

## On the ants (Hymenoptera: Formicidae) of the Philippine Islands: V. The genus *Odontomachus* LATREILLE, 1804

Daniela Magdalena SORGER & Herbert ZETTEL



### Abstract

A review of the Philippine species of *Odontomachus* treats eleven species including two unnamed species. They belong to four species groups, *Odontomachus simillimus* SMITH, 1858 to the *O. haematodus* group, *O. rixosus* SMITH, 1857 to the newly delimited *O. rixosus* group, and *O. malignus* to the newly established *O. malignus* group (excluded from the *O. infandus* group). None of these three species are endemic. The majority of species belongs to the *O. infandus* group, and all known species are endemic to the Philippines. These include *O. infandus* SMITH, 1858 (= *O. infandus* r. *striaticeps* STITZ, 1925) from Luzon and Mindoro, *O. philippinus* EMERY, 1893 sp.rev. from Panay, Negros and Siquijor, *O. banksi* FOREL, 1910 from Luzon, and three species new to science: *Odontomachus schoedli* sp.n. from northern Luzon, *O. alius* sp.n., wide-spread in the central and eastern Philippines, and *O. scifictus* sp.n. from Camiguin. In addition, we treat two species (sp. 1 and sp. 2) of uncertain status from southern Luzon and Mindanao which remain unnamed. For stability of nomenclature, lectotypes are designated for *O. infandus* SMITH, 1858, *O. infandus* r. *striaticeps* STITZ, 1925, *O. papuanus* st. *philippinus* EMERY, 1893, and *O. banksi* FOREL, 1910.

**Key words:** Formicidae, *Odontomachus*, *Odontomachus infandus* species group, *Odontomachus malignus* species group, *Odontomachus rixosus* species group, *Odontomachus haematodus* species group, new species, Philippines, key, island endemism, lectotype designation.

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### Introduction

Seen up close, a large *Odontomachus* worker moving slowly across the leaf litter in a dipterocarp forest in the Philippines (or elsewhere) is spectacular. The bizarre head of species of this genus bears strong jaw-muscles, and large, elongate trap-jaws which are carried sideways when foraging, ready to snap shut as potential prey comes in touch with the long frontal trigger hairs. A powerful stinger at the apex of the abdomen completes the image. These ants resemble nothing so much as small alligators lost among the dimensions of the litter.

*Odontomachus* LATREILLE, 1804 is a genus of the Ponerinae (sensu stricto) (BOLTON 2003) and contains 64 species (BOLTON 2010) plus three newly described species in this study. It is widely distributed in tropical regions, with highest species numbers in the Neotropics and Malesia (BROWN 1976).

Despite their peculiar appearance, the taxonomy of Philippine *Odontomachus* LATREILLE, 1804 was treated only superficially prior to this study – and not without reason: The sorting of slightly different morphological forms on the Philippine Islands still remains a great challenge. Two important studies on Pacific *Odontomachus* have been carried

out to date: WILSON's (1959) treatment of Melanesian species and BROWN's (1976, 1978) classification of the "subtribe Odontomachiti" (comprising ponerine ants with trap-jaws). We used BROWN's (1976) publication as a base for this study since it includes an interesting treatment of the Philippine *Odontomachus infandus* group species, which represented the core difficulty of our revision. However, we chiefly used WILSON's (1959) publication for understanding the taxonomy and variations of the widely distributed species.

The Philippine *Odontomachus* fauna can be broadly divided into two sets of species. One set contains three unrelated species (in three species groups) with wide distributions: *Odontomachus simillimus* is an open-land species, which can also be found in villages and plantations and was probably continuously and accidentally introduced by man into some parts of its large range (BROWN 1976: 87), *Odontomachus malignus* is a coastal species with unique habitat requirements in intertidal zones (e.g., OLSEN 2009; and observations by the second author) which probably favours colonization of new land, and *Odontomachus rixosus* is a widely distributed forest-species, present in the

Philippines only in the south. In other words, the first set exclusively includes species with broad distributions, whether in terms of habitat preferences or geography.

The second set of species contains a set of forest-inhabiting, endemic species all belonging to BROWN's (1976) *O. infandus* species group. This clade is distributed from the Philippines eastwards to Fiji. In BROWN's (1976) treatment of Philippine *O. infandus* group species, only two species, *O. infandus* and *O. banksi*, were recognised. Brown's studies of Philippine *Odontomachus* were mainly based on collections by Dr. James W. Chapman (most of which are housed in the Museum of Comparative Zoology, Harvard University, Cambridge, USA). Unfortunately, according to BROWN (1976), this material "is afflicted with some problems" because of "some label uncertainties." Wrongly labelled material obviously blurred Brown's view on endemic taxa (which we will show are now more clear, based on new and correctly labelled samples). After discussing the difficulties, BROWN (1976) finally decided against splitting the group into four species and decided instead to describe *O. banksi* "provisionally as a distinct species", and then to group the remaining forms (*O. infandus*, *O. papuanus philippinus*, and a third form described here as *O. alius* sp.n.) as *O. infandus*.

In revisiting the ants of this second set, we found the characters of island populations (except for the large island of Luzon) surprisingly stable. Based on this work, a new and interesting problem emerges, that of deciding which island populations represent separate species and which are only local forms of a more widely distributed species, a point to which we will turn in the results and the discussion.

For a bit of broader context, *Odontomachus* is not the only trap-jaw ant in the Philippines. The trap-jaw ants here include species from three subfamilies: Ponerinae (*Odontomachus*, *Anochetus*), Myrmicinae (*Pyramica*, *Strumigenys*) and Formicinae (*Myrmoteras*). Practically speaking, trap-jaw ants in Myrmicinae and Formicinae can be distinguished from *Odontomachus* by subfamily characters. *Anochetus* MAYR, 1861, the other ponerine trap-jaw ant, is closely related to *Odontomachus* and can be distinguished by head morphology (BROWN 1978): In *Anochetus* the nuchal carina is evenly curved while it forms into a sharp edge medially in *Odontomachus*. For the Philippine fauna, body length usually readily differentiates the two genera. *Anochetus* are small (total length of workers ca. 3.5 - 8.5 mm), *Odontomachus* are large (total length of workers ca. 7.5 - 16.0 mm) and only the relatively small *Odontomachus* species, *O. simillimus*, overlaps with *Anochetus* in size; however, this species has a very blunt mandible apex, while *Anochetus* species always possess sharp mandibles.

The aims of this study are to improve the taxonomy of Philippine *Odontomachus* species with special regard to the *O. infandus* species group; to present a key for identification; to delimit regional endemism; and to address conservation aspects of regionally endemic species.

## Material and methods

All specimens were dry mounted on card squares or triangles. Examination of specimens was carried out with an Olympus SZH10 Research and a Wild Heerbrugg stereomicroscope and measurements were taken at magnifications of 30× and 50×. Digital photographs (Figs. 1 - 45) were

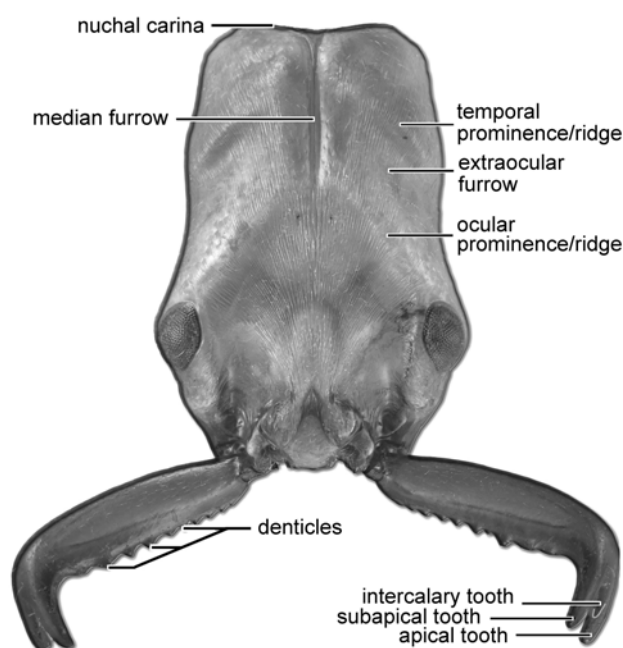


Fig. 1: *Odontomachus infandus* head with terms for head structures and mandibular dentition.

taken with a Leica DFC camera attached to a Leica MZ16 binocular microscope by help of Image Manager IM50 or Leica Application Suite V, and were processed with Helicon Focus 5.1, ZereneStacker 64-bit and Adobe Photoshop 7.0. Locality data are arranged zoogeographically based on the regions and subregions listed by ONG & al. (2002).

## Acronyms of repositories:

- BMNH The Natural History Museum, London, Great Britain (= British Museum of Natural History)
- CSW Coll. D.M. Sorger, Vienna, Austria
- CZW Coll. H. & S. V. Zettel, Vienna, Austria
- FMNH Field Museum of Natural History, Chicago, Illinois, USA
- MCSNG Museo Civico di Storia Naturale, "Giacomo Doria", Genoa, Italy
- MNHU Museum für Naturkunde, Humboldt Universität, Berlin, Germany
- MHNG Muséum d'histoire naturelle, Genève, Switzerland
- NHMW Natural History Museum, Vienna, Austria
- UPLB University of the Philippines, Los Baños, Philippines
- USC University of San Carlos (Entomological Collection), Cebu City, Philippines
- ZMUC Zoological Museum, University Copenhagen, Denmark

## Measurements and indices:

- CI Cephalic index.  $HW / HL \times 100$ .
- HL Head length. Maximum length of head in full-face view, excluding mandibles, measured from anterior-most point of clypeal margin to posterior-most point of head vertex, parallel to midline.
- HW Head width. Maximum width of head in full-face view (including eyes when surpassing head outline).
- MdI Mandible index.  $MdL / HL \times 100$ .
- MdL Mandible length. Maximum length of mandible in frontal view of head measured from mandibular insertion to apex.

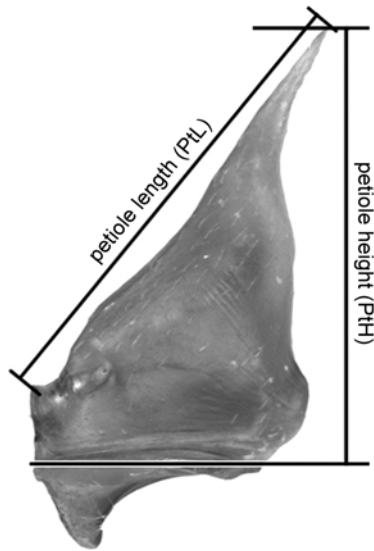


Fig. 2: Petiole of *Odontomachus infandus* showing PtH and PtL.

- MsL Mesosoma length. Maximum length of mesosoma, measured in lateral view, diagonal from cervical shield to posterolateral propodeal edge.
- PnW Pronotum width. Maximum width of pronotum in dorsal view.
- PtH Petiole height. Maximum height of petiole, measured in lateral view as a straight line from bottom edge of petiole, perpendicular to petiolar apex (see Fig. 2).
- PtL Petiole length. Measured in lateral view along dorsal outline of petiole from small antero-apical tooth to apex (see Fig. 2).
- PtW Petiole width. Maximum width of petiole in dorsal view.
- SI Scape index.  $SL / HW \times 100$ .
- SL Scape length. Maximum length of antennal scape in dorsal view excluding basal constriction.
- TL Total length. Length of entire ant measured in dorsal view with head stretched out, from anterior margin of mandible to apex of abdomen.

Measurements and verbal descriptions refer to Philippine specimens only, even if extralimital specimens of the same species have been studied. Measurements are taken from holotypes (lectotypes and paralectotypes) and from workers and gynes with smallest and largest HW. All measurements are in millimetres.

Terms for head structures and mandibular dentition follow BROWN (1976) (see Fig. 1). The palp formula consists of the numbers of maxillary and labial palp segments.

### Taxonomy

#### Key to Philippine species of *Odontomachus* (workers)

- 1 Subapical tooth of mandible truncate (Figs. 40, 43). ..... 2
- Subapical tooth of mandible acute (or very narrowly rounded if worn) (Figs. 3 - 8, 21, 24, 37). ..... 3
- 2 Subapical tooth and apex of mandible very short, blunt. Body dark brown. Temporal prominences striate. Striation on pronotum predominantly concentric. Gaster tergite 2 anteriorly with fine

- microsculpture. (*O. haematodus* species group) (Figs. 43 - 45) ..... ***Odontomachus simillimus***
- Subapical tooth and apex of mandible elongate. Head and gaster light brown. Temporal prominences smooth. Striation on pronotum predominantly transverse. Gaster tergite 2 anteriorly smooth. (*O. rixosus* species group) (Figs. 40 - 42) ..... ***Odontomachus rixosus***
- 3 Head posteriorly with pair of small, but distinct tubercles. Pronotum granulate, at most with very superficial striation.  $SI = 1.2 - 1.3$ . In lateral view, anterior face of gaster tergite 1 evenly convex, without impression at position of apex of petiolar spine. (*O. malignus* species group) (Figs. 37 - 39) ..... ***Odontomachus malignus***
  - Head posteriorly without tubercles (Figs. 3 - 8). Pronotum with distinct striation of variable directions.  $SI > 1.35$  (except in one species from Mindanao  $SI = 1.2$ ). In lateral view, anterior face of gaster tergite 1 flattened (Figs. 22, 25, 27, 33, 35), with small impression (pit or line) at position of apex of petiolar spine (rare individual exceptions for both characters do occur). (*O. infandus* species group) ..... 4
  - 4 Posterior dorsum of head mainly punctured, some faint striation near extraocular furrow often present (Figs. 6 - 8, 24). ..... 5
  - Posterior dorsum of head mainly striate, a very small smooth area posteriorly near median furrow common (Figs. 3 - 5, 9). ..... 8
  - 5  $SI = 1.2$ . Anterior part of tergite 1 almost evenly rounded. Pronotum postero-medially with longitudinal striation, horseshoe-shaped. Species of Mindanao. (Figs. 24 - 26) ..... ***Odontomachus* sp. 2**
  - $SI > 1.35$ . Anterior part of tergite 1 distinctly flattened. Pronotum with different striation. (Figs. 18 - 20) ..... 6
  - 6 Head yellowish orange. Mesopleuron completely striate. Mesosoma with dense pilosity. Species of southern Luzon. (Figs. 8, 14, 20) ..... ***Odontomachus banksi***
  - Head dark brown. Centre of mesopleuron largely smooth. Mesosoma with sparse pilosity (Figs. 6, 7, 12 - 13). ..... 7
  - 7 Smooth area on mesopleuron reaching meso-metapleural suture. Petiole widest at distinct anterior tubercles (width of node equal or smaller than width at tubercles). Species from Camiguin. (Figs. 7, 13, 19) ..... ***Odontomachus scifictus* sp.n.**
  - Mesopleuron with stripe of short striae along meso-metapleural suture. Petiole with weak tubercles, at node wider than at tubercles. Species from the Western Visayas (Negros, Panay, Siquijor). (Figs. 6, 12, 18) .... ***Odontomachus philippinus***
  - 8 Head and mesosoma unicolourous reddish brown. Petiole stout, with almost straight spine. Species from the mountains of northern Luzon. (Figs. 4, 10, 16) ..... ***Odontomachus schoedli* sp.n.**

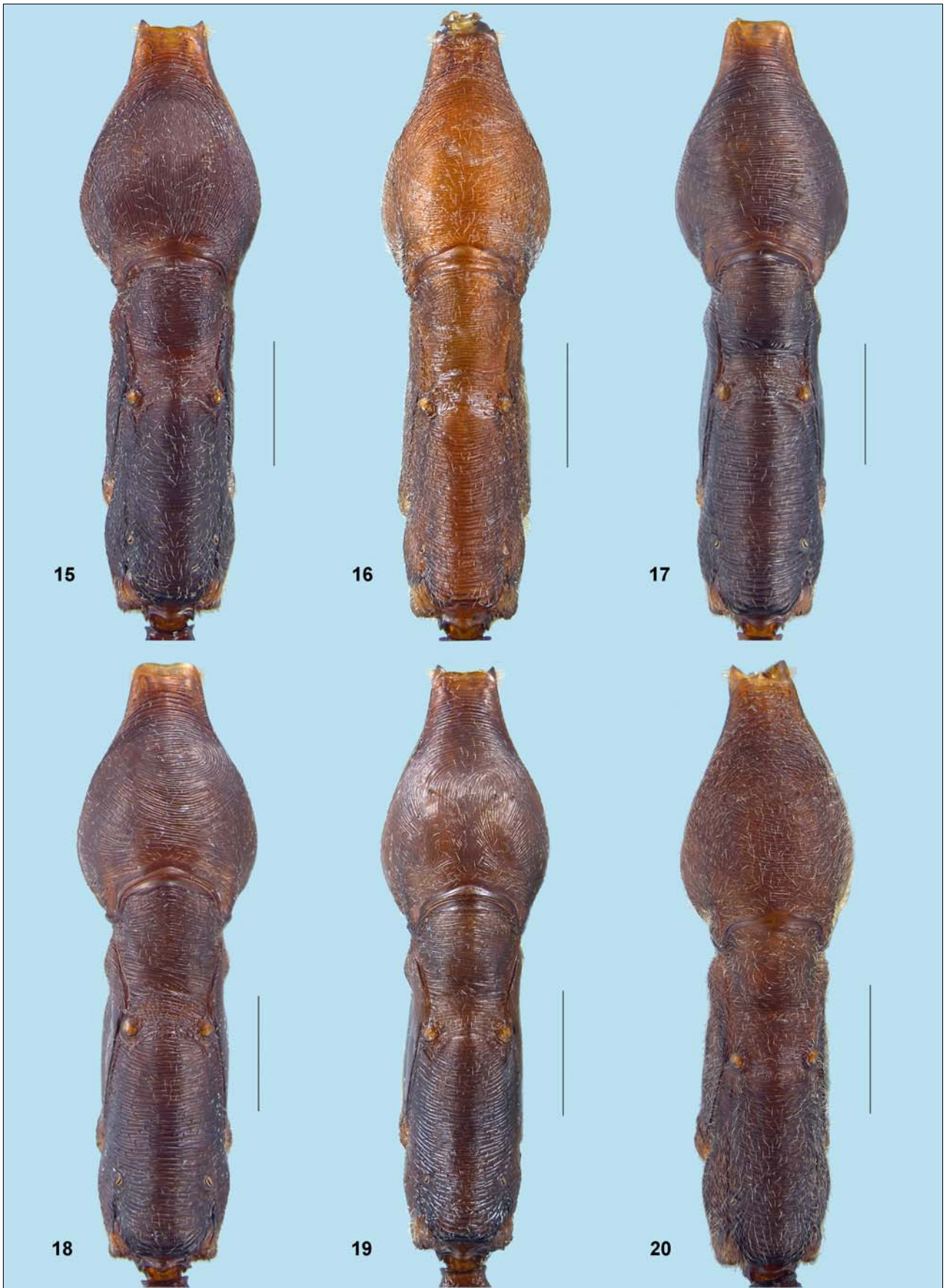






Figs. 9 - 14: *Odontomachus infandus* species group. Lateral view of mesosoma and petiole: (9) *O. infandus*; (10) *O. schoedli*; (11) *O. alius*; (12) *O. philippinus*; (13) *O. scifictus*; (14) *O. banksi*. Scales = 1 mm.

← Figs. 3 - 8: *Odontomachus infandus* species group. Head, full face view: (3) *O. infandus*; (4) *O. schoedli*; (5) *O. alius*; (6) *O. philippinus*; (7) *O. scifictus*; (8) *O. banksi*. Scales = 1 mm.



Figs. 15 - 20: *Odontomachus infandus* species group. Dorsal view of mesosoma: (15) *O. infandus*; (16) *O. schoedli*; (17) *O. alius*; (18) *O. philippinus*; (19) *O. scifictus*; (20) *O. banksi*. Scales = 1 mm.

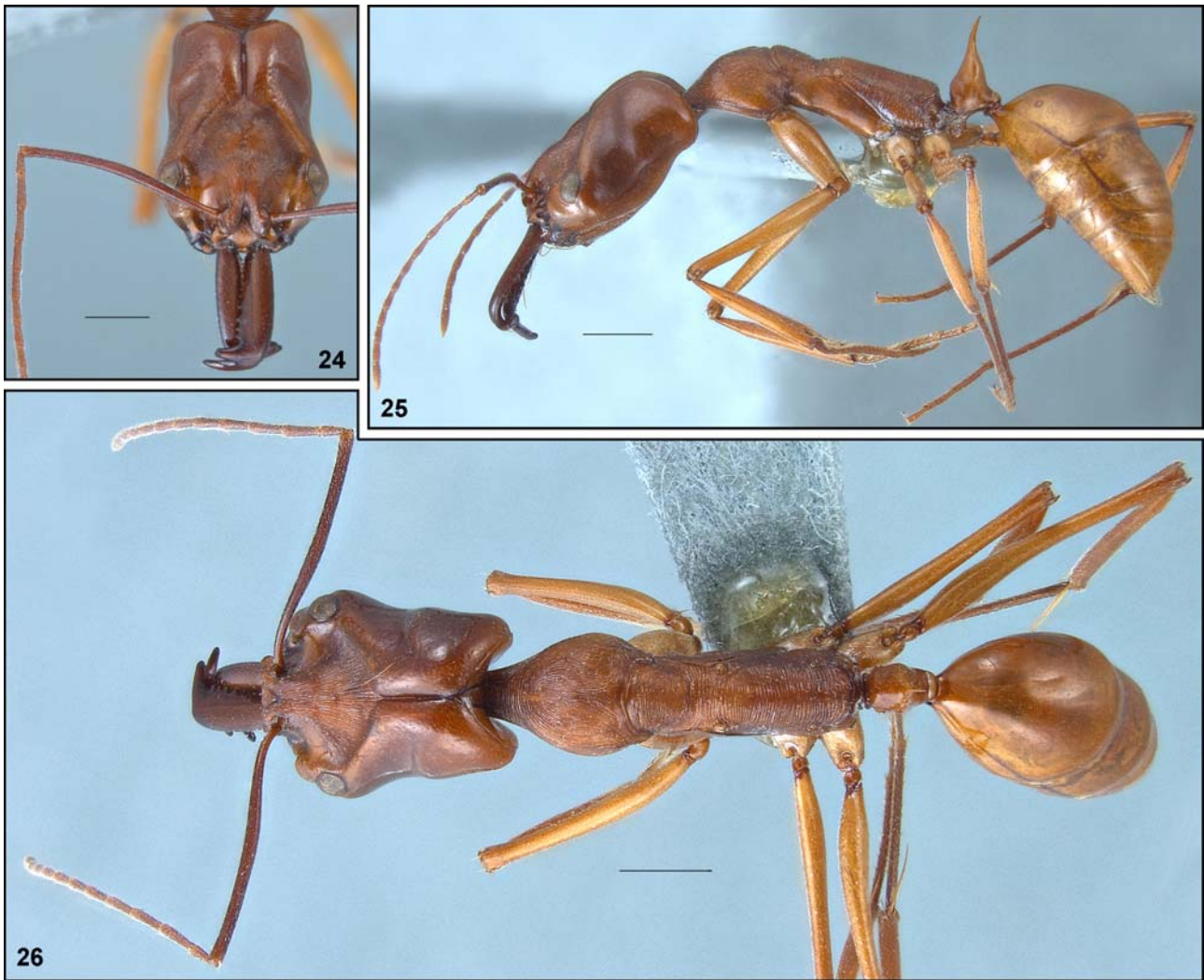


- Head distinctly lighter than mesosoma (exceptions in *O. infandus* only occur, if both parts are very dark brown). Petiole less stout. (Figs. 3, 5, 9, 11, 21, 22) ..... **9**
- 9 Gaster tergites 1 and 2 partly yellowish brown, tergite 1 anteriorly low, strongly flattened; impression, if pit-shaped, at or behind mid-length. Petiole with very elongate spine. Striation of pronotum variable (transverse or longitudinal). Species from the central and eastern Philippines (absent from Luzon and Mindoro). (Figs. 5, 12, 17) ..... ***Odontomachus alius* sp.n.**
- Gaster tergites 1 and 2 dark (blackish) brown, tergite 1 anteriorly comparatively high; impression, if pit-shaped, before mid-length (Fig. 22). Petiolar spine shorter (Figs. 9, 22). Striation of pronotum longitudinal, usually in loops (Figs. 15, 23). ..... **10**
- 10 Striation of head almost complete. Head usually light to dark brown. Petiolar spine curved. Species widely distributed on Luzon and Mindoro. (Figs. 3, 9, 15) ..... ***Odontomachus infandus***
- Striation of head posteriorly reduced. Head yellowish orange, strongly contrasting with mesosoma. Petiolar spine straight. Species from southern Luzon. (Figs. 21 - 23) ..... ***Odontomachus* sp. 1**



Figs. 21 - 23: *Odontomachus* sp. 1: (21) head, full face view; (22, below) habitus, lateral view; (23, below) habitus, dorsal view. Scales = 1 mm.





Figs. 24 - 26: *Odontomachus* sp. 2: (24) head, full face view; (25, 26) habitus, lateral and dorsal view. Scales = 1 mm.

## Treatment of species groups and species

### The *Odontomachus infandus* species group

**Diagnosis of worker:** Large and slender species with long antennae and legs. Palp formula 4, 4. Head long, with distinct temporal prominences. Mandibles long, with long and sharp apical and subapical teeth. Mesosoma depressed. Pronotum with species-specific striation. Petiole high, without false peduncle anteriorly, with long apical spine.

**Diversity and distribution:** The group has a centre of speciation in the Philippines. At present we recognize *Odontomachus banksi* FOREL, 1910, *O. infandus* SMITH, 1858, and *O. philippinus* EMERY, 1893 stat.n., three new species (*O. alius* sp.n., *O. schoedli* sp.n., *O. scifictus* sp.n.), and two further undescribed species (*O. sp. 1* and *O. sp. 2*) which remain unnamed. From New Guinea, three taxa are presently valid: *Odontomachus animosus* SMITH, 1860, *O. latissimus* VIEHMEYER, 1914, and *O. papuanus* EMERY, 1887. MAYR (1866) described one species from Fiji, *O. angulatus* MAYR, 1866, and BROWN (1976) described two species from the Lesser Sunda Islands east of Wallace's Line, *O. sumbensis* BROWN, 1976 and *O. floresensis* BROWN, 1976. The group is also present on Sulawesi (undescribed material).

**Notes:** We exclude *O. malignus* SMITH, 1859 from the *O. infandus* group based on a set of differences presented below (see *O. malignus* group). We also exclude *O. silvestrii* WHEELER, 1927, from Vietnam and China, which was included by BROWN (1976) based on mandible structures, as it differs greatly in many other characteristics, e.g., by short head and a densely punctured gaster.

Philippine species of this group differ from described taxa from other areas by an impression of the first gaster tergite in the worker caste at the point where the petiolar spine meets the gaster (BROWN 1976: 125 suggests impression during pupation). This character is not developed in gynes. Moreover, at NHMW we have seen three specimens of an undescribed taxon from Sulawesi (Indonesia) with this same impression. Such an impression is also developed in *O. saevissimus* SMITH, 1858 from the Moluccas to the Solomon Islands (in the *O. saevissimus* species group). In almost all Philippine worker specimens, the anterior slope of gaster tergite 1 is flattened (while it is rounded in species from other regions); an exception is the single worker of *Odontomachus* sp. 2 (unnamed) from Mindanao.

**Description of workers from the Philippines:** (Note: This description is provided to present characteristics that all Philippine species of this group have in common. These





Figs. 27 - 28: *Odontomachus infandus* lectotype at BMNH: (27) habitus, lateral view; (28) labels. Scale = 1 mm.

characters are not repeated in following species descriptions.)

Head in dorsal view broadly rectangular, longer than wide, broadest at level of eyes which do not surpass outline of head in frontal aspect. Temporal ridge shallow but present. Eyes situated dorsolaterally in anterior third of head. Head partly striate (except between eyes and antennal insertions, and posterior extension species-specific); in areas without striation, microsculpture smooth, with scattered, very fine punctures. Head dorsally with pair of long standing setae approximately at centre of head (occasionally broken off). Head venter with some long hairs (broken off in a few specimens). Clypeus with some fine short white hairs. Mandibles long, slightly shorter than head; ca. 12 teeth with peculiar dentition: teeth slightly increasing in size towards apex of mandible, but three apical teeth enlarged with intercalary tooth significantly (less than half) shorter than apical tooth and subapical tooth creating the "trap-jaw". Mandibles very finely striate laterally and dorsally, but smooth and shiny mesally and apically; with long trigger hairs located ventrally and directed forward.

Mesosoma slender, in dorsal view broadest at level of pronotum, all edges rounded. Pronotum roughly oval in dorsal aspect, with fine, species-specific striation. Mesonotum with transverse striation coarser than on pronotum. Propodeum with coarse transverse striation. Mesopleuron usually with fine transverse striation (reduced in some species). Mesosoma void of standing setae, except pronotum sometimes with two setae located approximately at centre (broken off in some specimens).

Metanotal spiracle large and situated near dorsal outline; propodeal spiracle situated laterally, approximately midway between dorsal and ventral outline of propodeum; metapleural gland orifice situated ventrolaterally.

Petiole long and acute, formed into an acute spine apically; in lateral view anterior face with an upward slope, petiolar spine bent backwards, posterior face of petiole usually S-shaped. Petiole usually smooth and shiny (except in *O. banksi* with some striation basolaterally).

Gaster rounded to oval in dorsal aspect, anterior face of tergite 1 usually flattened in lateral aspect (except in *Odontomachus* sp. 2 from Mindanao), and with a small impression; this impression usually pit-shaped, sometimes linear, sometimes weak (as individual variations without diagnostic importance). Gaster smooth and shiny, with dispersed fine hair pits. Gaster tergites 1 and 2 usually with-

out standing setae, or with few setae near posterior margin; following tergites with increasing numbers of setae.

**Description of gynes:** Although gynes are known only of four out of twelve species in this group, we assume that the following differences within worker morphs are applicable to all species of the *O. infandus* group.

Head structures similar to worker, but ocelli present, located medially in front of ocular ridge. Eyes slightly larger than in workers. Mesosoma strongly developed, high, bearing wings (or wing insertions). Pronotum transversely striate (striae curved). Mesonotum with coarse, parallel, longitudinal ridges, scutellum and metanotum smooth and shiny. Petiole slightly stouter than in workers, but of similar shape. Gaster large, tergite 1 without impression.

***Odontomachus infandus* SMITH, 1858** (Figs. 1 - 3, 9, 15, 27 - 32, 46)

*Odontomachus infandus* SMITH, 1858: 81 (description of worker, Philippines); VIEHMEYER 1916: 284 (distribution: Los Baños); BROWN 1976: 104 (taxonomy, key).

*Odontomachus infandus infandus*: BALTAZAR 1966: 239 (catalogue).

*Odontomachus infandus* r. *striaticiceps* STITZ, 1925: 117 (description of workers, Philippines); BROWN 1976: 104 (synonymy with *O. infandus*).

*Odontomachus infandus striaticiceps*: BALTAZAR 1966: 239 (catalogue).

*Odontomachus saevissimus* (misidentifications; nec *saevissimus* SMITH, 1858): WHEELER 1909: 339 (distribution: Romblon); WHEELER & CHAPMAN 1925: 71 (distribution: Port San Vicente, Cagayan; Romblon); CHAPMAN & CAPCO 1951: 46 (distribution: Manila); BALTAZAR 1966: 239 (catalogue).

**Type material examined:** Lectotype of *O. infandus* (by present designation, worker, BMNH; Fig. 27) labelled "Phil Isla", "*O. infandus* Type. Sm.", "Syntype" (Fig. 28), head missing, characters and type locality corresponding to original description. Note: A second worker labelled "Phil. Islas", "*infandus* F. Smith almost certainly a SYNTYPE" is present at BMNH and might be a paralectotype.

Lectotype of *O. striaticiceps* (by present designation, worker, MNHU; Fig. 29) labelled "Manila. Escholtz.", "*Odontomach. infandus* Sm. *striaticiceps* Stz.", "7156", "Type", "GBIF-D FoCol 1062 specimen + label data documented", "LECTOTYPUS *Odontomachus infandus* r. *striaticiceps* STITZ, 1925 des. Sorger & Zettel 2010", "*Odontomachus infandus* SMITH, 1858 det. Sorger & Zettel 2010" (Fig. 30) and two paralectotypes of *striaticiceps* (workers, MNHU; pronotum crushed in paralectotype 1, gaster missing in paralectotype 2, labels see Figs. 31 and 32).

**Additional material examined** (159 workers, 3 gynes: BMNH, CSW, CZW, FMNH, MNHU, NHMW, UPLB, USC): **Luzon:** without further locality data, leg. V. Rolle, 1 ♀. La Union: Bacnotan, Don Mariano Marcos Memorial State University, on bank of small stream, 24.X.2002, leg. H. Zettel (311), 2 ♂♂. Benguet: Baguio City, 2 km below Camp John Hay, in pine forest, 18.II.1999, leg. S. Schödl (13), 9 ♂♂, leg. H. Zettel (181), 6 ♀♀. Nueva Visaya: Santa Fe, Villaflores, Consuelo Creek, 600 m, 7.XI.2002, leg. H. Zettel (327), 1 ♀. Batangas: Limay, 24.XI.1924, leg. R.C. McGregor, 2 ♂♂. Manila: no further data, coll. G. Mayr, 1 ♀. Cavite: Alfonso, Pajo, 7.II.2010, leg. C.V. Pangantihon (P345), 8 ♂♂. Batangas:



Figs. 29 - 32: *Odontomachus striaticeps* lectotype at MNHU: (29) habitus, lateral view; (30) lectotype labels; (31) paralectotype 1, labels; (32) paralectotype 2, labels. Scale = 1 mm.

Bauan, Santa Maria, 19.V.2004, leg. C. V. Pangantihon (P96), 3 ♂♂. **L a g u n a** : Los Baños, Mt. Makiling, 7.V. 1977, leg. L. Watrous – Field Museum, 4 ♂♂, 13.-18.XI. 1992, leg. H. Zettel (1), 17 ♂♂, 150 - 500 m, 13.-14.XI. 1993, leg. H. Zettel (21), 4 ♂♂, 500 - 1144 m, 14.XI.1993, leg. H. Zettel (21a), 5 ♂♂, 300 - 500 m, 8.-9.II.1996, leg. H. Zettel (74), 1 ♀, 300 - 600 m, 10.II.1996, leg. H. Zettel (76), 12 ♂♂, ca. 600 m, 11.II.1998, leg. H. Zettel (133a), 6 ♂♂, 400 - 800 m, 27.XI.1999, leg. H. Zettel (211), 1 ♀. Los Baños, Mt. Makiling, Mud Spring, ca. 650 m, 23.-24.I.1999, leg. H. Zettel (167), 8 ♂♂, 13.II.1999, leg. S. Schödl (2), 16 ♂♂, 18.XI.1999, leg. H. Zettel (207), 3 ♂♂. Los Baños, Mt. Makiling, Flat Stones ["Rocks"], 10.II.1998, leg. H. Zettel (132), 1 ♀, 14.II.1999, leg. S. Schödl (4), 4 ♂♂. 14.II. 1999, leg. H. Zettel (175), 1 ♀. Los Baños, I.X., leg. Williams, coll. Donisthorpe, B.M.1934-4, 1 ♀, 500 ft (= ca. 150 m a.s.l.), 31.V.1947, leg. F.G. Werner, 1 ♀, 13.XI.1992, leg. H. Zettel (3), 1 ♀. Mt. Banahaw, above Kinabuhayan village, trail to Crystallino, 600 - 700 m, 24.XI.1995, leg. J. Kodada & B. Rigová, 1 ♀. Mt. Banahaw, above Kinabuhayan village, floor litter in degraded rain forest, 800 m, 25.XI.1995, leg. J. Kodada & B. Rigová, 1 ♀. **Quezon** : near Lucena City, "Site", Botanical Garden, 11.II.1996, leg. H. Zettel (78), 1 ♀. Quezon National Park at Atimonan, near Old Zigzag Road, 12.-13.II.1996, leg. H. Zettel (79a), 7 ♂♂, 24.-30.III.1998, leg. H. Zettel (165), 8 ♂♂, 2 ♀♀, 16. III.1999, leg. H. Zettel (202), 2 ♂♂, 27.-28.I.2002, leg. H. Zettel (300), 2 ♂♂. Dolores, Santa Lucia Falls, 16.IV.2005, leg. C. V. Pangantihon (P153), 3 ♂♂. **Camarines Sur** : ca. 20 km E Naga, 5 km E Carolina, slopes of Mt. Isarog, near Malabsay Falls, 4.III.1999, leg. H. Zettel (192), 2 ♂♂. **Albay** : ca. 40 km N Legaspi, ca. 1 km W Malilipot, Busai Falls, 23.2.1998, leg. H. Zettel (143), 1 ♀, 22.X.2005, leg. C. V. Pangantihon (P187), 3 ♂♂. **Mindoro**: Mindoro Oriental: ca. 10 km W Puerto Galera, Mindoro Beach, 24.XI.1992, leg. H.Zettel (17), 1 ♀. W Puerto Galera, near Aninuan Waterfalls, 27.I.1999, leg. H. Zettel (168), 1 ♀. Mindoro Beach, 24.XI.1992, leg. H.Zettel (17), 1 ♀. 28 km

S Calapan, Balete, 100 - 700 m, 27.-29.XI.1992, leg. M.A. Jäch (19), 4 ♂♂, leg. H.Zettel (18), 1 ♀. **"Philippines"**: without further locality information: "Philippinen", coll. G. Mayr, 1 ♀. "Philippinen", 1890, coll. Schadenberg, coll. G. Mayr, 1 ♀.

**Description of worker:** Measurements of lectotype of *O. infandus* (Note: Head missing): PnW 1.48, PtH 1.37, PtL 0.82, PtW 0.55.

Measurements of lectotype of *O. striaticeps*: CI 70, HL 3.20, HW 2.25, MdI 58, MdL 1.85, MsL (not visible), PnW 1.40, PtH 1.30, PtL 1.50, PtW 0.55, SI 140, SL 3.15, TL 16.57.

Measurements of paralectotype 1 of *O. striaticeps*: CI 70, HL 3.15, HW 2.20, MdI 57, MdL 1.80, MsL 4.55, PnW 1.38, PtH 1.22, PtL 1.47, PtW 0.53, SI 143, SL 3.15, TL 16.43. Measurements of paralectotype 2 of *O. striaticeps* (Note: Gaster missing.): CI 70, HL 3.28, HW 2.30, MdI 55, MdL 1.80, MsL 4.60, PnW 1.53, PtH 1.37, PtL 1.50, PtW 0.57, SI 142, SL 3.28.

Measurements: worker with smallest HW: CI 68, HL 2.68, HW 1.82, MdI 58, MdL 1.57, MsL 3.80, PnW 1.10, PtH 1.17, PtL 1.18, PtW 0.42, SI 152, SL 2.77, TL 12.00; worker with largest HW: CI 73, HL 3.47, HW 2.53, MdI 52, MdL 1.82, MsL 4.87, PnW 1.52, PtH 1.45, PtL 1.60, PtW 0.59, SI 138, SL 3.50, TL 16.31.

**Structures:** Head striate, striation reaching occipital margin. Pronotum with longitudinally (oval) oriented striation; loops and closed circles may occur in dorsal view. Mesopleuron with fine transverse striation. Short petiolar spine, S-shaped, tilted backwards (how strong differs considerably; usually, the spine is less developed and less curved in smaller workers).

**Pilosity:** Pubescence dense, short.

**Colour:** Generally a dark coloured species, but regional variations do occur (see Notes below). Head usually somewhat lighter than mesosoma.

**Description of gyne:** Measurements: gyne with smallest HW: CI 75, HL 3.33, HW 2.50, MdI 56, MdL 1.87,

MsL 4.73, SI 129, SL 3.22, PnW 1.78, PtH 1.58, PtL 1.62, PtW 0.71, TL 15.50; gyne with largest HW: CI 75, HL 3.37, HW 2.53, Mdi 58, MdL 1.97, MsL 4.87, PnW 1.82, PtH 1.66, PtL 1.66, PtW 0.74, SI 129, SL 3.27, TL 16.13.

Compared with worker, striation of mesopleuron reduced, medially either faded or even with small smooth area.

Colour: Head, mesonotum, scutellum, and metanotum variable, medium to light brown, contrasting with other, dark brown body parts. Mesopleuron, petiole, and gaster slightly lighter.

**Distribution** (Fig. 46): Endemic to the Philippines; widely distributed from northern to southern Luzon and also recorded from eastern Mindoro.

**Habitats:** *Odontomachus infandus* inhabits a wide range of forest habitats, from lowland dipterocarp forests to secondary pine forests at high elevations. It was also found in relatively small forest patches, but never in open land. Humidity and shade at nest sites are likely its main requirements.

**Notes:** The lectotype of *Odontomachus infandus* at BMNH is in poor condition (Fig. 27) but agrees well with the current interpretation of this taxon. The types of *O. striaticeps* have identical character expression (Fig. 29), and the synonymy with *O. infandus* is confirmed. After re-examination of the type of *Odontomachus papuanus* r. *philippinus*, its synonymy with *O. infandus* cannot be confirmed and it is here treated as a valid species (see below).

The following characteristics distinguish *O. infandus* from other species from Luzon, *O. banksi* and *O. schoedli* sp.n.: dorsum of head fully (or almost fully) striate; striation of pronotum predominantly longitudinal, apical of petiolar spine distinctly curved backwards; pilosity of head and mesosoma sparse. See also comparative notes for *O. banksi*, *O. schoedli* sp.n. and *O. sp. 1* from Camarines.

*Odontomachus infandus* has a wide distribution on Luzon and Mindoro, and expresses some variation in colour. We have studied a large series from Laguna (Mt. Makiling at Los Baños) which represents the most typical form of this species. Its mesosoma, petiole, and gaster are dark to blackish brown; the head is lighter, usually medium-brown. Other material from Central Luzon (provinces of Cavite and Batangas) agrees well with the Laguna form (the Cavite specimens being slightly more blackish); the same is true for specimens from nearby Mindoro Island. From northern Luzon we have only seen a few specimens which show a rather strong variability in colour. Southward, the material is also heterogeneous. A series from Quezon Province agrees very well with the typical form except that it has a lighter (brownish orange) head. However, the southernmost population (from Albay) is, again, very close to the typical form from Central Luzon.

***Odontomachus schoedli* sp.n.** (Figs. 4, 10, 16, 47)

**Etymology:** This species is named for our late colleague Stefan Schödl, former curator for Hymenoptera at the Natural History Museum Vienna, who collected a major part of the type series.

**Type material: Holotype worker (UPLB): Luzon:** Mountain Province: south of Sagada, Bagnen, slopes of Mt. Polis, 1600 m, 26.II.1999, leg. S. Schödl (23). **Paratypes** (24 workers (BMNH, CZW, NHMW, UPLB): same locality data as holotype, 13 ♂♂, leg. H. Zettel (189), 6 ♀♀.

Benguet: west of Baguio, at km 7 of Asin Road, 17.II.1999, leg. S. Schödl (11), 2 ♂♂, leg. H. Zettel (179), 2 ♀♀; Baguio, leg. C.F. Baker, 1 ♀.

**Description of worker:** Measurements: holotype worker: CI 72, HL 2.95, HW 2.12, Mdi 58, MdL 1.70, MsL 4.17, PnW 1.25, PtH 1.18, PtL 1.12, PtW 0.49, SI 146, SL 3.08, TL 16.25; paratype worker with smallest HW: CI 72, HL 2.98, HW 2.13, Mdi 55, MdL 1.65, MsL 4.00, PnW 1.20, PtH 1.18, PtL 1.18, PtW 0.51, SI 144, SL 3.07, TL 12.75; paratype worker with largest HW: CI 73, HL 3.60, HW 2.62, Mdi 59, MdL 2.13, MsL 5.93, PnW 1.52, PtH 1.48, PtL 1.53, PtW 0.56, SI 137, SL 3.58, TL 16.13.

Structures: Head striate; striation reaching occipital margin. Pronotum with fine, transverse striation. Mesopleuron with fine transverse striation. Petiole stout, with short spine, bent backwards only very slightly.

Pilosity: Pubescence sparse, long.

Colour: Head and mesosoma medium brown, petiole and gaster dark brown.

**Distribution** (Fig. 47): Endemic to the Philippines: only in the north of Luzon: Mountain Province, Benguet.

**Habitats:** This species was collected at higher elevations in strongly degraded forests.

**Notes:** *Odontomachus schoedli* sp.n. is only known from the western mountain ranges of northern Luzon. In Benguet it is sympatric with *O. infandus*. Main differences between these two species are the striation of the pronotum, which is transverse in *O. schoedli* sp.n. but more or less longitudinal in *O. infandus*, and the shape of the petiole, which is remarkably short and with a very straight anterior face of the node (including spine) in *O. schoedli* sp.n., whereas it has a longer, curved spine in *O. infandus* (only weakly developed in the smallest specimens). The uniformly light chocolate brown colour of head and mesosoma of *O. schoedli* sp.n. is striking, but we have seen a few specimens of *O. infandus* from northern Luzon with the same colouration.

***Odontomachus* sp. 1** (Figs. 21 - 23, 46)

**Material examined** (16 workers, 2 gynes; CZW, USC): **Luzon:** Camarines Norte: Mt. Labo – Mt. Bayabas area, 17.-18.III.2004, leg. H. Zettel & C.V. Pangantihon (382), 1 ♀. S Daet, Bicol National Park, Basud, Nalisan, 13.-14.III.2003, leg. H. Zettel, L. S. Vichozo & C. V. Pangantihon, 1 ♀, 26.II.2004, leg. H. Zettel & C. V. Pangantihon (376), 2 ♂♂, 13.III.2006, leg. H. Zettel, R. Gille & C. V. Pangantihon (446), 6 ♂♂. Camarines Sur: Lupi, Alanao, Bahi River, 14.XI.1999, leg. H. Zettel (205), 1 ♀. Sooc, 10.-12.III.2000, various local collectors (246), 1 ♀, 29.I.-10.II.2002, various local collectors (305), 1 ♀. Lupi, Sooc, Telecom, 31.III.2003, leg. C. V. Pangantihon, 2 ♂♂. Between Lupi, Sooc, Telecom and Sipocot, Tigman, 22.II.2004, leg. C. V. Pangantihon (P42+43), 3 ♂♂.

**Description of worker:** Measurements: worker with smallest HW: CI 77, HL 2.88, HW 2.23, MdL 1.67, Mdi 58, MsL 3.80, PnW 1.17, PtH 1.21, PtL 1.22, PtW 0.42, SI 133, SL 2.97, TL 12.38; worker with largest HW: CI 70, HL 3.30, HW 2.30, Mdi 59, MdL 1.95, MsL 4.17, SI 143, SL 3.28, PnW 1.37, PtH 1.19, PtL 1.32, PtW 0.50, TL 14.13.

Structures: Head striate, striation not reaching occipital margin, fading out slightly before margin; striation left and right of median furrow weak. Striation on pronotum longitudinally oriented, closed oval circles may be visible in dor-



sal view (sculpture strongly resembling *O. infandus*). Mesopleuron striate, although striation in the centre may be very weak. Petiole variable, rather short, dorsal surface usually straight, with short and simple petiolar spine.

**Pilosity:** Fine white, loose, semi-appressed pubescence on entire body, distance between hairs approximately their length. No setae on tergite 1, few setae on tergite 2, increasing in number and length towards apex of abdomen.

**Colour:** Dark brown, head usually lighter (towards medium brown) than rest, appendages light brown to yellowish.

**Description of gyne:** Measurements: gyne with smallest HW: CI 73, HL 3.33, HW 2.42, MdL 1.97, MdI 59, MsL 4.67, PnW 1.82, PtH 1.56, PtL 1.71, PtW 0.75, SI 130, SL 3.15, TL 15.25; gyne with largest HW: CI 76, HL 3.43, HW 2.60, MdL 1.93, MdI 56, MsL 4.80, PnW 1.78, PtH 1.64, PtL 1.83, PtW 0.78, SI 126, SL 3.28, TL 15.88.

Compared with *O. infandus* gyne, striation of head posteriorly reduced. Compared with *O. sp. 1* worker, striation of mesopleuron strongly reduced, in larger gyne faint, in smaller gyne absent except for short striation in front of meso-metapleural suture.

**Colour:** Head, mesonotum, scutellum, metanotum, and mesopleuron light brown, contrasting with other, dark brown body parts. Petiole and gaster slightly lighter.

**Distribution** (Fig. 46): Endemic to the Philippines: only in southern Luzon, in a small area in Camarines Norte and Camarines Sur.

**Habitats:** This species is only known from dipterocarp forests, although some samples are from strongly degraded forests.

**Notes:** Camarines Sur is the only province with four recorded *Odontomachus* species, i.e., *O. infandus*, *O. banksi*, *O. simillimus*, and *O. sp. 1*. The here treated form, which is represented by rather few individuals from a relatively small area, shares some characters with *O. infandus* and *O. banksi*, but can be clearly distinguished from both. It is distinguished from *O. infandus* by light coloured and posteromedially not striate head and a straight petiolar spine; from *O. banksi* by much more developed striation on head, longitudinal loops on pronotum, and sparse pilosity; the slightly reduced striation on medial mesopleuron and the light brown gaster separates this form from both species. Although there are several similarities with *O. alius* sp.n., and despite zoogeographical considerations (presence of *O. alius* sp.n. on Catanduanes), we do not assign this Camarines population to that species, mainly because of the strikingly different shape of the petiole.

***Odontomachus alius* sp.n.** (Figs. 5, 11, 17, 46)

**Etymology:** Latin for "the other", this name refers to the fact that samples of this species were already recognized as "different" by BROWN (1976) (but remained unnamed). The name is also inspired by the popular American TV show "Lost".

**Type locality:** Cebu, west of Cebu City, Minglanilla, Camp 7, 10° 16' N, 123° 45' E.

**Type material:** **Holotype** (worker, USC): **Cebu:** west of Cebu City, Minglanilla, Camp 7, secondary forest near small creek, 16.XI.2003, leg. H. Zettel & C. V. Pangantihon (358). **Paratypes** (101 workers, 2 gynes, CSW, CZW, NHMW, UPLB, USC): **Cebu:** same locality data as holotype, 4 ♂♂. Cebu City, Tabunan, Cantipla-I, forest reserve, ca. 800 m, 23.IX.2006, leg. C. V. Pangantihon (P250), 1 ♀,

18.II.2007, leg. H. Zettel (473), 1 ♀, 28.IX.2007, leg. C. V. Pangantihon (P270), 2 ♂♂, 8.II.2008, leg. H. Zettel & C. V. Pangantihon (503), 1 ♀, 19.-20.IX.2008, leg. C. V. Pangantihon (P301), 4 ♂♂, 1 ♀, 20.-24.VII.2009, leg. C. V. Pangantihon (P327), 2 ♂♂. Dalaguete, Mantalongon, 29.-30.VIII.2010, leg. C. V. Pangantihon (P361), 1 ♀. Dalaguete, Mantalongon, Dingayup River, 4.XI.2010, leg. H. Zettel & C. V. Pangantihon (524), 5 ♂♂. **Bohol:** Bilar, Man Made Forest, 29.XI.2005, leg. C. V. Pangantihon (P427), 4 ♂♂. **Leyte:** Leyte: E Ormoc, Lake Danao area, 11.III.1998, leg. H. Zettel (158), 2 ♂♂, 13.II.2000, leg. S. Schödl (16), 19 ♂♂, 13.II.2000, leg. H. Zettel (237), 3 ♂♂. Baybay, ViSCA/LSU, Mt. Pangasugan, Calbiga-a River, 50 - 200 m, 12.II.2000, leg. H. Zettel (236), 13 ♂♂, 20.-21.III.2005, leg. H. Zettel & C. V. Pangantihon (422), 12 ♂♂. **Biliran:** Almeria, Kabungasan, Mt. Panamao, Upper, 15.XI.2009, leg. C. V. Pangantihon (P334), 1 ♀. **Samar:** Western Samar: east of Basey, Sohoton National Park, banks of Sohoton River, 29.I.2000, leg. S. Schödl (2), 13 ♂♂, leg. H. Zettel (221), 9 ♂♂. **Catanduanes:** east of San Andres, below Lu Yong cave, 11.-12.III.1999, leg. H. Zettel (200), 2 ♂♂, 1 ♀, 12.III.1999, leg. F. Seyfert (26), 1 ♀, 12.IV.2000, leg. H. Zettel (254), 1 ♀.

**Description of worker:** Measurements: holotype worker: CI 69, HL 3.37, HW 2.32, MdI 60, MdL 2.03, MsL 4.27, PnW 1.38, PtH 1.38, PtL 1.44, PtW 0.53, SI 150, SL 3.48, TL 14.81; paratype worker with smallest HW: CI 68, HL 2.67, HW 1.80, MdI 58, MdL 1.53, MsL 3.47, PnW 1.03, PtH 1.02, PtL 1.11, PtW 0.46, SI 154, SL 2.77, TL 11.75; paratype worker with largest HW: CI 77, HL 3.40, HW 2.62, MdI 64, MdL 2.17, MsL 4.60, PtH 1.46, PtL 1.58, PtW 0.62, PnW 1.50, SI 136, SL 3.55, TL 15.56.

**Structures:** Head striate, but striation not reaching nuchal carina. Pronotum with variable fine striation, either transversely oriented or with roundish or longitudinal loops. Mesopleuron with fine transverse striation. Petiolar spine S-shaped, very long, acute, slightly bent backwards. Gaster low anteriorly, strongly flattened, impression distinct, often linear.

**Pilosity:** Pubescence sparse, short.

**Colour:** Bicoloured; head and gaster light brown to almost yellowish, contrasting with dark brown mesosoma and petiole.

**Description of gyne:** Measurements: gyne with smallest HW: CI 73, HL 3.43, HW 2.52, MdI 52, MdL 1.80, MsL 4.73, PnW 1.80, PtH 1.53, PtL 1.57, PtW 0.75, SI 131, SL 3.30, TL 16.56; gyne with largest HW: CI 75, HL 3.47, HW 2.62, MdI 56, MdL 1.95, MsL 5.20, PnW 1.95, PtH 1.91, PtL 1.80, PtW 0.77, SI 124, SL 3.25, TL 16.00.

Compared with *O. infandus* gyne, striation of head strongly reduced posteriorly. Compared with worker, striation of mesopleuron strongly reduced, in larger gyne absent except for striation in front of meso-metapleural suture, in smaller gyne almost totally absent, except most dorsal area.

**Colour:** Head, mesonotum, scutellum, metanotum, and mesopleuron pale, yellowish to very light brown, contrasting strongly with other brown body parts. Petiole and gaster light brown, similar to worker.

**Distribution** (Fig. 46): Endemic to the Philippines, recorded from the islands of Catanduanes, Samar, Biliran, Leyte, Bohol, and Cebu.

**Habitats:** Collected in lowland dipterocarp forests, some of the forests remnant patches or strongly degraded.

**Notes:** We characterize workers of *O. alius* sp.n. by the following combination of characters: Head distinctly and gaster notably lighter coloured than mesosoma. Head with extended striation (relatively short in specimens from Catanduanes), but never reaching nuchal carina medially. Mesopleuron without smooth area (although striation is faded in some individuals). Petiole with long, S-curved spine.

*Odontomachus alius* sp.n. is a variable species with five distinct island-endemic forms from (I) Cebu, (II) Bohol, (III) Leyte and Biliran, (IV) Samar, and (V) Catanduanes. *Odontomachus* sp. 1 from southern Luzon may also belong to this species, but its characters do not comfortably fit the pattern (see discussion for *Odontomachus* sp. 1). Each of these forms is relatively stable in its set of characters, and they may as well be treated as subspecies or morphologically weakly differentiated species. There is a distinct trend of changing characters from Cebu eastwards and northwards. The pronotum sculpture changes from transversely striate (Cebu) to roundish or transverse loops (Bohol) to longitudinal loops (other islands). The gaster is lightest (yellowish brown) in specimens from Cebu and Bohol, and darkest in specimens from Samar and Catanduanes. The striation of the temporal prominences is most strongly extended in specimens from Cebu, Bohol, Leyte, and Biliran, intermediate in specimens from Samar, and distinctly reduced in specimens from Catanduanes. This trend contrasts with the parapatric populations of *O. philippinus* on Negros with completely smooth temporal prominences and of *O. infandus* on southern Luzon with completely striate temporal prominences.

***Odontomachus philippinus* EMERY, 1893 stat.n.** (Figs. 6, 12, 18, 33, 34, 46)

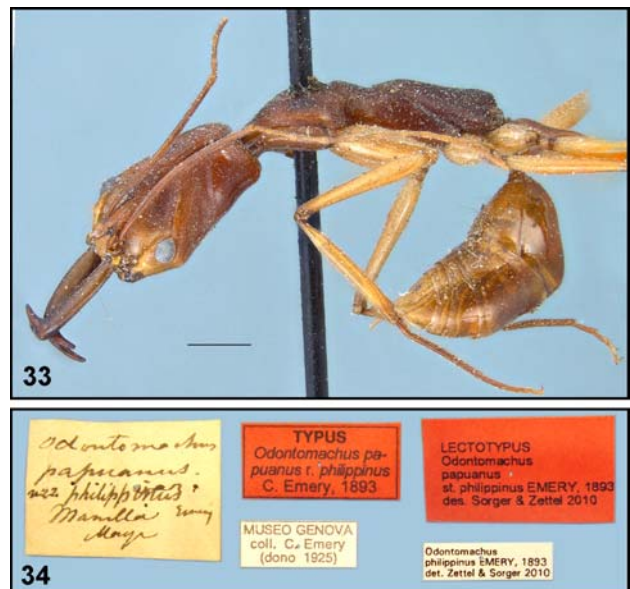
*Odontomachus papuanus* st. *philippinus* EMERY, 1893: 203 (description of worker; type locality: "Manila").

*Odontomachus papuanus* ssp. *philippinus*: WHEELER & CHAPMAN 1925: 71 (partim; distribution); CHAPMAN & CAPCO 1951: 45 (catalogue); BALTAZAR 1966: 239 (distribution: Luzon, Manila; Negros Oriental, Romblon); BROWN 1976: 104, 126-127 (new synonym of *O. infandus*, morphology, discussion).

*Odontomachus infandus* (misidentification; nec SMITH, 1858): FOREL 1910: 122 (distribution: Negros); WHEELER & CHAPMAN 1925: 71 (distribution: Negros).

**Type material examined: Holotype** (worker; MCSNG, Fig. 33) from "Manilla, Mayr" (labels see Fig. 34).

**Notes on the type locality:** EMERY (1893) describes *Odontomachus philippinus* as a race of *O. papuanus*, a species from New Guinea. He writes "provenient de Manille et m'a été envoyée par M. MAYR" [translated: origins from Manila and sent to me by Mr. Mayr]. A single worker in the Museum Genoa is the holotype. There are two further workers in the Natural History Museum Vienna which origin from Mayr's Collection and bear a label with Mayr's notes "papuanus var. m. gestreiften Seitengruben det. G. Mayr" [translated: papuanus variation with striped side grooves] [on head]. These specimens bear locality labels "Manilla Heer." and "Manilla Forel.", respectively. Both Heer and Forel were collectors, but like Mayr they never reached Asia. We assume that all three specimens are from the same series, but that their provenience from the



Figs. 33 - 34: *Odontomachus philippinus* holotype, MCSNG: (33) habitus, lateral view; (34) labels. Scale = 1 mm.

city of Manila is doubtful or – more unlikely – after human transportation. According to newly collected material, which agrees very well with the holotype, *O. philippinus* occurs only in the Western Visayas. Its native occurrence in Central Luzon, the best sampled area in the Philippines, is very unlikely.

**Additional material examined** (44 workers, BMNH, CSW, CZW, NHMW, USC): **Negros:** Negros Oriental: Canlaon City, Mananawin, Mandalagon Falls, 26.I.2007, leg. H. Zettel (455), 8 ♂♂. Dumaguete, leg. J.W. Chapman, 2 ♂♂. Dumaguete, Camp, leg. J.W. Chapman, 1 ♀. Cuernos de Negros, Valencia, Apolong, Casaroro Falls, 9.-13.III.2005, leg. H. Zettel (420), 2 ♂♂, 26.III.2006, leg. H. Zettel & C. V. Pangantihon (451), 8 ♂♂, 28.I.2007, leg. H. Zettel (456), 10 ♂♂. **Panay:** C a p i z : Dumalag, Suhut, 15.V.2005, leg. C. V. Pangantihon (P169), 12 ♂♂. **Siquijor:** Bandila-an National Park, between lodge and "Little Waterfall", 23.X.2004, leg. C. V. Pangantihon (P395), 3 ♂♂.

**Description of worker:** Measurements: worker with smallest HW: CI 68, HL 3.03, HW 2.07, MdI 62, MdL 1.88, MsL 4.70, SI 152, SL 3.13, PnW 1.22, PtH 1.22, PtL 1.36, PtW 0.44, TL 13.19; worker with largest HW: CI 72, HL 3.63, HW 2.60, MdI 57, MdL 2.07, MsL 4.80, PnW 1.57, PtH 1.54, PtL 1.68, PtW 0.54, SI 138, SL 3.60, TL 15.63.

**Structures:** Striation on head extending from frontal lobes to ocular ridge, rest of head smooth and shiny. Pronotum with relatively coarse transversely oriented striation, in dorsal view no loops visible (loops may be visible in lateral view); posterolateral parts without striation, smooth and shiny. Mesopleuron smooth and shiny, along meso-metapleural suture a few faint striae may occur dorsally or ventrally, but at its middle always smooth and shiny. Petiole S-shaped, strongly bent backwards, convex dorsally. Entire ant appearing very shiny / glossy.

**Pilosity:** Pubescence sparse, short.

**Colour:** Uniformly dark; slightly reddish brown in specimens from Siquijor.

**Distribution** (Fig. 46): Endemic to the Philippines and there restricted to the western Visayas islands of Panay, Negros and Siquijor. Natural occurrence in Central Luzon (Manila) (EMERY 1893) is doubtful.

**Habitats:** *Odontomachus philippinus* was found only in shaded, humid places in degraded primary forests or in secondary forests. This species is greatly endangered by the destruction of forests in the western Visayas region.

**Notes:** *Odontomachus philippinus* is closely related to *O. scifictus* sp.n.; it differs in mesopleuron sculpture and petiolar shape. See key and notes of *O. scifictus* sp.n.

***Odontomachus scifictus* sp.n.** (Figs. 7, 13, 19, 46)

**Etymology:** This name serves as an homage to early science fiction movies incorporating ants – the first author came across a poster of the movie "Empire of the Ants" (1977) directed by Bert I. Gordon that clearly depicts a giant, dangerously looking *Odontomachus* species and decided that such prominent display should be memorialized.

**Type locality:** Camiguin Island, municipality of Mambajao, W of Mambajao, near spring of Katibawasan, ca. 350 - 400 m a.s.l.

**Type material: Holotype worker (USC): Camiguin:** W Mambajao, Katibawasan spring area, 350 - 400 m, 13. and 15.III.2010, leg. H. Zettel & C. V. Pangantihon (515).

**Paratypes** (70 workers; CSW, CZW, NHMW, UPLB, USC): same locality data as holotype, 65 ♂♂. W Mambajao, Benon, Saran – Kampanan, 500 - 800 m, 16. and 18.III. 2010, leg. H. Zettel & C. V. Pangantihon (516), 1 ♀. Mambajao, Yumbing, 28.X.2008, leg. C. V. Pangantihon (P306), 1 ♀. Catarman, Mainit, Tuasan Falls, 23.X.2008, leg. C. V. Pangantihon (P302), 3 ♂♂.

**Description of worker:** Measurements: holotype worker: CI 70, HL 3.32, HW 2.33, Mdi 60, MdL 2.00, MsL 4.47, PnW 1.38, PtH 1.36, PtL 1.48, PtW 0.50, SI 141, SL 3.28, TL 14.50; paratype worker with smallest HW: CI 67, HL 2.93, HW 1.97, Mdi 54, MdL 1.58, MsL 3.80, PnW 1.18, PtH 1.15, PtL 1.28, PtW 0.42, SI 151, SL 2.97, TL 12.63; paratype worker with largest HW: CI 71, HL 3.42, HW 2.42, Mdi 59, MdL 2.00, MsL 4.80, SI 139, SL 3.37, PnW 1.43, PtH 1.38, PtL 1.60, PtW 0.52, TL 15.25.

**Structures:** Striation on head extending from frontal lobes to ocular ridge, rest of head smooth and shiny. Pronotum with fine, roughly round striation, closed circles or loops clearly visible in dorsal view; posterolateral parts without striation, smooth and shiny. Mesopleuron smooth and shiny, some fine transverse striation may occur to varying extent but always at least the central region smooth and shiny. S-shaped, long and acute petiolar spine, slightly bent backwards. Entire ant appearing very shiny / glossy.

**Pilosity:** Pubescence sparse, short.

**Colour:** Uniformly reddish brown.

**Habitats:** Collected in shaded, humid places mostly in degraded, dipterocarp forests. The type locality was near a stream.

**Distribution** (Fig. 46): Endemic to the Philippines and only known from the island of Camiguin.

**Notes:** *Odontomachus scifictus* sp.n. is very similar to *O. philippinus*, but differs in the extension of the smooth area on the mesopleuron reaching the meso-metapleural suture, and by the distinct tubercles of the petiole (petiole in anterodorsal aspect widest at tubercles). The distribution of *O. scifictus* sp.n. and *O. philippinus* are separated by an-

other vicariant form, *Odontomachus alius* sp.n. See also notes for *Odontomachus* sp. 2 from Mindanao.

***Odontomachus* sp. 2** (Figs. 24 - 26, 46)

**Material examined** (1 worker, FMNH): **Mindanao:** Davao: east slope of Mt. McKinley [a peak in the Mt. Apo massif], 1.IX.1946, 5200 ft. (= ca. 1600 m a.s.l.), on ground, leg. F.G. Werner, 1 ♀.

**Description of worker:** Measurements: CI 76, HL 2.90, HW 2.22, Mdi 52, MdL 1.50, MsL 3.57, SI 121, SL 2.68, PnW 1.33, PtH 1.35, PtL 1.38, PtW 0.54, TL 12.38.

**Structures:** Striation on head strong until ocular ridge, fading out toward temporal ridge, except along median furrow smooth and shiny like posterior part of head. Striation on pronotum conspicuous: longitudinal posteromedially, horseshoe-shaped around; fine in centre, coarser towards outer margins. Mesopleuron with some longitudinal striation, smooth and shiny at centre. Petiole elongate S-shaped (posterior face concave) with long petiolar spine that is slightly bent backwards. Anterior slope of tergite 1 almost evenly convex, with sharp impression.

**Pilosity:** Pubescence on head and mesosoma loose, distance between hairs approximately their length. No setae on tergite 1, tergite 2 with 3 setae, setae increasing in length and number towards apex of abdomen.

**Colour:** Body uniformly light brown, however, possibly bleached out due to long storage in alcohol.

**Distribution** (Fig. 46): Mindanao: Davao.

**Notes:** The single worker from Davao resembles *O. philippinus* and *O. scifictus* sp.n., but striation on head and mesopleuron is more extensive, striation on pronotum peculiar. Compared to all Philippine *O. infandus* group species, the anterior of tergite 1 is more convex. The specimen strongly resembles some workers from the nearby island of Sulawesi, Indonesia (from Mayr's collection at NHMW, without details on locality) which belong to an undescribed species.

***Odontomachus banksi* FOREL, 1910** (Figs. 8, 14, 20, 35, 36, 47)

*Odontomachus banksi* FOREL, 1910: 121 (description of worker, erroneously labelled as "♀" from Mt. Banahaw, Laguna, Luzon); VIEHMEYER 1916: 284 (description of gyne from Mt. Banahaw, Laguna, Luzon); WHEELER & CHAPMAN 1925: 71 (distribution: Mt. Banahaw, Laguna, Luzon); BALTAZAR 1966: 239 (catalogue). BROWN 1976: 116, 127 (taxonomy, key, discussion).

**Type material examined:** Lectotype (worker; MHNG; present designation, Fig. 35) and paralectotypes (2 workers; MHNG), mounted on one pin, from L a g u n a P r o - v i n c e (according to FOREL 1910) (labels see Fig. 36).

**Notes:** There is a discrepancy since the types are workers, but FOREL (1910) describes gyness ("♀"). However, we believe that this is due to a typesetting error, as the characters "Mésonotum fortement et largement échancré" [translated: Mésonotum strongly and broadly indented] and "les stries ... du pronotum fines et serrés, parfois longitudinales au milieu" [translated: striae...on pronotum fine and tight together, sometimes longitudinal in the middle] must refer to workers. We select the uppermost worker as the lectotype (Fig. 35).

**Additional material examined** (59 workers; BMNH, CSW, CZW, NHMW, UPLB, USC): **Luzon:** L a g u n a :





Figs. 35 - 36: *Odontomachus banksi* lectotype at MHNG: (35) habitus (upper specimen), lateral view; (36) labels.

Ubi, no further data, det. W.L. Brown, 1 ♂. Camarines Norte: SW Daet, San Vicente, Fabrica, Mananap, 6.II.2001, leg. H. Zettel, E. S. & L. S. Vichozo (264), 4 ♂♂, 17.III.2003, leg. H. Zettel, C. V. Pangantihon & L. S. Vichozo (348), 3 ♂♂. Labo, Tulay na Lupa, Mt. Labo – Mt. Bayabas area, 17.-18.III.2004, leg. H. Zettel & C. V. Pangantihon (382), 9 ♂♂, 18.V.2006, leg. C. V. Pangantihon (P238), 7 ♂♂. Camarines Sur: Naga City, ca. 20 km E of city, 5 km E Carolina, slopes of Mt. Isarog, Malabsay Falls, 19.II.1998, leg. H. Zettel (141), 9 ♂♂, 4.III.1999, leg. H. Zettel (192), 18 ♂♂, 4.III.1999, leg. F. Seyfert (19), 6 ♂♂, 20.IX.1999, leg. H. Zettel (208), 8 ♂♂.

**Description of worker:** Measurements: lectotype: CI 77, 2.80 HW, 3.65 HL, 56 MdI, 2.05 MdL, 4.95 MsL, 1.60 PnW, 1.47 PtH, 1.63 PtL, 0.58 PtW, 132 SI, 3.70 SL, 16 TL worker with smallest HW: CI 67, HL 2.90, HW 1.95, MdI 56, MdL 1.63, MsL 4.13, PnW 1.13, PtH 1.02, PtL 1.16, PtW 0.40, SI 157, SL 3.07, TL 12.38; worker with largest HW: CI 74, HL 3.70, HW 2.73, MdI 55, MdL 2.05, MsL 5.33, SI 138, SL 3.77, PnW 1.59, PtH 1.58, PtL 1.68, PtW 0.58, TL 15.75.

**Structures:** Striation on head extending from frontal lobes to ocular ridge, rest of head smooth and shiny. Pronotum with round to transverse striation, closed loops and circles may be visible in dorsal view. Mesopleuron with fine transverse striation. Petiole with some fine striation laterally and with long and acute petiolar spine; anterior face of node straight to almost concave.

**Pilosity:** Pubescence dense, long.

**Colour:** Bicoloured; head light brown contrasting with reddish brown mesosoma and petiole, dark brown gaster.

**Distribution** (Fig. 47): Endemic to the Philippines and present only in the central and southern parts of Luzon; records from Laguna, Quezon (BROWN 1976), Camarines Norte and Camarines Sur.

**Habitats:** Only in dipterocarp forests, sometimes degraded, on mountain slopes.

**Notes:** *Odontomachus banksi* is the most distinct Philippine member of the *O. infandus* group species. It can be distinguished from all other species by the relatively long and dense pilosity of the mesosoma and by striation on the petiole. The smooth and shiny posterior of the head is also



Fig. 37: *Odontomachus malignus*, head, full face view. Scale = 1 mm.

present in three other species: *Odontomachus philippinus* in the Western Visayas, *O. scifictus* sp.n. on Camiguin, and *O. sp. 2* on Mindanao. They have brown heads and a smooth area on the mesopleuron, whereas the head of *O. banksi* is yellowish orange and its mesopleuron densely and fully striate. A population of *O. alius* sp.n. from Catanduanes resembles *O. banksi* in light and (partly) smooth head, but differs in sparse pilosity of mesosoma, fine striation of mesopleuron, distinctly curved petiolar spine (straight in *O. banksi*), and brownish gaster (blackish in *O. banksi*). The range of *O. banksi* is within the distribution of the more common *O. infandus*, which clearly indicates its specific status. See also notes under *Odontomachus* sp. 1 from Camarines.

#### *Odontomachus malignus* species group

**Diagnosis:** Palp formula 4, 4. Head short, posteriorly with pair of tubercles. Mandibles long with long and sharp apical and subapical teeth. Antennae relatively short. Mesosoma not depressed. Pronotum with delicate sculpture. Petiole comparatively small and low.

**Diversity and distribution:** This group contains only one species, *O. malignus* from the western Pacific area.

**Notes:** BROWN (1976) included *O. malignus* in the *O. infandus* species group, mainly because of its mandibular structures. However, the short head, short scape, and comparatively high and stout mesosoma differ considerably from both the *O. infandus* and the *O. rixosus* species group. The combination of morphological characters and the unique biology justify the erection of a separate species group.

#### *Odontomachus malignus* SMITH, 1859 (Figs. 37-39, 47)

*Odontomachus malignus* SMITH, 1859: 144 (description of worker, type locality: Aru Island, Indonesia). WILSON 1959: 495 (discussion, ecological notes); BROWN 1976: 159-160 (discussion, ecological notes, distribution: Tawi-Tawi, Sitanki Jolo Island, Rennell Island); OLSEN 2009: 11 (distribution, ecological notes).



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Figs. 38 - 39: *Odontomachus malignus*: (38) habitus, lateral view; (39) habitus, dorsal view. Scales = 3 mm.

*Odontomachus tuberculatus* ROGER, 1861: 28 (syn. WILSON 1959).

*Odontomachus retrolator* VIEHMEYER, 1914: 113 (syn. BROWN 1976)

**Material from the Philippines examined** (17 workers; CSW, CZW, NHMW, USC): (Cebu Prov.): **Bantayan:** Atop-Atop, N Santa Fe, coast, 18.X.2004, leg. C. V. Pangantihon (P388), 7 ♂♂. **Bohol:** Loay, Villa Olympia, 25.-26.VIII.2004, leg. C. V. Pangantihon (P116), 8 ♂♂. Loay, coast with mangroves near mouth of Loboc river, 27.XI.2005, leg. C. V. Pangantihon (P425b), 2 ♂♂.

**Material from other countries examined:** 1 worker from Sarawak, Malaysia (NHMW).

**Description of worker:** Measurements: worker with smallest HW: CI 81, HL 2.25, HW 1.82, MdI 64, MdL 1.43, MsL 3.57, PnW 1.03, PtH 0.87, PtL 0.83, PtW 0.56, SI 128, SL 2.33, TL 10.00; worker with largest HW: CI

82, HL 2.82, HW 2.32, MdI 63, MdL 1.78, MsL 4.57, SI 123, SL 2.85, PnW 1.33, PtH 1.12, PtL 1.12, PtW 0.66, TL 11.13.

**Structures:** Mandibles long, reaching beyond midpoint of head, similar to *O. infandus* group. Head roughly rectangular, longer than wide, broadest at level of eyes. Conspicuous tubercles on both sides of median furrow dorso-posteriorly. Eyes located in first third of head. Dorsum of head striate, not reaching nuchal carina. Mesosoma elongate, broadest at level of pronotum. Pronotum rounded, metanotal groove in lateral view present. Very fine longitudinally oriented sculpture on pronotum; metanotum and propodeum with coarse transverse sculpture. Petiole short, truncated; short petiolar spine, anterior and posterior face flat; smooth and shiny, some fine striation may occur laterally. Gaster rounded to oval. Microsculpture on mesosoma and head finely granulate; ant appears matte.

Pilosity: Fine, loose semi-appressed white pubescence on head, mesosoma and petiole; gaster void of pubescence (some isolated hairs may occur), legs and antennae with dense white pubescence. Head with two standing setae, pronotum with some standing setae (2 - 3), setae on gaster increasing in number and length towards apex of abdomen.

Colour: Almost uniformly reddish brown, only head slightly lighter than rest.

**Distribution** (Philippines: Fig. 47): Widely distributed in the Western Pacific area, with records from Borneo, Philippines, Sulawesi, Palau, New Guinea, New Britain, and Solomon Islands (WILSON 1959, BROWN 1976, OLSEN 2009). BROWN (1976) presents the first records from the Philippines: Tawi-Tawi and Jolo Island in the country's extreme south. Here we present more northern records from the central Philippines, i.e., Bantayan and Bohol.

**Habitats:** WILSON (1959), BROWN (1976), and OLSEN (2009) describe the unusual habitat preference of *O. malignus* in intertidal zones. On Bantayan Island, the second author observed foraging workers in the intertidal zone of coral reef flats during low tide. On Bohol Island, one nest entrance was found in a mangrove close to the open sea.

**Notes:** This is a unique species, morphologically defined by group characters, and ecologically defined by living in intertidal zones.

#### *Odontomachus rixosus* species group

**Diagnosis:** Palp formula: 4, 4. Subapical teeth of mandibles short and truncate (*O. latidens*, *O. monticola*) or only slightly truncate and long (*O. rixosus*). Posterior portion of head tends to be fairly broad. Petiolar node tending to height reduction.

**Diversity and distribution:** BROWN (1976) includes three species: *Odontomachus latidens* MAYR, 1867, *O. monticola* EMERY, 1892, and *O. rixosus* SMITH, 1857. The group comprises those Oriental species with truncate subapical teeth of the mandibles, except *O. simillimus*, which belongs to the *O. haematodus* group (with palp formula 4, 3). *Odontomachus monticola* is distributed from northeastern India to southern China and Vietnam; *O. latidens* from Peninsular Malaysia to Borneo, Sumatra and Java; and *O. rixosus* from southeast Asia to Java, Borneo, and the southern Philippines (BROWN 1976, and this study). *Odontomachus monticola* is strongly varying (see BROWN 1976: pp. 157-159), but some of its synonyms are probably valid species.

In its present concept, the *O. rixosus* group is almost complementary biogeographically to the *O. infandus* group, with one exception: an overlap on the island of Mindanao.

#### *Odontomachus rixosus* SMITH, 1857 (Figs. 40 - 42, 47)

*Odontomachus rixosus* SMITH, 1857: 64 (description of worker; type locality: Singapore).

*Odontomachus rixosus* var. *obscurior* FOREL, 1900: STITZ 1925: 115 (distribution: Binaluan, Palawan) (syn. BROWN 1976).

**Material from the Philippines examined** (34 workers; CSW, NHMW, UPLB): **Palawan:** Mt. Mantalingajan, Pinigisan, 600 m, 11.IX.1961, Noona Dan Expedition, 1 ♂. **Mindanao:** Surigao del Norte: SW Bacuag, Payapag, Little Baguio Waterfalls, 6.II.2000, leg. S. Schödl (9), 33 ♂♂.

**Material from other countries examined:** 105 workers, 9 gynes (CZW, NHMW) from Myanmar (Tenasse-

rim), Thailand, (North, East, Central, South), Malaysia (Peninsular, Sarawak, Sabah), and Indonesia (Sumatra, Mentawai).

**Description of worker:** Measurements: worker with smallest HW: CI 71, HL 2.38, HW 1.68, MdI 57, MdL 1.37, MsL 3.33, PnW 1.05, PtH 0.78, PtL 0.77, PtW 0.42, SI 145, SL 2.43, TL 10.31; worker with largest HW: CI 76, HL 2.57, HW 1.95, MdI 56, MdL 1.43, MsL 3.62, PnW 1.17, PtH 0.84, PtL 0.92, PtW 0.48, SI 131, SL 2.63, TL 12.94.

**Structures:** Mandibles long, with ca. 6 basal denticles (widely separated from each) and three apical teeth: proximate tooth truncated, intercalary tooth only slightly shorter than apical. Head rectangular, broadest at level of eyes. Striation on head until ocular ridge, some more striation between ocular and temporal ridge, rest of head smooth and shiny. Microsculpture on head with fine isodiametric reticulum. Mesosoma elongate, slender and low, broadest at level of pronotum. Pronotum rounded, metanotal groove in lateral view present. Coarse rounded sculpture on pronotum (closed circles visible in dorsal view), metanotum and propodeum with coarse transverse sculpture. Petiole short, smooth and shiny, almost conical, with very short petiolar spine, which is rarely absent in small specimens (for example, *O. rixosus* var. *conifera* FOREL, 1913).

Pilosity: Fine loose semi-appressed white pubescence on head, mesosoma and petiole; distance between hairs approximately their length. Head with two standing setae, tergite 1 without setae, tergite 2 with a few setae, number of setae and length increasing towards apex of abdomen.

Colour: Medium brown, mesosoma slightly darker than head, petiole and gaster.

**Distribution:** (Philippines: Fig. 47) Southeast Asian mainland (Myanmar, Thailand, Peninsular Malaysia, Singapore), Sumatra, Mentawai Islands, Java, Borneo (BROWN 1976, and new material listed above). BROWN (1976) specifically noted the absence of *O. rixosus* from the Philippines, but overlooked the record of *O. rixosus* var. *obscurior* – a taxonomically insignificant colour variation – by STITZ (1925) from Palawan. This record is also lacking in BALTAZAR'S (1966) catalogue. In the material we examined we found more specimens from Palawan and one record from northeastern Mindanao.

**Habitats:** The only encounter in the Philippines by the senior author was at a waterfall area in a slightly degraded dipterocarp forest. Observations from Borneo confirm that *O. rixosus* is a forest species.

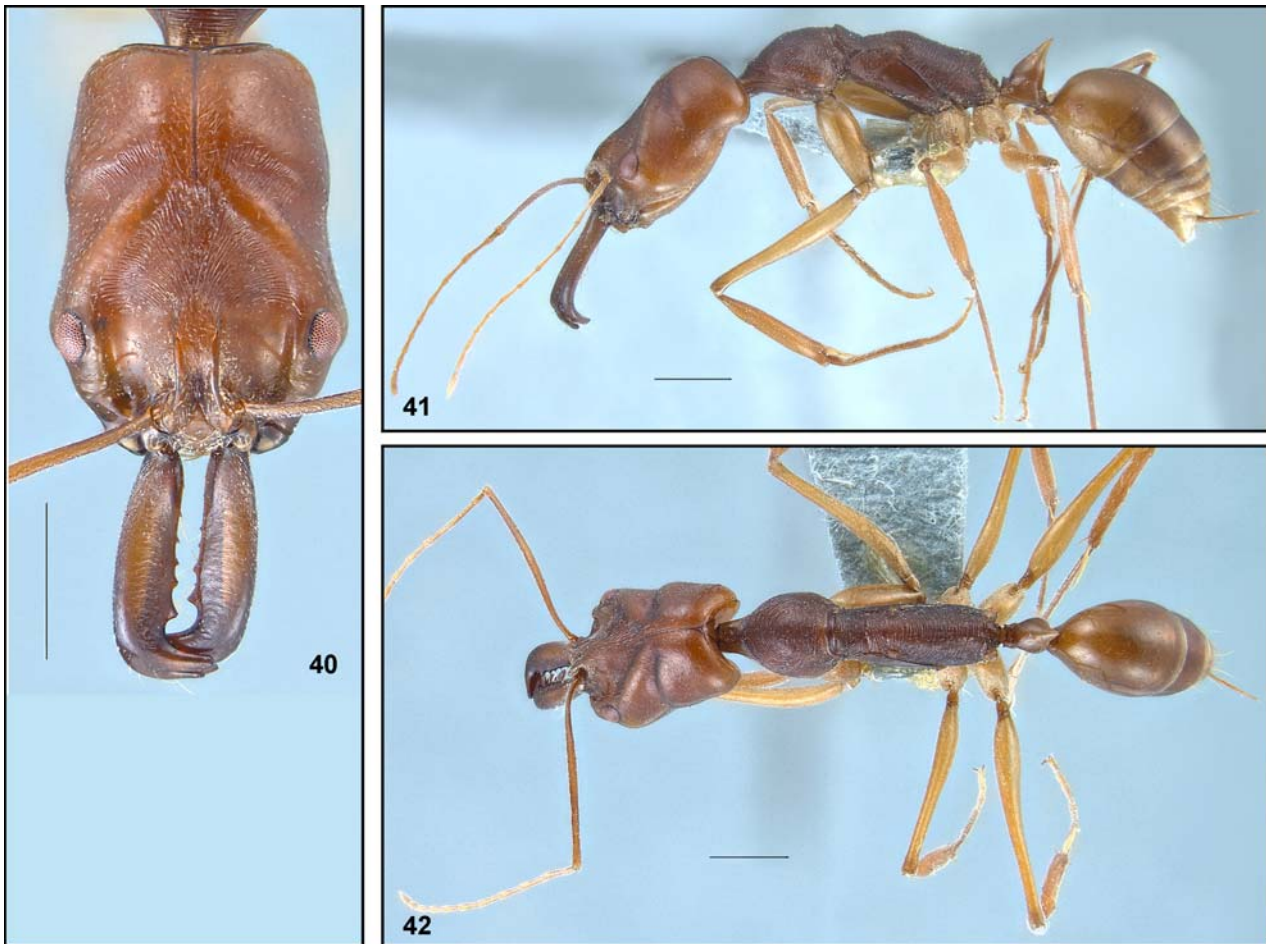
**Notes:** There is considerable variation in *O. rixosus*, especially in size and colour, but it seems unconnected with certain geographical populations. This includes the var. *obscurior*, described from Myanmar and Thailand (FOREL 1900), and later recorded from Palawan by STITZ (1925).

In the Philippines, *O. rixosus* can be recognized by group characters, especially by the elongate and truncate subapical tooth of the mandible.

#### *Odontomachus haematodus* species group

**Diagnosis:** Palp formula 4, 3 (one labial palp segment lost by fusion; unique in *Odontomachus*, see BROWN 1976). Head broad. Mandibles stout and relatively short, with short, blunt teeth; apical and especially subapical tooth short, tooth is scarcely or not at all projecting beyond the inner mandibular border (in callow workers, consists of two





Figs. 40 - 42: *Odontomachus rixosus*: (40) head, full face view; (41) habitus, lateral view, (42) habitus, dorsal view. Scales = 1 mm.

low, obtuse points separated by a weak concavity). Antennae tending to be shorter than in other groups (especially scapes of larger species only slightly surpassing posterior margin of head). In most species dorsal surface strongly sculptured, mostly by striation, in many species also petiole and gaster tergites with some striation or reticulation. Mesosoma stout, not depressed. Petiole stout, without or with short spine.

**Diversity and distribution:** *Odontomachus simillimus* SMITH, 1858 is the only Indo-Pacific species of this speciose group. *Odontomachus troglodytes* SANTSCHI, 1914 inhabits Africa, Madagascar, and the Seychelles. Most species (19) are found in the Neotropics: *Odontomachus affinis* GUÉRIN-MÉNEVILLE, 1844, *O. allolabis* KEMPF, 1974, *O. bauri* EMERY, 1892, *O. biolleyi* FOREL, 1908, *O. bumbonatus* BROWN, 1976, *O. brunneus* (PATON, 1894), *O. caelatus* BROWN, 1976, *O. chelifèr* (LATREILLE, 1802), *O. clarus* ROGER, 1861, *O. erythrocephalus* EMERY, 1890, *O. haematodus* (LINNAEUS, 1758), *O. insularis* GUÉRIN-MÉNEVILLE, 1844, *O. laticeps* ROGER, 1861, *O. mayi* MANN, 1912, *O. meinerti* FOREL, 1905, *O. opaciventris* FOREL, 1899, *O. panamensis* FOREL, 1899, *O. spissus* KEMPF, 1962, *O. yucatecus* BROWN, 1976.

***Odontomachus simillimus* SMITH, 1858** (Figs. 43 - 45, 47)

*Odontomachus simillimus* SMITH, 1858 (description of gyne; type locality: Fiji, also recorded from Sri Lanka).

*Odontomachus simillimus*: WILSON 1959: 499 and BROWN 1976: 165-166 (synonymies).

*Odontomachus haematoda* (misidentifications, nec *haematoda* LINNAEUS, 1758 from Neotropis, see WILSON (1959) and BROWN (1976)): EMERY 1893: 262 (distribution: Manila); WHEELER & CHAPMAN 1925: 71 (distribution: Los Baños, Laguna; Manila; Romblon; Port Cataingan, Masbate; Dumaguete, Negros); WHEELER 1929: 37 (distribution: Los Baños, Laguna); CHAPMAN & CAPCO 1951: 43 (partim, general distribution); BALTAZAR 1966: 239 (distribution: Luzon; Laguna, Manila; Masbate, Negros Oriental, Romblon).

**Material from the Philippines examined** (183 workers, 15 gynes; CSW, CZW, FMNH, NHMW, UPLB, USC, ZMUC): **Luzon:** Laguna: Los Baños, Mt. Makiling, 13.-18.XI.1992, leg. H. Zettel (1), 1 ♀. Los Baños, Mt. Makiling, 300 - 500 m, 8.-9.II.1996, leg. H. Zettel (74), 1 ♀. Los Baños, UPLB campus, 14.II.1999, leg. S. Schödl (3), 1 ♀. Los Baños, Mt. Makiling, UPLB - Mud Spring, 18.XI.1999, leg. H. Zettel (207), 1 ♀. Los Baños, Mt. Makiling, Flat Stones ["Rocks"], 14.II.1999, leg. S. Schödl (4), 3 ♀♀, 11.II.2002, leg. H. Zettel (308), 1 ♀. Camarines Norte: Labo, Tulay na Lupa, Mt. Labo - Mt. Bayabas area, 17.-18.III.2004, leg. H. Zettel & C. V. Pangantihon (382), 1 ♀. Daet, Bicol NP, Nalisan, 26.II.2004, leg. H. Zettel & C. V. Pangantihon (376), 1 ♀. Camarines Sur: Lupi, Alanao, Bahi River, 14.XI.1999, leg. H. Zettel (205), 16♂♂, 3.III.



Figs. 43 - 45: *Odontomachus similis*: (43) head, full face view; (44) habitus, lateral view and (45) dorsal view. Scales = 1 mm.

1999, leg. H. Zettel (191), 2 ♂♂. Lupi, N Sipocot, Sooc, XII.1999-I.2000, leg. S. V. Zettel (5), 1 ♀, 10.-12.III.2000, various collectors (246), 2 ♂♂, 1.-9.IV.2000, various collectors (252), 1 ♀, 10 ♂♂, 10.-21.IV.2000, various collectors (256), 1 ♀, 22.-29.IV.2000, various collectors (258), 29.II.2004, leg. C. V. Pangantihon (P47), 2 ♂♂, 18.-23.II.2004, leg. H. Zettel & C. V. Pangantihon (374), 1 ♀, 31.III.2004, leg. C. V. Pangantihon (P68), 1 ♀, 1 ♀. Lupi, Sooc, Looban, 15.III.2004, leg. H. Zettel (381), 1 ♀. Lupi, Sooc, Bicol NP, 100 m, 22.II.2008, leg. H. Zettel (508), 1 ♀. 20 km E Naga, 3 km E Carolina, Mainit Spring ("Hydro"), 4.III.1999, leg. H. Zettel (193), 1 ♀. Albay: 40 km N Legaspi, 1 km W Malilipot, Busai Falls, 23.II.1998, leg. H. Zettel (143), 1 ♀. NE Legaspi, St. Domingo, Reyes, 20.III.1998, leg. H. Zettel (163), 1 ♀. Sorsogon: NE Irosin, N San Roque, Lake Bulusan, 630 m, 26.II.1998, leg. H. Zettel (146), 1 ♀. **Catanduanes:** S of Summit, N Narsari, 9.III.1999, at small creek, leg. H. Zettel (198), 1 ♀. E San Andres, 11.-12.III.1999, leg. H. Zettel (200), 1 ♀, 12.III.1999, leg. F. Seyfert (26), 1 ♀. (Rombon Prov.) **Sibuyan:** E Magdiwang, W Silum, Lambigan Falls, 21.XI.1994, leg. H. Zettel (69), 2 ♂♂. (Rombon Prov.) **Tablas:** San Agustin, Dubduban, Busai Falls, 23.-25.XI.1994, leg. H. Zettel (70), 8 ♂♂. **Mindoro Oriental:** Puerto Galera, S Big La Laguna, 25.XI.1993, leg. H. Zettel (33), 1 ♀. S Puerto Galera, Big Tabinay River, 27.XI.1993, leg. H. Zettel (36), 1 ♀. Baco, Hidden Paradise, 19.-20.XI.1993, leg. H. Zettel (27), 1 ♀. **Cebu:** Cebu City, Talamban,

University of San Carlos campus, 12.-16.XI.2003, leg. C. V. Pangantihon, 2 ♂♂, 19.IV.2004, leg. C. V. Pangantihon, 3 ♂♂. Talamban, University of San Carlos campus, dormitory, 22.V.2005, leg. C. V. Pangantihon (P154), 1 ♀. W Cebu City, Minglanilla, Camp 7, near creek and waterfall, 16.XI.2003, leg. H. Zettel & C. V. Pangantihon (358), 2 ♂♂. S Badian, Matutinao, Kawasan Falls, 2-50 m, 23.-24.II.1997, leg. H. Zettel (116), 6 ♂♂. Malapuyug, Monteneza, 0 - 10 m, 13.XI.2003, leg. C. V. Pangantihon (P353), 2 ♂♂. (Cebu Prov. : ) **Bantayan:** Atop-Atop, N Santa Fe, coast, 18.X.2004, leg. C.V. Pangantihon (P388), 1 ♀. **Siquijor:** Lazi, Po-o River, 1.III.1997, leg. H. Zettel (121), 2 ♂♂. Lazi, Po-o River, near Cambugahay Falls, 22.X.2004, leg. C. V. Pangantihon (P392), 2 ♂♂. Bandila-an NP, Lodge - Little Waterfall, 23.X.2004, leg. C. V. Pangantihon (P395), 2 ♂♂. **Samar:** Western Samar: E Basey, Sohoton National Park, at Sohoton River, 29.I.2000, leg. S. Schödl (2), 1 ♀. **Leyte:** Leyte Prov.: N Tacloban, Babatngon, Busay Falls, 28.I.2000, leg. S. Schödl (1), 9 ♂♂, leg. H. Zettel (220), 1 ♀. Baybay, ViSCA, along coast line, 12.II.2000, leg. S. Schödl (15), 4 ♂♂. Baybay, ViSCA campus, Mt. Pangasugan, 100 m, secondary forest, 31.I.2000, leg. S. Schödl (4), 1 ♀. Baybay, ViSCA, Mt. Pangasugan, above Forestry Department, 250 m, 11.II.2000, leg. S. Schödl (14), 2 ♀♀, 2 ♂♂. Baybay, Mt. Pangasugan, along Lago-Lago River, 50 - 250 m, secondary forest, 1.II.2000, leg. S. Schödl (5), 2 ♂♂, 1 ♀. Baybay, Mt. Pangasugan, Calbiga-a River, 50 - 200 m, 12.II.2000, leg. H. Zettel (236), 1 ♀, 50 - 100 m,



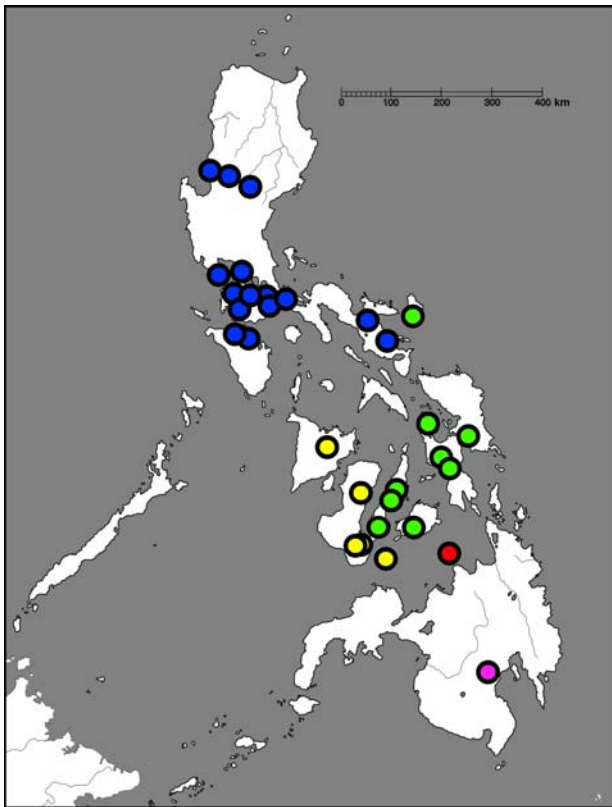


Fig. 46: Map of the Philippines with distribution of *Odonotomachus infandus* (blue), *O. philippinus* (yellow), *O. alius* sp.n. (green), *O. scifictus* sp.n. (red), *O. sp. 1* (violet), and *O. sp. 2* (pink).

20.-21.III.2005, leg. H. Zettel & C. V. Pangantihon (422), 1 ♂. Southern Leyte: San José, 14.I.1945, leg. E. Ray (90) (Chicago-NHM), 1 ♀. N Maasin, at small stream E Lonoy, 20.XI.2003, leg. H. Zettel & C. V. Pangantihon (362), 3 ♀♀. Ibarra, Divisoria, near small creek, 21.XI.2003, leg. H. Zettel & C. V. Pangantihon (363), 1 ♂. **Camiguin:** W Mambajao, Katibawasan spring area, 350 - 400 m, 13. and 15.III.2010, leg. H. Zettel & C. V. Pangantihon (515), 1 ♂. W Mambajao, Benon, between Saran and Kampanan, 500 - 800 m, 16. and 18.III.2010, leg. H. Zettel & C. V. Pangantihon (516), 1 ♀. (Surigao del Norte Prov.) **Dinagat:** 6.8 km along round north of Dinagat proper, Busay, 3.II.2000, leg. S. Schödl (6), 7 ♂♂. (Surigao del Norte:) **Bayagnan:** southwest coast, 7. II.2000, leg. S. Schödl (10), 22 ♂♂. (Surigao del Norte:) **Hikdop:** south and southwest coast, 5.II.2000, leg. S. Schödl (8), 23 ♂♂, leg. H. Zettel (227), 2 ♂♂. **Mindanao:** Surigao del Sur: Tandag, San Antonio, 25. X.2010, leg. C.V. Pangantihon (P366), 1 ♂. **Tawi-Tawi:** Bongao, Lapid Lapid, at Manalik Channel, 20.XI.1961, Noona Dan Expedition, 4 ♂♂. (Palawan Prov.) **Busuanga:** 5 km NW Coron, Mabentangen Forest Reserve, 1.-7.II.1999, leg. H. Zettel (170), 7 ♂♂. **Palawan:** Brooke's Point, Uring-Uring, 25.VIII.1961, Noona Dan Expedition, 3 ♂♂, 1 ♀. Mantalingajan Range, Mt. Balabag, 2800 ft (= ca. 850 m a.s.l.), 4.V.1947, leg. F.G. Werner, Chicago-NHM - Philippine Zoological expedition 1946-47, 1 ♂. (Palawan Prov.) **Balabac:** Dalawan Bay, 10. and 12.X.1961, Noona Dan Expedition, 2 ♀♀.

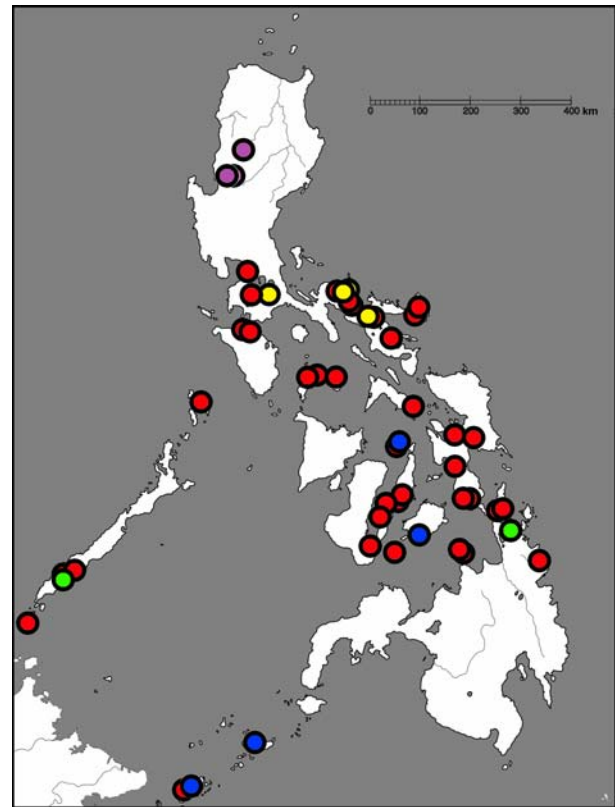


Fig. 47: Map of the Philippines with distribution of *Odonotomachus schoedli* sp.n. (violet), *O. banksi* (yellow), *O. rixosus* (green), *O. malignus* (blue), and *O. simillimus* (red).

**Material from other countries examined:** 175 workers and 6 gynes (CZW, NHMW) from Sri Lanka, India (Nicobar Isl.), Malaysia (Peninsular), Indonesia (Nias, Sulawesi, Irian Jaya), Papua New Guinea, Samoa, and New Caledonia.

**Description of worker:** Measurements: worker with smallest HW: CI 83, HL 1.97, HW 1.63, MdI 53, MdL 1.05, MsL 2.43, SI 108, SL 1.77, PnW 0.87, PtH 0.75, PtL 0.64, PtW 0.38, TL 7.63; worker with largest HW: CI 82, HL 2.52, HW 2.07, MdI 53, MdL 1.33, MsL 2.93, PnW 1.13, PtH 0.89, PtL 0.99, PtW 0.52, SI 106, SL 2.20, TL 11.06.

**Structures:** Mandibles short and stout, with very fine denticles, sometimes completely edentate but always with three apical teeth (intercalary tooth slightly shorter than apical and subapical teeth). Apex of mandibles with some setae. Mandibles mostly smooth, some fine ridges / striae may occur, with fine white pubescence, hair pits distinct. Head in dorsal view rectangular, longer than wide, broadest at level of eyes which do not surpass outline of head. Dorsum of head striate, striation almost reaching nuchal carina (at dorsal margin, area of about the width of the scape, smooth). Eyes located dorsolaterally in first third of head. Mesosoma elongate in dorsal view, broadest at level of pronotum. Pronotum with round striation, often slightly oval or longitudinal in centre, but some entire circles always visible in dorsal view. Mesonotum and propodeum with transverse striation (slightly coarser on propodeum). Mesopleuron smooth in centre, some striation at margins. Metanotal spiracle inconspicuous, situated dorsolaterally. Petiole short and straight, conspicuously "tear-shaped" in



frontal view, broad with short petiolar spine, posteriorly flat with transverse striation. Gaster rounded to oval; anterior part of first tergite evenly convex in lateral aspect, without impression; first tergite smooth, second with some reticulation, at least anteriorly.

**Pilosity:** Fine white semi-appressed pubescence on entire body, very dense on appendages including petiole, on mesosoma, head and gaster distance between hairs approximately their length. Few standing setae on pronotum, several standing hairs on gaster increasing in length towards apex of abdomen. Some isolated hairs on head venter and one pair of standing setae on head dorsum.

**Colour:** Body, including all appendages, dark brown (almost black in some specimens).

**Description of gyne:** Measurements: gyne with smallest HW: CI 87, HL 2.27, HW 1.97, MdI 57, MdL 1.30, MsL 2.93, PnW 1.60, PtH 1.00, PtL 0.78, PtW 0.49, SI 107, SL 2.10, TL 9.88; gyne with largest HW: CI 85, HL 2.47, HW 2.10, MdI 54, MdL 1.33, MsL 3.13, PnW 1.65, PtH 1.02, PtL 0.88, PtW 0.61, SI 104, SL 2.18, TL 10.31.

**Structures:** Differs only in the following characters: pronotum with transverse striation, mesonotum with longitudinal striation, scutellum shiny, sexual female morph-specific characters (wing insertions, mesosoma and gaster bigger).

**Notes:** *Odontomachus simillimus* can be easily recognised even in the field by small size, dark colour, proportionally large head and short scape. In the Philippines, there is no other species with a short, truncate subapical tooth of the mandible (Fig. 43), and none with fine reticulation on visible part of gaster tergite 2 (but note that the anterior part of tergite 2 which is usually covered by tergite 1 is also reticulate in other species).

*Odontomachus simillimus* is surprisingly uniform over its large distribution area. It is distinguished from the second Old World species, *O. troglodytes* from Africa, Madagascar, and the Seychelles, by its smooth gaster tergite 1.

**Distribution** (Philippines: Fig. 47): Widely distributed from India to Polynesia (WILSON 1959, BROWN 1976), "undoubtedly many of the island records represent accidental introductions by man" (BROWN 1976: 87). No distribution limit in the Philippines; records from 21 islands (19 in this study).

**Habitats:** *Odontomachus simillimus* is a common species which also can be found in open or moderately to strongly disturbed habitats, like coastal areas, coconut groves, villages, and even lawns on university campuses. It usually does not enter dense forests, but can be occasionally found on banks of stream running through forests. According to collections by Chapman in eastern Negros, the species can be found from sea level up to an elevation of 900 m (WHEELER & CHAPMAN 1925).

## Discussion

Although *Odontomachus* are very conspicuous ants, little attention has been paid to their taxonomy since BROWN's (1976) revision. As we have mentioned previously, the Philippines harbour two sets of *Odontomachus* species, one of which is generally widespread in distribution and the other of which, the one we discuss here in more detail, includes more range-restricted species. Regarding the latter set, what might be called the Philippine *O. infandus* group species, BROWN's (1976) concept of a widely distributed,

highly variable species, *O. infandus*, turned out to be wrong; perhaps simply because it was blurred by incorrect label data. New and correctly labelled samples show a pattern of distinct, sympatric and allopatric species, each with a comparatively stable character set and endemic on one or a few islands. Sympatry is observed only on the island of Luzon (four species), allopatry on several other islands. In other words, there appears to be a radiation of native *Odontomachus* species both among and within islands. Ranges of the more widely distributed species agree relatively well with patterns found in other terrestrial or limnic organisms and are largely effected by the areas covered by the large Pleistocene islands (e.g., ONG & al. 2002 and references cited therein).

The present study includes two unnamed species. Species 1 from southern Luzon is somewhat problematic as it shows affinities to the sympatric species, *O. infandus* and *O. banksi* (in one instance even sharing the same habitat with the latter), and similarities with the allopatric *O. alius*. Species 2, although only based on one individual, must be regarded as an undescribed species, but it seems advisable to see more specimens before naming it.

A key next step is to study the molecular phylogenetic relationships of species and isolated populations of the Philippine *O. infandus*-group species. The archipelago is among the earth's most important biodiversity hot-spots (MITTERMEIER & al. 2005, CATIBOG-SINHA & HEANEY 2006) and a "laboratory of evolution", many thousand times more diverse than the famous Galapagos Islands. *Odontomachus* species, with their conspicuous and consequential feeding morphology have the potential to serve as living laboratory for understanding evolution of this diverse region, not quite Darwin's finches, but perhaps Brown's trap-jaws.

There is a lack of taxonomic knowledge of the sexuals of most *Odontomachus* species. Males are presently not identifiable at all. Excavations of complete nests (e.g., see TSCHINKEL 2011) would help, also for learning about size and development of *Odontomachus* colonies. Focused studies of these species in general would be rewarding. It is perhaps worth noting in this regard that the collections by the second author and co-fellows are by-products of his project on aquatic Hemiptera (GAPUD & ZETTEL 1999) rather than focussed ant research.

Another area for promising research might be to consider the biology of the enigmatic species, *O. malignus*. There are only a few anecdotal notes on its life (WILSON 1959, BROWN 1976, OLSEN 2009), but it is well known that ants in intertidal zones can display fascinating adaptations to their unfavourable habitats (NIELSEN 2011).

Finally, we would be remiss if we did not mention the conservation implications of our findings. Ants do have a potential importance for conservation biology (e.g., KAUTZ & MOREAU 2011 and references therein), particularly in tropical countries. Sadly, destruction of forests in the Philippines is still ongoing, despite the present low level of natural forest cover (ONG & al. 2002, CATIBOG-SINHA & HEANEY 2006). Our results suggest that based on morphology, ants of the Philippines may include more endemic species than currently recognized. The number seems likely to increase further with molecular work. Forest-inhabiting, endemic ants are strongly affected and threatened by extinction and range-restricted taxa are more threatened than those that are widespread. This danger is perhaps most

acute for species on the Visayas Islands (*O. philippinus* and *O. alius*), where forests have been diminished to a few remnant spots (e.g., on Panay, Negros, Siquijor, Cebu, Bohol) (see ONG & al. 2002), as well as for the very locally distributed *O. scifictus* on Camiguin. The more we see the unique elements of local species and forms in *Odontomachus*, as well as more generally, the more we are aware of their threat and, similarly, just how little we know of what is being lost.

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### Zusammenfassung

Eine Übersicht über die philippinischen *Odontomachus*-Arten behandelt elf Arten einschließlich zweier unbenannter Spezies. Diese gehören zu vier Artengruppen: *Odontomachus simillimus* SMITH, 1858 in die *O. haematodus*-Gruppe, *O. rixosus* SMITH, 1857 in die neu definierte *O. rixosus*-Gruppe und *O. malignus* in die neu errichtete, von der *O. infandus*-Gruppe abgetrennte *O. malignus*-Gruppe. Keine dieser drei Arten ist endemisch. Hingegen gehört die Mehrzahl der Arten in die *O. infandus*-Gruppe und alle Arten sind auf den Philippinen regional-endemisch. Dazu gehören *O. infandus* SMITH, 1858 (= *O. infandus* r. *striaticeps* STITZ, 1925) von Luzon und Mindoro, *O. philippinus* EMERY, 1893 sp.rev. von Panay, Negros und Siquijor, *O. banksi* FOREL, 1910 von Luzon sowie drei weitere, neu beschriebene Arten, nämlich *O. schoedli* sp.n. von Nordluzon,

*O. scifictus* sp.n. von Camiguin und der auf den zentralen und östlichen Philippinen weit verbreitete *O. alius* sp.n. Zusätzlich werden zwei weitere Arten (sp. 1 und sp. 2) behandelt, welche vorerst unbenannt bleiben. Zur Sicherung der Stabilität der Nomenklatur werden Lectotypen für die folgenden Taxa designiert: *O. infandus* SMITH, 1858, *O. infandus* r. *striaticeps* STITZ, 1925, *O. papuanus* st. *philippinus* EMERY, 1893, und *O. banksi* FOREL, 1910.

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