

Two new species from Malaysia and further taxonomic notes on *Polyrhachis* s.str. (Hymenoptera: Formicidae)

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Abstract

Two new ant species from Malaysia, *Polyrhachis (Polyrhachis) dostali* sp.n. and *Polyrhachis (Polyrhachis) lacroixi* sp.n., are described, illustrated, and compared to other species of the subgenus. Important characters of *P. dostali* sp.n. are a comparatively dark colouration, a distinct lateral and posterior demarcation of the dorsum of the propodeum, and the lack of standing setae on most body parts. The spines on pronotum, mesonotum, and petiole are similarly developed as in *Polyrhachis olybria* FOREL, 1912. Important characters of *P. lacroixi* sp.n. are a shiny clypeus and shiny gaster tergites, a low medial tubercle separating dorsal and posterior face of propodeum, and the lack of standing setae on most body parts. Its spines on pronotum, mesonotum, and petiole are similarly developed as in *Polyrhachis bihamata* (FABRICIUS, 1775). A key to the workers of *Polyrhachis* s.str. of the Malay Peninsula is provided. To stabilize taxonomy, a neotype of *Formica bihamata* FABRICIUS, 1775 from Thailand and a lectotype of *Polyrhachis (Polyrhachis) bihamata* var. *tonsilis* SANTSCHI, 1928 are designated. *Polyrhachis (Polyrhachis) tonsilis* SANTSCHI, 1928 stat.n. is recognized as a distinct species.

Key words: Formicinae, spiny ants, *Polyrhachis*, taxonomy, new species, new status, type designations, key, Malay Peninsula, Borneo.

Zusammenfassung

Zwei neue Ameisenarten aus Malaisien, *Polyrhachis (Polyrhachis) dostali* sp.n. und *Polyrhachis (Polyrhachis) lacroixi* sp.n., werden beschrieben, abgebildet und mit den übrigen Arten der Untergattung verglichen. Wichtige Merkmale von *P. dostali* sp.n. sind die vergleichsweise dunkle Färbung, eine deutliche seitliche und hintere Abgrenzung der Dorsalfläche des Propodeum sowie das Fehlen aufrechter Borsten auf den meisten Körperteilen. Die Dornen auf dem Pronotum, dem Mesonotum und dem Petiolus sind ähnlich wie bei *Polyrhachis olybria* FOREL, 1912 ausgebildet. Wichtige Merkmale von *P. lacroixi* sp.n. sind ein glänzender Clypeus und glänzende Gastertergite, ein niedriger, in der Mitte befindlicher Tuberkel zwischen dorsaler und hinterer Fläche des Propodeum sowie das Fehlen aufrechter Borsten auf den meisten Körperteilen. Die Dornen auf dem Pronotum, dem Mesonotum und dem Petiolus ähneln jenen von *Polyrhachis bihamata* (FABRICIUS, 1775). Ein Bestimmungsschlüssel für Arbeiterinnen von *Polyrhachis* s.str. von der Malaiischen Halbinsel wird vorgestellt. Aus Gründen der Stabilität werden ein Neotypus für *Formica bihamata* FABRICIUS, 1775 aus Thailand und ein Lectotypus für *Polyrhachis (Polyrhachis) bihamata* var. *tonsilis* SANTSCHI, 1928 festgelegt. *Polyrhachis (Polyrhachis) tonsilis* SANTSCHI, 1928 stat.n. wird als eigenständige Art erkannt.

Introduction

The over 700 valid species and subspecies of *Polyrhachis* SMITH, 1857 (BOLTON 2019) are tropically and subtropically distributed from southern Africa to Japan and New Caledonia (ANTMAPS 2019). In addition to their known diversity in Southeast Asia, numerous species remain undescribed, especially in the large subgenera *Myrma* BILLBERG, 1820 and *Myrmhopla* FOREL, 1915. In contrast, the small subgenus *Polyrhachis* s.str. is an exceptionally well-studied clade. It was revised by HUNG (1970) and KOHOUT (1988, 1998, 2014). Hitherto, only eleven valid species were known (KOHOUT 2014), which range from Myanmar to Japan and northern Australia. Therefore, the discovery of two new species from the Malay Peninsula was highly surprising. During my studies I recognized the unsatisfying taxonomic situation of *Polyrhachis bihamata* (FABRICIUS, 1775) and its proposed synonym *Polyrhachis bihamata* var. *tonsilis* SANTSCHELI, 1928. For the reason of nomenclatural stability it became necessary to designate a neotype for *Formica bihamata* FABRICIUS, 1775 that is concordant with the current interpretation of this taxon.

Material and methods

The type material of *P. dostali* sp.n. chiefly consists of 14 workers from the author's collection. They originate from one locality in Kelantan, but it is unknown if they belong to a single nest series. One additional paratype from Borneo has been discovered among *P. bihamata* specimens in the collection of the Natural History Museum Basle. The type material of *P. lacroixi* sp.n. consists of three workers from two localities deposited in the Natural History Museum Vienna and in the author's collection. Two syntypes of *P. tonsilis* stat.n. were loaned from the Natural History Museum Basle. The neotype of *P. bihamata* is selected from the collection of the Natural History Museum Vienna.

For comparison the photographs provided by KOHOUT (2014) and by ANTWEB (2019) and the following specimens housed in the Natural History Museum Vienna (incl. Coll. W. Klemm), Natural History Museum Basle, Coll. D.M. Sorger (Vienna), and in the author's collection were used:

Polyrhachis bellicosa (SMITH, 1859): 17 workers from Indonesia (Sulawesi, Moluccas) and "New Guinea".

Polyrhachis bihamata (FABRICIUS, 1775): 125 workers from Indonesia (Java, Sumatra), Laos, Malaysia (West and East), Myanmar, Singapore, and Thailand.

Polyrhachis erosispina EMERY, 1900: 2 workers from Papua New Guinea and unstated locality.

Polyrhachis maliau KOHOUT, 2014: 4 workers from Malaysia (East).

Polyrhachis mindanaensis EMERY, 1923: 90 workers from the Philippines.

Polyrhachis olybria FOREL, 1912: 262 workers from Indonesia (Mentawai), Malaysia (West and East), the Philippines, Singapore, and Thailand.

Polyrhachis taylori KOHOUT, 1988: 6 workers (incl. 2 paratypes) from Indonesia (New Guinea) and Papua New Guinea.

Polyrhachis ypsilon EMERY, 1887: 37 worker from Indonesia (Borneo, Java, Mentawai), Malaysia (West and East), Singapore, Thailand, and "Indochina".

Descriptions and measurements were carried out with a WILD M10 binocular microscope, magnification up to 128×. The following measurements and indices are given (following KOHOUT 2014, except for TL):

- TL Total length. Approximate length of outstretched ant from apex of mandible to apex of gaster.
- HW Head width. Measured in perfect full-face view immediately in front of eyes.
- HL Head length. Maximum length of head in perfect full-face view measured from anterior-most point of clypeal border to posterior-most point of occipital margin.
- CI Cephalic index. $HW/HL \times 100$
- SL Scape length. Maximum length of antennal scape excluding the condyle.
- SI Scape index. $SL/HW \times 100$
- PW Pronotum width. Greatest width of the pronotal dorsum measured in dorsal view of specimen.
- PeH Petiolar height. Measured from ventral edge of petiolar spiracle to most distant tangent point of petiolar hook in lateral view.
- PI Petiolar index. $PeH/HL \times 100$
- MtL Metatibia length. Maximum length measured from apex of metafemur to apex of metatibia.

Stacked digital images were taken with a Leica Z16 APO zoom macroscope, using Leica Application Suite V3. Images were stacked with ZereneStacker 64-bit, and processed with Adobe Photoshop 7.0.

Taxonomy

Polyrhachis (Polyrhachis) dostali sp.n. (Figs. 1–3)

Etymology: I dedicate this species to my friend Alexander Dostal, honorary president of the Austrian Entomologists' Association, carabidologist and omnicollector, on the occasion of his 60th birthday.

Type material: Holotype (worker) and 13 paratypes (workers), Malaysia, Kelantan, 30 km south of Jeli, west of Kampung Timor, Gunung Jual, N5°36', E101°49', 800 m a.s.l., 10.IV.–6.V., leg. P. Cechovský. The holotype will be deposited in BORNEENSIS, Institute for Tropical Biology and Conservation, Universiti Malaysia Sabah, paratypes in the Natural History Museum Vienna, the Seiki Yamane Collection in Kagoshima-shi, Japan, the Alexander Dostal Collection and the author's collection, both in Vienna, Austria; 1 paratype (worker), Malaysia, Sabah [labelled British North Borneo], Sandakan, leg. Dr. Stamm, in the Natural History Museum Basle.

Diagnosis of worker: Size moderately small, body length ca. 9.2–9.8 mm, head width 1.90–1.99 mm. Colour predominantly black, with reddish areas only on mesosoma and petiole. Short pubescence dense, standing setae lacking on head (except on clypeus), mesosoma, petiole, and gaster tergites 1–2. Surface matt. Eyes in full-face view not surpassing outline of head. Dorsum of propodeum laterally delimited by an obtuse edge,

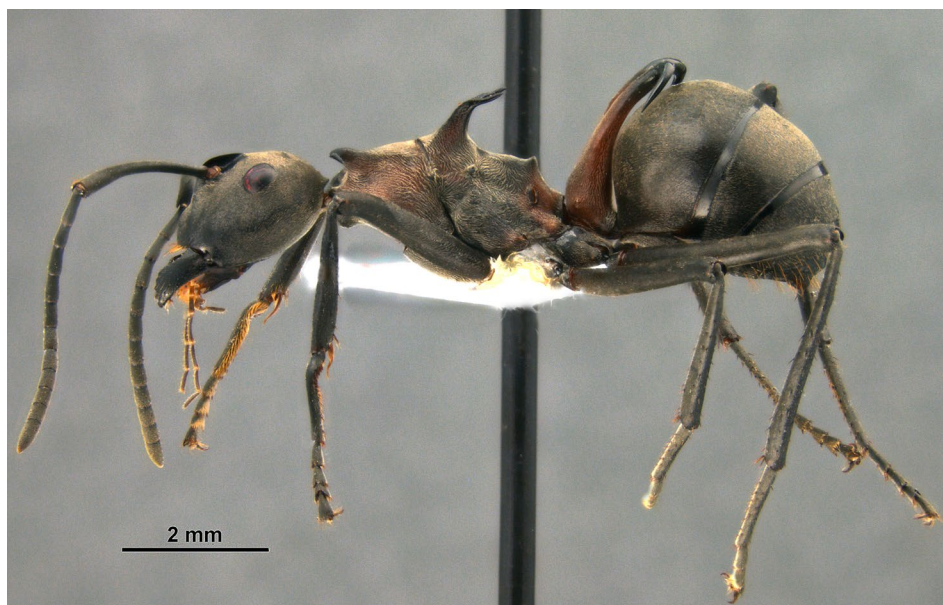


Fig. 1: *Polyrhachis (Polyrhachis) dostali* sp.n., holotype worker, lateral view. © Daniela Lehner.

posteriorly by a complete transverse carina that is laterally elevated, without spines or teeth. Petiole columnar; spines hooked, parallel and almost touching each other for most of length.

Description of worker: Measurements of holotype: TL 9.6; HL 2.29; HW 1.96; CI 86; SL 2.84; SI 145; PW 1.04; PeH 2.40; PI 105; MtL 3.65. Measurements of paratypes (n = 14): TL 9.2–9.8; HL 2.21–2.38; HW 1.90–1.99; CI 84–86; SL 2.66–2.97; SI 139–153; PW 1.02–1.12; PeH 2.25–2.44; PI 100–106; MtL 3.53–4.01.

Structures: Almost entire body with fine, dense puncturation, matt, on gaster partly with very fine isodiametric reticulation. Head shape relatively broad; occipital margin slightly protruded in middle. Eyes in full-face view not surpassing outline of head, in most specimens just touching it, or minimally distant. Median ocellus present, although small. Lateral ocelli very small, or vestigial and replaced by scars. Frontal triangle distinct. Frontal sulcus distinct between frontal carinae, posteriorly evanescent. Clypeus with very obtuse median carina; anterior third and along midline with sparse puncturation and shiny; along foremargin a row of large setae-bearing punctures. Mandible 5-toothed, shiny, finely striate and with fine setae-bearing punctures, apically smooth and with a few larger punctures. Mesosoma with four curved spines, apices of all spines punctured and more or less shiny. Pronotal spines slender, moderately curved, apices pointing more laterally than posteriorly; pronotal dorsum well delimited by lateral edges. Mesonotal spines stout in basal half, then suddenly narrowed and bent posteriorly; apices pointing posteriorly, only slightly dorsally and laterally. Propodeum with relatively well-delimited squared dorsal face; lateral edges obtuse, but distinct, posterior edge with a complete transverse carina that is laterally elevated into a pair of short convex crests. Petiolar spines long and slender, medially almost touching each other until base of strong apical curvature; apices



Figs. 2–3: *Polyrhachis (Polyrhachis) dostali* sp.n., holotype worker, full-face view (2) and dorsal view of mesosoma and petiole (3). © Daniela Lehner.

directed ventrolaterally, punctured and shiny, extreme apices smooth. Gaster with a fine and dense reticulation, except discs of tergites 2 and 3 with very dense puncturation, tergites with very narrow smooth hind margins.

Pilosity: Short appressed pubescence dense and pale to brown. Standing setae strongly reduced. Clypeus with row of light brown standing setae at anterior margin. Gaster with rows of brown standing setae on tergites 3 (only laterally), 4, and 5, and on all sternites. No other standing setae on trunk and appendages. Short stiff black spines abundant on tibiae and tarsi.

Colour: Trunk and appendages almost entirely black. Dark reddish brown patches on pronotum dorsally and on thorax laterally. Declivity of propodeum entirely reddish brown (usually paler than marks on thorax). Petiole reddish brown except apices of spines black.

Variation: The single worker from Borneo is among the smallest (HW 1.91) and clearly differs from the West Malaysian specimens by shorter appendages (SL 2.66 vs. 2.73–2.97; SI 139 vs. 142–153; MtL 3.53 vs. 3.70–4.01), but otherwise completely agrees with them.

Comparative notes: *Polyrhachis dostali* sp.n. belongs to the *P. bihamata* species group as defined by HUNG (1970) and KOHOUT (2014). Using the key by KOHOUT (2014),

workers of the new species will be identified as *P. erosispina*, a species of Sulawesi and New Guinea. However, *P. dostali* sp.n. differs strongly from *P. erosispina* by much darker colouration, a higher petiole (PI < 100 in *P. erosispina*; fide KOHOUT 2014), and by the lack of standing setae on head (except for the clypeal setae), mesosoma, petiole, and gaster tergites 1–2.

The colour of *P. dostali* sp.n. is much darker than in any species of the subgenus except the East Palaearctic species *P. lamellidens* SMITH, 1874, which is almost entirely black and belongs to the *P. lamellidens* species group (see, e.g., KOHOUT 2014).

A reduced pilosity as in *P. dostali* sp.n. is also observed in some populations of *P. olybria* (which demands a closer examination of conspecificity of *P. olybria* populations in the future), in *P. bellicosa* from Sulawesi and New Guinea, in *P. taylora*, from New Guinea, and in *P. tonsilis* stat.n. However, *P. tonsilis* shares most of the structural details with *P. bihamata* and *P. lacroixi* sp.n.; for distinction see notes on *P. tonsilis* and the key below.

Distribution: Malay Peninsula, Borneo.

***Polyrhachis (Polyrhachis) lacroixi* sp.n.** (Figs. 4–6)

Etymology: I dedicate this species to the late Austrian myrmecologist Dr. Friedrich Lacroix (1906–1995).

Type material: Holotype (worker) and 1 paratype (worker), Malaysia, Perak, 40 km southeast of Ipoh, Banjaran Titi Wanea, Ringlet, N4°25', E 101°23', 900 m a.s.l., 3.IV., leg. P. Cechovský, both in the Natural History Museum Vienna; 1 paratype (worker), Malaysia, Kelantan, 10 km west of Dabong, Jelawan Jungle, N5°22', E 101°52', 150–350 m a.s.l., leg. S. Bečvář, in the author's collection, Vienna, Austria.

Diagnosis of worker: Size small, body length ca. 8.5–9.4 mm, head width 1.86–2.02 mm. Bicoloured: head, appendages, tips of spines and posterior part of gaster black; mesosoma, petiole and gaster tergite 1 predominantly reddish. Short pubescence variably dense, sparse on gaster. Standing setae lacking on head (except on clypeus), mesosoma, petiole, and gaster tergites 1–2. Surface mostly matt, shiny on clypeus and gaster. Eyes in full-face view more or less surpassing outline of head. Dorsum of propodeum laterally rounded, posteriorly with a small medial tubercle, without spines or teeth; spiracles strongly elevated. Petiole columnar; petiolar spines hooked, parallel for most of length. Gaster tergites 1–4 with dispersed large shallow punctures.

Description of worker: Measurements of holotype: TL 9.4; HL 2.23; HW 2.02; CI 91; SL 2.94; SI 146; PW 1.03; PeH 2.55; PI 114; MtL 4.07. Measurements of paratypes (n = 2): TL 8.5, 8.9; HL 2.05, 2.15; HW 1.86, 1.92; CI 91, 89; SL 2.65, 2.80; SI 142, 146; PW 0.98, 1.00; PeH 2.34, 2.42; PI 114, 113; MtL 3.75, 3.82.

Structures: Head shape relatively broad; occipital margin slightly protruded in middle. Eyes in full-face view clearly (in Perak specimens) or hardly (in Kelantan specimen) surpassing outline of head. Head posteriorly densely punctured, anteriorly reticulated, on clypeus with reduced reticulation and shiny. Median ocellus present, although small. Lateral ocelli lacking. Frontal triangle indistinct. Frontal midline distinctly raised between frontal carinae, posteriorly evanescent, or reaching median ocellus in the Kelantan specimen. Clypeus strongly convex in lateral view, with distinct, raised, shiny median carina; along foremargin a row of large setae-bearing punctures. Mandible 5-toothed, shiny, finely striate and with fine setae-bearing punctures, apically smooth and with a few larger

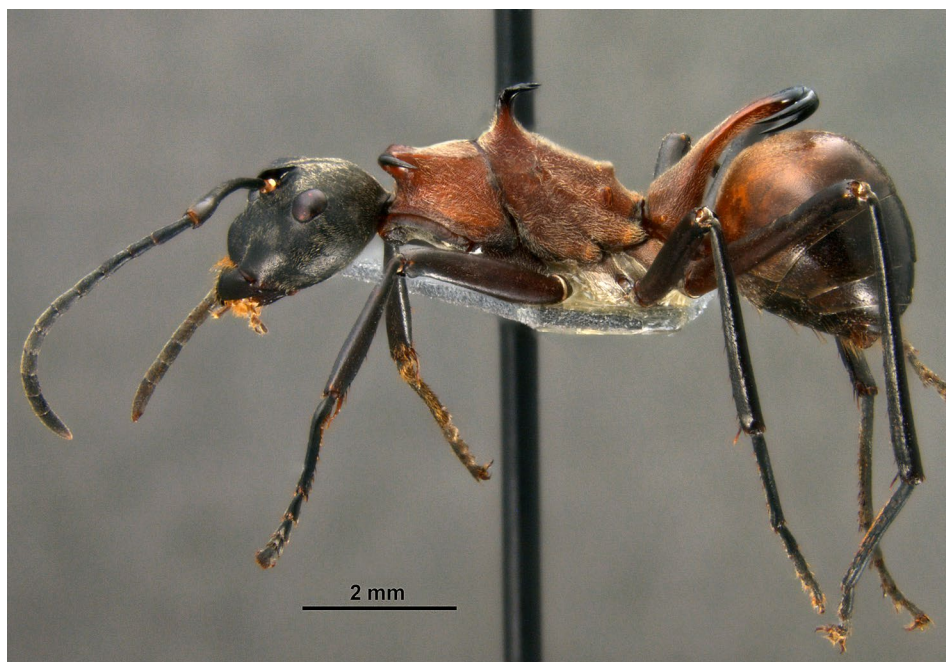


Fig. 4: *Polyrhachis (Polyrhachis) lacroixi* sp.n., holotype worker, lateral view. © Daniela Lehner.

punctures. Mesosoma densely punctured and matt, with four curved spines; apices of all spines punctured and more or less shiny. Pronotal spines slender, strongly curved, apices pointing more posteriorly than laterally; pronotal dorsum delimited by lateral edges behind bases of spines. Mesonotal spines placed close together, stout in basal half, then suddenly narrowed and bent posteriorly; apices pointing posteriorly, only slightly dorsally. Propodeum low; dorsal face laterally rounded, continuous with sides, its posterior end marked by a small and low roundish medial tubercle (weakly depressed in middle in the Perak paratype); spiracles strongly elevated. Petiolar spines long and slender, medially parallel until base of strong apical curvature; apices directed ventrally, with few small, scattered punctures and shiny, extreme apices smooth; in the Perak paratype the columnar part of petiole long, the bases of spines comparatively short. Gaster tergites 1–4 strongly shiny, with a fine, in some areas evanescent reticulation; few large, shallow punctures scattered on the entire surfaces except declivitous part of tergite 1; small punctures interspersed, but relatively dense near the smooth hind margins of tergites.

Pilosity: Short, mostly appressed pubescence pale, of varying density: scarce on head, especially on clypeus; moderate on mesosoma and petiole, but denser on propodeum, ventral parts of meso- and metapleuron and entire propodeum, and ventral areas of petiole; sparse and thin on gaster; on dorsal area of propodeum pubescence semi-erect and inclined anteriorly. Standing setae strongly reduced. Clypeus with row of light brown protruding setae at anterior margin. Gaster with rows of brown standing setae on tergites 3 (only laterally), 4, and 5, and on all sternites. No other standing setae on trunk and appendages. Short black spines on tibiae and tarsi restricted to flexor side.



Figs. 5–6: *Polyrhachis (Polyrhachis) lacroixi* sp.n., holotype worker, full-face view (5) and dorsal view of mesosoma and petiole (6). © Daniela Lehner.

Colour: Head, antennae, and legs black. Mesosoma reddish brown, ventrally slightly infuscated; apices of spines black. Petiole reddish brown, apices of spines black. Gaster chiefly black; tergite 1 (except posteriorly) and sternite 1 pale reddish brown; apex dark brown.

Comparative notes: *Polyrhachis lacroixi* sp.n. belongs to the *P. bihamata* species group as defined by HUNG (1970) and KOHOUT (2014). Within this group, the shiny gaster tergites of *P. lacroixi* sp.n. – conspicuous to the naked eye – are an important character and otherwise only present in *P. tonsilis* stat.n. (see below). The tergites bear rather large, dispersed punctures (not present in *P. tonsilis*) and their reticulated microsculpture is fine and weakly impressed. Strongly shiny tergites are also present in both species of the *P. lamellidens* group, but their workers differ, among other characters, by a pair of elongated spines on the propodeum. The second important character of *P. lacroixi* sp.n. workers is the strong reduction of propodeal structures to a single, low medial tubercle between its dorsal and declivitous face. It differs clearly from *P. olybria*, a similarly small species with distinct paired teeth at the same position. Further, workers of *P. lacroixi* sp.n. possess a median ocellus, that is usually lacking in *P. olybria*. In details of the spines, *P. lacroixi* sp.n. is similar to the sympatric *P. bihamata*. This species, however, differs by rich standing pilosity, a matt, densely sculptured gaster, and a pair of more laterally positioned ridges at the base of the propodeal declivity.

Distribution: Malay Peninsula.

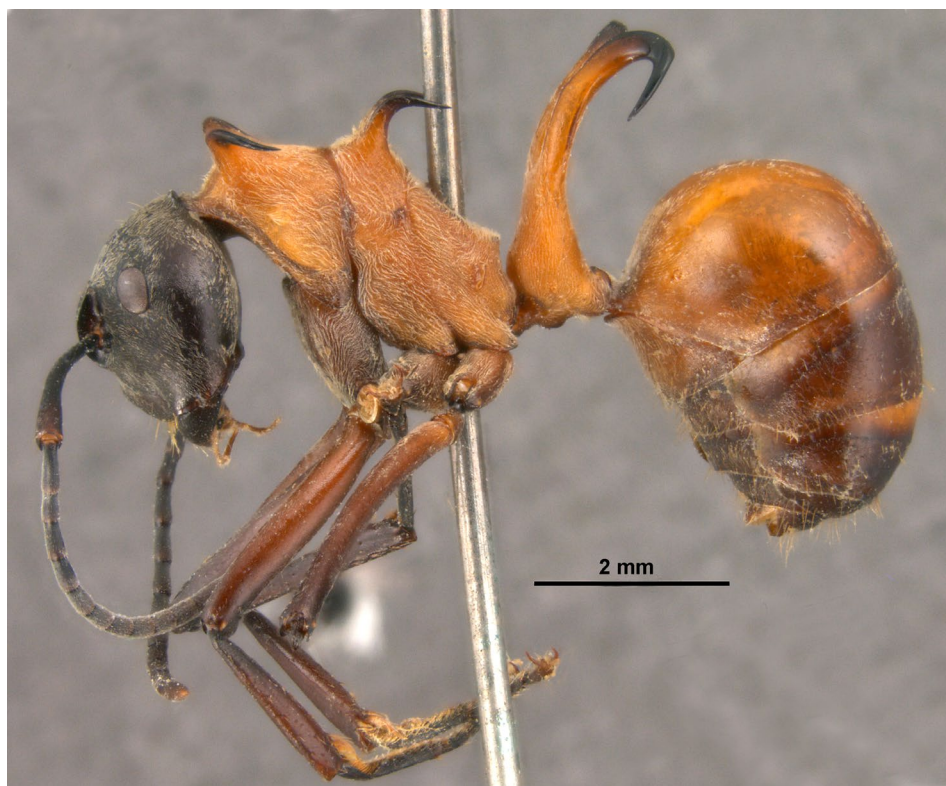


Fig. 7: *Polyrhachis (Polyrhachis) tonsilis*, lectotype worker, lateral view.

***Polyrhachis (Polyrhachis) tonsilis* SANTSCHI, 1928, stat.n. (Figs. 7–9)**

Taxonomic notes: SANTSCHI (1928) described four workers from Sibolangit in North Sumatra and named them “*Polyrhachis (Polyrhachis) bihamata* DRURY v. *tonsilis* v. n.”. HUNG (1970) synonymized this taxon with *P. bihamata*, but the synonymy was questioned by KOHOUT (1998), and shortly discussed by KOHOUT (2014). KOHOUT (2014) also mentioned a possible synonymy of *tonsilis* and var. *minor* KARAVAEV, 1927 from Java, which I have not seen. However, this is only of zoogeographical importance, because var. *minor* KARAVAEV is a primary homonym of *P. armata* var. *minor* FOREL, 1886.

I have studied the two syntypes from the Santschi Collection in the Natural History Museum Basle. The whereabouts of the other two specimens is unclear. For the reason of nomenclatural stability, I fix the identity of the species by designating the specimen figured by ANTWEB (CASENT0912165) as the lectotype.

Type material examined: Lectotype (worker, CASENT0912165; present designation): “Corporaal Sumatra O. K. Sibolangit 1918” and one paralectotype (worker) from the same locality, both in the Natural History Museum Basle.

Diagnosis of worker: Medium-size, body length ca. 9.7–10.0 mm, head width 2.12–2.18 mm. Bicoloured: head, antenna, tips of spines, and tarsi black; mesosoma, petiole and gaster tergite 1 predominantly pale reddish orange; other tergites and tibiae



Figs. 8–9: *Polyrhachis (Polyrhachis) tonsilis*, lectotype worker, full-face view (8) and dorsal view of mesosoma and petiole (9). © Daniela Lehner.

mostly dark brown; femora reddish brown. Short pubescence variably dense, sparse and thin on head and gaster, dense and long on mesosoma and petiole. Standing setae lacking on scape, mesosoma and petiole, reduced in number and length on head and gaster tergites. Surface mostly matt, shiny on clypeus and gaster. Eyes in full-face view just not reaching outline of head. Dorsum of propodeum laterally rounded, posteriorly with a pair of short transverse, somewhat angular carinae; spiracles distinctly elevated. Petiole columnar; petiolar spines hooked, parallel for most of length. Gaster tergites 1–4 without large punctures.

Description of type specimens: Measurements of lectotype: TL 10.0; HL 2.45; HW 2.18; CI 89; SL 3.10; SI 142; PW 1.13; PeH 2.93; PI 120; MtL –. Measurements of paralectotype: TL 9.7; HL 2.41; HW 2.12; CI 88; SL 3.10; SI 146; PW 1.08; PeH 2.78; PI 115; MtL –.

Structures: Head shape relatively broad; occipital margin slightly protruded in middle. Eyes in full-face view just not reaching outline of head. Head densely reticulated and matt posteriorly, weaker and more shiny anteriorly. Median ocellus very small. Lateral ocelli lacking. Frontal triangle indistinct. Frontal midline slightly raised between frontal carinae, posteriorly almost reaching median ocellus as a fine line. Clypeus strongly convex in lateral view, its fine puncturation sparse in distal half, with distinct, broadly raised median carina in basal half, with row of large setae-bearing punctures along foremargin. Mandible 5-toothed, shiny, finely striate and with fine setae-bearing punctures, apically with a few larger punctures, smooth only on teeth. Mesosoma densely punctured and matt, with four curved spines; apices of all spines punctured and more or less shiny. Pronotal

spines moderately stout at base, strongly curved, apices pointing posteriorly; pronotal dorsum behind bases of spines weakly delimited towards sides. Mesonotal spines placed close together, slender, evenly narrowed and almost evenly curved from base to tip; apices pointing posteriorly, only slightly dorsally. Propodeum low; dorsal face laterally rounded, continuous with sides, its posterior end distinctly marked by a pair of short transverse carina that are indistinctly separated from each other; spiracles distinctly elevated. Petiolar spines long and slender, medially parallel and touching each other at base of strong apical curvature; apices directed ventrally, smooth and shiny. Gaster tergites 1–4 strongly shiny, with a fine, in some areas evanescent reticulation; no large punctures present, on discs; hind margins with rows of moderate setae-bearing punctures.

Pilosity: Short, mostly appressed pubescence pale, of varying density and length: on head short, sparse, and thin, especially on clypeus; on mesosoma and petiole long and dense, on gaster short, very sparse and thin. Standing setae scarce. Head with few scattered short setae posterodorsally, and with the usual row of marginal setae on clypeus. Scape, mesosoma and petiole lacking any standing setae. Gaster tergites 1 and 2 with rows of short standing setae near hind margin; tergites 3–5 with rows of longer setae; disc of tergite 1 without, of the following tergites with scattered short setae; all sternites with long setae. Setae on tibiae and tarsi pale and slender.

Colour: Head with antennae and mandibles black; palpi brown. Mesosoma and petiole reddish orange, ventrally hardly infuscated; apices of spines black. Gaster tergite 1 anteriorly pale orange, posteriorly brownish infuscated; the following tergites darker. Legs basally brown; femora reddish; tibiae reddish brown, more or less infuscated; tarsi black.

Comparative notes: *Polyrhachis tonsilis* shows a mixture of characters found in *P. olybria* and *P. bihamata* (see also KOHOUT 1998), with a closer affinity to the latter. In *P. olybria* the median ocellus is absent or strongly reduced (as in *P. tonsilis*), and populations with strongly reduced pilosity do exist. However, all studied populations of *P. olybria* have some long setae on the underside of the head which are lacking in *P. tonsilis*. Similarities with *P. bihamata* are the posteriorly pointing pronotal spines (laterally pointing in *P. olybria*) and the low, short, transverse, paired carinae of the propodeum (pair of teeth in *P. olybria*). *Polyrhachis tonsilis* also differs from *P. bihamata* by a narrower pronotal dorsum. *Polyrhachis tonsilis* also resembles *P. lacroixi* sp.n. by the strongly shiny gaster tergites. However, *P. lacroixi* sp.n. can be readily distinguished from *P. tonsilis* by a single median tubercle on the propodeum and by the dispersed large punctures on gaster tergites 1–4.

***Polyrhachis (Polyrhachis) bihamata* (FABRICIUS, 1775) (Figs. 10–13)**

Taxonomic notes: FABRICIUS (1775) attributed the name to Drury, which was followed by subsequent authors until KOHOUT (2014), but taxonomically corrected by B. Bolton in a note to the “Online Catalog of the Ants of the World” (ANTCAT 2019). DRURY (1773) illustrated and described this ant without providing a name. From the illustration, the ant can be recognized as a worker specimen of *Polyrhachis* s.str. Drury noted that it was collected on Johanna Island near Madagascar (“d’isle de Johanna, près Madagascar”). Today Johanna Island (or île de Johanna) is called Anjouan and is part of the Comoros. The Comoros are clearly out of the distribution range of the subgenus *Polyrhachis* (see Introduction), which means that the type locality is erroneous. The specimen on which the illustrations were based is presumed lost (e.g., KOHOUT 2014). The illustration and description provided by DRURY (1773) do not allow a clear assignment to a distinct species of *Polyrhachis* s.str. A strict interpretation of the figured characters (see Fig. 10: no median

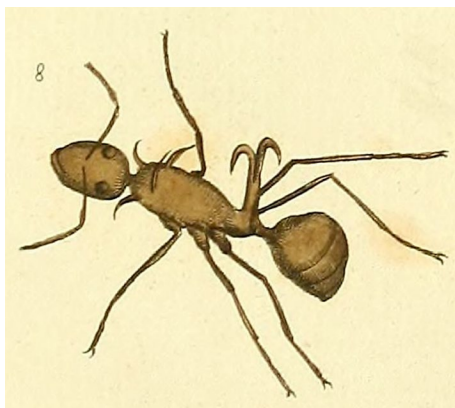


Fig. 10: The original illustration in DRURY (1773: pl. XXXVIII, fig. 8) on which FABRICIUS (1775) based his *Formica bihamata* (from Biodiversity Heritage Library).

chis (Polyrhachis) bihamata DRURY v. *perplexa* v. n.” HUNG (1970) synonymized this taxon with *P. bihamata*; the synonymy was accepted by KOHOUT (1998, 2014). I have examined all nine specimens of var. *perplexa* from the Santschi Collection in the Natural History Museum Basle and I agree that their characters are within the variability of *P. bihamata*. It should be noted, however, that six specimens (on three pins) are labelled “Muong Sai” (= Muang Xay) referring to another locality in northern Laos, while three specimens (on one pin) do not bear any locality label. Despite that discrepancy, I follow HUNG (1970), KOHOUT (1998, 2014), and ANTWEB (2019; “syntype“ specimen CASENT0912164) that the series represents the syntypes. Probably, SANTSCHI (1925) wrote an incorrect type locality in error.

Neotype of *Polyrhachis bihamata* (worker, NHMW; present designation): Thailand, Chiang Mai Province, Doi Suthep-Pui National Park, Chiang Mai, environment of Monthatarn Falls, N18°48', E98°56', 700–750m a.s.l., 6.XI.1995, leg. H. Zettel (#8), in the Natural History Museum Vienna.

Diagnosis of worker: Size usually large, dimensions (according to KOHOUT 2014): body length ca. 9.5–12.0 mm, head width 1.91–2.47 mm. Bicoloured: head, antenna, tips of spines, and legs black; mesosoma, petiole and most of gaster orange brown (apex of gaster variably infuscated). Short pubescence very dense, sparse on head and gaster. Standing setae long and abundant all over trunk, short but numerous on scape. Surface matt. Eyes in full-face view just not reaching outline of head. Ocelli usually present. Pronotal spines pointing posteriorly. Dorsum of propodeum laterally rounded, posteriorly with a pair of short transverse carinae; spiracles not strongly elevated. Petiole columnar; petiolar spines hooked, parallel for most of length. Gaster tergites 1–3 with fine, dense puncturation or reticulation.

Description of neotype: Measurements: TL 10.2; HL 2.58; HW 2.26; CI 88; SL 3.35; SI 148; PW 1.39; PeH 2.93; PI 114; MtL 4.38.

Structures: Head shape relatively broad; occipital margin slightly protruded in middle. Eyes in full-face view just not touching outline of head. Head densely punctured, only anteriorly,

ocellus, laterally pointing pronotal spines, parallel bases of petiolar spines) would rather indicate a specimen of *P. olybria* than what we understand as *P. bihamata* today. However, the illustration is entirely inaccurate, so that the present interpretation of *P. bihamata* will follow the modern revisions by HUNG (1970) and KOHOUT (2014). FABRICIUS (1775), referring to these illustrations, named this species *Formica bihamata*. Later, SMITH (1857) transferred the species to *Polyrhachis*. In order to stabilize the nomenclature of *Polyrhachis bihamata*, I designated a neotype. For the terra typica I chose northern Thailand, which lays in the main distributional area of *P. bihamata*.

SANTSCHI (1925) described an unstated number of workers from “Muong Pek” (= Phonsavan) in northern Laos and named them “*Polyrha-*



Fig. 11: *Polyrhachis (Polyrhachis) bihamata*, neotype worker, lateral view. © Daniela Lehner.

on clypeus and genae reticulated. Median ocellus present, although small. Lateral ocelli lacking. Frontal triangle indistinct. Frontal midline shortly raised between antennal pits, anteriorly and posteriorly evanescent. Clypeus strongly convex in lateral view, midline at base shortly and bluntly elevated; along foremargin a dense row of moderately large setae-bearing punctures. Mandible 5-toothed, densely and finely striate and with fine setae-bearing punctures, apically with a few larger punctures; smooth and shiny only on teeth. Mesosoma densely punctured and matt, with four curved spines; apices of all spines punctured and more or less shiny. Pronotal spines moderately slender, strongly curved, apices pointing posteriorly; pronotal dorsum hardly delimited behind bases of spines, appearing comparatively broad. Mesonotal spines placed close together, evenly narrowed from bases to apices; apices pointing posteriorly. Propodeum low; dorsal face laterally rounded, continuous with sides, its posterior end marked by a pair of short, transverse carinae which appear rounded in posterior view; spiracles not distinctly elevated. Petiolar spines long and rather stout, medially parallel until base of strong apical curvature; apices directed ventrally, without punctures, shiny and smooth. Gaster tergites 1–3 matt, with fine, dense puncturation; tergite 4 with slightly sparser puncturation and somewhat shiny.

Pilosity: Short, appressed pubescence pale yellowish and densely developed all over trunk except on apices of spines; slightly shorter and sparser on scapes and legs. Standing setae abundant all over trunk, except on basal part of clypeus; on gaster tergites the standing setae slightly shorter than on head, mesosoma, and petiole. Scape with numerous standing setae on leading edge, and a few posteriorly. On legs, short black setae or spines present on flexor sides of femora, on tibiae and tarsi.



Figs. 12–13: *Polyrhachis (Polyrhachis) bihamata*, neotype worker, full-face view (12) and dorsal view of mesosoma and petiole (13). © Daniela Lehner.

Colour: Head with antennae and mandibles black; palpi brown. Mesosoma reddish brown, ventrally hardly infuscated; apices of spines black. Petiole reddish brown, apices of spines black. Gaster chiefly reddish; tergites 2–5 increasingly infuscated. Femora reddish brown with infuscated apices. Tibiae and tarsi predominately black.

Comparative notes: *Polyrhachis bihamata* can be readily identified with the key by KOHOUT (2014), when considering the two new species and *P. tonsilis*. These three species are easily separable from *P. bihamata* by their strongly reduced standing pilosity. However, I have seen a few specimens of *P. bihamata* with a vestigial median ocellus, which do not fully fit the character “median ocellus always present” in couplet 9.

Key to workers of *Polyrhachis* s.str. from the Malay Peninsula
(partly following HUNG 1970 and KOHOUT 2014)

- 1 Petiolar spines strongly diverging from base. Pronotal spines stout. Large species with abundant long setae. *P. ypsilon*
- Petiolar spines parallel over most of their length; pronotal spines slender (Figs. 3, 6, 9, 13). Size and pilosity variable. 2

- 2 Gaster tergites shiny (Fig. 4) with sparse shallow punctures, a reticulate microsculpture of interspaces evanescent. Propodeum with a single low tubercle at midline (Fig. 6). Head (except clypeus margin), mesosoma, petiole, and gaster tergites 1–2 without standing setae. Pronotal spines pointing posteriorly. *P. lacroixi* sp.n.
- Gaster tergites matt (Fig. 1), densely and finely punctured. Propodeum with paired structures. Either body with numerous standing setae or pronotal spines pointing laterally. 3
- 3 Propodeal dorsum laterally rounded, posteriorly with pair of short, closely set teeth or (rarely) sharp tubercles, without transverse carina. Median ocellus usually lacking. Gaster anteriorly pale reddish. Pilosity variable. *P. olybria*
- Propodeal dorsum posteriorly without short teeth, with transverse carina (Fig. 3) which can be medially interrupted (if reduced to short transverse tubercles in some specimens of *P. bihamata*, then more widely separated). Median ocellus usually present (Fig. 5). 4
- 4 Head (except clypeus margin), mesosoma, petiole, and gaster tergites 1–2 without standing setae (Figs. 1–3). Pronotal spines moderately curved, pointing laterally (Fig. 3). Propodeal dorsum laterally with obtuse edge, posterior carina complete, laterally elevated (Fig. 3). Gaster black. *P. dostali* sp.n.
- Body with numerous standing setae. Propodeal dorsum laterally rounded; posterior carina incomplete. Pronotal spines strongly curved, pointing posteriorly. Gaster anteriorly pale reddish. *P. bihamata*

Discussion

The subgenus *Polyrhachis* s.str. has been intensively studied by HUNG (1970) and KOHOUT (1988, 1998, 2014); the last review recognized eleven species. In this study, I add two new species from Malaysia.

According to KOHOUT (2014) the synonymy of *Polyrhachis bihamata* was not yet finally decided. Here I raise var. *P. tonsilis* (SANTSCHI 1928) to species rank and confirm the synonymy of var. *perplexa* (SANTSCHI 1925) with *P. bihamata* that was established by HUNG (1970). The species identity of the primary homonym var. *minor* (KARAVAIEV 1927) still needs verification as neither types nor images were available to me. Despite the detailed revisions by A.C.F. Hung and R.J. Kohout the doubtful identity on *P. bihamata* itself was never discussed in detail. I solve this problem by designating a neotype that corresponds to the current interpretation of this taxon.

In this study, I raise the species number in *Polyrhachis* to 14. However, during the examination of extensive material I came across some other taxonomic problems that appear not properly solved yet. The most challenging project would be the strong variation of the common *P. olybria*, especially regarding its variable arrangement of standing setae (unpublished data), that may indicate that *P. olybria* in the present sense rather comprises a species complex than being a single species. Possibly a combination of molecular and morphometric data could successfully bring order into this diversity. The same is true for the closely related taxa distributed east of Wallace's Line (*P. bellicosa*, *P. erosispina*, and *P. taylori*) whose taxonomic difficulties were already pointed out by KOHOUT (1988, 2014). Finally, I also observed a considerable morphological variability in the Philippine endemic *P. mindanaensis* (unpublished data). There are also a few historical specimens in the Natural History Museum Vienna – all in a moderate condition – which may represent

new species but remain untreated in this study: a single worker from Singapore, similar to *P. bihamata*, but with strongly inflated petiole; and three workers from New Guinea, similar to *P. dostali* sp.n., but of slightly lighter colour and with deviating propodeal structures.

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