



The Thai species of the *Polyrhachis* (*Myrmatopa*) *flavicornis* Smith, 1857 species group, with description of a new species (Hymenoptera, Formicidae, Formicinae)


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Abstract

The *Polyrhachis* (*Myrmatopa*) *flavicornis* species group in Thailand is reviewed. Four species are recognized, of which one species closely related to *Polyrhachis constructor* Smith, 1857 is described and illustrated as new to science based on the worker caste under the name *Polyrhachis longipilosa* **sp. nov.** The queens of *P. flavicornis* Smith, 1857 and *P. constructor*, and the males of *P. flavicornis* and *P. varicolor* Viehmeyer, 1916 are described. The new species is distributed in western Thailand in the area north of the Isthmus of Kra, while *P. constructor* is distributed in Malaysia (West Malaysia and Sabah), Indonesia, Singapore, southern and western Thailand. *Polyrhachis piliventris* Smith, 1857 and *Polyrhachis elii* Emery, 1900 are synonymized with *P. constructor*. A key to the Thai species of the *Polyrhachis flavicornis* species group is given. The type series of *P. longipilosa* was collected from the canopy of a dry evergreen forest.

Key words: Formicinae, new species, *Polyrhachis*, spiny ant, taxonomy, Thailand

Introduction

The spiny ant genus *Polyrhachis* Smith, 1857 is one of the largest ant genera in the world and is mainly distributed in the Old-World tropics and subtropics. Currently, 706 extant species, 82 extant subspecies, and one fossil species are known (Robson and Kohout 2007, Mezger and Moreau 2015, Bolton 2022). *Myrmatopa* Forel, 1915 is a subgenus of *Polyrhachis*, with 41 described species and can be divided into three species groups, with, *P. flavicornis*, *P. schang* and *P. wallacei* groups (Kohout 2008). Most species of the subgenus are known as lower-vegetation inhabitants (Noon-anant *et al.* 2008, Noon-anant *et al.* 2009). Khachonpisitsak *et al.* (2020) recorded 62 species including three subspecies in the genus *Polyrhachis* from Thailand. Among them, three species, i.e., *Polyrhachis flavicornis* Smith, 1857, *Polyrhachis piliventris* Smith, 1858 and *Polyrhachis varicolor* Viehmeyer, 1916, belong to the *Polyrhachis flavicornis* species group.

Surveys of ants in Kanchanaburi province, Western Thailand, led to the discovery of a few unidentified *Polyrhachis* specimens belonging to the *P. flavicornis* species group of *Myrmatopa*. Having carefully compared them with the type materials of closely related species, we concluded that this species is new to science. In this paper we review the *P. flavicornis* group in Thailand and describe a new species as *Polyrhachis longipilosa* **sp. nov.** based on the worker caste. *Polyrhachis piliventris* Smith, 1858 and *Polyrhachis elii* Emery, 1900 are synonymized with *P. constructor*. Thus, we have recognized four species in the *P. flavicornis* group from Thailand.

Materials and methods

The type series of the new species was collected from western Thailand, Kanchanaburi province, Thong Phaphum

district, Sahakhon Nikhom village (14.76255556°N, 98.80966667°E). The area is covered by dry evergreen forest. The holotype and paratypes of the new species were point-mounted and examined along with other specimens of the *Polyrhachis* subgenus *Myrmatopa* deposited in the ant collection at Prince of Songkla University, Thailand and the Natural History Museum of the National Science Museum, Thailand. Six alate queens collected from southern and western Thailand and preliminarily identified as *Polyrhachis constructor* Smith, 1857 were compared with the syntype (alate queen) of this taxon, their conspecificity was confirmed. Thus, by association, the workers from the colonies to which the above-mentioned queens belonged were also identified as *P. constructor*. These workers were then compared with the holotype and paratype workers of the new species. One syntype queen of *Polyrhachis piliventris* Smith, 1858 and two syntype workers of *Polyrhachis elii* Emery, 1900 were also examined.

Most morphological observations were made with a ZEISS Discovery.V12 stereoscope. Multi-focused montage images were produced using NISElements-D from a series of source images taken by a Nikon Digital Sight-R11 camera attached to a Nikon AZ100M stereoscope. The holotype and ten paratypes were measured using a micrometer (accurate to 0.01 mm). All measurements are expressed in millimeters to the hundredths place.

The abbreviations used for the measurements and indices are as follows (after Kohout 1988):

| | |
|------------|--|
| TL | Total length (the necessarily composite measurement of the entire ant). |
| HL | Head length (the maximum measurable length of the head in perfect full-face view, measured from the anterior-most point of the clypeal border or teeth to the posterior-most point of the occipital margin). |
| HW | Head width (width of the head in perfect full-face view, measured immediately in front of the eyes; eyes excluded). |
| SL | Scape length (length of the antennal scape, excluding the condyle). |
| PW | Pronotal width (width of the pronotal dorsum measured across the humeri). |
| MTL | Metathoracic tibial length (maximum measurable length of the tibia of the hind leg). |
| CI | Cephalic index ($HW/HL \times 100$). |
| SI | Scape index ($SL/HW \times 100$). |

Abbreviations of the type depositories and others are as follows:

| | |
|--------------|--|
| BMNH | The Natural History Museum, London, UK. |
| OXUM | Hope Entomological Collections, Oxford University Museum of Natural History, Oxford, UK. |
| MCSN | Museo Civico di Storia Storia Naturale “Giacomo Doria”, Genoa, Italy. |
| PSUSC | Faculty of Science, Prince of Songkla University, Songkhla, Thailand. |
| SKYC | SKY Collection at Kitakyushu Museum of Natural History and Human History, Japan. |
| THNHM | Natural History Museum of the National Science Museum, Pathum Thani, Thailand. |

Taxonomy

Six alate queens of the *P. constructor* species complex collected from southern Thailand (Colonies A, C, E, and F) and eastern Malaysia (Borneo) were compared with a syntype of *P. constructor* syntype (alate queen from East Malaysia, Borneo, Sarawak). They were similar in body size, structure, sculpture, pilosity, and coloration to the *P. constructor* syntype. All workers collected from southern Thailand agreed in most characters with workers from the mentioned four colonies and were identified as *P. constructor*. Workers collected from western Thailand, Kanchanaburi Province, were also similar to *P. constructor* but differed in some key characters from Bornean and southern Thailand specimens. Thus, we here identify the specimens collected from southern Thailand and Borneo as *P. constructor* and those from western Thailand as a new species, *P. longipilosa* **sp. nov.** We compared a syntype alate queen of *P. piliventris* with the syntype of *P. constructor*. Both syntypes were not different in morphological characters, thus we synonymized *P. piliventris* with *P. constructor*. We also compared two syntype workers of *P. elii* with the workers from colonies of *P. constructor* to which the alate queens belonged. These specimens were also not different in most characters; thus, we also synonymized *P. elii* with *P. constructor*.

Polyrhachis flavicornis species group

Diagnosis. Members of the species group can be distinguished from other species groups by the following characteristics: 1) the mesosoma that is box-like and dorsolaterally marginate throughout its length; 2) pronotum in dorsal view convex median portion and narrowed posteriorly, armed with humeral teeth; 3) propodeal spine short and directed upward; 4) petiole in lateral view with anterior slope distinctly convex; 5) petiole with two spines dorsolaterally, without denticles between the spines; 6) petiolar spine in lateral view curved backwards, as long as or longer than the height of petiole. This species group is most similar to the *Polyrhachis wallacei* species group but can be separated by 1) pronotum dorsolaterally marginate throughout its length (pronotum dorsolaterally not marginate in *P. wallacei* group); 2) humerus armed with teeth or denticle (unarmed in *P. wallacei* group); 3) petiole in profile view with anterior slope distinctly convex (anterior slope almost straight in *P. wallacei* group); 4) petiolar spine in profile view curved backwards (vertical and almost straight in *P. wallacei* group).

Species in the *Polyrhachis flavicornis* species group

Polyrhachis alpea Smith, 1863.

Polyrhachis chaita Kohout, 2008.

Polyrhachis constructor Smith, 1857.

= *Polyrhachis piliventris* Smith, 1858, **syn. nov.**

= *Polyrhachis elii* Emery, 1900, **syn. nov.**

Polyrhachis flavicornis Smith, 1857.

Polyrhachis fruhstorferi Emery, 1898.

Polyrhachis hilaris Kohout, 2008.

Polyrhachis longipilosa **sp. nov.**

Polyrhachis menozzii Karavaiev, 1927.

Polyrhachis neglecta Kohout, 2008.

Polyrhachis sulawesiensis Kohout, 2008.

Polyrhachis varicolor Viehmeyer, 1916.

Key to species of the *Polyrhachis flavicornis* species group from Thailand based on the worker caste

1. Antennal scape, dorsum of mesosoma, and first gastral tergite without standing hairs. 2
- Antennal scape, dorsum of mesosoma, and first gastral tergite with dense standing hairs. 3
2. Head, mesosoma, and petiole distinctly black. *P. flavicornis* Smith, 1857
- Head, mesosoma, and petiole reddish brown. *P. varicolor* Viehmeyer, 1916
3. Standing hairs on antennal scape shorter than maximum width of scape; petiole including spines without standing hairs.
- *P. constructor* Smith, 1857
- Standing hairs on antennal scape longer than or as long as maximum width of scape; petiole including spines with dense, long standing hairs. *P. longipilosa* **sp. nov.**

Polyrhachis constructor Smith, 1857

(Figs 1–3)

Polyrhachis constructor Smith, 1857, queen, Borneo: 60; Donisthorpe 1932: 445; Bolton 1995: 43; Pfeiffer *et al.* 2011: 41.

Polyrhachis piliventris Smith, 1858: 60, pl. 4, fig. 24, queen, Singapore; Bolton, 1995: 354; Dorow, 1995: 44; Khachonpisitsak *et al.* 2020: 72; Wang *et al.* 2022: 10. **Syn. nov.**

Polyrhachis elii Emery, 1900: 711, worker, Mentawai Is.; Emery, 1925: 180 (combination in *P. (Myrmatopa)*); Kohout and Mohamed 2008: 67; Pfeiffer *et al.* 2011: 41. **Syn. nov.**

Types examined. The syntype alate queen of *Polyrhachis constructor* from East Malaysia, Borneo, Sarawak (A.R. Wallace), deposited in OXUM. The syntype alate queen of *Polyrhachis piliventris* from Singapore (A.R. Wallace), deposited in BMNH. Two syntype workers of *Polyrhachis elii* from Indonesia, Mentawai Island, Sipora, Sereinu, V–VI.1894 (E. Modigliani), deposited in MCSN.

Non-type material examined. S Thailand: Songkhla Prov., Ton Nga Chang W.S. 100–300 m a.s.l., nesting on lower vegetation, 2.40 m above ground, 22.V.2004, N. Noon-anant leg., Colony B (workers, PSUSC, THNHM); Phangnga Prov., Lampi Waterfall, 0–100 m, nesting on lower vegetation, 2.20 m above ground, 19.IV.2005, N. Noon-anant leg., Colony C (workers, queen, PSUSC); Trang Prov., Pak Jam Waterfall 130–190 m a.s.l., nesting on lower vegetation, 1.83 m above ground, 28.II.2006, N. Noon-anant leg., Colony D (workers, PSUSC, THNHM); Prachuab Khiri Khan Prov., Pala U Waterfall, 220–350 m a.s.l., nesting on lower vegetation, 2.00 m above ground, 29.I.2007, N. Noon-anant leg., Colony E (workers, queens, PSUSC, THNHM); Prachuab Khiri Khan Prov., Pala U Waterfall 220–350 m a.s.l., nesting on lower vegetation, 2.80 m above ground, 30.I.2007, N. Noon-anant leg., Colony F (workers, queen). **W Thailand:** Petchaburi Prov., Kaeng Krachan National Park, 350 m alt., 26.VI.2014, Sk. Yamane, N. Noon-anant & M. Maruyama leg., KK14-Pol-06 (workers and foundress queen). **E Malaysia:** Borneo, Sabah, Tawu Hills N.P., 12.VII.1996, Sk. Yamane leg., TH14-SKY-Colony A (worker, queen, SKYC); Sabah, Danum Valley, 14–19.XII.2006, Ant-mimic sample, 18-e9 (worker, SKYC).

Measurements and indices. Worker (17 non-types). TL 7.25–7.55, HL 1.33–1.87, HW 1.03–1.57, SL 1.83–2.77, PW 0.83–1.33, MTL 1.90–2.67, CI 74–86, SI 171–184. Syntype worker (*Polyrhachis elii*). TL 7.25–7.30, HL 1.77–1.90, HW 1.47–1.50, SL 2.57–2.60, PW 1.03–1.27, MTL 2.47–2.67 CI 78–83, SI 173–175. Queen (2 syntypes, 6 non-types). TL 8.85–9.15, HL 1.90–2.20, HW 1.53–1.70, SL 2.80–3.07, PW 1.73–1.87, MTL 2.67–3.13, CI 75–77, SI 175–191.

Description of worker (Figs. 1 A–C, 3 A–C)

Head in full-face view distinctly longer than broad with posterior margin roundly convex. Clypeus in dorsal view, broad and weakly convex median portion, its anterior margin broadly convex; median portion of anterior margin produced with a pair of short lateral teeth, and margin between teeth almost straight. Frontal carinae in lateral view well elevated, in full-face view weakly sinuate, and reaching level of mid-length of eye. Mandible subtriangular, its masticatory margin with five distinct teeth (including basal and apical teeth). Antennal scape long, clavate, ca. 1.6 times as long as head width including eyes. Eye in full-face view convex, distinctly protruding from the lateral outline of head and located just posterior to mid-length of head laterally.

Pronotum in dorsal view broader than long, with convex lateral margins, humerus armed with short but sharp tooth; anterior margin of pronotal disc weakly convex and posterior margin concave; lateral face of pronotum subtriangular. Mesonotum in dorsal view subtrapezoidal, slightly broader than long, distinctly narrowed posteriad, shorter and narrower than pronotum; mesopleuron rectangular in profile shorter than high, with posteroventral corner roundly lobate. Propodeum in dorsal view rectangular, broader than long, not demarcated from posterior declivity by transverse carina; propodeal spines blunt, short, and pointed upward.

Petiole node (excluding spines) in dorsal view without distinct dorsum; in profile view almost as long as high, tapered apically with posterior slope much longer than anterior slope; petiolar spines in dorsal view divergent, in lateral view slightly curved backwards, as long as the height of petiole; subpetiolar process weakly developed, posteriorly angulate or with small denticle.

Mandible densely and very minutely puncto-striate but weakly shiny. Vertex and frons of head densely macropunctate; clypeus, antenna, and legs micropunctate; lateral faces of mesosoma and petiole densely macropunctate; petiolar spines micropunctate; pronotum longitudinally weakly striate; mesonotum and dorsum of propodeum macropunctate. Gastral tergites densely superficially punctate and shiny.

Dorsa of head and mesosoma with dense, short standing hairs. Median point of anterior clypeal margin with a long hair. Antennal scape with dense standing hairs (most of them shorter than the maximum width of antennal scape); antennal segments II–XII with short standing hairs. Petiole with sparse appressed hairs; petiolar spines without hairs; sternite with sparse standing hairs. Gaster with dense pubescence mixed with sparse short hairs that are shorter than those on head. Legs with sparse short hairs. Body entirely black; legs reddish brown. Gaster in some specimens from colonies WJT04-S31 and KK14-Pol-06 reddish brown.

Description of queen (Figs 1 D–F, 2 A–F)

Similar to the worker in structure, sculpture, pilosity, and coloration, with the following conditions that should be noted: body slightly larger; head in full-face view oval, clearly longer than broad with posterior margin roundly convex; eye large, located close to posterolateral corner of head; median ocellus located at level of posterior margin of eye and slightly larger than lateral ocellus; in dorsal view, pronotum short, its anterior margin distinctly convex and posterior margin distinctly concave; mesoscutum trapezoidal; parapsidal line distinct and long; scutellum trapezoidal, almost as long as broad; metanotum short; metanotopropodeal sulcus deep; propodeum in profile view

with almost straight dorsal outline; propodeal junction bluntly angular; petiolar spine short comparing with petiolar node; body hairs relatively denser and longer than in the worker.



FIGURE 1. *Polyrhachis constructor*. A–C, Non-type worker (NN220308-01); D–F, non-type alate queen (NN220308-02); A, D, body in profile view; B, E, body in dorsal view; C, F, head in full-face view.

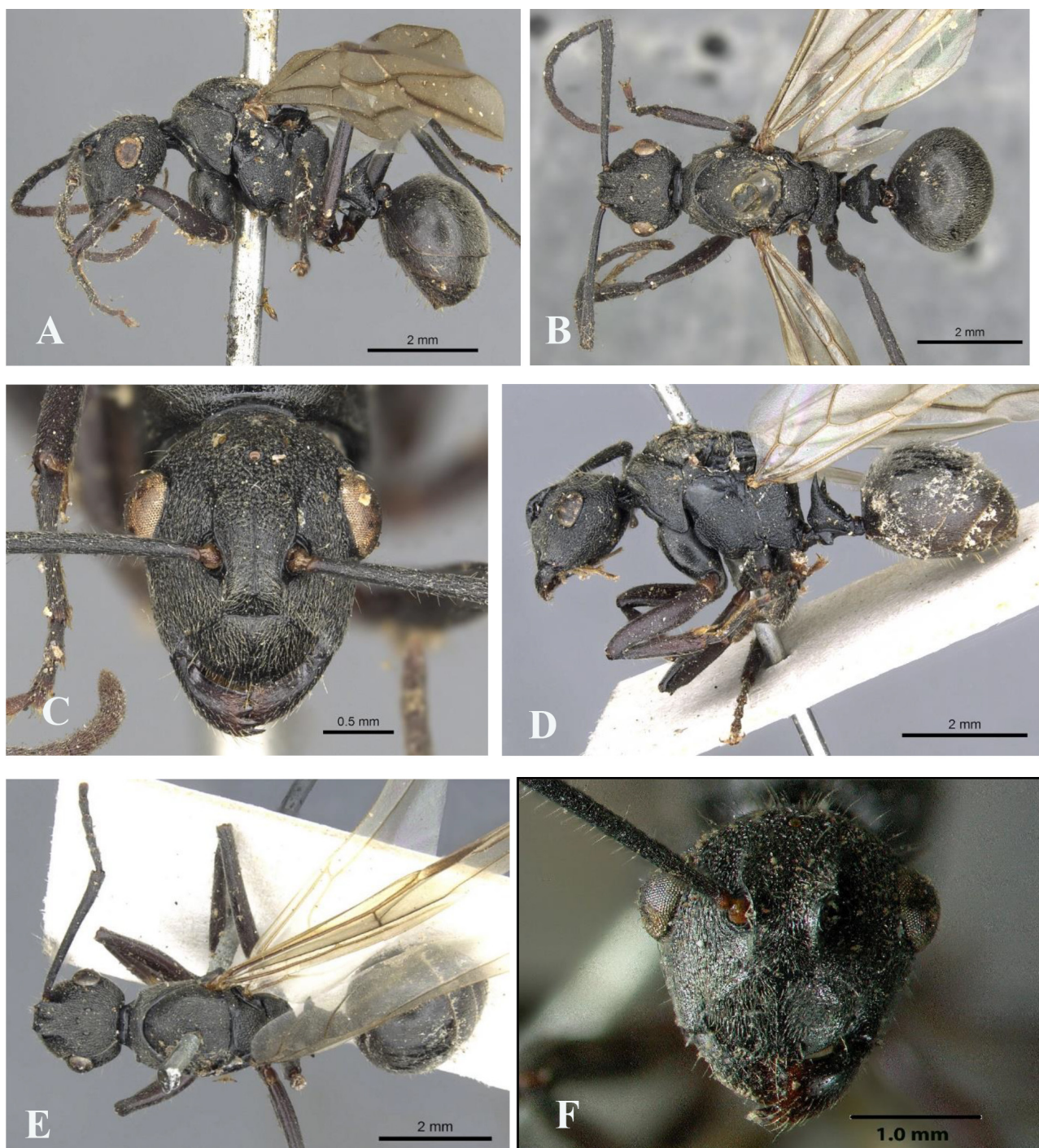


FIGURE 2. *Polyrhachis constructor*. A–C, Syntype of *Polyrhachis constructor* (alate queen ANTWEB CASENT0901846); D–F, syntype of *Polyrhachis piliventris* (alate queen); A, D (ANTWEB CASENT0903307), body in profile view; B, E (ANTWEB CASENT0903307), body in dorsal view; C, F, head in full-face view.

Habitat. Carton nests of *P. constructor* were found on the underside of plant leaves or between leaves. They were located c.a. 1.59–2.80 m above ground on shrubs. The nest was around 1.74–10.53 cm long, 1.51–5.66 cm wide, and 0.22–0.95 cm deep, with only one nest entrance.

Polyrhachis constructor is distinctly allopatric with *P. longipilosa* in distribution, occurring in Sundaland (southern Thailand and Borneo) and southernmost part of Indochina subregions (Prachuap Khirikhan Province). On the other hand, *P. longipilosa* is recorded from western part of Thailand (Kanchanaburi Province).

Distribution. Thailand, Malaysia, Singapore, and Indonesia (Fig. 10 A).

Remarks. *Polyrhachis constructor* is most similar to *P. longipilosa* **sp. nov.** in having hairs on dorsa of head,

mesosoma and gaster and on antennal scape. However, *P. constructor* has the shorter hairs and weaker sculpturing than in the latter (see figures 1 A–C and 6 for comparison). See ‘Remarks’ under *P. longipilosa*. The syntype alate queen of *P. constructor* quite similar to the syntype alate queen of *P. piliventris*. Only minor differential characteristics or just variation have been seen: 1) head is slightly longer (CI 73 in *P. constructor*; CI 85 in *P. piliventris*); 2) posterior margin of head stronger convex than in *P. piliventris*; 3) anterior margin of mesoscutum weaker convex than in *P. piliventris*. The syntype workers of *P. elii* are most similar to workers of *P. constructor* in most aspects but the body size is slightly larger and slightly denser hairs. However, we did not find any major characteristics to distinguish *P. constructor* (Figs. 1 A–C, 2 A–C) from the syntypes of *P. piliventris* (Fig. 2 D–F) and *P. elii* (Fig. 3 A–C). Thus, we here synonymize *P. piliventris* and *P. elii* with *P. constructor*.



FIGURE 3. Syntype of *Polyrhachis elii* (worker, ANTWEB CASENT0905566); A, Body in profile view; B, head in full-face view; C, body in dorsal view.

Polyrhachis flavicornis Smith, 1857

(Figs 4–6)

Polyrhachis flavicornis Smith, 1857: 63, worker and queen, Singapore; Donisthorpe, 1932: 446, combination in *Polyrhachis* (*Myrmatopa*); Jaitrong & Nabhitabhata 2005: 38; Pfeiffer *et al.* 2011: 41; Khachonpisitsak *et al.* 2020: 64; Yamane *et al.* 2021: 124; Wang *et al.* 2022: 10.

Types examined. One syntype worker and one syntype alate queen of *Polyrhachis flavicornis* from Singapore (A. R. Wallace), deposited in OXUM.

Non-type material examined. **LAOS:** Vientiane, Naxaythong dist., Sivilay vill., carton nest on leaf, 11.VI.2010, Sk. Yamane, LA10-SKY-077 (workers, SKYC). **THAILAND:** W Thailand, Tak Prov., Huai Khaeng, 26.II.2016, Sk. Yamane leg. (workers, SKYC); W Thailand, Phetchaburi Prov., Kaeng Krachan N.P., 250–350 m, 30.V.2005, nesting on lower-vegetation, 2.30 m above ground, Colony L, N. Noon-anant leg. (workers, queens, PSUSC, THNHM); NE Thailand, Nakhon Ratchasima Prov., Wang Nam Kheao Dist., Sakaerat Environmental Research Station, 26.IX.2021, W, Jaitrong leg., TH21-WJT-636 (workers, alate queens, THNHM); E Thailand, Chacheongsao Prov., Khao Ang Reu Nai W.S., Lamchangwat Stn., 21.VIII.2003, carton nest on leaf, Sk. Yamane leg., TH03-SKY-18 (workers, SKYC, THNHM); same loc., 22.VIII.2003, Sk. Yamane leg., TH03-SKY-61 (workers, male); same data, TH03-SKY-62 (workers, queens, SKYC); same loc., 21.III.2003, S. Hasin leg., TH03-SH-004 (workers, males, THNHM); same loc., 26.IV.2003, W. Jaitrong leg., WJT03-TH-11 (workers, THNHM); same loc., 23.IV.2003, W. Jaitrong leg., WJT03-TH-14 (workers, THNHM); same loc., 22.VIII.2003, W. Jaitrong leg., WJT03-TH-256 (workers, alate queen, male, THNHM); E Thailand, Chanthaburi Prov., Pong Nam Ron Dist., Khao Soi Dao, Soi Dao Waterfall, 13.V.2006, W. Jaitrong leg., WJT06-E041 (worker, dealate queen, alate queens, THNHM); S Thailand, Songkhla prov., Ton Nga Chang W.S., carton nest, 22.X.2011, Sk. Yamane leg., TH11-SKY-173 (workers, queen, male, SKYC); Narathiwat Prov., Bala Forest, Hala-Bala W.S., 50–300 m, 15.I.2002, on lower vegetation, N. Noon-anant leg. (workers, PSUSC); Satun Prov., Ludu Waterfall, Tatutao N.P., 0–200 m, 6.III.2005, on lower vegetation, N. Noon-anant leg. (workers, PSUSC); Songkhla Prov., Ton Nga Chang W.S., 100–300 m, 21.I.2002, canopy fogging, S. Tongjerm leg. (workers, PSUSC); same loc., 27.III.2004, nesting on lower vegetation, 1.84 m above ground, Colony E, N. Noon-anant leg. (workers, queen, PSUSC); Phatthalung Prov., Ton Pra Tong Waterfall 100–200 m, 19.III.2005, nesting on lower vegetation, 1.63 m above ground, Colony F, N. Noon-anant leg. (workers, PSUSC); Nakhon Si Thammarat Prov., Aey Kiew Waterfall, Khao Luang N.P. 100–300 m, 8.VIII.2005, on lower vegetation, N. Noon-anant leg. (workers, PSUSC); Nakhon Si Thammarat Prov., Khao Nun N.P. 100–500 m, 16.IV.2005, nesting on lower vegetation, 2.35 m above ground, Colony G, N. Noon-anant leg. (workers, queen, PSUSC); Surat Thani Prov., inner mainland, Klong Sang W.S. 100–300 m, 1.V.1994, canopy fogging, L. Lebel leg. (workers, PSUSC); Surat Thani Prov., Tai Rom Yen N.P. 400–500 m, 31.VII.2005, nesting on lower vegetation, 2.25 m above ground, Colony H, N. Noon-anant leg. (workers, PSUSC); Ranong Prov., Kuan Mayoy Mom W.S. 190–250 m, 28.IX.2005, nesting on lower vegetation, 2.20 m above ground, Colony I, N. Noon-anant leg. (workers, queens, PSUSC); Prajuab Khiri Khan Prov., Ka Oon Waterfall, 100–200 m, 10.II.2007, nesting on lower vegetation, 2.05 m above ground, Colony J, N. Noon-anant leg. (workers, queen, PSUSC); Prajuab Khiri Khan Prov., Kuy Buri N.P., 100–300 m, 30.V.2005, nesting on lower vegetation, 1.93 m above ground, Colony K, N. Noon-anant leg. (workers, queen, PSUSC). **INDONESIA:** Sumatra, Aceh, P. Simeulue, Babulmakmur, 15.IX.2012, Sk. Yamane leg., SU12-SKY-090 (workers, queen, male, SKYC); West Sumatra, Mentawai Is., P. Siberut, Surisura, 20.II.2007, light-attracted, Sk. Yamane leg. (queen, SKYC). **MALAYSIA:** Sabah, Danum Valley, 3–4.III.1999, Sk. Yamane (worker, SKYC); Sarawak, Miri, Lambir Hills NP, 21–27.II.2009, Sk. Yamane leg. (worker, SKYC).

Measurements and indices. Worker (10 non-types). TL 3.20–3.35, HL 1.15–1.25, HW 0.95–1.00, SL 1.45–1.55, PW 0.75–0.80, MTL 1.35–1.45, CI 79–87, SI 150–158. Queen (2 non-types). TL 4.30–4.35, HL 1.40–1.45, HW 1.15–1.20, SL 1.80–1.85, PW 1.15–1.20, MTL 1.75–1.80, CI 82–83, SI 154–157. Male (non-type). TL 4, HL 0.85, HW 0.60, SL 0.95, PW 1.30, MTL 1.55, CI 71, SI 158.

Description of worker (Fig. 4 A–C, Fig. 5 A–C)

Head in full-face view distinctly longer than broad, with posterior margin evenly and roundly convex, lateral margins distinctly converging anteriad. Frontal carinae distinctly elevated, posteriorly reaching level of mid-length of eye, parallel anteriorly, divergent in middle, parallel posteriorly. Clypeus transverse, trapezoidal, its posteromedian margin straight to very shallowly emarginated; anterior margin slightly convex; anteromedian portion weakly produced, with straight anterior margin and blunt lateral angles. Mandible subtriangular, masticatory margin with

5 distinct teeth. Antennal scape long, ca. 1.37–1.40 times as long as head width including eyes; pedicel more than 2.5 times as long as broad, much longer than first flagellomere that is shortest of all flagellomeres; all flagellomeres longer than broad. Eye in full-face view convex and prominent, in full-face view breaking lateral margin of head, located posterior to mid-length on lateral face of head.



FIGURE 4. *Polyrhachis flavicornis* (non-type worker, WJT08-E068). A, Body in profile view; B, head in full-face view; C, body in dorsal view.

Pronotum in dorsal view much broader than long, anteriorly slightly convex, laterally roundly convex, with straight posterior margin; humerus rounded, weakly angled or produced as very small process; in profile view lateral face of pronotum with shallow furrow along its anterior margin; posteroventral corner broadly rounded. Mesonotum in dorsal view demarcated anteriorly and posteriorly by distinct furrows, much narrower than pronotum, broader than long, trapezoidal, gradually narrowed posteriad; in profile view dorsal margin almost flat but posterior portion

of lateral keel of mesonotal dorsum bluntly angled; mesopleuron in profile demarcated from pronotum by deep sinuate furrow but completely fused with metapleuron. Metanotal groove short ('narrow') and shallow, continuing down to metathoracic spiracle that has upward-directed small round opening. Propodeum in dorsal view posteriorly as broad as mesonotum; dorsal face rectangular, broader than long, gradually merging with posterior declivity; lateral face not demarcated from metapleuron; propodeal spine short, directed upward; propodeal spiracle located on lateral margin of declivity, prominent, with oblong opening.

Petiole in dorsal view broader than long; dorsal face not clearly differentiated from anterior and posterior slopes, with a pair of long lateral spines that diverge in basal part and are parallel in apical two-thirds, intercalary denticle absent; in profile view anterior slope of node straight, much shorter than posterior slope that is roundly convex; subpetiolar process ventrally with round margin but sometimes with blunt posterior angle.

Head almost entirely puncto-reticulate; area between frontal carinae with much weaker sculpture. Clypeus very densely puncto-reticulate. Mandible in basal half very densely and finely striate with scattered punctures from which setae arise; apical half with much sparser and weaker sculpture and matte or weakly shiny. Antenna densely micropunctate. Pronotum and mesonotum puncto-striate, other parts of mesosoma densely puncto-reticulate to indistinctly puncto-striate. Petiole densely puncto-reticulate; sculpture on posterior face coarser; lateral spines with finer and irregular punctation. Tibiae and tarsi of all legs micropunctate and matte; femora in apical area densely punctate but in other parts superficially and more striated sculptured and shiny; coxae superficially rugulose and shiny. Gastral tergites densely micropunctate and matte; sternites with larger punctures, weakly shiny.

Body with very sparse short appressed pubescence that is absent in some parts, with few long standing hairs; pubescence abundant on gastral tergites and sternites; few standing hairs present on outer margin and along masticatory margin of mandible, clypeus anteriorly, frontal lobe, petiolar sternite anteriorly and venter of gaster. Eye without standing hairs. Head including clypeus, mesosoma, forecoxa and petiole black; mandible, antenna, legs except for forecoxa and gaster yellowish brown to dark reddish brown; antennal scape, mid- and hindcoxae, hindtibia and gaster generally darker than other brownish portions; labial and maxillary palpi yellowish.

Description of queen (Fig. 5 D–F)

General habitus similar to the worker except for caste-specific structures. Body slightly larger with head width 1.15–1.20 mm (0.95–1.00 mm in the worker). Eye larger and more prominent; ocelli arranged in low triangle. Pronotal humerus round, without any projection. Mesoscutum in dorsal view widest at midlength, with convex lateral margins, with distinct longitudinal median shallow furrow in anterior 1/4 length of scutum, notauli absent, parapsidal line in posterior half of scutum; prescutal carina absent; mesoscutellum narrower than mesoscutum, narrowed posteriorly, with ill-defined posterior face; mesopleuron divided into upper and lower sections by groove, anterior margin of lower section with high acute keel (inconspicuous in the worker). Metanotum in dorsal view short ('narrow'), indented, sharply demarcated from propodeum by deep furrow; metapleuron barely differentiated from mesopleuron, completely fused with propodeal side; propodeal spines short, blunt. Petiolar spines much thicker and relatively shorter than in the worker; subpetiolar process developed with ventral margin straight. Body slightly hairier than in the worker; in addition to standing hairs mentioned for the worker, queen bears standing hairs as follows: one or two around ocelli, several on mesoscutum, some on mesoscutellum, some on second to fifth gastral tergites. Body color almost identical to the worker.

Description of male (Fig. 6)

With general characteristics of *Polyrhachis* males (Wong and Guénard, 2020). Body with weak cuticle, often deformed in dry-mounted specimens. Head in full-face longer than broad, but if including eyes, then distinctly broader than long. Clypeus transverse, posteriorly clearly demarcated from frons with posteromedian margin shallowly emarginate medially, anteriorly broadly convex, with anterior margin entire. Mandible weakly sclerotized, spatulate, twice as long as broad with outer margin curved; masticatory margin short and edentate with apex bluntly pointed. Eye large, positioned at mid-length of lateral face of head; distance between mandibular base and anterior margin of eye (malar space) half as long as maximum diameter of eye; ocelli large, arranged in very low triangle; distance between median ocellus and lateral ocelli equal to diameter of median ocellus; distance between lateral ocelli twice as long as diameter of median ocellus. Antennal scape moderately long, as long as head width including eyes.

Mesosoma in dorsal view much broader than head including eyes. Pronotum short ('narrow'), almost entirely concealed by inflated mesoscutum; prescutal furrow complete. Mesoscutum with faint longitudinal median line, without notauli; parapsidal line present in posterior half of scutum; scuto-scutellar sulcus prominent; mesoscutellum

much narrower than mesoscutum, distinctly narrowed posteriad. Metanotum short ('narrow'), deeply indented, clearly defined from propodeum with deep furrow. Propodeum without distinct separation of dorsum from declivity; spines absent. Petiole low and globular, in dorsal view as broad as long. Gaster rather weakly sclerotized, easily deformed after drying.

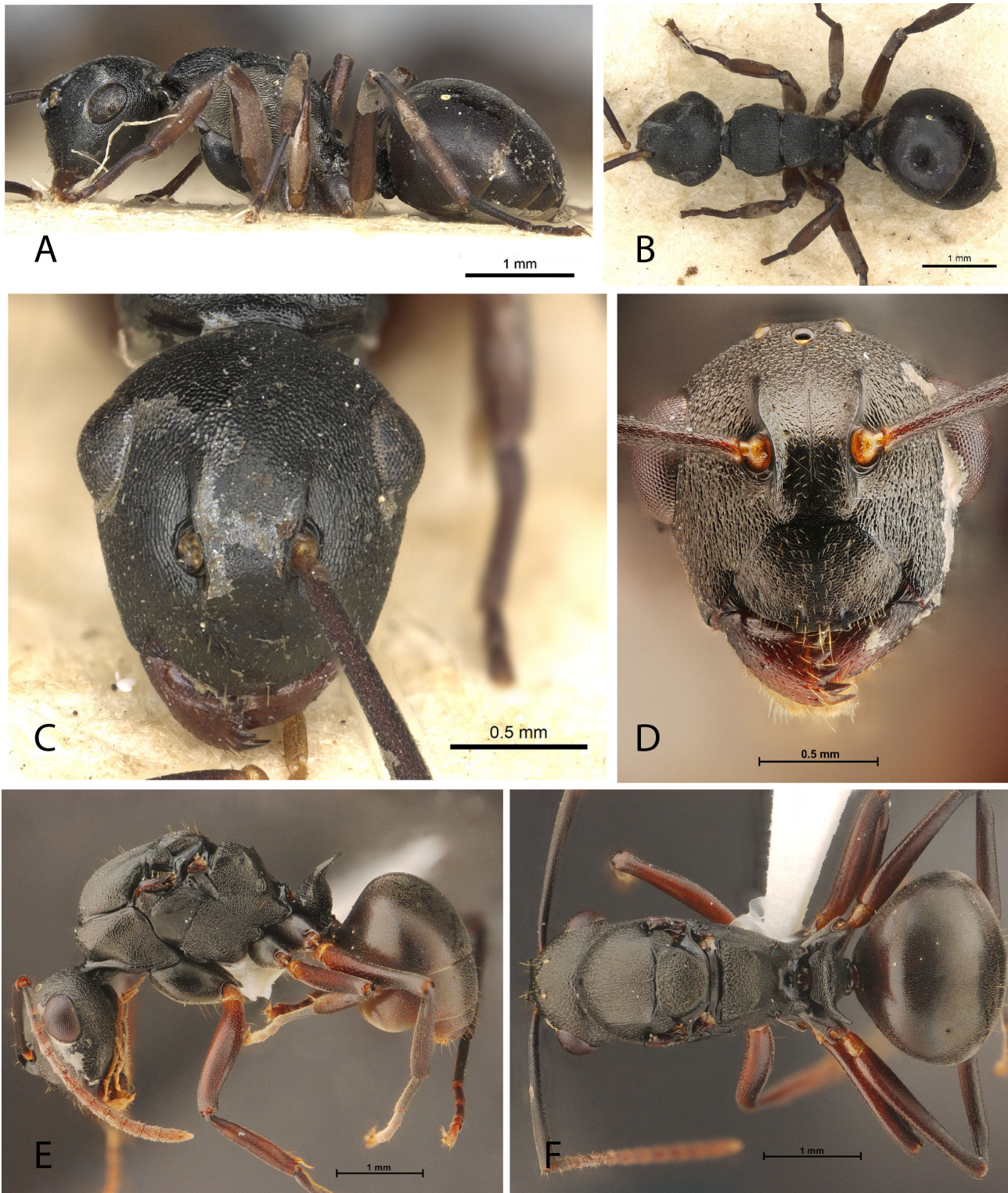


FIGURE 5. *Polyrhachis flavicornis*. A–C, Syntype worker of *Polyrhachis flavicornis* (ANRWEB CASENT 0901857); D–F, non-type dealate queen of *Polyrhachis flavicornis* (TH21-WJT-636); A, E, body in profile view; C, D, head in full-face view; B, F, body in dorsal view.

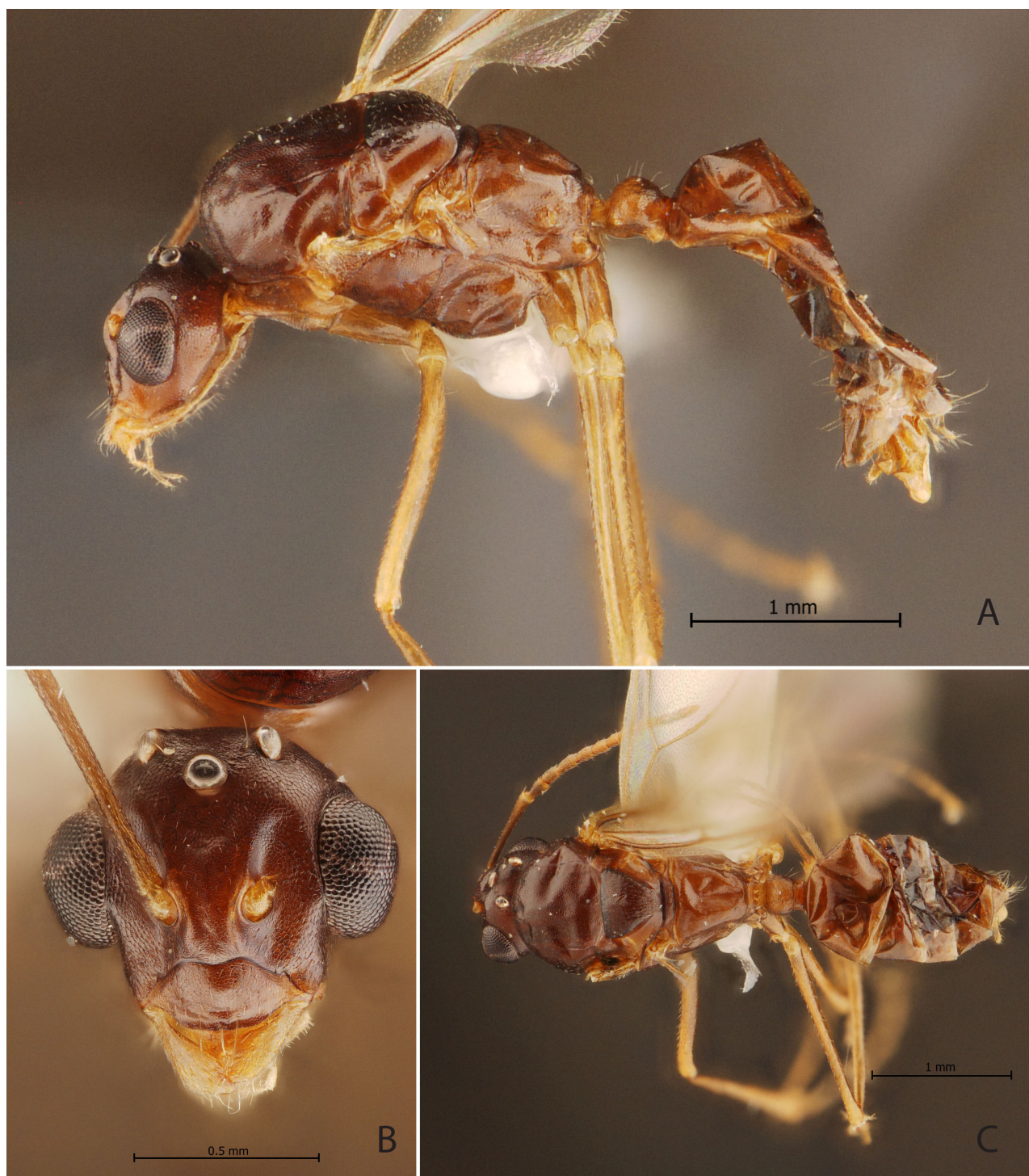


FIGURE 6. *Polyrhachis flavicornis* (non-type male, TH03-SH005). A, Body in profile view; B, head in full-face view; C, body in dorsal view.

Entire body superficially and finely sculptured, weakly shiny. Short appressed hairs present over body surface but often indistinct; standing hairs confined to following parts: clypeus with pair of standing hairs along posterior margin and two to three long hairs anteriorly; mandible with some long hairs of varying length on outer surface; standing hairs on maxillary and labial palpi numerous; mesoscutum with few or no standing hairs; mesoscutellum with several standing hairs and sparse appressed hairs that are longer than standing hairs; a few standing hairs present in posterolateral area of propodeum and around propodeal spiracle; petiole with ca. 20 fine standing hairs dorsally, pair of standing hairs on its sternite ventroposteriorly, and thick golden hairs on anterior face of petiolar node. Gastral tergites generally lacking standing hairs except on apical tergites; gastral sternites with more standing

hairs; coxae of all legs with sparse standing hairs. Eye bearing microscopic hairs that can be recognized under high magnification ($>100\times$). Body brown to dark brown; mandible, legs and genitalia yellowish or light brown; maxillary and labial palpi yellowish.

Habitat. Carton nests of *P. flavicornis* were found on the underside of plant leaves or between leaves in lowland evergreen forest and dry evergreen forest.

Distribution. Laos, Cambodia, Thailand, Singapore, Malaysia, and Indonesia (Fig. 10 B).

Remarks. *Polyrhachis flavicornis* is most similar to *P. varicolor*. For the worker caste, the head and mesosoma are clearly black in *P. flavicornis*, but reddish brown in *P. varicolor*. For body size, *P. flavicornis* (HW 0.95–1.00 mm in worker, 1.15–1.20 mm in queen, 0.60 mm in male) is on average smaller than *P. varicolor* (HW 1.00–1.25 mm in worker, 1.25 mm in queen, 0.65 mm in male).

***Polyrhachis longipilosa* sp. nov.**

(Fig. 7)

Holotype. Worker (THNHM-I-26206, THNHM), W Thailand, Kanchanaburi Prov., Thong Pha Phum Dist., Ban Sahakorn Nikhon, dry evergreen forest, canopy, 25 m from ground, 8.XI.2021, W. Jaitrong leg., TH21-WJT-789.

Paratypes: eleven workers (THNHM-I-26207 to THNHM-I-26217, THNHM) same data as holotype.

Measurements and indices (holotype and 11 paratypes). TL 6.05–6.50, HL 1.65–1.68, HW 1.22–1.32, SL 1.91–1.98, PW 0.92–0.99, MTL 1.91–1.98, CI 77–78, SI 150–157.

Description of worker (Fig. 7)

Head in full-face view distinctly longer than broad with posterior margin roundly convex. Clypeus in dorsal view broad and weakly convex, its anterior and posterior margins distinctly convex; median portion of anterior clypeal margin with a pair of short teeth, diastema between teeth weakly concave. Mandible subtriangular, masticatory margin with 5 distinct teeth (including basal and apical teeth); basal margin straight, unarmed besides basal tooth. Frontal carinae in full-face view weakly sinuate, and reaching level of mid-length of eye, in profile well elevated. Antennal scape long, clavate, and extending beyond posterior margin of head by at least half of its length. Eye convex, slightly protruding from lateral outline of head and located just posterior to midlength of head laterally.

Mesosoma box-like, its dorsum distinctly marginate laterally along entire length. Pronotum in dorsal view, slightly shorter than broad, slightly narrowed posteriorly, and armed with anterolateral teeth, in profile view pronotum weakly convex dorsal outline; margin between the anterolateral teeth convex; lateral face of pronotum subtriangular. Mesonotum in dorsal view shorter than pronotum, almost as long as broad; mesopleuron in profile rectangular, shorter than high, and almost flat. Propodeal dorsum subrectangular and almost as long as broad; propodeal junction produced as pair of short, blunt, and upward-pointed spines.

Petiole node (excluding spine) in profile view round and almost as long as high; petiole spines in dorsal view divergent apical, in lateral view slightly curved backwards, as long as height of petiole; subpetiole process weakly developed, with convex ventral outline.

Mandible entirely with very fine superficial microsculpture and dull. Vertex and frons of head areolate-rugose, area between frontal carinae areolate-rugose posteriorly and punctate anteriorly; areas between eyes and frontal carinae reticulate-striate. Clypeus, antenna, and legs reticulate. Lateral faces of mesosoma and petiole densely areolate-rugose; petiole spine macropunctate in basal half, while its apical half more weakly sculptured and shiny; pronotum longitudinally finely striate; mesonotum and dorsum of propodeum irregularly striate rather than punctate.

Antennal scape with dense brown standing hairs (most of them longer than maximum width of antennal scape); antennal segments II–XII with short standing hairs; dorsa of head and mesosoma densely with long brown standing hairs; petiole spine densely with long brown standing hairs; gaster with dense pubescence mixed with dense long brown standing hairs; median point of anterior clypeal margin with a long standing hairs; legs with dense standing hairs. Body entirely black; legs entirely black, except trochanters which are paler than elsewhere.

Etymology. The specific epithet “*longipilosa*” is a Latin word meaning “with long hairs” and refers to the hairs on body compared with the very short or missing standing hairs in other species of the *Polyrhachis flavicornis* species group.

Habitat. The new species was collected from the canopy at about 25 m above the ground, while *P. constructor*, *P. varicolor*, and *P. flavicornis* were found on shrub trees at 1.59–5 m above the ground and nested on the underside of plant leaves or between leaves (Noon-anant *et al.* 2008, Noon-anant *et al.* 2009).

Distribution. Thailand (Kanchanaburi province, Fig. 10 A).

Remarks. *Polyrhachis longipilosa* **sp. nov.** is similar to *P. constructor*. However, *P. longipilosa* is easily distinguished from the latter by the following worker characteristics: 1) hairs on antennal scape longer than maximum width of antennal scape (shorter or almost as long as maximum width of antennal scape in *P. constructor*); 2) petiolar spine with long standing hairs (without standing hairs in *P. constructor*); 3) hairs on first gastral tergite almost as long as maximum diameter of eye (distinctly short than maximum diameter of eye in *P. constructor*); 4) head and mesosoma with stronger sculpturing (weaker sculpturing in *P. constructor*; see figs 1A–C and 6 for comparison); 5) striation on pronotum well-defined (ill-defined in *P. constructor*; see figs 1B and 7C for comparison).

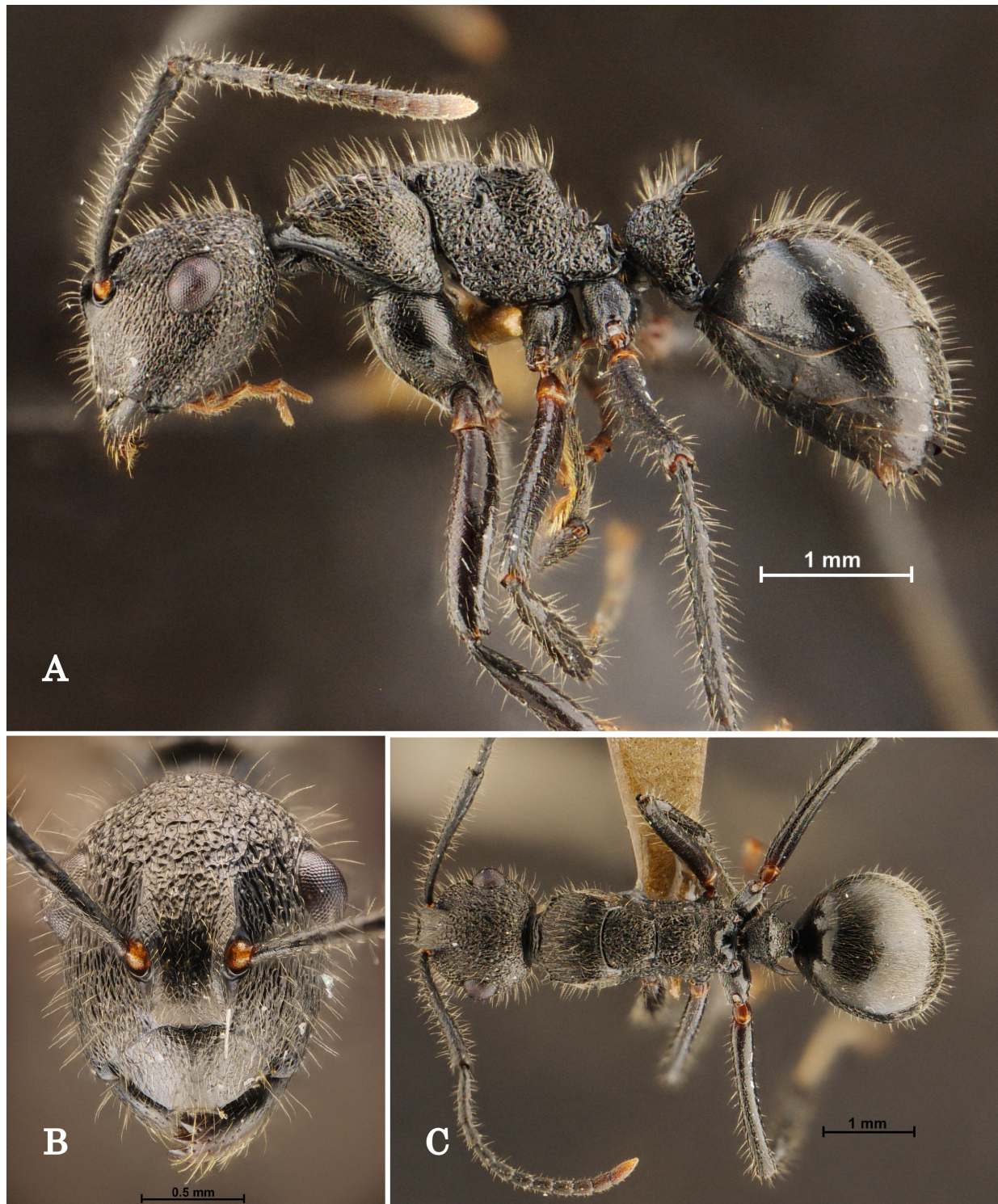


FIGURE 7. *Polyrhachis longipilosa* **sp. nov.** (holotype worker, THNHM-I-26206). A, Body in profile view; B, head in full-face view; C, body in dorsal view.

***Polyrhachis varicolor* Viehmeyer, 1916**

(Figs 8–9)

Polyrhachis (*Campomyrma*) *fruhstorferi* subsp. *varicolor* Viehmeyer, 1916: 163, worker & queen, Singapore.

Polyrhachis varicolor: Kohout 2008: 259 (raised to species); Noon-anant *et al.* 2009: 177, figs 3–8; Khachonpisitsak *et al.* 2020: 75; Wang *et al.* 2022: 59.

Non-type material examined. THAILAND: W Thailand, Prachuab Khiri Khan Prov., Nakon Si Thammarat Prov., 180 m alt., lower-vegetation, 8.III.2006, N. Noon-anant leg., NAW-POL6-024 (workers, PSUSC, SKYC); Central Thailand, Nakhon Nayok Prov., Muaeng Dist., near Nang Rong Temple, nest under leaf, 26.III.2021, W. Jaitrong leg., TH21-WJT-003 (THNHM, workers, dealate queen, alate queens, males); S Thailand, Nakhon Si Thammarat Prov., Khao Nan NP, Yod Nam Waterfall, 27.IX.2008, Sk. Yamane leg. (worker, SKYC).

Measurements and indices. Worker (10 non-types). TL 3.05–4.65, HL 1.30–1.45, HW 1.00–1.25, SL 1.75–1.95, PW 0.85–1.05, MTL 1.50–1.75, CI 80–83, SI 150–180. Queen (3 non-types). TL 5.00–5.45, HL 1.60–1.70, HW 1.25, SL 1.90–2.05, PW 1.45–1.50, MTL 1.85–2.00, CI 74–78, SI 152–164. Male (non-type). TL 4.8, HL 0.9, HW 0.65, SL 1.00, PW 1.25, MTL 1.7, CI 72, SI 154.

Description of worker (Fig. 8 A–C)

Head in full-face view distinctly longer than broad, with posterior margin evenly and roundly convex, lateral margins distinctly converging anteriorly. Frontal carinae in full-face view posteriorly reaching level of mid-length of eye, parallel anteriorly, divergent in middle, parallel posteriorly; frontal carina in profile distinctly elevated. Clypeus in dorsal view transverse, trapezoidal; its posteromedian margin straight to very shallowly emarginated; anterior margin slightly convex; anteromedian portion weakly produced with its anterior margin straight and usually with acute lateral angles. Mandible subtriangular, masticatory margin with five distinct teeth. Antennal scape long, ca. 1.30–1.37 times as long as head width including eyes; pedicel (antennal segment II) about 2 times as long as antennal segment III; all flagellomeres longer than broad with the first shortest. Eye in full-face view convex and prominent, distinctly breaking lateral margin of head, located posterior to mid-length on lateral face of head.

Pronotum in dorsal view much broader than long, anteriorly and laterally weakly convex, with very shallowly concave posterior margins; humerus bluntly angled or produced as small process; in profile view lateral face of pronotum with shallow furrow along its anterior margins; posteroventral corner broadly rounded. Mesonotum in dorsal view demarcated anteriorly and posteriorly by distinct furrows, broader than long, gradually narrowed posteriorly, posteriorly much narrower than pronotum; in profile view dorsal margin almost flat but lateral keel with angle in its posterior half; mesopleuron anteriorly demarcated from pronotum by sinuated deep furrow but completely fused with metapleuron. Metanotal groove short ('narrow') and shallow, continuing down to metathoracic spiracle that has an upward-directed small opening. Propodeum in dorsal view as broad as mesonotum posteriorly; dorsal face rectangular, slightly broader than long, gradually merging with posterior declivity; propodeal spine short, upward directed; lateral face not demarcated from metapleuron; propodeal lobe very small; propodeal spiracle located on lateral margin of declivity, prominent, with oblong opening.

Petiole in dorsal view broader than long; dorsal face not clearly differentiated from anterior and posterior slopes, with pair of long lateral spines that diverge in basal part and are parallel in apical two-thirds, without denticle between them; in profile view anterior slope of node straight, much shorter than posterior slope that is roundly convex; subpetiolar process weakly developed, subtrapezoid with straight ventral margin.

Vertex and frons of head areolate-rugose, area between frontal carinae puncto-reticulate, areas between eyes and frontal carinae weakly sculptured; gena behind eye and venter of head densely puncto-reticulate. Clypeus densely punctate. Mandible in basal half very densely and finely striate with scattered punctures from which setae arise; apical half with much sparser and weaker sculpture and shiny. Antenna densely micropunctate. Dorsum of pronotum puncto-striate, but with weak striation; mesonotum and dorsum of propodeum densely macropunctate; lateral face of mesosoma including lateral face of pronotum densely macropunctate. Petiole densely macropunctate. Gastral tergites finely micropunctate and matte; sternites with coarser punctures but interspaces shiny. Legs micropunctate and matte.

Dorsa of head, mesosoma, petiole, and gaster almost without standing hairs; few very short standing hairs present on outer margin of mandible, clypeus anteriorly, frontal lobe, petiolar sternite anteriorly and venter of gaster. Eye without standing hairs. Antennal scape without standing hairs. Body brown to dark reddish brown; gaster darker than elsewhere [in some specimens gaster with similar color or slightly paler than head and mesosoma]

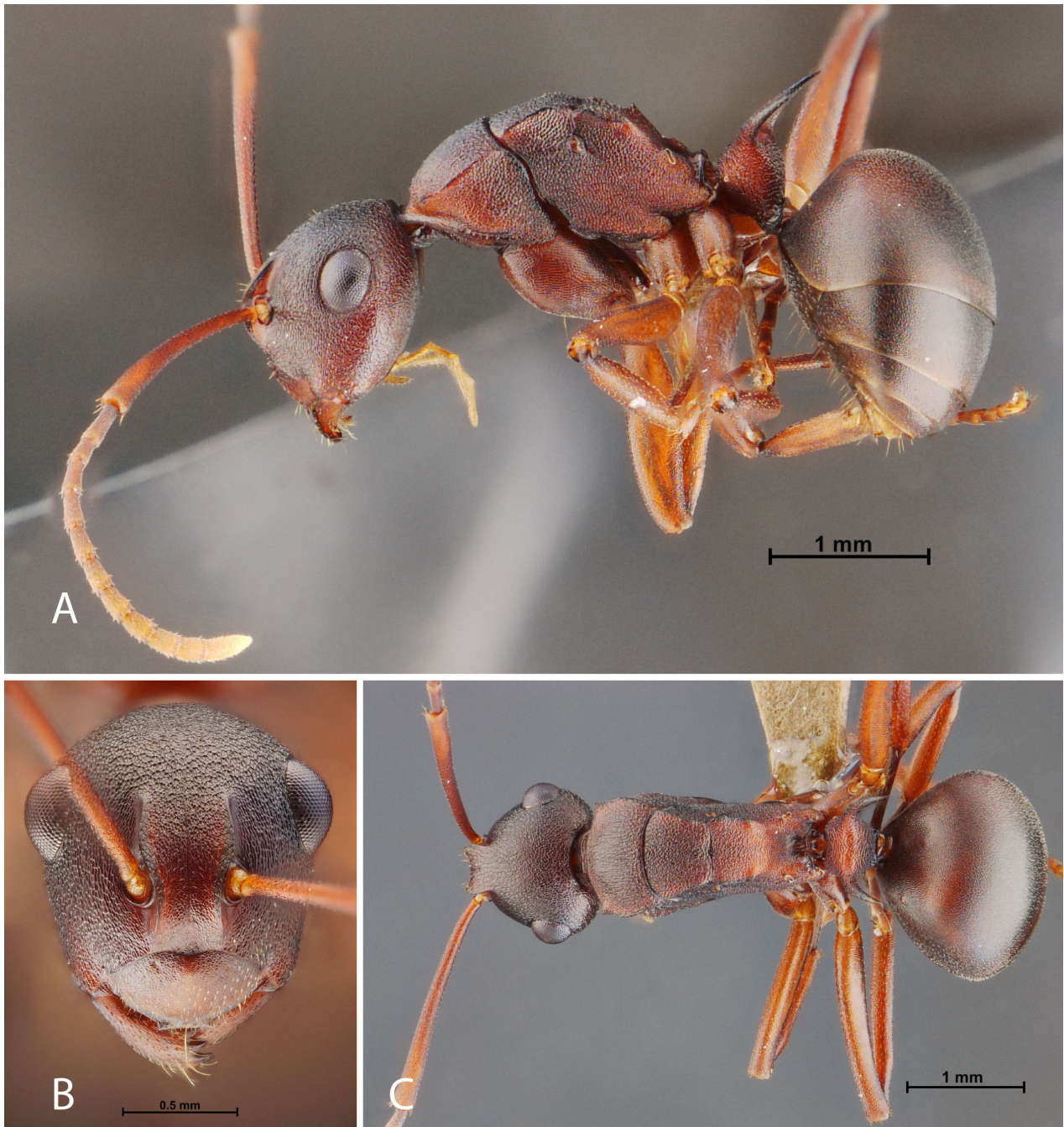


FIGURE 8. *Polyrhachis varicolor* (non-type worker, TH21-WJT-003/1). A, Body in profile view; B, head in full-face view; C, body in dorsal view.

Description of queen (Fig. 9 A–C)

General habitus similar to the worker except for caste-specific structures. Body slightly larger than the average worker with head width 1.25 mm (1.00–1.25 mm in worker). Eye larger and more prominent; ocelli arranged in low triangle. Anterolateral corner of pronotal dorsum round, without any projection. Mesoscutum without notauli, with weak parapsidal line in posterior half of scutum; prescutal carina absent; mesopleuron divided into upper and lower sections by groove; anterior margin of lower section with high acute keel (not conspicuous in the worker). Metanotum in dorsal view short ('narrow'), indented, sharply demarcated from propodeum by deep furrow; metapleuron barely differentiated from mesopleuron, completely fused with propodeal side; propodeal spines short, blunt. Body slightly hairier; in addition to standing hairs mentioned for the worker, queen bears standing hairs as follows: one or two around ocelli, several on mesoscutum, some on mesoscutellum, some on second to fifth gastral tergites. Body color almost identical to the worker.

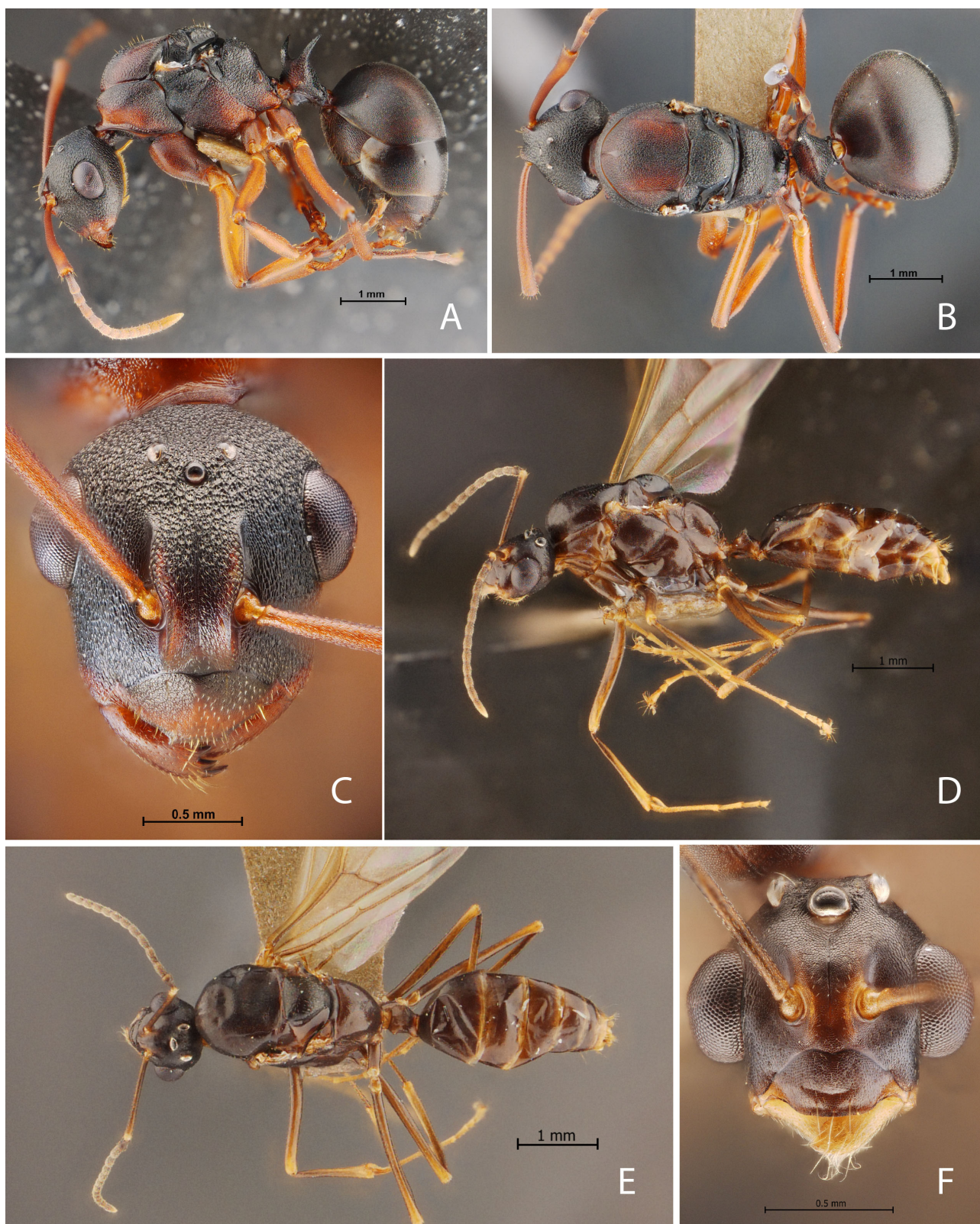


FIGURE 9. *Polyrhachis varicolor*: A–C, Non-type dealate queen (TH21-WJT-003/2); D–F, non-type male (TH21-WJT-003/3); A, D, body in profile view; B, E, body in dorsal view; C, F, head in full-face view.

Description of male (Fig. 9 D–F)

Head in full-face view longer than broad, but if including eyes, then distinctly broader than long. Clypeus in dorsal view broad, with transverse impression in its median portion, posteriorly clearly demarcated from frons, with posteromedian margin shallowly emarginated medially and anterior margin broadly convex. Mandible spatulate,

weakly sclerotized, twice as long as broad with outer margin curved and apex bluntly pointed; masticatory margin short and edentate. Eye large, positioned at mid-length of lateral face of head; distance between mandibular base and anterior margin of eye (malar space) half as long as major diameter of eye. Antennal scape moderately long, as long as head width including eyes.

Mesosoma in dorsal view much broader than head including eyes. Pronotum in dorsal view short ('narrow'), almost entirely concealed by inflated mesoscutum. Mesoscutum with faint median line, without notauli; parapsidal line present in posterior half of scutum; scuto-scutellar sulcus prominent; mesoscutellum much narrower than mesoscutum, distinctly narrowed posteriad. Metanotum short ('narrow'), indented, clearly defined from propodeum with deep furrow. Propodeum without separation of dorsum from declivity; spines absent. Petiole low and globular, in dorsal view as broad as long. Gaster rather weakly sclerotized, easily deformed after drying.

Entire body superficially and finely sculptured, weakly shiny. Short appressed hairs present over body surface; standing hairs confined to following parts: clypeus with two to three long hairs anteriorly; mandible with some long hairs of varying length on outer surface; standing hairs on maxillary and labial palpi numerous; mesoscutum without standing hairs; mesoscutellum without standing hairs but with sparse appressed hairs that are relatively short; a few standing hairs present in posterolateral area of propodeum and around propodeal spiracle; petiole with ca. 20 fine standing hairs dorsally, pair of standing hairs present on sternite posteriorly, and thick golden hairs anteriorly; gastral tergites generally lacking standing hairs except on apical tergites; gastral sternite with more standing hairs; coxae of all legs with sparse standing hairs. Eye without hairs that are recognized under high magnifications (>100 x). Body brown to dark brown; mandible, legs and genitalia yellowish or light brown; maxillary and labial palpi yellowish. The male of *P. varicolor* is very similar to that of *P. flavicornis* but is distinctly larger than the latter (HW 1.25 mm in this species; 0.95–1.00 mm in *P. flavicornis*).

Habitat. Nests of *P. varicolor* were found on the underside of plant leaves or between leaves in dry evergreen forests and evergreen forests (2–5 m above the ground). Silk, carton and other materials were used in constructing the nests.

Distribution. Thailand and Singapore (Fig. 10 B).

Remarks. *Polyrhachis varicolor* is similar to *P. flavicornis*. See under 'Remarks' of *P. flavicornis*.

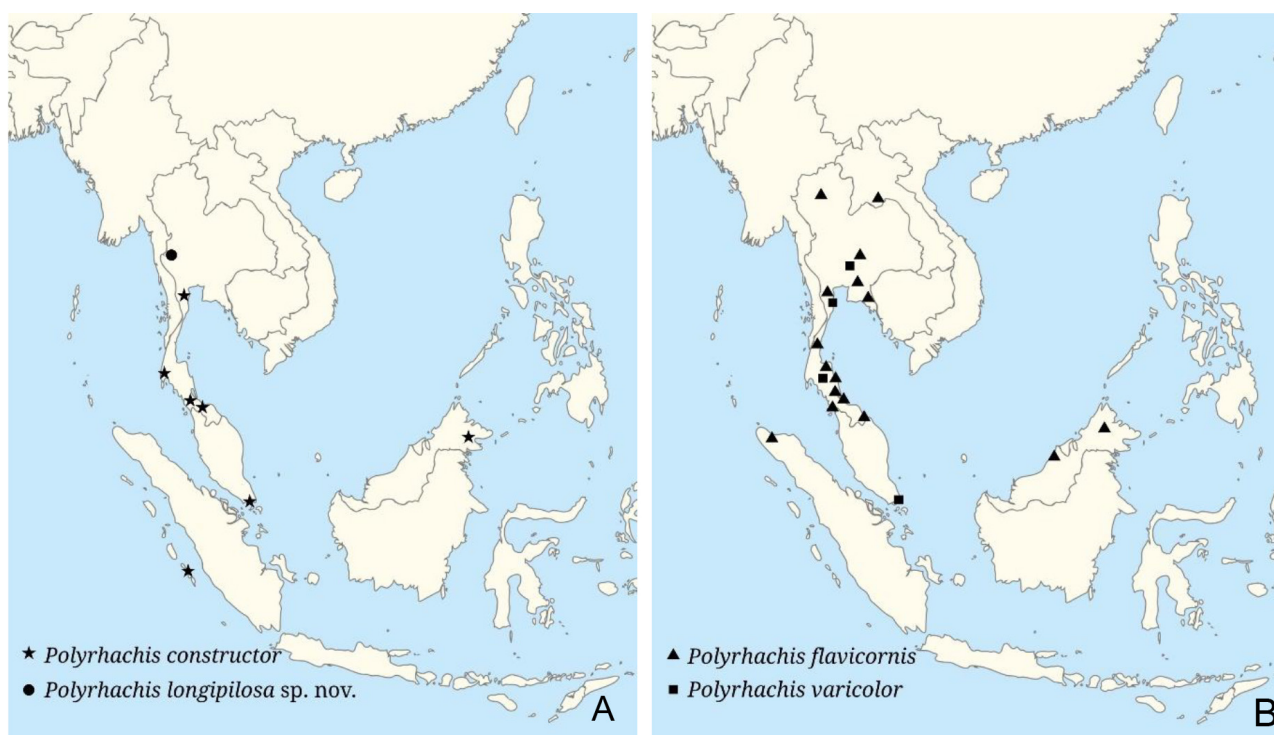


FIGURE 10. Distribution map of *Polyrhachis flavicornis* species group. A) *P. constructor* and *P. longipilosa* sp. nov. B) *P. flavicornis* and *P. varicolor*.

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References

- Antwiki (2022) *Polyrhachis*. Available from: <http://www.antwiki.org/wiki/Polyrhachis> (accessed 1 April 2022)
- AntWeb (2023) *Polyrhachis elii*. Available from: <http://www.antweb.org> (accessed 15 January 2023)
- Bolton, B. (2022) An outline catalog of the ants of the world. Available from: <https://antcat.org/> (accessed 2 April 2022)
- Donisthorpe, H. (1932) On the identity of Smith's types of Formicidae (Hymenoptera) collected by Alfred Russell Wallace in the Malay Archipelago, with descriptions of two new species. *Annals and Magazine of Natural History*, Series 10, 10 (59), 441–476.
<https://doi.org/10.1080/00222933208673595>
- Dorow, W.H.O. (1995) Revision of the ant genus *Polyrhachis* Smith, 1857 (Hymenoptera: Formicidae: Formicinae) on subgenus level with keys, checklist of species and bibliography. *Courier Forschungsinstitut Senckenberg*, 185, 1–113.
- Khachonpisitsak, S., Yamane, S., Siriwichai, P. & Jaitrong, W. (2020) An updated checklist of the ants of Thailand (Hymenoptera, Formicidae). *ZooKeys*, 998, 1–182.
<https://doi.org/10.3897/zookeys.998.54902>
- Kohout, R.J. (2008) A review of the *Polyrhachis* ants of Sulawesi with keys and descriptions of new species. *Memoirs of the Queensland Museum*, 52, 255–317.
- Kohout, R.J. (2012) A review of the Australian *Polyrhachis* ants of the subgenera *Myrma* Billberg, *Myrmatopa* Forel, *Myrmotherinx* Forel and *Polyrhachis* F. Smith. *Memoirs of the Queensland Museum-Nature*, 52, 25–59.
- Kohout, R.J. & Mohamed, M. (2008) A preliminary list of the *Polyrhachis* ants of the Maliau Basin Conservation area in Sabah, Borneo (Hymenoptera: Formicidae: Formicinae). *Asian Myrmecology*, 2, 63–70.
- Mezger, D. & Moreau, C.S. (2015) Out of South-East Asia: phylogeny and biogeography of the spiny ant genus *Polyrhachis* Smith (Hymenoptera: Formicidae). *Systematic Entomology*, 4 (2), 369–378.
<https://doi.org/10.1111/syen.12163>
- Noon-anant, N., Watanasit, S., Yamane, S. & Wiwatwitaya, D. (2008) Nesting habits of the *Polyrhachis* (*Myrmatopa*) *flavicornis* (Formicidae: Formicinae) in the lowland tropical rain forest of Peninsular Thailand. *Sociobiology*, 51 (1), 73–86.
- Noon-anant, N., Kohout, R.J., Watanasit, S., Yamane, S. & Wiwatwitaya, D. (2009) Additional Records of *Polyrhachis* (*Myrmatopa*) *varicolor* Viehmeyer (Formicidae: Formicinae) from Southern Thailand, with Notes on Its Nesting Habits. *The Natural History Journal of Chulalongkorn University*, 9 (2), 171–188.
- Pfeiffer, M., Mezger, D., Hosoishi, S., Yahya, B.E. & Kohout, R.J. (2011) The Formicidae of Borneo (Insecta: Hymenoptera): a preliminary species list. *Asian Myrmecology*, 4, 9–58.
- Robson, S.K.A. & Kohout, R.J. (2007) A review of the nesting habits and socioecology of the ant genus *Polyrhachis* Fr. Smith. *Asian Myrmecology*, 1, 81–99.
- Smith, F. (1857) Catalogue of the hymenopterous insects collected at Sarawak, Borneo; Mount Ophir, Malacca; and at Singapore, by A. R. Wallace. [part]. *Journal of the Proceedings of the Linnean Society of London Zoology*, 2, 42–88.
<https://doi.org/10.1111/j.1096-3642.1857.tb01759.x>
- Wang, W.Y., Soh, E.J.Y., Yong, G.W.J., Wong, M.K.L., Guénard, B., Economo, E.P. & Yamane, S. (2022) Remarkable diversity in a little red dot: a comprehensive checklist of known ant species in Singapore (Hymenoptera: Formicidae) with notes on ecology and taxonomy. *Asian Myrmecology*, 15, e015006.
<https://doi.org/10.20362/am.015006>
- Wong, T.L. & Guénard, B. (2020) Review of ants from the genus *Polyrhachis* Smith (Hymenoptera: Formicidae: Formicinae) in Hong Kong and Macau, with notes on their natural history. *Asian Myrmecology*, 13, e013001.
<https://doi.org/10.20362/am.013001>
- Yamane, S., Tanaka, H.O., Hasimoto, Y., Ohashi, M., Meleng, P. & Itioka, T. (2021) A list of ants from Lambir Hills National Park and its vicinity, with their biological information: Part II. Subfamilies Leptanillinae, Proceratiinae, Amblyoponinae, Ponerinae, Dorylinae, Dolichoderinae, Ectatomminae and Formicinae. *Contributions from the Biological Laboratory, Kyoto University*, 31, 87–157.