ein Juniorsynonym von *A. decamera* (EMERY, 1901), beschrieben aus Sri Lanka. *Anillomyrma decamera* wird für die Philippinen neu gemeldet. Von *Anillomyrma tridens* BOLTON, 1987 ist bisher nur die Typenserie bekannt; die Art ist *A. decamera* morphologisch sehr ähnlich. Die morphologischen Merkmale, die die beiden Arten eindeutig trennen, sind die folgenden: Kaurand der Mandibel bei *A. tridens* 3-zählig, aber bei *A. decamera* 4-zählig; dritter Zahn bei *A. tridens* viel größer als der zweite, aber bei *A. decamera* gleich groß wie der zweite; hinterer Teil des Propodeum in seitlicher Ansicht bei *A. tridens* stärker postero-dorsad ausgezogen als bei *A. decamera*; Petiolus in lateraler Ansicht bei *A. tridens* schlanker als bei *A. decamera*. Die Gattung ist recht gut von den anderen Gattungen der *Solenopsis* WESTWOOD, 1840 Gattungsgruppe unterscheidbar, nämlich anhand der Form des Clypeus, der Ausprägung des Auges, der Segmentierung von Antenne und Palpen, der Form von Promesonotum, Vorderhüfte und Petiolus, der Segmentierung zwischen Postpetiolus und erstem Gastersegment und der Ausprägung des Stachels.

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