

NOTES ON DISTRIBUTION AND GENETIC VARIATION OF *OOCERAEA QUADRIDENTATA* YAMADA, LUONG ET EGUCHI, 2018 (HYMENOPTERA: FORMICIDAE: DORYLINAЕ)

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Summary. The ant *Ooceraea quadridentata* was known from the central highlands of Vietnam and Thailand. In the present study this species is recorded from Sumatra Island for the first time. The specimens of this ant were collected in a small hill in the middle of urban area. The morphological and genetic variability of this species is discussed.

Key words: ants, genetic, variability, fauna, new record, Sumatra, Indonesia.

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Резюме. Муравей *Ooceraea quadridentata* был известен из центральных высокогорий Вьетнама и Таиланда. В настоящей работе этот вид впервые отмечен с о-ва Суматра. Экземпляры этого муравья были собраны на небольшом холме посреди городской территории. Обсуждается морфологическая и генетическая изменчивость этого вида.

INTRODUCTION

The ant genus *Ooceraea* Roger, 1862 is one of the members of subfamily Dorylinae. This genus was previously experienced a long taxonomic history (Borowiec, 2016; Bharti, 2021), previously as a junior synonym of *Cerapachys* (Brown 1975), then revived as valid genus by Borowiec (2016). Total 17 species of this genus was known in the world, while in Sumatra only *Ooceraea biroi* was recorded (Borowiec, 2016; Yamada *et al.*, 2018; Bharti *et al.*, 2021; Jaitrong *et al.*, 2021).

According to Yamada *et al.* (2018), *Ooceraea quadridentata* Yamada, Luong et Eguchi, 2018 is easily recognized by its distinctive characteristic, its propodeum contains two pairs of denticles. The morphological characteristics of the worker as follows: eye and ocelli completely

absent; antenna 11 segmented and segment III very short; propodeum with two conspicuous denticles; in lateral view postpetiole subrectangular.

In the course of our study of the diversity of ants in Sumatra, we reported some genera of ants (Satria *et al.*, 2015; Satria *et al.*, 2017; Satria & Yamane, 2019; Satria & Herwina, 2020; Satria & Jannatan, 2021; Musfira *et al.*, 2022; Satria *et al.*, 2022; Satria & Eguchi, 2022; Satria *et al.*, 2023) including the genus *Ooceraea*. In the present study, we collected part of colony of *Ooceraea quadentata* in the lowland disturbed forest in West Sumatra. The location where this species was found is quite interesting, due to its located in the middle of the city. This finding is a new record of the *Ooceraea quadridentata* in Sumatra. After carefully examined of the specimens from Sumatra, and compare to the holotype images and original description of this species (Yamada *et al.*, 2018), and data from Thailand (Jaitrong *et al.*, 2021), we recognized few morphological variations between the population of Sumatra and Vietnam. Then we analyzed the genetic variation of these populations, and reported it in the present study.

MATERIAL AND METHODS

We conducted a survey of leaf-litter ants from June 2023 to August 2023. Few workers of *Ooceraea quadridentata* were collected by using the winkler extraction method in lowland disturbed forest near Gunung Pangilun (0°54'59.7"S, 100°22'4.7"E), North Padang District, Padang, West Sumatra Province, Indonesia. The species determination was done by referring to the key of the *Ooceraea* species in the Oriental (Yamada *et al.*, 2018), by holotype images provided in Antweb (2003) with specimen code: ANTWEB1041156 and by the original description.

Multi-focused montage images were produced using Helicon Focus Pro. (Helicon Soft Ltd., <http://www.heliconsoft.com/>) from a series of source images taken by a Canon EOS KissX5 digital camera attached to a Nikon SMZ1270 stereomicroscope. Artifacts/ghosts and unnecessary parts (unfocused appendages, insect pin, etc.) surrounding or covering target objects were erased and cleaned up using the retouching function of Helicon Focus Pro, and the color balance, contrast, and sharpness were adjusted using Adobe Photoshop CS6.

The following parts of the bodies were measured using ImageJ 1.49m (National Institute of mental Health, USA, available at <http://imagej.nih.gov/ij/>) based on the photographs taken using a Canon EOS KissX5 digital camera attached to Nikon SMZ1270 stereo microscope. The morphological terminology Borowiec (2016), measurements and indices are modified from Yamada *et al.* (2018) as follows: HL = Head Length, midline length of the cephalic capsule, measured in full-face (dorsal) view, from the anterior margin of the clypeus to the midpoint of a line drawn across the occipital margin (including occipital lobes if present); HW = maximum width of head, measured in the same plane as HL, excluding the eyes; SL = Scape Length, length of the first antennal segment, excluding the neck and basal condyle; ML = diagonal length, measured in lateral view from the anterior margin of the pronotum (excluding the collar) to the posterior extremity of the basal angle of metapleuron; PL = Petiolar length; PH = Petiolar height; PPL = Postpetiolar length, maximum length of postpetiolar in lateral view (excluding helcium); PPH = Postpetiolar height, maximum height of postpetiolar in lateral view; PPW = Postpetiolar width, maximum width of postpetiolar in dorsal view; CI = Cephalic Index, HW/HLx100; SI = Scape Index, SL/HWx100; PI1 = Petiolar index 1, PL/PH × 100; PI2 = Petiolar index 2, PW/PL × 100; PPI1 = Postpetiolar index 1, PPL/PPH × 100; PPI2 = Postpetiolar index 2, PPW/PPL × 100; WI = Waist index, PPW/PW × 100.

The Mitochondrial COI gene was used to analyze the comparisons between specimens according to Satria *et al.* (2015). The primer sets used are primers that have been adapted

from the ant genome, namely: LCO-EG (TTTCAACAAATCACAAAGAYATYGG) and HCO-EG (TAAACTCAGGRTGACCRAAAAATCA). The data of COI of *Ooceraea quadridentata* from Vietnam was analyzed with accession no. from GenBank: LC611729.10 as the paratype. The outgroups of phylogenetic analysis were used *Cerapachys biroi* (with accession no. JX157196.1) and *Proformica nasuta* (with accession no. KU749633.1). Then the sequences data were analyzed by MEGA 11 application by selecting clustalW, and reconstruct the phylogenetic tree by using the Maximum Likelihood method with 1000 bootstrap.

RESULTS

Ooceraea quadridentata Yamada, Luong et Eguchi, 2018

Fig. 1

MATERIAL EXAMINED. **Indonesia:** West Sumatra: Padang: Kota Padang, Gunung Pangilun, 0°54'59.7"S, 100°22'4.7"E, ca 70 m asl., 2023, worker (Colony code: GP-30v23-01).

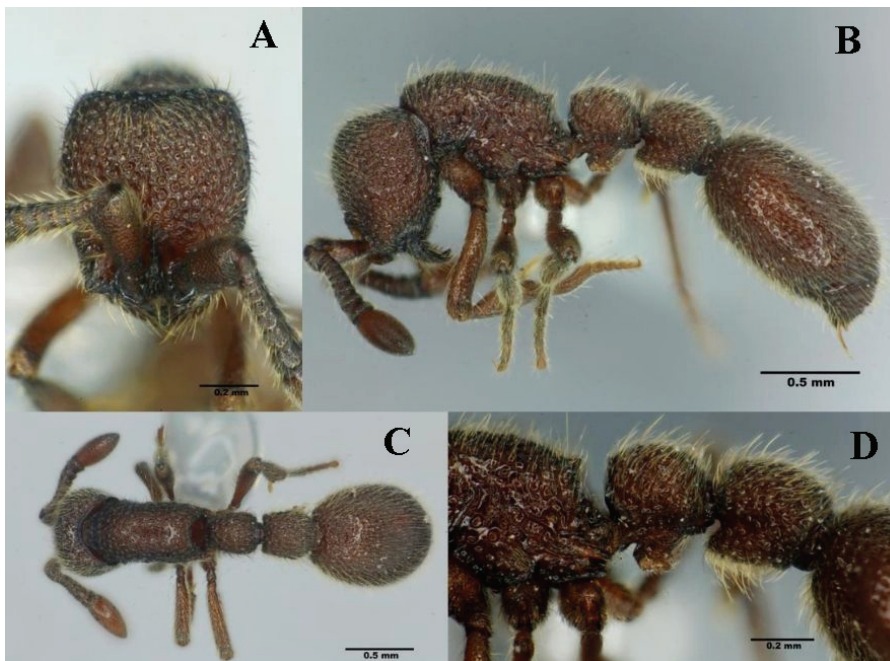


Fig. 1. *Ooceraea quadridentata* Yamada, Luong et Eguchi, 2018, worker (individual code: SEMUT23viii23A). A – head in full-face; B – body in lateral view; C – body in dorsal view; D – petiole in lateral view.

DIAGNOSIS. Worker (Fig. 1). This specimen is similar to *Ooceraea quadridentata* but it has morphological variations seen from the lateral view, the propodeum denticles shorter than the holotype. The diagnosis of the worker agree well with original description of this

species as follows: in the full face view, the cranium is subrectangular with weakly convex lateral margins and a medially concave posterior margin; the antennal scape is folded back to almost reach the midlength of the cranium; region surrounding the antennal socket, which is strongly depressed and bounded by the torulo-posttorular complex and parafrontal ridge. A row of tiny, barely noticeable teeth can be seen on the mandibular masticatory margin; in dorsal view, the parafrontal ridge clearly produced the anterior; complete absence of ocelli and compound eye; with an enlarged apical segment XI that is nearly as long as segments V–X combined, antenna 11-segmented.

MEASUREMENTS AND INDICES. Worker: HL – 0.68; HW – 0.63; SL – 0.4, ML – 0.92; PL – 0.32; PH – 0.41; PW – 0.3; PPL – 0.38; PPH – 0.36; PPW – 0.35; CI – 92.65; SI – 63.49; PI1 – 78.05; PI2 – 93.75; PPI1 – 105.55; PPI2 – 92.1; WI – 116.67.

DISTRIBUTION. **Indonesia:** Sumatra (new record); **Vietnam:** Dak Lak; **Thailand:** Udom Sab Subdist.

REMARKS. The denticles of propodeum of specimens from Sumatra are shorter and body smaller than the same of holotype and specimens from Thailand. We assumed that the *O. quadridentata* has intraspecific morphological variations in the worker caste. The variations of these characters not prevent the identification process of this species, due to the unique characteristics of this species, i.e. the two pair of denticles in propodeum. Moreover, Jaitrong *et al.* (2021) recognized the morphological variation between the population from Thailand and Vietnam.

We collected the *Ooceraea quadrendata* in the lowland disturbed forest in West Sumatra, while Yamada *et al.* (2018) collected the colony of this species in a disturbed and bamboo-mixed evergreen forest in the highland of Vietnam. The habitat of the colony found in Sumatra is a relatively unique which is a fragmented disturbed forest in the middle of the city and surround by residential areas. The vegetation of this area is completely different from the habitat where the holotype collected. In Sumatra, the colony of *O. quadrendata* was collected in the leaf-litter on hillsides at the edge of hiking trails.

The DNA barcoding system that uses the mitochondrial gene cytochrome C oxidase subunit 1 (cox 1 or COI) is very efficient for distinguishing vertebrate and invertebrate species (Rodrigues, 2017). In this study we used COI to determine the genetic variation of the same species but have a geographic range. The diversity in this study was collected from areas several hundred kilometers apart, which may have contributed to their morphological and genetic differentiation (Mary, 2016). Even though they are the same species, *Ooceraea quadridentata* from the two regions has a genetic distance of ± 0.16 and the average genetic distance of the outgroup is ± 0.2 (Table 1).

Table 1. Pair-wise distances of *Ooceraea quadridentata*, *Cerapachys biroi* and *Proformica nasuta*

No	Taxa	1	2	3	4
1	<i>Ooceraea quadridentata</i> from Sumatra sp. 1	X			
2	<i>Ooceraea quadridentata</i> from Sumatra sp. 2	0.00335	X		
3	LC611729.1 <i>Ooceraea quadridentata</i> from Vietnam	0.16392	0.15942	X	
4	JX157196.1 <i>Cerapachys biroi</i>	0.24665	0.24206	0.24123	X
5	KU749633.1 <i>Proformica nasuta</i>	0.25193	0.24725	0.28969	0.26433

In this study we found that genetic variation occurs in ant *Ooceraea quadentata* populations with geographic ranges. New branches were formed in *O. quadridentata* sp. 1 and sp. 2 from Sumatra, this indicates genetic variation with the *O. quadridentata* from Vietnam (Fig. 2). This condition is actually affected by the biotic and abiotic factors caused the individualism ability to survive and procreate. In different populations of the same species, this leads to genetic variation. Population adaptation to different geographic ranges results in genetic variation (Eckert, 2008).

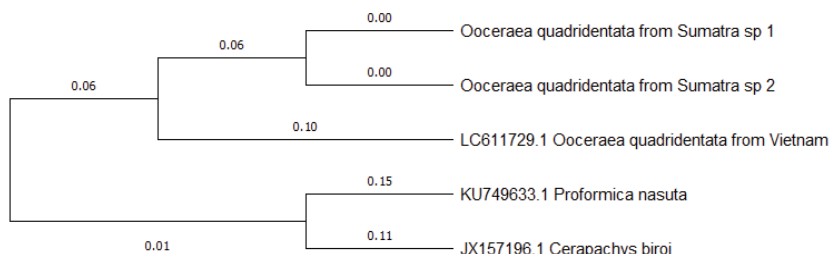


Fig. 2. Phylogenetic tree of *Ooceraea quadentata* and and outgroups (*Cerapachys biroi* and *Proformica nasuta*)

DISCUSSION

The ant *Ooceraea quadridentata* may have a wide distribution worldwide in tropical and subtropical regions, similar to the distribution of *O. biroi*. Research on the distribution of *O. biroi* is due to all workers being able to produce diploid eggs through the lytokous parthenogenesis (Tsuji & Yamauchi, 1995, Ravary & Jaisson, 2004, Lecoutey *et al.*, 2011). The species *O. biroi* is still have unresolved taxonomical problems due to its high morphological variations and wide distribution. We assumed that, the *O. quadridentata* has similar pattern with the *O. biroi*, but we suggested that the more intensive collections on the Asia and further research of this species are needed to understand about the genetic and morphological variations of this species.

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