First discovery of subdichthadiigyne in *Yunodorylus* Xu, 2000 (Formicidae: Dorylinae)

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Abstract

_Yunodorylus_ comprises four named species and has so far been known exclusively from the Indo-Chinese and Indo-Malayan subregions. Recently, two queen-right colonies of *Yunodorylus eguchii* Borowiec, 2009 were found in a lowland evergreen forest in Lo Go Xa Mat National Park, southwestern Vietnam. The present paper is the first description of the queen caste of _Yunodorylus_. The queens were interestingly subdichthadiiform. This discovery has an important implication in our further understanding of the evolution of the “Army Ant Adaptive Syndrome” in the subfamily Dorylinae.

Key words: Cerapachys sexspinus group - Vietnam - queen - morphology - army ant adaptive syndrome.

INTRODUCTION

The ant genus _Yunodorylus_ was established by Xu (2000) based on a single species _Y. sexspinus_ from Yunnan province, China. He placed _Yunodorylus_ under the subfamily Dorylinae based on its general habitus recalling the worker of _Dorylus_: waist consisting of a single-segment; worker polymorphic; and terrestrial habits (Xu, 2000). At the same time he considered it as “a possible inter-link between the subfamilies Dorylinae and Cerapachyinae in evolution”, because _Yunodorylus_ also has features of Cerapachyinae: masticatory margin of mandible long and oblique, and armed with more than 3 teeth; promesonotal suture absent; propodeal spiracles low on side; pygidium not impressed medially, and posterolaterally armed with minute peg-like spines (Xu, 2000). However, Bolton (2003) synonymized _Yunodorylus_ with _Cerapachys_ under Cerapachyinae, because “the worker features used to define _Yunodorylus_ included apomorphies and other morphological aspects that are characteristic of Cerapachyinae” (see also Bolton, 1990).

Borowiec (2009) basically followed the classification proposed by Bolton (2003) and redefined _Yunodorylus_ as the _Cerapachys sexspinus_ group and provided diagnosis of the species group based on the worker. However, according to the most recent molecular phylogenetic analysis of the major dorylomorph lineages (Brady et al., 2014), the six previous dorylomorph subfamilies, i.e., Aenictinae, Dorylinae, Ecitoninae, Aenictogitoninae, Leptanilloidinae, and Cerapachyinae, should be subsumed into a single subfamily, Dorylinae. Of these six families, “Cerapachyinae” is non-monophyletic and highly heterogeneous, while the others are monophyletic and _Yunodorylus_ is an independent clade. Therefore, we hereafter refer to the _Cerapachys sexspinus_ group sensu Borowiec (2009) as _Yunodorylus_.

_Yunodorylus_ currently comprises four named species and has so far been known exclusively from the Indo-Chinese and Indo-Malayan subregions (Borowiec, 2009). Although the queen and male had been unknown for the genus, the present authors (K. Eguchi, R. Satria and V. A. Dang) found two queen-right colonies (no. Eg20ix15-01 and Eg19ix15-01) of _Yunodorylus eguchii_ Borowiec, 2009 in a lowland evergreen forest in Lo Go Xa Mat National Park, southwestern Vietnam. The queens were interestingly subdichthadiiform. In the
present paper we describe the external morphology of the subdichthadigyne. Results of laboratory observations on their foraging and reproduction will be presented in a separate paper.

**MATERIALS AND METHODS**

Species determination of the colonies Eg20ix15-01 and Eg19ix15-01 was done by referring to Borowiec (2009) and comparing the workers of the colonies with the paratypes of *Yunodorylus eguchi*.

Abbreviation of specimen depositories are as below:

- ACEG: Ant Collection of Katsuyuki Eguchi (see contact address given under the title of this article).
- IEBR: Institute of Ecology and Biological Resources, Vietnam Academy of Science and Technology, 18 Hoang Quoc Viet Road, Cau Giay District, Hanoi, Vietnam.
- MCZC: Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, USA.
- MHNG: Musée d’Histoire Naturelle, Geneva, Switzerland.

Multi-focused, montage images were produced by Helicon Focus Pro 6.2.2 from a series of source images taken by an Olympus Pen Lite E-PL7 digital camera or Panasonic Lumix DMC-GX8 attached to a Nikon AZ100 microscope. Fine hairs and other features not recognized automatically were copied from the focused parts source from the source images on 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 CS6.

Photographs for measuring were taken by an Olympus Pen Lite E-PL7 digital camera attached to a Nikon AZ100 microscope under suitable magnification. The following body parts were measured by ImageJ 1.49m (National Institute of Mental Health, USA, available at http://imagej.nih.gov/ij/) and then the indices were calculated: HL, maximum length of head measured from the level crossing the apaxes of lateroclypeal teeth to the level crossing the posterolateral corners of head; HW, maximum width of head in full-face view; SL, maximum measurable length of scape, from the proximal point of scape shaft, not including the condyle, to the distal end of scape; ML, mesosomal length in dorsal view measured from the midpoint of anterior margin of mesosoma; PH, maximum height of petiole, measured from the posteroventral apex of metapetiole process to the highest point of the dorsal outline of petiole; PW, maximum width of petiolar node; A3W, maximum width of abdominal segment III (gastral tergite I); A3L, maximum length of abdominal segment III (excluding helcium) in dorsal view; CI=HW/HL×100; MBI=MBL/HW×100; SI=SL/HW×100; MI=ML/PNW×100; MFI=FL/HW×100; A3I=A3W/PW×100.

**DESCRIPTION OF THE SUBDICHTHADIGYNE OF *YUNODORYLUS EGUCHII***

**Description** (Figs 1-12): Head in full-face view subrectangular, longer than broad, broadest slightly behind midlength of head, with lateral margins weakly convex and posterior margin broadly and strongly concave (Fig. 1), relatively low dorsoventrally (Fig. 4); preoccipital carina absent (Fig. 8); frontal lobes present as narrow erect to subrectangular walls narrowly separated from each other by a longitudinal strip of median portion of clypeus (Fig. 2); antennal socket in full-face view fully exposed, very close to anterior margin of head; clypeus narrow from front to back, with a weakly convex anteromedian margin; lateroclypeal teeth low and blunt (blue arrow in Fig. 2); anterior margin of clypeus (red arrow in Fig. 2); parafrenal ridges completely absent; antennal socket in full-face view fully exposed, very close to anterior margin of head; clypeus narrow from front to back, with a weakly convex anteromedian margin; lateroclypeal teeth low and blunt (blue arrow in Fig. 2); mandible triangular, with a large apical tooth followed by two small teeth on the masticatory margin; antenna 12-segmented; segment II longer than broad; segment III to XI broader than long; apical segment bullet-shaped with blunt apex, much longer than broad; compound eye absent; median ocellus vestigial, recognized as a small impression (red arrow in Fig. 4), but lateral ocelli absent; palp formula unknown (not dissected); mesosoma almost box-shaped, stout, in lateral view with dorsal margin slightly convex, in dorsal view slightly constricted in front of propodeum lateral margins, without flight sclerites; mesonotal suture weakly recognized, convex anteriad (red arrow in Fig. 8); metanotal groove relatively conspicuous dorsally and laterally, in dorsal view convex posteriad (blue arrow in Fig. 8); anterior margin of mesopleuron forming a small lobe projecting over basal part of forecoxa (black arrow in Fig. 9); metapleural gland orifice concealed beneath a ventrolaterally directed cuticular flap (red arrow in Fig. 9); propodeum without any spines, carinae, etc. posteriorly, in lateral view with posterodorsal corner bluntly angulate, in posterodorsal view with a faint
median longitudinal depression; an endophragmal pit distinct on the lateral face of propodeum (blue arrow in Fig. 9); propodeal lobe very low; mesotibia and metatibia with a small simple spur in front of a large pectinate spurs; inner margin of pretarsal claws of all legs without teeth; metatibial gland absent; waist consisting of a single small segment (petiole); petiole without tergosternal fusion, in dorsal view much broader than long, broadest around the posterior 1/3 length of the petiolar length, with anterior margin weakly concave and lateral margins weakly convex; subpetiolar process developed as a rectangular lobe, with an obtuse anteroventral and acute posteroventral angle (Fig. 7); abdominal segments III–VII without tergosternal fusion; abdominal segment III

Figs 1-4. Subdichthadiigyne (specimen no. IMG20160315-1; colony no. Eg20ix15-01). (1) Head in full-face view. (2) Clypeus in full-face view. (3) Left antenna. (4) Vertex in full-face view.
with anterodorsal face (above helcium) vertical, with anteroventral face (below helcium) weakly humped; the anteroventral face without any margin or carina; pygidium convex, but not flattened nor impressed dorsally (Fig. 10), apically with relatively long, thick and truncate-tipped setae (red arrows in Fig. 12), but without any peg-like or spine-like setae on posterolateral margins; hypopygium flattened ventrally, with a U-shaped posterior margin.

without any peg-like or spine-like setae on posterolateral margins (Fig. 11); sting developed (Fig. 12). Body densely covered with short standing hairs, less sculptured but densely with hair pits, yellowish-brown (see Figs 1, 5, 6); sclerotization of body relatively weak (head and some of legs deformed during dry-mounting).

Specimen used for the description: MHNG; VIETNAM, Tay Ninh Province, Lo Go Xa Mat National Park, N11°35'17", E105°53'01-10", ca. 5-15 m alt.; K. Eguchi leg.; 20/IX/2015; subdichthadiigyne (specimen no. IMG20160315-1; colony no. Eg20ix15-01).

Specimens used for the species determination: ACEG; VIETNAM, Dong Nai Province, South Cat Tien National Park; K. Eguchi leg.; 21/X/2004; 2 paratype workers. – ACEG, IEBR, MCZC, MHNG, VNMN; for collection data see above; 20 workers (Eg20ix15-01). – ACEG, IEBR, MCZC, MHNG, VNMN; VIETNAM,

Discovery of subdichthadiigyne in *Yunodorylus* contained many larger larvae probably in the final instar and a few pupae only. These field observations suggest the presence of synchronized brood development in *Yunodorylus*. Both colonies were brought back to our laboratory in Kagawa Univ., Japan, and their foraging and reproduction behaviors had been observed for several months (Fig. 14). During the observation the subdichthadiigyne of Eg19ix15-01 died or was killed, and then the body was destroyed or eaten by workers. Thus it was unusable for our morphological examination. The results of our laboratory observation will be presented in a separate paper.

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**Bionomics:** The colonies Eg20ix15-01 and Eg19ix15-01 were found in thick soil walls of termite mounds built on the ground of lowland evergreen forest fragments of Lo Go Xa Mat National Park (Fig. 13). The Eg20ix15-01 colony contained tiny larvae probably in earlier instar only, and the Eg19ix15-01 colony contained many larger larvae probably in the final instar and a few pupae only. These field observations suggest the presence of synchronized brood development in *Yunodorylus*. Both colonies were brought back to our laboratory in Kagawa Univ., Japan, and their foraging and reproduction behaviors had been observed for several months (Fig. 14). During the observation the subdichthadiigyne of Eg19ix15-01 died or was killed, and then the body was destroyed or eaten by workers. Thus it was unusable for our morphological examination. The results of our laboratory observation will be presented in a separate paper.

**Remarks:** The “full-dichthadiigyne” in the dorylomorph lineages is usually defined by a combination of the following characteristics: compound eyes vestigial or absent; head swollen and subglobular, often with falcate mandibles; mesosoma without flight sclerites; petiole hypertrophied, commonly bilaterally cornulate; gaster distended (Bolton, 1990; Hölldobuler & Wilson, 1990; Gotwald, 1995). Thus, it is safe to conclude that the queen of *Y. eguchii* is subdichthadiiform, based on the following exceptions: head less swollen and not subglobular; mandibles triangular (as seen in the worker); petiole less hypertrophied and simple in shape. In other words, the worker-queen dimorphism is weaker in *Yunodorylus* than in the dorylomorph lineages with a full dichthadiigyne. The remarkable differences between the worker and queen in *Yunodorylus* are the body proportion, presence (worker) or absence (queen) of metatibial gland, and presence (worker) or absence (queen) of pygidial peg-like or spine-like setae. Interestingly, the absence of pygidial peg-like or spine-like setae is also known in the normal and subdichthadiiform queens of the genus *Acanthostichus* (Brown, 1975; Mackay, 2004).
REFERENCES


