

Revision of the genus *Euagathis* Szépligeti (Hymenoptera, Braconidae, Agathidinae) from Thailand, with description of three new species

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Abstract

The species of the genus *Euagathis* Szépligeti (Hymenoptera, Braconidae, Agathidinae) from Thailand are revised. Eight species are treated, three new species are described, i.e. *Euagathis breviantennata* **sp. n.**, *E. setosimaculata* **sp. n.** and *E. pallitarsis* **sp. n.** *Disophrys sogdiana* Fahringer, 1937, *D. chinensis* Fahringer, 1937, and *Euagathis sentosus* Chen & Yang, 1995, are new junior synonyms of *Euagathis chinensis* (Holm-gren, 1868). *Euagathis guangxiensis* (Chen & Yang, 2006) is a new combination. Lectotypes are designated for *Disophrys sogdiana* Fahringer, 1937, and *D. chinensis* Fahringer, 1937. A dichotomous illustrated key to species is presented; links to electronic interactive keys and to distribution maps are also included.

Keywords

Thailand, Insecta, identification key, taxonomy, systematics, new species, *Euagathis*, Braconidae

Introduction

Agathidinae is a moderately large subfamily of medium-sized to fairly large Braconidae with 1,154 described species worldwide and 316 in the Oriental Region (Yu et al. 2012), although there are an estimated 2,000–3,000 species awaiting description worldwide (Sharkey et al. 2006). The subfamily has a worldwide distribution, but its members are more common in subtropical and tropical regions than in temperate areas. The history of the classification of the Agathidinae was summarized by Sharkey (1992) and Sharkey et al. (2006) conducted phylogenetic analyses based on morphology and the D2–D3 regions of 28S rDNA. The Oriental fauna of Agathidinae was first revised by Bhat and Gupta (1977), who provided a detailed history of taxonomic research for the area. Keys to the Oriental genera of Agathidinae were published by Sharkey et al. (2009), van Achterberg and Long (2010) and Sharkey and Clutts (2011). The first key to the Oriental species of the genus *Euagathis* Szépligeti, 1900 was provided by Bhat and Gupta (1977). The Indo-Australian species of the genus *Euagathis* were revised by Simbolotti and van Achterberg (1990, Sulawesi; 1995, Sunda islands), van Achterberg and Chen (2002, China and Vietnam), van Achterberg (2004, Wallacea, Australian region), van Achterberg and Raychaudhuri (2004, India) and van Achterberg and Long (2010, Vietnam). Chen and Yang (2006) provided a key to the Chinese species of *Euagathis*. The genus *Euagathis* was shown in the phylogenetic analysis by Sharkey et al. (2006) to be firmly nested within the tribe Disophrini and closely related to the genus *Coccygidium* de Saussure, 1892.

Methods

As part of the TIGER (Thailand Inventory Group for Entomological Research) NSF-funded entomological inventory of Thailand, three Malaise traps (per locality) were used at 30 different localities throughout Thailand from 2006–2010, comprising approximately 90 Malaise trap years. The specimens dealt with here are primarily from these traps. Species concepts are based on morphological and molecular data from COI and 28S.

Morphological terms follow van Achterberg (1988) and van Achterberg and Long (2010). Distributional data are listed for all new species and a Google map with associated distributional data is included for all species.

Phylogenetic methods: Regions D2–D3 of 28S rDNA (roughly 560 base pairs) were sequenced using the primers 28SD2hymF (5'-AGAGAGAGTTCAAGAGTACGTG-3') and 28SD3hymR (5'-TAGTTCACCATCTTTTCGGGTC-3'). Sequences were edited using Geneious Pro v4.7.5 (Drummond et al. 2009) and aligned using MAFFT (Katoh et al. 2006) through the GUIDANCE server (Penn et al. 2010) which was used to assess confidence scores for each column in the alignment. Columns with confidence scores < 93% (default) were removed prior to all phylogenetic analyses. COI sequences were generated with the primers LepF1 (5'-ATTCAACCAATCATAAAGATATTGG-3') and LepR1 (5'-TAAACTTCTGGATGTCCAAAAAATCA-3'). MAFFT was used to align the COI



Figure 1. Map showing the collection sites in Thailand.

sequences and no regions of ambiguous alignment were detected. Three permutations of the molecular data were phylogenetically analyzed herein: (1) a 49-OTU 28S-only data set, (2) a 31-OTU COI-only data set and (3) a 30-OTU data set in which all OTUs contain both COI and 28S sequences. The data sets were analysed under Bayesian Inference (BI) with MrBayes (v3.2; Huelsenbeck and Ronquist 2001, Ronquist and Huelsenbeck 2003) under the GTR+I+G model of evolution (Rodriguez et al. 1990), partitioned by gene in the 2-gene data set, and conducted for 10 million generations. Additionally, the data sets were analyzed under maximum likelihood (ML) using Garli (v1.0; Zwickl 2006), using the default settings and the GTR+I+G model for best-tree searches and 100-replicate bootstrap analyses. Finally, 100 maximum parsimony (MP) bootstrap replicates were conducted on each data set using PAUP* (v4.0b10; Swofford 2001). Herein, we present the tree with the highest log-likelihood from each ML analysis, with nodal support values

obtained from each method. Rooting the analyses with *Disophrys* spp. (GenBank accession numbers: COI: KC899814-KC899816; 28S: HQ667969-HQ667971, JF506257, KC867209) was based on the close relationship between these two genera recovered from analyses of large agathidine data sets (Sharkey, unpublished).

Distribution data, pdf's of non-copyright references, images, notes, and host and type information can be found by searching TaxaBank (a combined specimen and taxonomic database; <http://purl.org/taxabank>. Codes beginning with an "H" and followed by numbers are unique identifiers used for specimens in the HIC (below), and in the specimen database TaxaBank (e.g., H 647).

Abbreviations used for specimen depositories

HIC	Hymenoptera Institute Collection, University of Kentucky, Department of Entomology, Lexington, Kentucky, USA.
NRMS	Naturhistoriska Riksmuseet, Stockholm, Sweden.
QSBG	Queen Sirikit Botanic Gardens, Chiang Mai, Thailand.
RMNH	Naturalis Biodiversity Center Collection [formerly Rijksmuseum van Natuurlijke Historie], Leiden, Netherlands.

Results

Species delimitation. Both morphological and molecular data, specifically COI and 28S, were used to determine species limits. Our original morphological species concepts were tested against the molecular data. Most of these morphological concepts were corroborated, including the rather subtle morphological differences between *E. abbotti* and *E. forticarinata*, which are distinguished with both COI (Fig. 2) and 28S (Fig. 3).

The COI ML tree (Fig. 2) shows two distinct lineages of *E. forticarinata* and one specimen (H004) that is an outlier from both of these clades. The sole specimen of the morphologically distinct species *E. setosimaculata* lies between the two clades. This strongly suggests that *E. forticarinata* may be comprised of more than one species. However we could discover no consistent morphological differences between the two lineages. The COI ML tree (Fig. 2) also shows considerable variation within *E. abbotti*, but again we could not discern morphological characters consistent with these lineages. The 28S ML tree (Fig. 3) is more conservative and provides different information for our purposes, it separates all of our morphologically based species concepts and all members within these species have identical sequences, with the following two exceptions. First, *E. ophippium* and *E. pallitarsis* are distinct morphologically but have identical 28S sequences; nonetheless based on the morphological data we chose to suggest species status for both. Second, the two *E. forticarinata* specimens, H004 and H743, are identical and distinct from the other *E. forticarinata* specimens. We do not have COI data for H743, however COI data for H004 is distinct and widely separated from all other *E. forticarinata* specimens (Fig. 2).

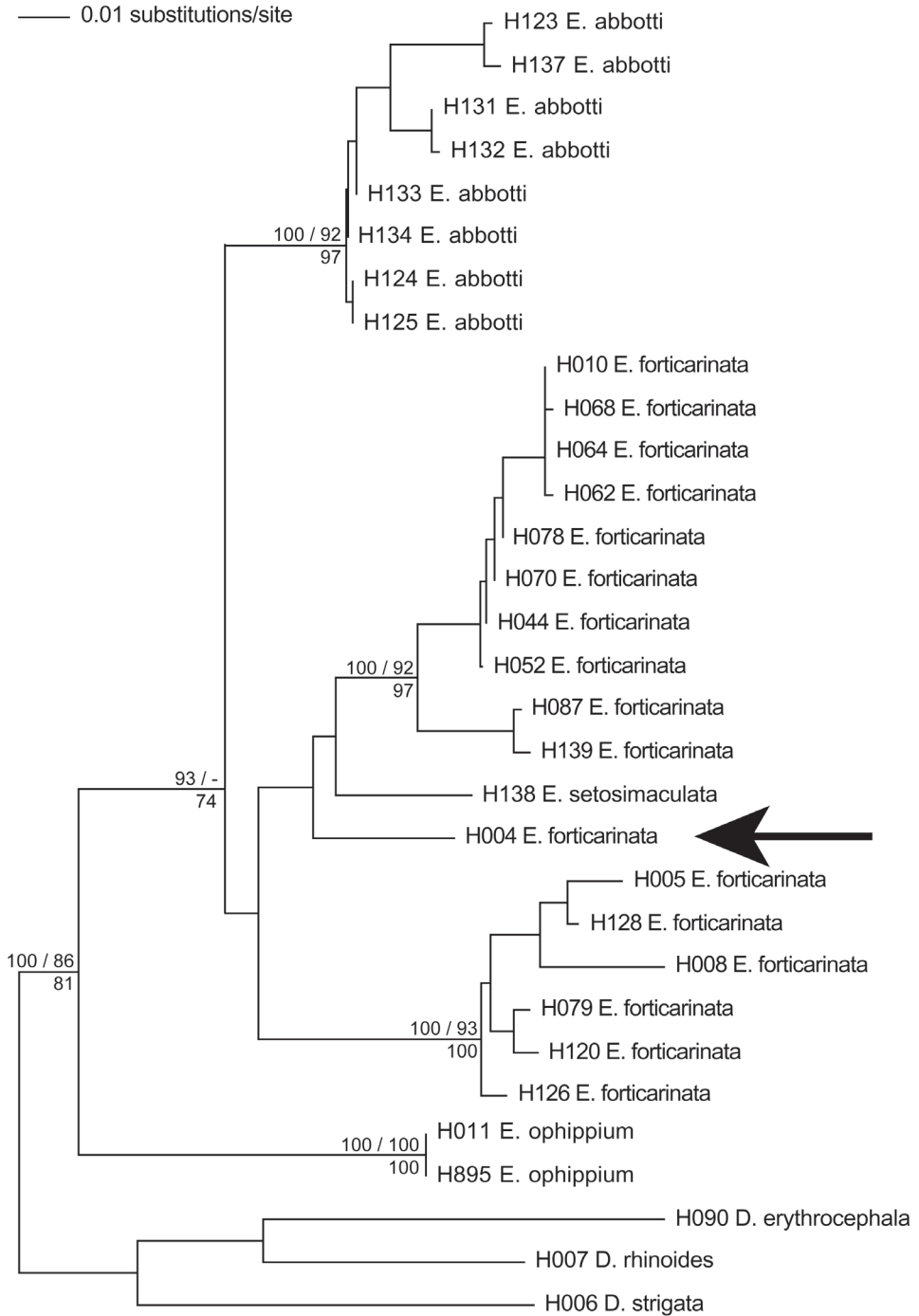


Figure 2. ML tree from the analysis of the COI-only data set with BI posterior probabilities ($\times 100$) and ML bootstrap values above the branches (left to right) and MP bootstrap values below the branches. Arrow points to a rogue exemplar of *E. forticarinata*.

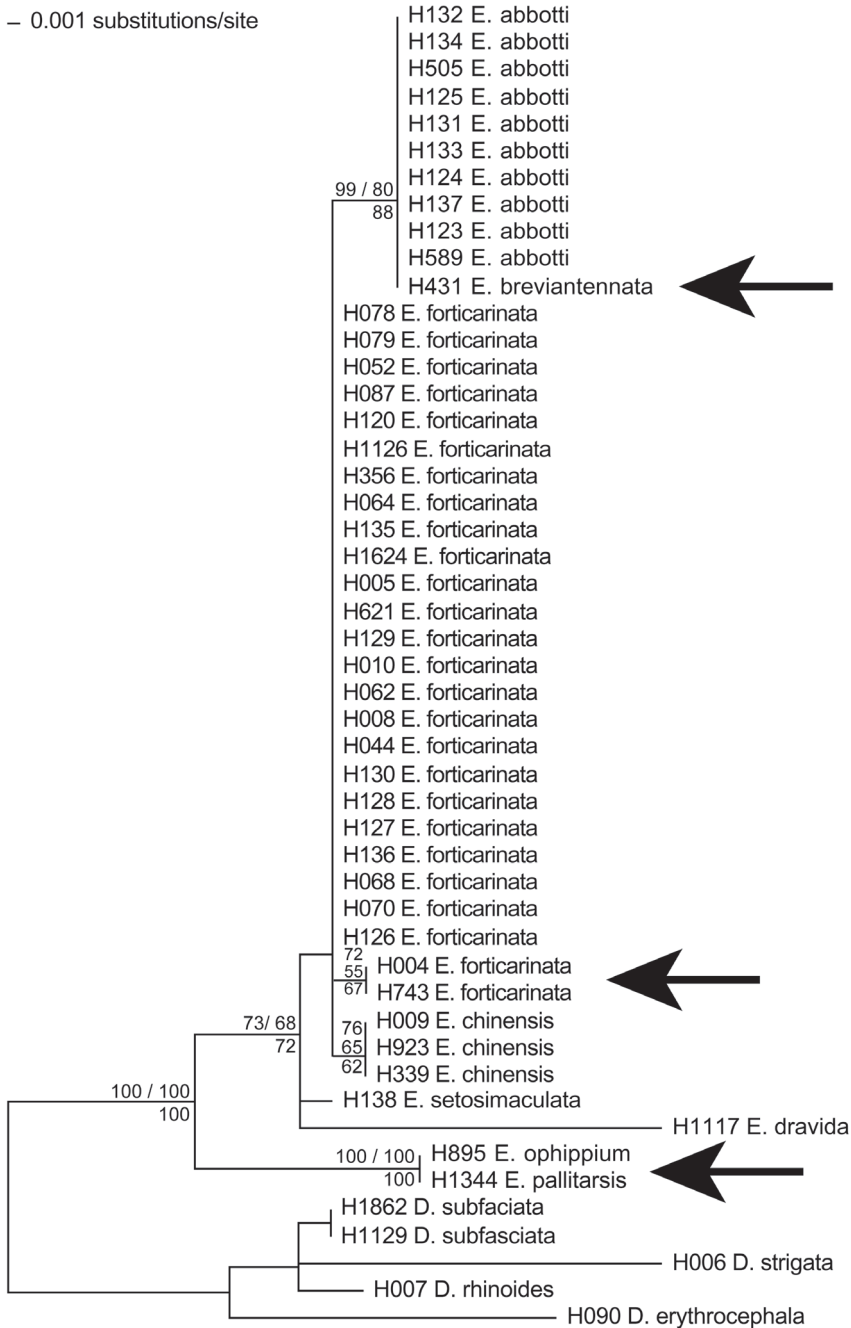


Figure 3. ML tree from the analysis of the 28S-only data set with BI posterior probabilities ($\times 100$) and ML bootstrap values above the branches (left to right) and MP bootstrap values below the branches. Top to bottom, arrows point to **a** sequence of *E. brevantennata* identical to those of *E. abbotti* **b** rogue exemplars of *E. forticarinata* that may indicate a new species and **c** sequences of *E. ophippium* and *E. pallitarsis* which are identical to one another.

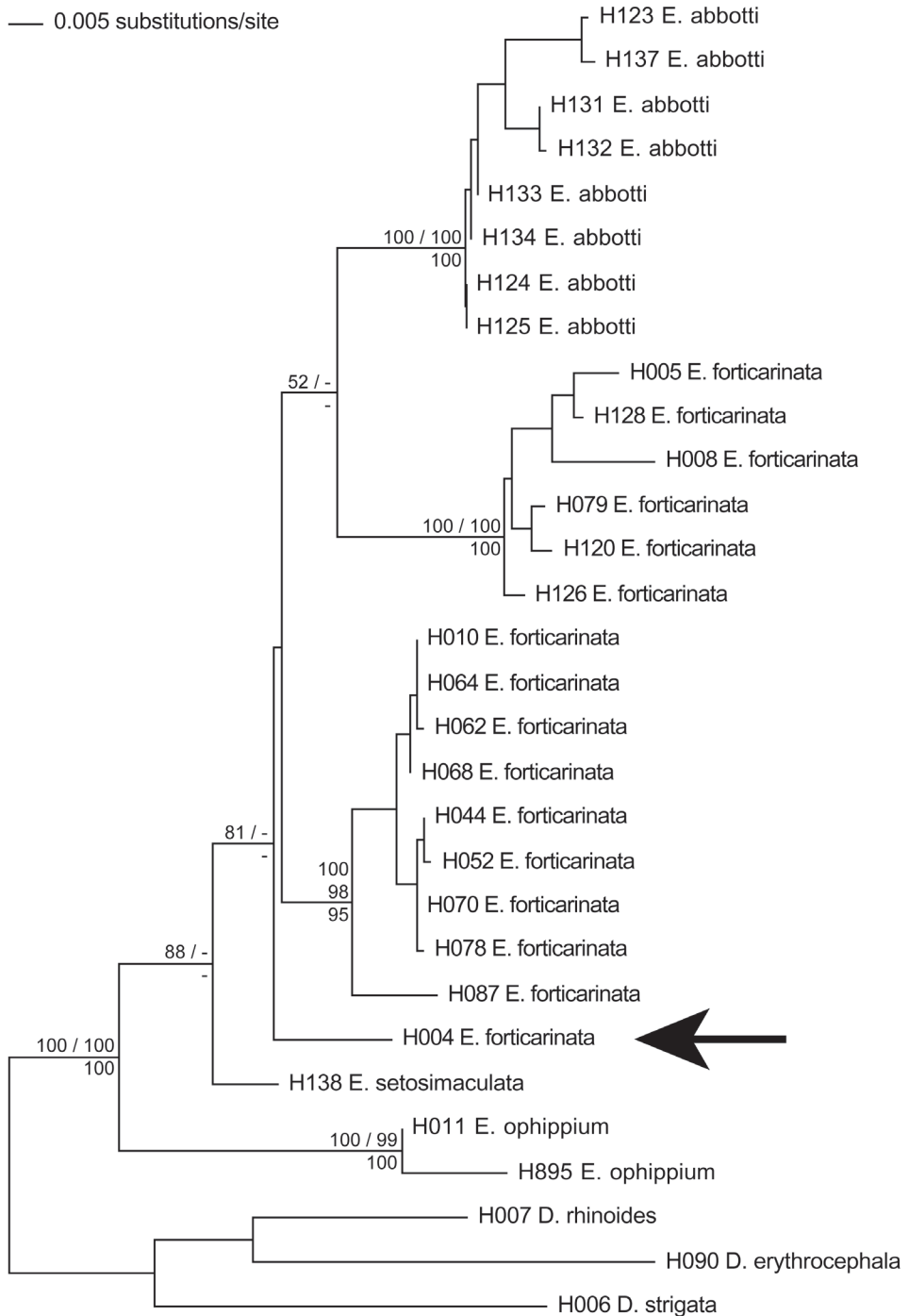


Figure 4. ML tree from the analysis of the COI+28S data set in which every taxon has both genes. BI posterior probabilities ($\times 100$) and ML bootstrap values are above the branches (left to right) and MP bootstrap values are below the branches. Arrow points to a rogue exemplar of *E. forticarinata*.

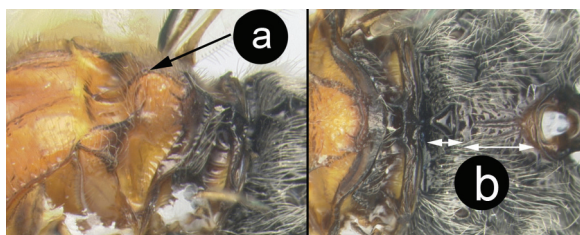
Unfortunately, both H004 and H743 are male specimens and they both appear identical to other melanic males of *E. forticarinata* (see Fig. 9k). It is our opinion that these two specimens probably represent a new species, but due to the lack of female specimens, the lack of diagnostic characters to distinguish the putative species from *E. forticarinata* and our rather small sample size, we have decided against proposing a new species. Figure 4 is a ML tree of the combined COI and 28S data. Since the 28S data are largely monotonous within species the topology mostly reflects that of the COI tree (Fig. 2).

Genus *Euagathis* Szépligeti, 1900

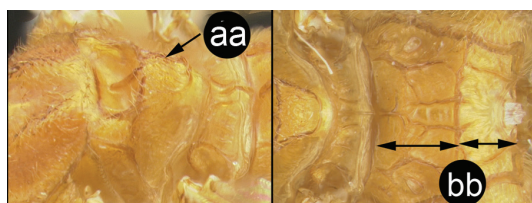
Key to species of the genus *Euagathis* Szépligeti from Thailand

(see also the interactive key here)

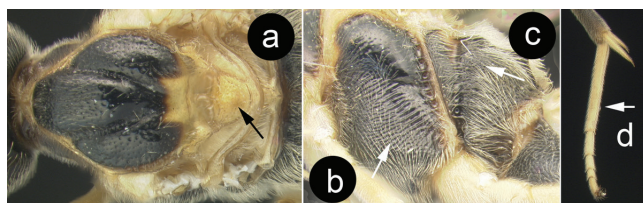
- 1 Scutellum strongly tuberculate, protruding and with long setae (a); anterior/dorsal face of propodeum much shorter than its posterior face (b) 2



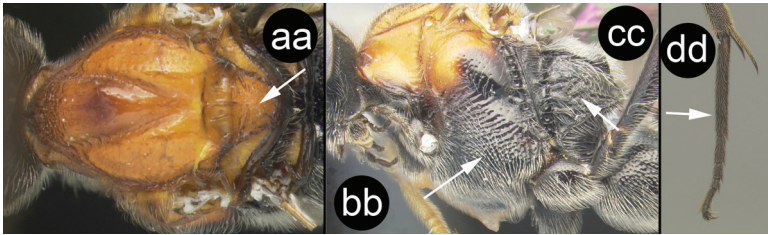
- Scutellum weakly to moderately convex and with short setae (aa); dorsal face of propodeum usually about as long as or longer than its posterior face (bb) (except shorter in *E. setosimaculata* sp. n. [Fig. 12g]) 3



- 2 Scutellum pale yellow (a); area below precoxal sulcus densely punctate-rugose (b); metapleuron finely reticulate-punctate (c); hind tarsus ivory (d)
..... *E. pallitarsis* sp. n.



- Scutellum mostly reddish brown (aa); area below precoxal sulcus densely punctate (bb); metapleuron coarsely vermiculate-rugose (cc); hind tarsus black (dd) *E. ophippium* (Cameron, 1899)



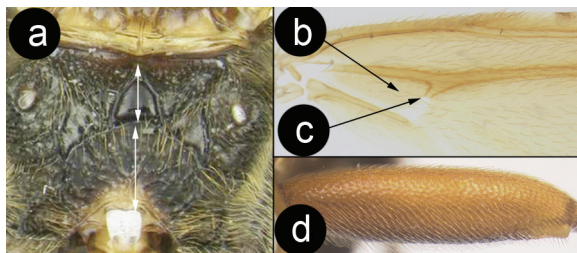
- 3 Lateral lobes of mesoscutum distinctly convex posteriorly and medially distinctly punctate (but sometimes sparsely and/or partly striate) (a); metapleuron usually densely punctate submedially (b); first metasomal tergite 1.7–2.1 times as long as apical width (c) 4



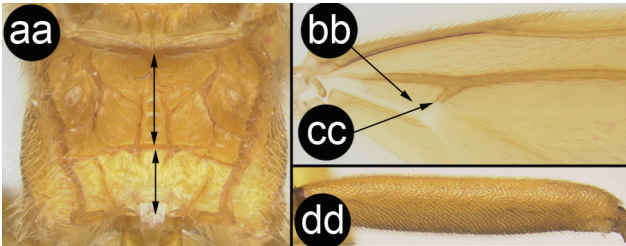
- Lateral lobes of mesoscutum weakly convex or flattened posteriorly and lobes submedially largely smooth (aa); metapleuron sparsely punctate medially (bb); first tergite 1.3–1.6 times as long as apical width (cc) *E. chinensis* (Holmgren, 1868)



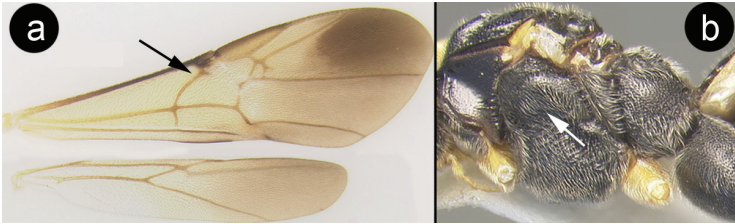
- 4 Dorsal face of propodeum much shorter than posterior face of propodeum (a); area near vein cu-a of hind wing distinctly setose (b); vein cu-a of hind wing about as long as wide (c); hind femur thick (d) *E. setosimaculata* sp. n.



- Dorsal face of propodeum about as long as posterior face of propodeum (aa); area near vein cu-a of hind wing glabrous or sparsely setose (bb); vein cu-a of hind wing distinctly longer than wide (cc); hind femur slender (dd)5



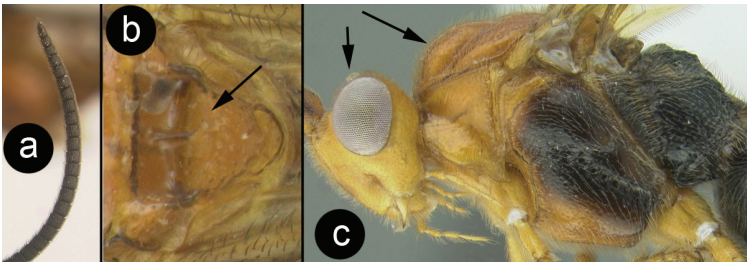
- 5 Stigmal spot of fore wing absent (a); mesopleuron of both sexes mostly black or dark reddish-brown (b).....6



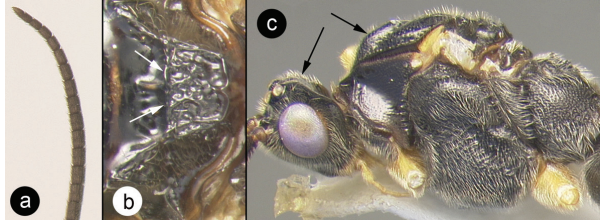
- Stigmal spot of fore wing medium-sized to large (aa); mesopleuron of female yellowish-brown (bb), male mesopleuron sometimes dark brown or black..... 7



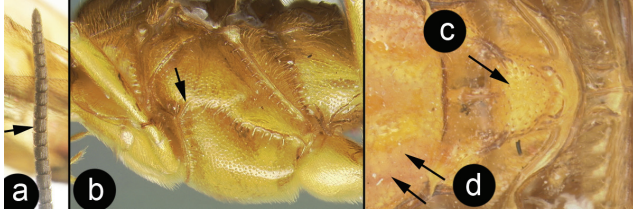
- 6 Antennal segments of female short (mostly as long as wide) and bristly (a); scutellum rounded anteriorly, without transverse carina anteriorly (b); head and mesoscutum reddish- or yellowish-brown (c) ... *E. brevantennata* sp. n.



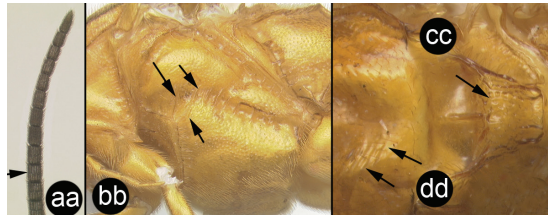
- Antennal segments of female mostly longer than wide and setose (aa); scutellum angulate anteriorly, with transverse carina anteriorly (bb); head and mesoscutum black (cc)..... *E. dravida* Bhat & Gupta, 1977



- 7 Tenth antennal segment, from apex, of female 0.9–1.1 times as long as wide and sub-apical segments sub-moniliform (a) (male 1.3–1.4 times); anterior crenulae of precoxal sulcus short (b); anterior face of scutellum rounded dorsally (c); lateral lobes of mesoscutum without oblique rugae near medio-posterior area (d) *E. abbotti* (Ashmead, 1900)



- Tenth antennal segment, from apex, of female 1.2–1.4 times as long as wide and sub-apical segments normal (aa) (male 1.5–1.6 times); anterior crenulae of precoxal sulcus often medium-sized or long (bb); anterior face of scutellum angulate dorsally and smooth except for median carina (cc); lateral lobes of mesoscutum often with fine oblique rugae near medio-posterior area of mesoscutum (dd) *E. forticarinata* (Cameron, 1899)



Descriptions

Euagathis abbotti (Ashmead, 1900)

http://species-id.net/wiki/Euagathis_abbotti

Distribution. For a distribution map of Thai specimens and their associated data, see Appendix I. Brunei; Indonesia (Java, Sumatra); Laos; East Malaysia (Sabah); Thailand; Vietnam. Reported from Thailand by Simbolotti and van Achterberg (1995).

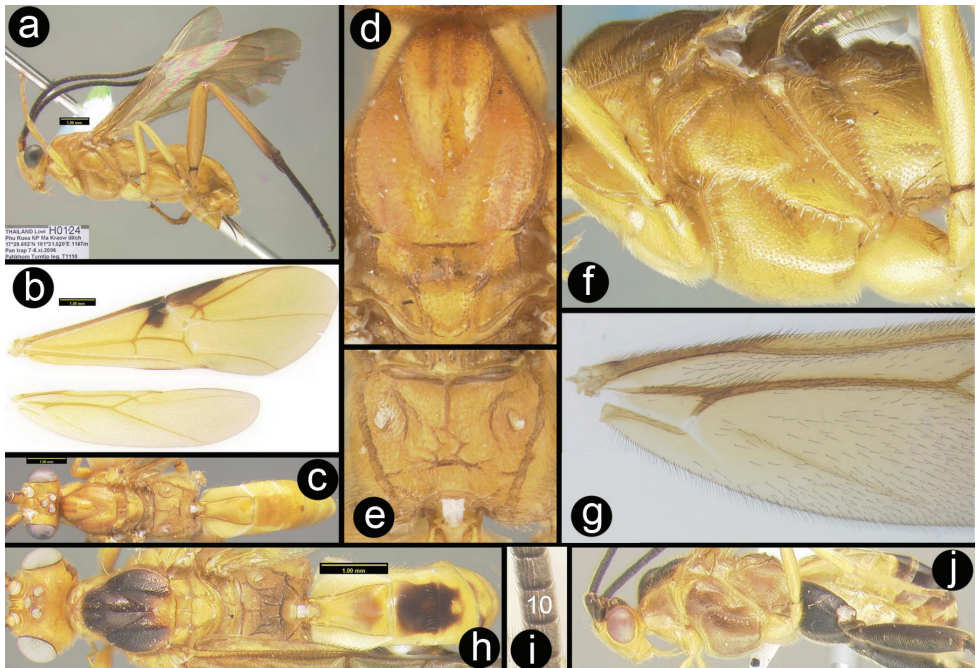


Figure 5. *Euagathis abbotti* (Ashmead), female. **A** lateral habitus **B** wings **C** dorsal habitus **D** dorsal mesothorax **E** propodeum **F** lateral mesosoma **G** base of hind wing **H** male, dorsal habitus **I** female, 10th flagellomere from apex **J** male, lateral habitus.

Molecular data. Genbank accession numbers: KC899817-KC899824 (COI); KC867210-KC867217, KC867219-KC867220 (28S).

Notes. The pterostigma, mesosoma, metasoma and hind leg of the male are usually largely dark brown or black.

***Euagathis breviantennata* van Achterberg & Sharkey, sp. n.**

<http://zoobank.org/A2CAEB56-6BD6-4C9C-9C9E-03CE7463227E>

http://species-id.net/wiki/Euagathis_breviantennata

Type material. Holotype, ♀ (QSBG), “**Thailand:** Chiang Mai, Doi Chiang Dao N. P., Headquarter, 19°24.278'N, 98°55.311'E, 491 m elev., Malaise trap, 14-21.viii.2007, S. Jugsu & A. Watwanich” (H928; T5672). Paratypes (3 ♀): 1 ♀ (RMNH), Thailand: “Chiang Mai, Doi Chiang Dao W. S., Pha Trang unit, 19°24.978'N, 98°54.886'E, 526 m elev., Malaise trap, 21-28.x.2007, Songkran & Apichart” (H340); 1 ♀ (HIC), “Chiang Mai Prob., Queen Sirikit Botanic. Garden, 18°52'50.7"N, 98°51'42.3"E, alt. 811 m elev., by Malaise trap, 9-16.vi.2009, semi-evergreen forest, K. Kaewjanta et al. QSBG-2009-125” (H694); 1 ♀ (QSBG), “Nakhon Si Thammarat, Namtok Yong N. P., behind lavatory, 8°10.397'N, 99°44.503'E, 95 m elev., Malaise trap, 26.v.-2.

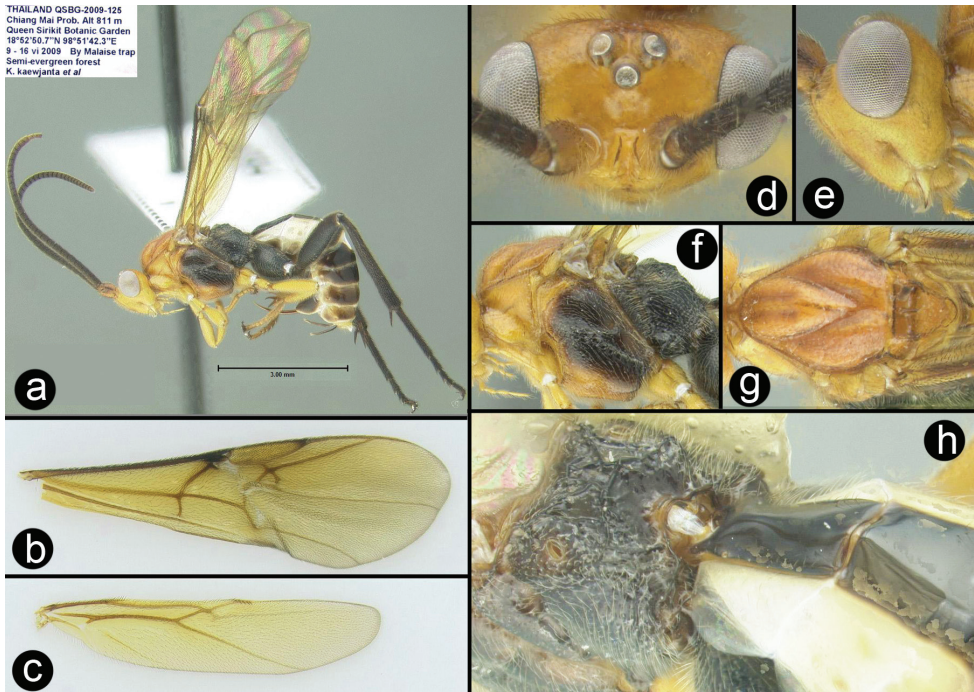


Figure 6. *Euagathis breviantennata* sp. n., female, paratype. **A** lateral habitus **B** fore wing **C** hind wing **D** dorsal head **E** lateral head **F** lateral mesosoma **G** dorsal thorax **H** postero-lateral propodeum and anterior metasoma.

vi.2009, U-prai K.” (H431); 1 ♀ (HIC) Chiang Mai, Doi Chiangdao NP, Pha Tang substation, 19.416°N, 98.915°E, 526 m elev., Malaise trap, 28.viii–4.ix.2007, S. Jugsu & A. Watwanich (H4107).

Diagnosis. This new species keys to *E. fuscnotum* Enderlein, 1920, from the Sunda area (Java, Sumatra, Borneo, West Malaysia) in the key by Simbolotti and van Achterberg (1995). Females of both species have the segments of the apical half of the antenna about as long as wide. *E. breviantennata* sp. n. differs by having the hind femur punctate-rugose ventrally (coarsely punctate in *E. fuscnotum*), third antennal segment of female about twice as long as wide (about 3 times), setae of middle tarsus about as long as width of tarsal segments (about half as long as width of segments), anterior crenulae of precoxal sulcus long (short to medium-sized), head normally triangular in anterior view and about 1.2 times wider than high (eyes strongly protruding, head about 1.4 times wider than high in female), apical half of fore wing with yellowish tinge (without yellowish tinge) and first tergite comparatively elongate and 1.7–2.2 times as long as wide apically (comparatively short and 1.4–1.9 times as long as wide apically).

Description. Holotype, ♀, length of body 8.2 mm, of fore wing 7.9 mm, of ovipositor sheath 0.8 mm.

Head. Antennal segments 45, length of third segment 1.3 times fourth segment, length of third, fourth and penultimate segments 2.2, 1.8 and 1.0 times their width,

respectively; apical antennal segment as long as penultimate segment; maxillary palp 0.6 times height of head; malar space 2.8 times as long as basal width of mandible; length of eye 2.1 times temple; temple directly narrowed posteriorly and slightly concave laterally; POL:OD:OOL = 6:5:9; face shiny with shallow medial groove dorsally, spaced punctulate and setose; frons, vertex and temple shiny and smooth (Fig. 6d); temple concave near lower level of eye.

Mesosoma. Length of mesosoma 1.4 times its height; pronotum smooth, but setose and punctulate dorsally and finely crenulate posteriorly; area near lateral carina of mesoscutum smooth; mesoscutum shiny, with spaced and rather coarse punctures and lateral lobes distinctly convex posteriorly (Fig. 6g); notauli complete, smooth or nearly so; scutellum convex and densely coarsely punctate, antero-dorsal margin rounded and without transverse carina; precoxal sulcus complete and anterior crenulae long (Fig. 6f); mesopleuron and metapleuron medially coarsely punctate with interspaces equal to diameter of punctures or wider; propodeum coarsely areolate, anterior face about as long as posterior face.

Wings. Fore wing: second submarginal cell pentagonal and with short ramellus (Fig. 6b); vein SR1 straight; $r:3\text{-SR:SR1} = 4:1:72$; vein 2-R1 0.5 times as long as 1-R1; vein cu-a slightly antefurcal; no stigmal spot. Hind wing: vein M+CU 3.2 times as long as vein 1-M; area near vein cu-a glabrous.

Legs. Length of hind femur, tibia and basitarsus 4.9, 8.3 and 7.6 times their width, respectively; hind femur punctate-rugose ventrally; setae of middle tarsus about as long as width of tarsal segments; fore and middle tarsal segments moderately slender; length of outer and inner spur of middle tibia 0.6 and 0.8 times middle basitarsus, respectively; outer side of middle tibia without pegs, except for 1 apical peg; length of outer and inner spur of hind tibia 0.4 and 0.6 times hind basitarsus.

Metasoma. First tergite 1.9 times as long as wide apically, smooth, moderately elongate and apically widened (Fig. 6h); second metasomal suture absent; ovipositor sheath 0.1 times as long as fore wing, truncate apically and somewhat widened (Fig. 6a).

Colour. Black; head, scapus and pedicellus (both partly darkened), palpi, mesosoma (but mesopleuron (except anteriorly), metapleuron and propodeum black and mesosternum largely dark brown) and fore and middle legs, yellowish-brown; basal half of metasoma largely ivory ventrally and laterally, apical half of metasoma largely dark brown, but hypopygium with ivory patch medially; pterostigma and veins brown; wing membrane brownish with a yellowish tinge (Fig. 6b, c); apex of ovipositor sheath ivory.

Variation. Length of fore wing 5.9–7.9 mm; length of ovipositor sheath 0.11–0.12 times as long as fore wing; antennal segments of female 40(1), 44(1) or 45(1); first metasomal tergite 1.7–2.2 times as long as its apical width; mesosternum and mesopleuron ventrally largely dark brown or yellowish-brown.

Biology. Unknown.

Distribution. Only known from Thailand. For a distribution map, see Appendix I.

Molecular data. Genbank accession numbers: KC867218 (28S).

Etymology. From “brevis” (Latin for “short”) and “antenna” (Latin for “sailyard, feeler”) because of the short antenna of the female.

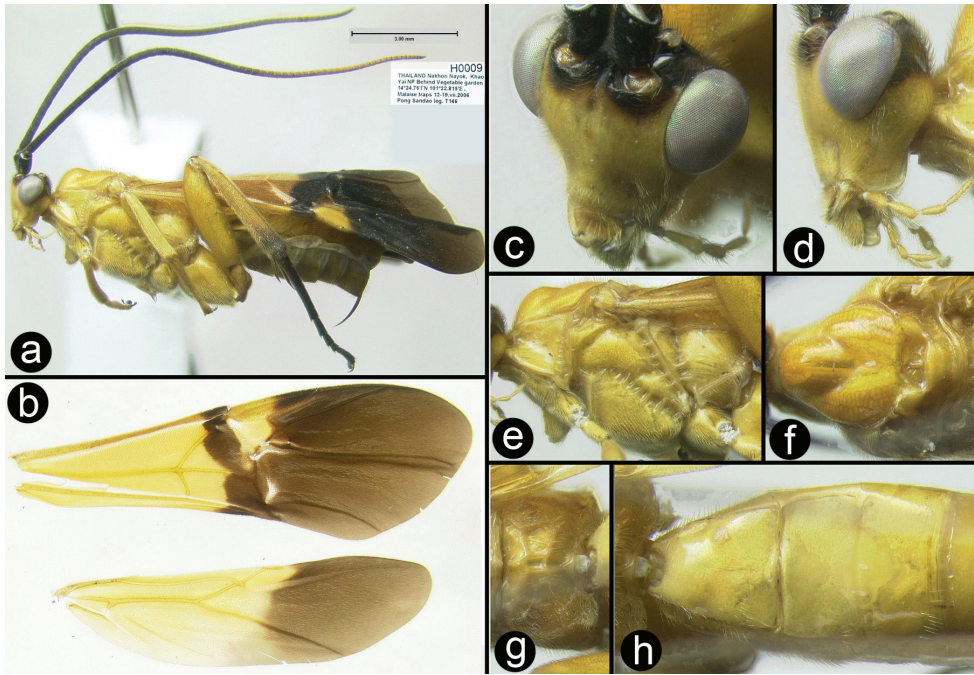


Figure 7. *Euagathis chinensis* (Holmgren), female. **A** lateral habitus **B** wings **C** antero-lateral head **D** lateral head **E** lateral mesosoma **F** dorsal thorax **G** dorsal propodeum **H** dorsal metasomal tergites 1–3.

***Euagathis chinensis* (Holmgren, 1868)**

http://species-id.net/wiki/Euagathis_chinensis

Distribution. For a distribution map of Thai specimens examined and their associated data, see Appendix I. China (Anhui, Fujian, Guangdong, Guangxi, Guizhou, Hainan Island, Hong Kong, Hunan, Jiangsu, Jiangxi, Qinghai, Sichuan, Taiwan, Yunnan, Zhejiang); India; Indonesia (Java, Sumatra); Japan; Laos; West Malaysia; Myanmar; Nepal; Pakistan; Singapore; Sri Lanka; Thailand; Vietnam. First reported from Thailand by Bhat and Gupta (1977).

Molecular data. Genbank accession numbers: KC867221–KC867223 (28S).

Notes. The following species belong to *E. chinensis* (Holmgren, 1868):

Disophrys sogdiana Fahringer, 1937: lectotype here designated (NRMS), “China, Kolthoff”, “Provins Kiangsu”, “Sept.”, “Typ.”, “*Disophrys sogdiana* sp. N., Type, det. Dr. Fahringer”, “NHRS-HEVA, 000000041”; according to the original description there are 2 additional females from the same locality. The lectotype belongs to *Euagathis chinensis* (Holmgren, 1868) syn. n. It has the vein 1-R1 of fore wing and its setae dark brown (as most of the wing membrane), the second metasomal suture is absent, the stemmaticum and the vertex are black; apical 0.8 of hind tibia dorsally (but only ventral 0.3) and hind tarsus dark brown.

Disophrys chinensis Fahringer, 1937: lectotype here designated (NRMS), “China, Kolthoff”, “Provins Kiangsu”, “Sept.”, “Typus”, “*Disophrys chinensis* sp. N., Type, det.

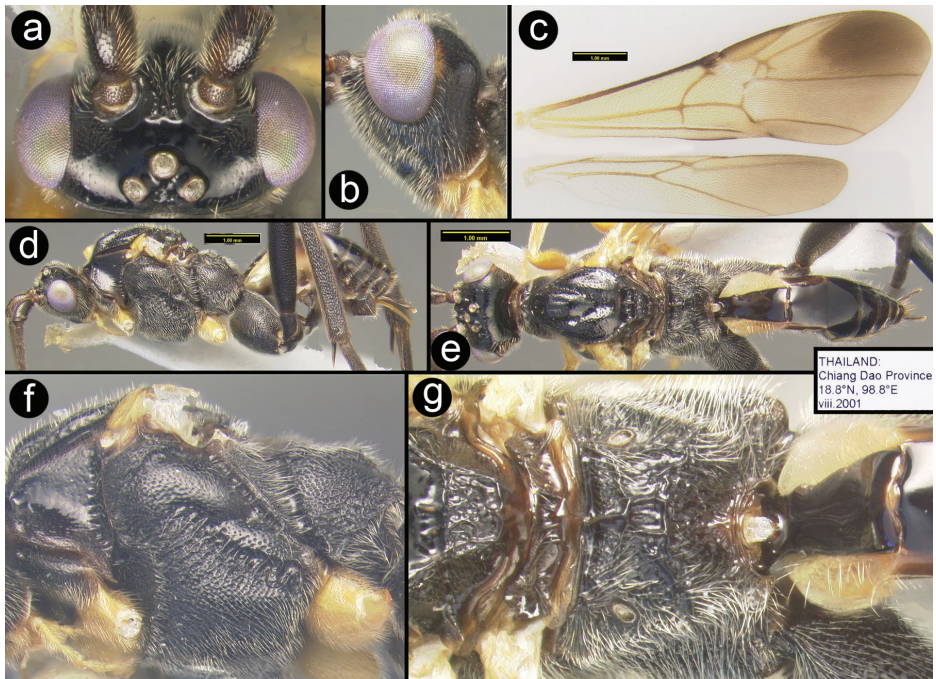


Figure 8. *Euagathis dravida* Bhat & Gupta, female. **A** Dorsal head **B** lateral head **C** wings **D** Lateral habitus **E** dorsal habitus **F** lateral mesosoma **G** dorsal scutellum and propodeum.

Dr. Fahringer”, “NHRS-HEVA, 000000042”; according to the original description there are 2 additional females and a male from the same locality. The lectotype belongs to *Euagathis chinensis* (Holmgren, 1868) syn. n. It is very similar to *E. sogdiana*, but has a narrow band below the pterostigma and the basal half of the fore wing yellowish. The paralectotype male has the basal half of the fore wing partly darkened near vein cu-a.

Euagathis sentosus Chen & Yang, 1995, was purported to be a valid species because of the dark setae of vein 1-R1 of the fore wing and by having a shallow second metasomal suture (van Achterberg 2004), but the presence or absence of the second metasomal suture is variable in the series of *E. chinensis* from Thailand. In addition, *E. sogdiana*, *E. chinensis* (Fahringer) and the specimens from Thailand and Vietnam have the setae of vein 1-R1 dark brown. Therefore, *E. sentosus* is considered to be conspecific with *E. chinensis* (Holmgren) syn. n.

Euagathis dravida Bhat & Gupta, 1977

http://species-id.net/wiki/Euagathis_dravida

Distribution. For a map showing the locality of the sole Thai specimen, see Appendix I. India; Vietnam. New for Thailand.

Molecular data. Genbank accession number 28S: DQ201905.

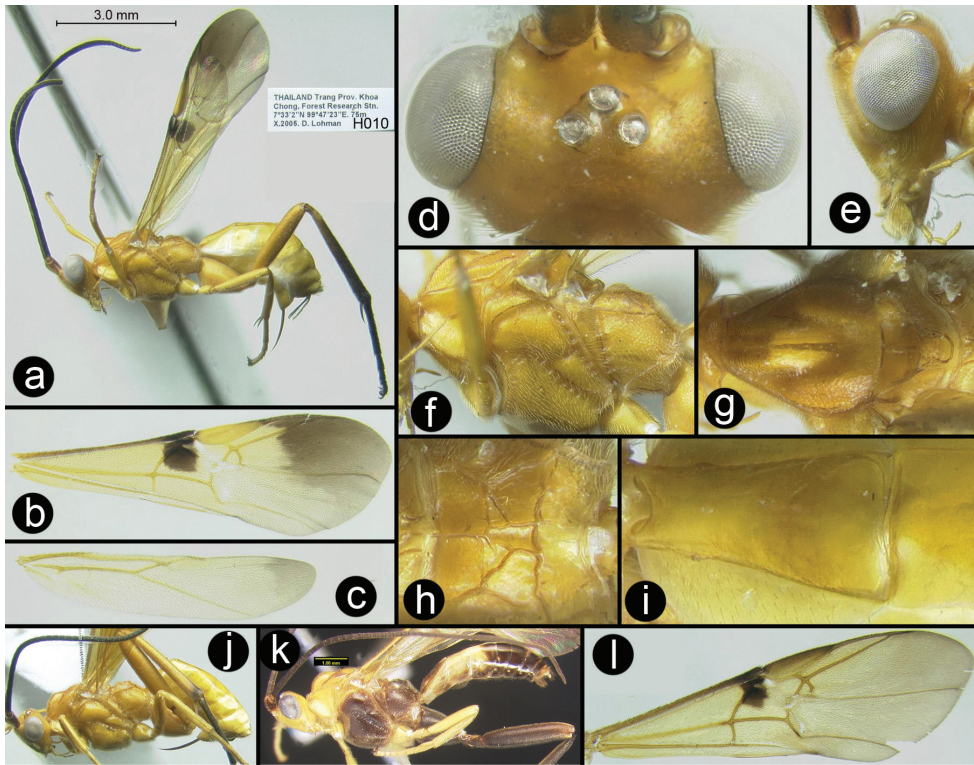


Figure 9. *Euagathis forticarinata* (Cameron). **A** female, lateral habitus **B** fore wing **C** hind wing **D** dorsal head **E** dorsal head **F** lateral mesosoma **G** dorsal thorax **H** propodeum **I** first metasomal tergite **J** female, lateral habitus showing variation, note color of hind tibia **K** male, lateral habitus **L** fore wing variation.

***Euagathis forticarinata* (Cameron, 1899)**

http://species-id.net/wiki/Euagathis_forticarinata

Distribution. For a distribution map of Thai specimens and their associated data, see Appendix I. China (Fujian, Guangdong, Guangxi, Guizhou, Hainan Island, Hong Kong, Hubei, Jiangxi, Macau, Sichuan, Taiwan, Yunnan, Zhejiang); India; Indonesia (Java, Sulawesi, Sumatra, West Lesser Sundas); West Malaysia; Nepal; Philippines (Luzon); Sri Lanka; Thailand; Vietnam.

Molecular data. Genbank accession numbers: KC899825-KC899841 (COI); KC867224-KC867249 (28S).

Notes. This is a variable species, females vary in sculpture of the mesosoma and the males both in colour and sculpture. Males may have the body yellow (as female) up to largely black (except head, anterior part of mesosoma, fore and middle legs; Fig. 9k); intermediates occur and melanic males are more common in Thailand than are yellow ones. The area below the precoxal sulcus varies from widely spaced punctate, densely punctate, punctate-rugulose to densely obliquely rugulose with dense puncta-

tion and the mesoscutum may be sparsely punctate to distinctly striate posteriorly; the apical half of the hind tibia may be largely dark brown or only apically dark brown. Especially small (5–6 mm) specimens may have a less densely sculptured mesopleuron, metapleuron and mesoscutum. See species delimitation section for comments on the limits of this species.

***Euagathis ophippium* (Cameron, 1899)**

http://species-id.net/wiki/Euagathis_ophippium

Distribution. For a distribution map of Thai specimens and their associated data, see Appendix I. China (Beijing, Fujian, Guangxi, Guizhou, Hunan, Jiangsu, Jilin, Shandong, Yunnan, Zhejiang); India; Japan; Korea; Nepal; Russia (Primor'ye Kray); Vietnam. New for Thailand.

Molecular data. Genbank accession numbers: KC899842 (COI); KC867250–KC867251 (28S).

***Euagathis pallitarsis* van Achterberg & Sharkey, sp. n.**

<http://zoobank.org/32DC5893-4D11-4191-9EAC-AF4E211CC75E>

http://species-id.net/wiki/Euagathis_pallitarsis

Type material. Holotype, ♀ (QSBG), “**Thailand:** Petchaburi, Kaeng Krachan N. P., km 3.3/helipad, 12°50.177'N, 99°20.688'E, 735 m elev., Malaise trap, 18–25.v.2009, Sirichai” (H1344; T4943). Paratypes (3 ♀): 1 ♀ (RMNH), “Thailand: Petchaburi, Kaeng Krachan N. P., Panernthang, 12°49.302'N, 99°22.263'E, Malaise trap, 18–25.i.2009, Sirichai” (H2441; T4408); 1 ♀ (HIC), id., but 4–11.iii.2009, Sirichai & Chusak (H756; T4734); 1 ♀ (HIC), id., but checkpoint 2 at Ban Krang, 12°47.896'N, 99°27.196'E, 336 m elev., sweep, 25.vi.2008, Sharkey (H738; T2853).

Diagnosis. This new species keys to *E. ophippium* (Cameron, 1899), from North India, Nepal, Thailand, Vietnam, Oriental and Palaearctic China, Korea, Japan and Far East Russia in the keys by van Achterberg and Chen (2002) and van Achterberg and Raychaudhuri (2004). Both species have a tuberculate scutellum and a wide second submarginal cell of the fore wing (vein r distinctly shorter than vein 3-SR). *E. pallitarsis* differs by having the hind tarsus and base of the hind tibia ivory (black in *E. ophippium*), the metapleuron finely reticulate-punctate (coarsely vermiculate-rugose), the scutellum pale yellow (largely reddish brown), the area below the precoxal sulcus densely punctate-rugose (densely punctate) and the propodeum with long golden or pale yellow setae (medium-sized silvery setae).

Gyrochus guangxiensis Chen & Yang, 2006, from Oriental China (Guangxi) has a similar tuberculate scutellum and is transferred to *Euagathis* (*E. guangxiensis* (Chen & Yang, 2006) comb. n.). *E. guangxiensis* differs by having the mesoscutum finely punctate (fairly coarsely punctate in *E. pallitarsis* sp. n.), the fore wing pale yellowish (brown), the

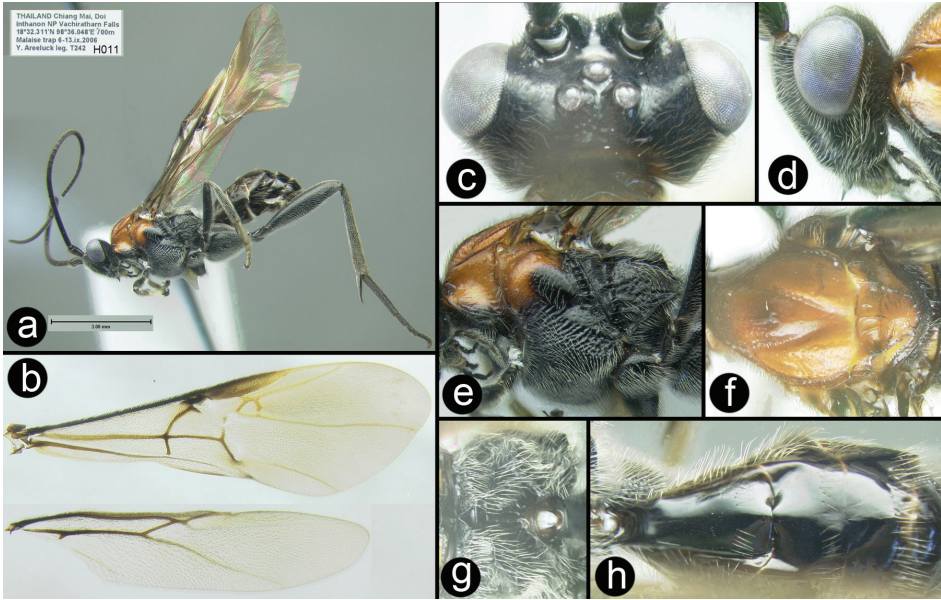


Figure 10. *Euagathis ophippium* (Cameron), female. **A** lateral habitus **B** wings **C** dorsal head **D** lateral head **E** lateral mesosoma **F** dorsal thorax **G** propodeum **H** dorsal metasomal tergites 1–3.

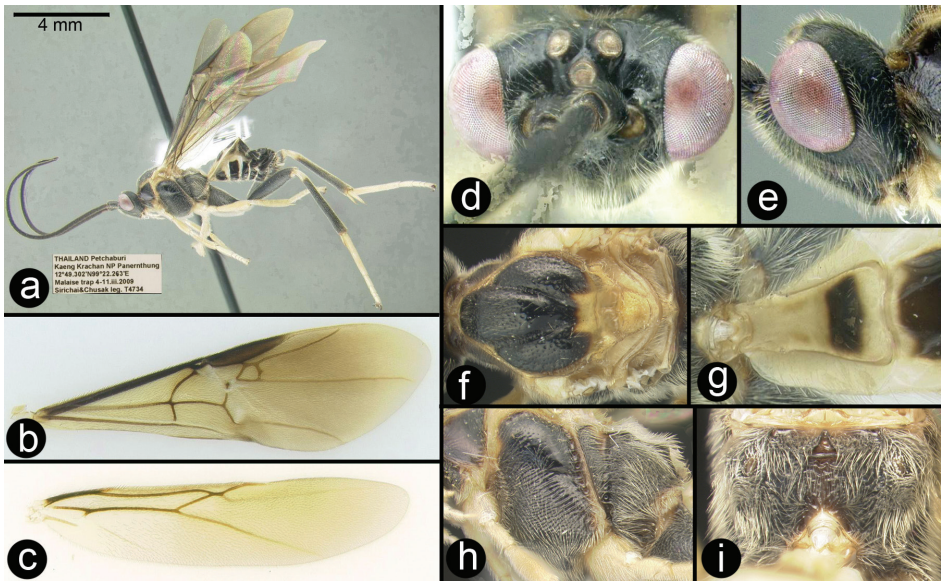


Figure 11. *Euagathis pallitarsis* sp. n., female, paratype. **A** lateral habitus **B** fore wing **C** hind wing **D** dorsal head **E** lateral head **F** dorsal thorax **G** dorsal first metasomal tergite **H** lateral mesosoma **I** dorsal propodeum.

crenulae of the precoxal sulcus coarse (medium-sized), the third and fourth segments of the fore tarsus normal (shortened) and the head, hind femur and mesoscutum largely brown (black).

Description. Holotype, ♀, length of body 8.5 mm, of fore wing 9.8 mm, of ovipositor sheath 0.6 mm.

Head. Antennal segments 49, length of third segment 1.4 times fourth segment, length of third, fourth and penultimate segments 2.8, 2.0 and 1.2 times their width, respectively; apical antennal segment 1.3 times as long as penultimate segment; maxillary palp 0.7 times height of head; malar space 2.8 times as long as basal width of mandible; length of eye 1.8 times temple; temple directly narrowed posteriorly, with long setae and slightly concave laterally; POL:OD:OOL= 5:5:8; face shiny with shallow medial groove dorsally, punctulate, finely rugulose medio-ventrally and long setose; frons, vertex and temple shiny and smooth (Fig. 11d); temple nearly straight near lower level of eye.

Mesosoma. Length of mesosoma 1.3 times its height; pronotum largely smooth, but with some curved striae anteriorly, punctulate dorsally and finely crenulate posteriorly; area near lateral carina of mesoscutum smooth anteriorly and finely crenulate posteriorly; mesoscutum shiny, with spaced and rather coarse punctures and lateral lobes distinctly convex posteriorly (Fig. 11f); notauli complete, anterior half finely crenulate and posterior half smooth or nearly so; scutellum tuberculate, with long setae and densely coarsely punctate, antero-dorsal margin rounded and with irregular transverse rugae; precoxal sulcus complete and all crenulae long and connected to rugae ventrally, area below it punctate-rugose (Fig. 11h); metapleuron coarsely punctate-rugose; propodeum coarsely areolate-rugose, anterior face much shorter than posterior face and with many long setae.

Wings. Fore wing: second submarginal cell wide pentagonal and with short ramellus (Fig. 11b); vein SR1 nearly straight; r:3-SR:SR1 = 4:10:110; vein 2-R1 0.2 times as long as 1-R1; vein cu-a interstitial; no stigmal spot. Hind wing: vein M+CU 2.9 times as long as vein 1-M; area near vein cu-a glabrous.

Legs. Length of hind femur, tibia and basitarsus 5.3, 8.0 and 10.2 times their width, respectively; hind femur superficially pimply and largely smooth ventrally; setae of middle tarsus shorter than width of tarsal segments; third and fourth fore and middle tarsal segments shortened; length of outer and inner spur of middle tibia 0.4 and 0.5 times middle basitarsus, respectively; outer side of middle tibia without pegs, except for 2 apical pegs; length of outer and inner spur of hind tibia 0.3 and 0.6 times hind basitarsus.

Metasoma. First tergite 2.3 times as long as wide apically, gradually widened apically, with short dorsal carinae basally and smooth (Fig. 11g); second metasomal suture faintly impressed; ovipositor sheath 0.06 times as long as fore wing, truncate apically and widened.

Colour. Black; mouthparts (including palpi), fore and middle legs, pronotal side laterally, mesopleuron dorsally and posteriorly, tegulae, mesoscutum posteriorly, scutellum, metanotum, metapleuron near base of hind coxa, apex and ventral face of hind coxa, hind trochanter and trochantellus, base of hind tibia, hind tarsus, first tergite (except subapical dark brown patch), second tergite anteriorly and laterally (but with dark brown patch on epipleuron), posterior margin of following tergites, sternites apically

and apex of ovipositor sheath more or less ivory; pterostigma and veins dark brown, but vein 1-R1 of fore wing light brown; wing membrane light brown (Fig. 11b, c).

Variation. Length of fore wing 8.6–9.8 mm; length of ovipositor sheath 0.06 times as long as fore wing; antennal segments of female 48 (1) or 49 (3); first metasomal tergite 1.9–2.3 times as long as its apical width; dark brown patch of first tergite minute or large; third epipleuron large black or ivory anteriorly.

Distribution. Only known from Thailand. For a distribution map, see Appendix I.

Molecular data. Genbank accession number KC867252 (28S).

Etymology. From “pallidus” (Latin for “pale”) and “tarsos” (Greek for “flat part of the foot between toes and heel”) because of the pale hind tarsus.

***Euagathis setosimaculata* van Achterberg & Sharkey, sp. n.**

<http://zoobank.org/89F401F5-90EF-4F53-8003-F784218DCB84>

http://species-id.net/wiki/Euagathis_setosimaculata

Type material. Holotype, ♀ (QSBG), “**Thailand:** Phetchabun, Thung Salaeng Luang N. P., Kaeng Wang Nam Yen, 16°36.587'N, 100°53.395'E, Malaise trap, 22-26. xi.2006 (H138; T1160). For a distribution map, see Appendix I.

Diagnosis. This new species keys to *E. abbotti* (Ashmead, 1900) from the Sunda area, Thailand, Laos and Vietnam in the key by Simbolotti and van Achterberg (1995). Females of both species have the third and fourth segments of the fore tarsus slender, vein 1-R1 of fore wing somewhat darker than the pterostigma, the precoxal sulcus comparatively narrow, the mesoscutum distinctly punctate and the scapus yellow. *E. setosimaculata* sp. n. differs by having the dorsal face of the propodeum much shorter than its posterior face (about as long as posterior face in *E. abbotti*); the hind femur about 4 times as long as wide (5-6 times); the area near vein cu-a of the hind wing glabrous (sparsely setose); vein cu-a of hind wing about as long as wide (distinctly longer than wide).

Description. Holotype, ♀, length of body 7.2 mm, of fore wing 7.5 mm, of ovipositor sheath 0.6 mm.

Head. Antennal segments 48, length of third segment 1.1 times fourth segment, length of third, fourth and penultimate segments 3.1, 2.8 and 1.2 times their width, respectively; apical antennal segment 1.8 times as long as penultimate segment; maxillary palp 0.6 times height of head; malar space 2.7 times as long as basal width of mandible; length of eye 1.8 times temple; temple directly narrowed posteriorly and slightly concave laterally (Fig. 12c); POL:OD:OOL= 12:10:21; face shiny with shallow medial groove dorsally, punctulate and short densely setose; frons, vertex and temple shiny and smooth (Fig. 12c); temple concave near lower level of eye.

Mesosoma. Length of mesosoma 1.5 times its height; pronotum smooth, but setose and punctulate dorsally and moderately crenulate posteriorly; area near lateral carina of mesoscutum finely crenulate; mesoscutum shiny, with spaced and rather coarse punctures and lateral lobes distinctly convex posteriorly (Fig. 12f); notauli complete, crenulate, but posterior third mainly smooth; scutellum slightly convex and densely

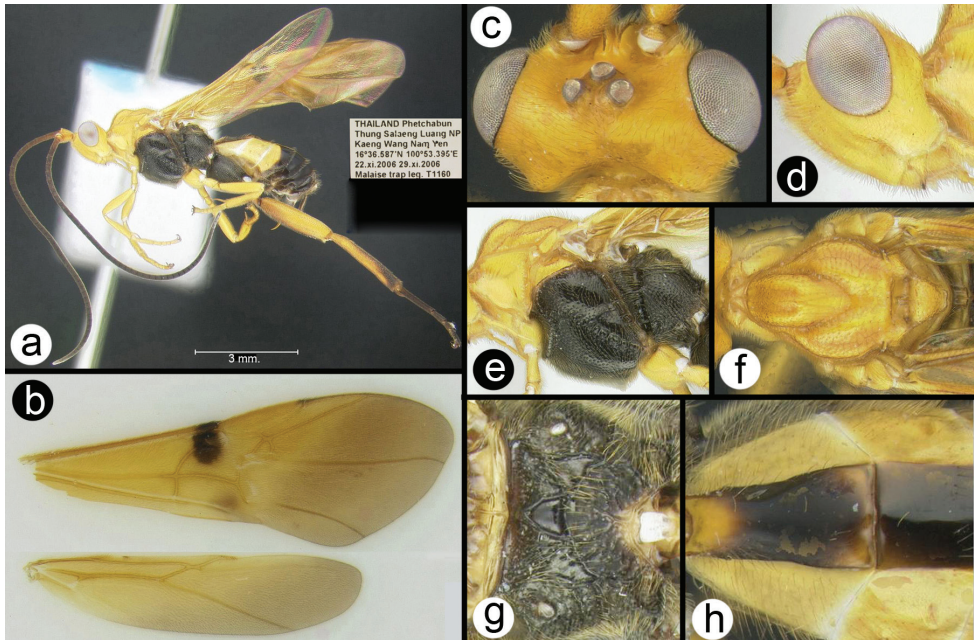


Figure 12. *Euagathis setosimaculata* sp. n., female, holotype. **A** lateral habitus **B** wings **C** dorsal head **D** lateral head **E** lateral mesosoma **F** dorsal thorax **G** propodeum **H** dorsal metasomal terga 1–2.

coarsely punctate, antero-dorsal margin angulate and with transverse carina; precoxal sulcus complete and anterior crenulae comparatively short (Fig. 12e); mesopleuron below precoxal sulcus and metapleuron medially coarsely punctate with interspaces about equal to diameter of punctures; propodeum coarsely areolate and partly rugose, moderately setose, anterior face much shorter than its posterior face.

Wings. Fore wing: second submarginal cell pentagonal and without ramellus (Fig. 12b); vein SR1 straight; $r:3-SR:SR1 = 4:2:88$; vein 2-R1 0.3 times as long as 1-R1; vein cu-a interstitial; with stigmal spot. Hind wing: vein M+CU 2.9 times as long as vein 1-M; area near vein cu-a setose; vein cu-a about as long as wide.

Legs. Length of hind femur, tibia and basitarsus 3.9, 7.3 and 8.4 times their width, respectively; hind femur reticulate-rugose ventrally; setae of middle tarsus shorter than width of tarsal segments; fore and middle tarsal segments moderately slender; length of outer and inner spur of middle tibia 0.5 and 0.7 times middle basitarsus, respectively; outer side of middle tibia without pegs, except for 2 apical pegs; length of outer and inner spur of hind tibia 0.25 and 0.55 times hind basitarsus.

Metasoma. First tergite twice as long as wide apically, gradually widened apically, without dorsal carinae and smooth (Fig. 12h); second metasomal suture absent; ovipositor sheath 0.08 times as long as fore wing, truncate apically and widened.

Colour. Black; head, scapus and pedicellus, palpi, mesosoma (but mesopleuron, mesosternum, metapleuron, propodeum and hind coxa black), fore and middle legs yellow; nota of first and second tergites, third tergite (but antero-laterally yellow) and

following segments black or dark brown; hind trochanter and femur ventrally, apex and outer side of hind tibia (except basally) and hind tarsus dark brown; pterostigma and veins yellow, but vein 1-R1 infusate; wing membrane yellowish, but apically brownish (Fig. 12b); apex of ovipositor sheath brown and remainder black.

Distribution. Known only from Thailand. For map showing the locality of the sole specimen, see Appendix I.

Molecular data. Genbank accession numbers: KC899843 (COI); KC867253 (28S).

Etymology. From “setosus” (Latin for “bristly”) and “macula” (Latin for “spot, mark”) because of the setose base of the hind wing and the partly black body.

Acknowledgements

We are grateful to Dr. Hege Vårdal (NRMS) for the loan of types of Chinese Agathidinae. We thank the staff at Queen Sirikit Botanic Gardens in Chiang Mai for sorting the many hundreds of samples and for the Thai park staff for running Malaise traps and other collection devices. A special thanks to Chaweewan Hutacharern for managing the Thai end of the NSF TIGER project. Funding for MJS was provided by NSF grants DEB-0542864 and EF-0337220.

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Appendix I

Distribution maps for the described species.

Euagathis abbotti

<http://goo.gl/8RAVmM>

Euagathis brevi antennata

<http://goo.gl/3tALum>

Euagathis chinensis

<http://goo.gl/PZhsVN>

Euagathis dravida

<http://goo.gl/JwI3tF>

Euagathis forticarinata

<http://goo.gl/H88q3v>

Euagathis ophippium

<http://goo.gl/U47xzu>

Euagathis pallitarsis

<http://goo.gl/c85anm>

Euagathis setosimaculata

<http://goo.gl/cX48eN>

Interactive key, in IntKey format, to *Euagathis* Szépligeti

<http://sharkeylab.org/sharkeylab/sharkeyKeys.php>