New Species and Records of *Gymnophora* Macquart (Diptera: Phoridae) from Southeast Asia

Brian V. Brown[1]

ABSTRACT. Seven new species of *Gymnophora* are described: one—*G. malaisei*—from Kambaiti, Myanmar (Burma), five—*G. palmula, G. emarginata, G. inthanonensis, G. thormini,* and *G. dispariseta*—from Doi Inthanon National Park, Thailand, and one—*G. parva*—from Khao Yai National Park, Thailand. A species previously known from the Holarctic Region, *G. fastigiorum* Schmitz, is recorded from Doi Inthanon National Park, Thailand.

INTRODUCTION

The species of *Gymnophora* Macquart are small, brown, relatively inconspicuous flies found in the Holarctic, Oriental, and Neotropical regions. The species of Asian *Gymnophora* were most recently revised by Brown (1989), who recorded 13 species from Nepal and Japan. Below, I describe some new species from Thailand and Myanmar (Burma).

METHODS

DESCRIPTIONS. Northern Hemisphere *Gymnophora* species are extremely similar in external appearance. In general, only the presence of a costal swelling of the wing is a useful, nongenitalic character. Therefore, the descriptions of the new species in this paper will be based largely on details of the male terminalia.

COLLECTING LOCALITIES. Material was collected from two sites in Thailand (Doi Inthanon National Park, 18.58°N, 98.48°E, and Khao Yai National Park, 14.17°N, 101.45°E) and one in Myanmar (Kambaiti, 25.42°N, 98.1°E) (Fig. 41). The trapping locality at Kambaiti was described by Malaise (1937), who also included two photographs of the site. The forest type at Khao Yai National Park is semievergreen tropical forest, described in detail by Smitinand (1968). Collections at Doi Inthanon were made at three elevations, in at least superficially different forest types (Robbins and Smitinand, 1966): rich mixed oak forest at 1,700 m, less diverse oak forest at 2,200 m and oak/rhododendron forest near the summit at 2,500 m. Collections made at a lower, drier site at Doi Inthanon (below 1,000 m) yielded no specimens of *Gymnophora.*

MATERIAL. Specimens are deposited in the collections listed below (curator names in parentheses). Codens preceding the collection name are from Arnett et al. (1993), except for the Royal Forest Department in Thailand, whose collection apparently was not included in that work.

LACM Entomology Section, Natural History Museum of Los Angeles County, 900 Exposition Boulevard, Los Angeles, CA 90007, U.S.A. (B.V. Brown)

MCZC Museum of Comparative Zoology, Harvard University, Cambridge, MA 02138, U.S.A. (on indefinite loan to B.V. Brown)

NHRS Naturhistoriska Riksmuseet, S-10405 Stockholm, Sweden (T. Pape)

THAI Forest Insect Research Division, Royal Forest Department, Paholyotin Road, Bangkok 10900, Thailand (C. Hutacharern)

USNM United States National Museum, Smithsonian Institution, Washington, DC 20560, U.S.A. (on indefinite loan to B.V. Brown)

BARCODED LABELS. In addition to the usual insect labels recording locality information, specimens were labeled with barcoded insect labels (Thompson, 1994), and data were recorded in a database. All barcoded labels begin with the abbreviation LACM ENT, indicating that the Natural History Museum of Los Angeles County is the institution where the data are stored. To make later recognition of holotypes easier, I list their individual barcode number in brackets.

SYSTEMATICS

Genus *Gymnophora* Macquart

Gymnophora Macquart, 1835:631. Type species: *Phora arcuata* Meigen, 1830:222 (by monotypy).

GENUS RECOGNITION. Species of *Gymnophora* can be identified using Disney's (1994) key to world genera. Generally, they are brown-colored phorids with extremely short setation, a notopleural cleft in both sexes, Dufour's mechanism present in females, male terminalia derotated 90° and usually withdrawn into abdomen.

WAY OF LIFE. Species of *Gymnophora* apparently are scavengers. For example, *G. arcuata* has been reared from decaying molluscs, dead insects, and small vertebrate carrion (personal observation; Buck, 1997; Joswig, 1985). The Nearctic Region

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species *G. luteiventris* Schmitz was reared from dead slugs (Brown, 1985), and I have reared *G. luteiventris* and an unknown species from Thailand (probably *G. dispariseta* new species, below, although the specimens died as pupae) from dead insects. Earlier, W.H. Robinson (personal communication) reared *G. luteiventris* to the pupal stage from rotting potato peels.

GEOGRAPHICAL DISTRIBUTION. Species of *Gymnophora* are known from all world regions except the Afrotropical and Australasian Regions.

PHYLOGENETIC RELATIONSHIPS. It is hypothesized that *Gymnophora* is part of a monophylum that I previously referred to as the *Gymnophora*-subgroup of genera (Brown, 1992). It includes part of *Megaselia* Rondani (which is thus rendered paraphyletic) and all species of *Woodiphora* Schmitz (see Brown, 1992; Disney, 1989 for further details).

The relationships within *Gymnophora* were discussed in a series of papers by Brown (1987a, b, 1989). There is considerable uncertainty about the placement of some Asian species, including those treated in this paper. A new phylogenetic revision is needed, but I prefer to defer such an analysis until the Asian fauna is more thoroughly sampled and characterized.

SPECIES-LEVEL TREATMENTS. For species from the Holarctic Region except Japan, see Brown (1987b); for Japan and Nepal see Brown (1989); for the Neotropical Region see Brown (1987a). The key presented below will be useful for species from Myanmar, Thailand and possibly some neighboring countries.

Gymnophora fastigiorum Schmitz

Figures 1, 2

Gymnophora fastigiorum Schmitz, 1952:180, fig. 1.
Gymnophora quartomollis; Brues, 1950:56, fig. 6B (*nec* Schmitz).

DISCUSSION. Two specimens from Thailand key to *G. fastigiorum* in the latest key to *G. nigripennis*-subgroup species (Brown, 1989), and their terminalia are identical to those of *G. fastigiorum* from Japan and North America. The range of this species is remarkably large—it is found in three biogeographic regions—and raises the possibility that a complex of more than one extremely similar species are involved.

MATERIAL. THAILAND: Chiang Mai, Doi Inthanon National Park, 1♂, 30.iv–12.v., 1♂, 6–12.v.1990, B.V. Brown, E.R. Fuller, Malaise trap, 2,500 m (LACM).

Gymnophora palmula new species

Figures 3, 4, 17, 18

SPECIES RECOGNITION. This species can be recognized by the broad process on the epandrium and by the shape of the aeadeagus.

DESCRIPTION. Male. Body length 1.75 mm. Mean frontal ratio (length divided by width) 0.95. Frontal setation 0–0–4. Flagellomere 1 round, dark brown. Palpus brown, with long apical setae. Mean costal length 0.46 wing length. Mean costal sector ratio 9.2:2.8:1. Costal thickening present. Halter brown. Left side of epandrium with broad, posterior process; with ventromedial process. Right side of epandrium shallow, lacking posteroventral notch. Left hypandrial lobe without dorsal process; with broad, posterior process. Basiphallus dorsally pointed. Outer left arm elongate, with a posteroventral process; broadly fused to basiphallus. Anterior lobe short, fusing with outer left arm. Dorsal sclerite of anterior lobe short. Right arm ending at dorsal sclerite. Distiphallus tall, dark, wrapped with thin membrane. Lateral arm elongate, sinuous. Lower arm elongate, abruptly deflected to right at tip. Cercus elongate. Hypoproct elongate.

Female. Unknown.

DISTRIBUTION. Doi Inthanon in northwestern Thailand.

DERIVATION OF SPECIFIC EPITHET. The name is based on a Latin word for oar, referring to the broad, ventral process of the left side of the epandrium.

HOLOTYPE. ♂, THAILAND: Chiang Mai, Doi Inthanon National Park, 27.iv.1990, B.V. Brown [hand collected], 1,700 m [LACM ENT 003067] (LACM).

Gymnophora emarginata new species

Figures 5, 6, 19, 20

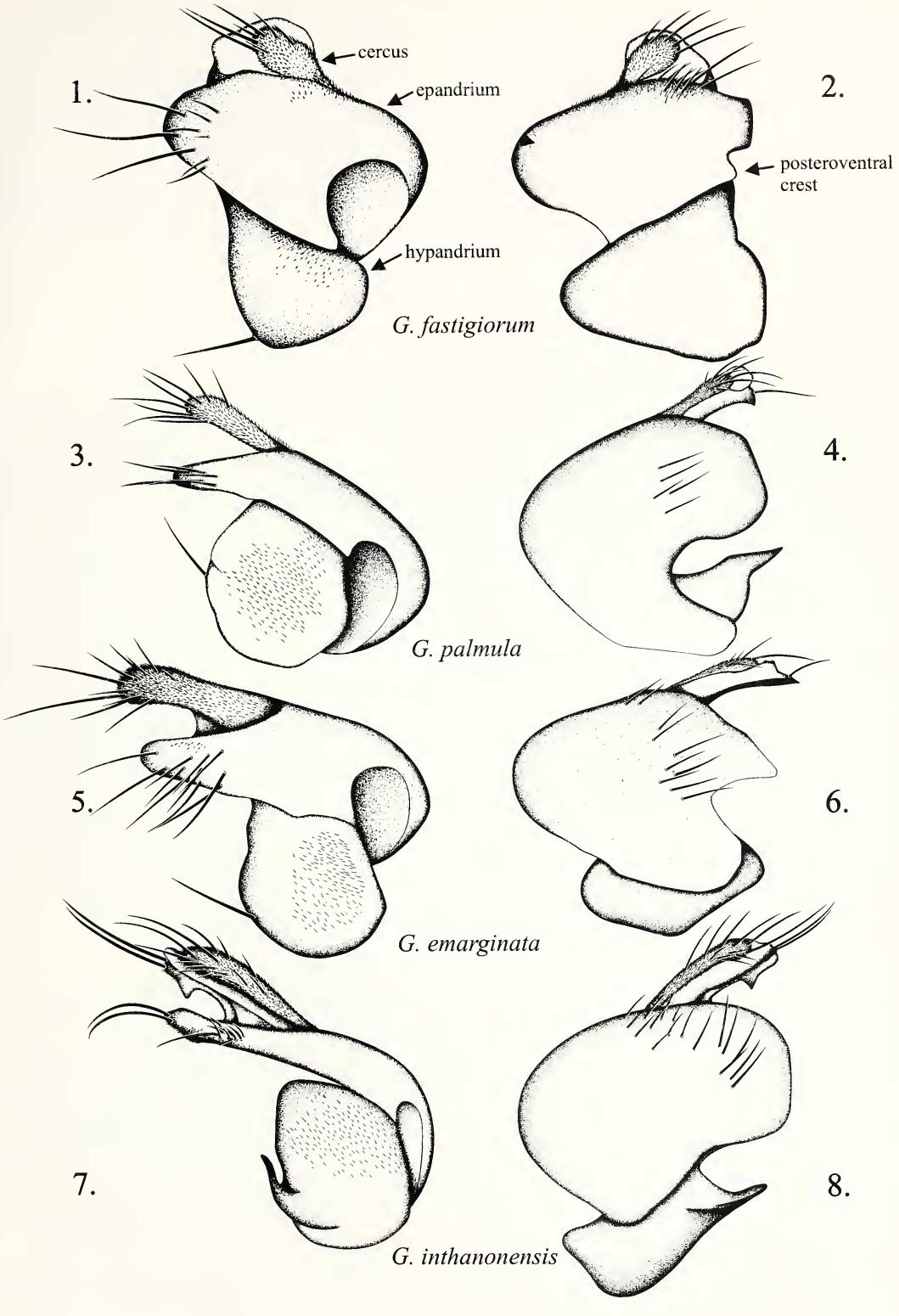
SPECIES RECOGNITION. This species is similar to *G. palmula,* differing mainly in the structure of the aedeagus (compare Figs. 18 and 20).

DESCRIPTION. Male. Body length 1.6–2.3 mm. Mean frontal ratio 1.05. Frontal setation 0–0–4. Flagellomere 1 round, dark brown. Palpus brown, with long apical setae. Mean costal length 0.45 wing length, range 0.43–0.47. Mean costal sector ratio 7.51:1.79:1, range 5.89–8.92:1.44–2.14:1. Costal thickening present. Halter brown to gray. Left side of epandrium with posterior process broad basally, narrowed posteriorly; with ventromedial process. Right side of epandrium shallow, lacking posteroventral notch. Left hypandrial lobe without dorsal process; with broad, posterior process. Basiphallus broad on right dorsal corner. Outer left arm short, but with separate, curved sclerite laterally and large dorsal process; broadly fused to basiphallus. Anterior lobe elongate, extending across left side of aedeagus, and with large dorsal projection. Dorsal sclerite of anterior lobe short. Right arm ending at dorsal sclerite. Distiphallus broad. Lateral arm elongate, sinuous. Lower arm extremely broad, flat. Cercus elongate. Hypoproct elongate.

Female. Unknown.

DISTRIBUTION. Doi Inthanon in northwestern Thailand.

DERIVATION OF SPECIFIC EPITHET. The



Figures 1–8. Male terminalia, right lateral, left lateral.

name is based on a Latin word for notched, referring to the posterior margin of the left side of the epandrium.

HOLOTYPE. ♂, THAILAND: Chiang Mai, Doi Inthanon National Park, 27.iv–3.v.1990, B.V. Brown, Malaise trap, 1,700 m [LACM ENT 003046] (LACM).

PARATYPES. THAILAND: Chiang Mai, Doi Inthanon National Park, 4♂, 27.iv.1990, B.V. Brown [hand collected], 1,700 m (LACM, THAI), 1♂, 30.iv.1990, B.V. Brown, sweeping, 1,700 m (LACM), 1♂, 27.iv–3.v.1990, B.V. Brown, Malaise trap, 1,700 m (LACM).

Gymnophora inthanonensis new species

Figures 7, 8, 21, 22, 31

SPECIES RECOGNITION. This species and *G. malaisei* new species (below) are both somewhat similar to the Japanese species *G. priora* Brown. Both of the new species, however, have aedeagi with a distinctively tall, dorsally projecting distiphallus (Figs. 21–24), whereas *G. priora* has a much lower structure (Brown, 1989, figs. 12, 13). Furthermore, both species have a dorsal process on the left side of the aedeagus that is lacking from *G. priora.*

Males of *G. inthanonensis* have a dorsal sclerite of the aedeagus (Fig. 31) that projects much further back posteriorly than that of *G. malaisei* (Fig. 32) and has small, fingerlike processes dorsally on the distiphallus (Figs. 22, 31).

DESCRIPTION. **Male.** Body length 2–2.5 mm. Mean frontal ratio 1. Frontal setation 0–0–4. Flagellomere 1 round, dark brown. Palpus brown, with long apical setae. Mean costal length 0.52 wing length, range 0.51–0.53. Mean costal sector ratio 6.98:1.97:1, range 6.00–8.38:1.58–2.38:1. Costal thickening present. Halter yellow to gray. Left side of epandrium with broad, posterior process; without ventromedial process. Right side of epandrium shallow, lacking posteroventral notch. Left hypandrial lobe with unusual dorsal process; without broad, posterior process. Basiphallus broad on right dorsal corner. Outer left arm short, extending only midway across aedeagus; broadly fused to basiphallus. Anterior lobe short, fusing with outer left arm. Dorsal sclerite of anterior lobe large, dark, inserting into hollowed thickening on basiphallus; narrowly attaching to right arm. Right arm ending at dorsal apex of basiphallus. Distiphallus tall, dark, wrapped with thin membrane. Lateral arm elongate, sinuous. Lower arm with elongate extension and large, lateral lobe. Cercus elongate. Hypoproct elongate.

Female. Unknown.

DISTRIBUTION. Doi Inthanon in northwestern Thailand.

DERIVATION OF SPECIFIC EPITHET. The name is based on the type locality of this and most other new species described in this paper.

HOLOTYPE. ♂, THAILAND: Chiang Mai, Doi Inthanon National Park, 6–12.v.1990, B.V. Brown, Malaise trap, 2,200 m [LACM ENT 003042] (LACM).

PARATYPES. THAILAND: Chiang Mai, Doi Inthanon National Park, 1♂, 28.iv–6.v.1990 (THAI), 1♂, 6–12.v.1990, B.V. Brown, Malaise trap, 2,200 m (LACM), 1♂, 30.iv–12.v.1990, E.R. Fuller, Malaise trap, 2,500 m (LACM).

Gymnophora malaisei new species

Figures 9, 10, 23, 24, 32

SPECIES RECOGNITION. See *G. inthanonensis,* above.

DESCRIPTION. **Male.** Body length 1.75–2 mm. Mean frontal ratio 1.1. Frontal setation 0–0–4. Flagellomere 1 round, reddish brown. Palpus brown, with long apical setae. Mean costal length 0.53 wing length, range 0.52–0.54. Mean costal sector ratio 7.38:2.03:1, range 6.4–8.75:1.5–2.6:1. Costal thickening slight. Halter yellow. Left side of epandrium without broad, posterior process; without ventromedial process. Right side of epandrium shallow, lacking posteroventral notch. Left hypandrial lobe with unusual dorsal process; without broad, posterior process. Basiphallus broad on right dorsal corner. Outer left arm not extending past basiphallus; broadly fused to basiphallus. Anterior lobe short, extending only slightly past outer left arm on left side of aedeagus. Dorsal sclerite of anterior lobe large, dark, inserting into hollowed thickening on basiphallus; narrowly attaching to right arm. Right arm ending at dorsal sclerite. Distiphallus tall, with right lateral process. Lateral arm elongate, sinuous. Lower arm with elongate extension and large, lateral lobe; lobe with lateral carinae. Cercus elongate. Hypoproct elongate.

Female. Unknown.

DISTRIBUTION. Kambaiti in northeastern Myanmar (Burma).

DERIVATION OF SPECIFIC EPITHET. The name is based on the collector, René Malaise, who not only caught the specimens, but who also developed the highly effective Malaise trap, a mainstay of my phorid fieldwork.

HOLOTYPE. ♂, BURMA: Kambaiti, 23.v.1934, R. Malaise [LACM ENT 003189] (NHRS).

PARATYPES. BURMA: Kambaiti, 2♂, 11.vi.1934, R. Malaise (LACM, NHRS).

Gymnophora parva new species

Figures 11, 12, 25, 26, 33, 35, 37, 38

SPECIES RECOGNITION. Males of this species can be recognized by the small posterior process on

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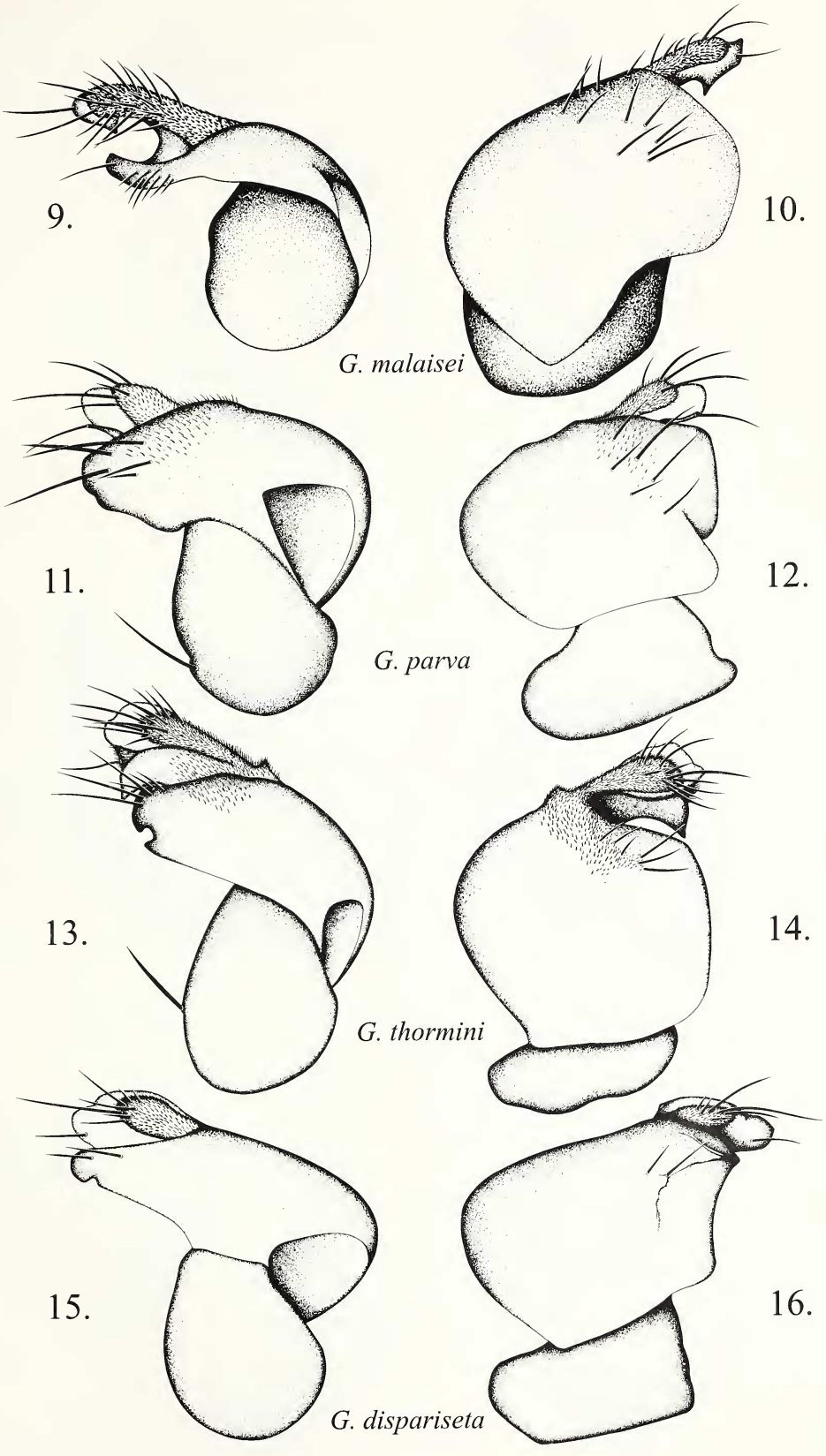
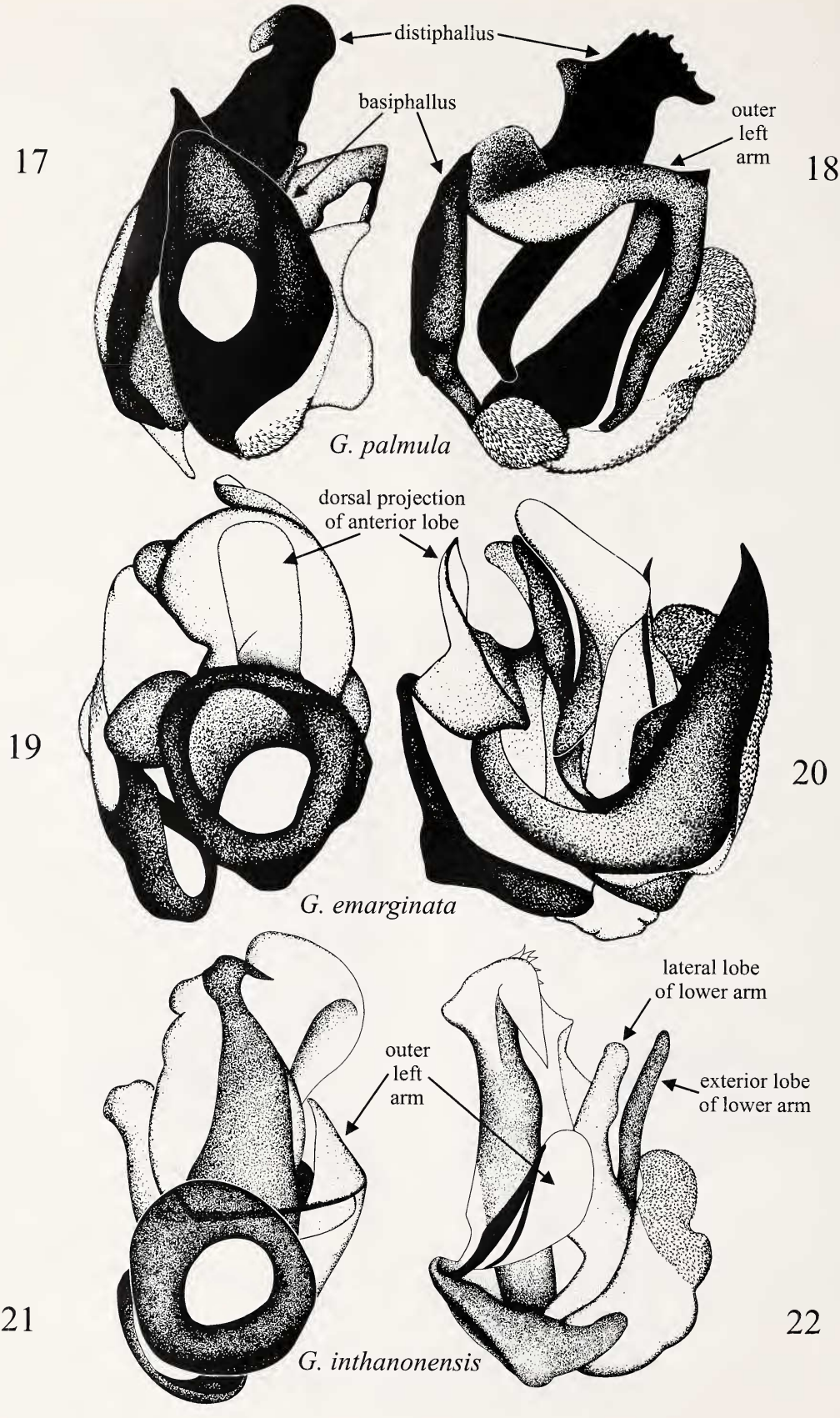
Figures 9–16. Male terminalia, right lateral, left lateral.


9.
10.
G. malaisei
11.
12.
G. parva
13.
14.
G. thormini
15.
16.
G. dispariseta


17
distiphallus
basiphallus
outer
left
arm
18
G. palmula
dorsal projection
of anterior lobe
19
20
G. emarginata
lateral lobe
of lower arm
outer
left
arm
exterior lobe
of lower arm
21
22
G. inthanonensis

the left side of the epandrium (Fig. 12), and by the aedeagus, which has a distinctive process with three dorsal peaks (Fig. 25).

DESCRIPTION. Body length 1.25–1.75 mm. Mean frontal ratio 1.2. Frontal setation 0–0–4. Flagellomere 1 round, reddish brown. Palpus other, with long apical setae. Mean costal length 0.47 wing length, range 0.46–0.48. Mean costal sector ratio 7.34:1.41:1, range 7.08–7.6:1.2–1.62:1. Costal thickening slight. Halter brown.

Male abdomen. Left side of epandrium with posteroventral process; without ventromedial process. Right side of epandrium deeper, with posteroventral notch. Left hypandrial lobe without dorsal process; with small, posteroventral process. Basiphallus slightly broader dorsally. Outer left arm elongate, with a left lateroventral process and three dorsal peaks; apparently not attached to basiphallus. Anterior lobe elongate, largely fused to outer left arm. Dorsal sclerite of anterior lobe extensively fused with outer left arm but apparently consisting of long, narrow process extending over right side, plus dorsal, rounded lobe. Right arm ending at dorsal apex of basiphallus. Distiphallus broad, short, with sclerotized, curved region dorsally. Lateral arm broad. Lower arm apparently absent or fused with distiphallus. Cercus short. Hypoproct short.

Female abdomen. Tergites 3–5 greatly reduced but present (Fig. 37). Tergite 7 narrow, wedge-shaped (Fig. 35); sternite 7 narrow, black, sclerotized strip. Tergite 8 elongate rectangular (Fig. 38); venter of abdominal segment 8 with two small sclerites (Fig. 33). Internal, sclerotized loop round, flat.

DISTRIBUTION. Khao Yai National Park, in southcentral Thailand.

DERIVATION OF SPECIFIC EPITHET. The name is based on a Latin word for small, referring to the body size of this diminutive species.

HOLOTYPE. ♂, THAILAND: 180 km NE Bangkok, Khao Yai National Park, 11–18.iv.1990, B.V. Brown, Malaise trap, semievergreen forest [LACM ENT 045164] (LACM).

PARATYPES. THAILAND: 180 km NE Bangkok, Khao Yai National Park, 1♂, 10–15.iv.1990, 2♀, 11–18.iv.1990, B.V. Brown, Malaise trap, semievergreen forest (LACM).

Gymnophora thormini new species

Figures 13, 14, 27, 28

SPECIES RECOGNITION. This species is easily recognized by a lateral view of the highly distinctive aedeagus (Fig. 28).

DESCRIPTION. Male. Body length 1.75–2.5 mm. Mean frontal ratio 1.13. Frontal setation 0–0–4. Flagellomere 1 round, reddish brown. Palpus brown, with short apical setae. Mean costal length 0.48 wing length, range 0.44–0.53. Mean costal sector ratio 5.71:1.71:1, range 5.20–6.17:1.20–3.17:1. Costal thickening present. Halter brown. Left side of epandrium with broad, posterior process; without ventromedial process. Right side of epandrium deeper, with posteroventral notch. Left hypandrial lobe without dorsal process; without broad, posterior process. Basiphallus evenly rounded. Outer left arm membranous near basiphallus, nearly invisible; extended posteriorly to rear part of aedeagal complex where it becomes sclerotized and forms an extremely long process; process extended anteriorly, with two dorsal lobes. Anterior lobe absent. Dorsal sclerite of anterior lobe absent. Right arm ending at dorsal apex of basiphallus. Distiphallus with anterior and posterior sections; posterior section divided into two arms; right arm again bifurcated. Lateral arm short, bifurcated. Lower arm short. Cercus short. Hypoproct short.

Female. Unknown.

DISTRIBUTION. Doi Inthanon in northwestern Thailand.

DERIVATION OF SPECIFIC EPITHET. This species is named for Mr. Terry Thormin of the Alberta Provincial Museum, Canada, who collected the first specimen and who inspired me to visit Thailand.

HOLOTYPE. ♂, THAILAND: Chiang Mai, Doi Inthanon National Park, 29.iv.1990, B.V. Brown [hand collected], 1,700 m [LACM ENT 003047] (LACM).

PARATYPES. THAILAND: Chiang Mai, Doi Inthanon National Park, 1♂, 7.ii.1989, T.W. Thormin, pan traps, 1,570 m (LACM), 1♂, 27.iv.1990, B.V. Brown [hand collected], 1,700 m (LACM), 1♂, 27.iv–3.v.1990, B.V. Brown, Malaise trap, 1,700 m (THAI), 1♂, 6–12.v.1990, B.V. Brown, Malaise trap, 2,200 m (LACM).

Gymnophora dispariseta new species

Figures 15, 16, 29, 30, 34, 36, 39

SPECIES RECOGNITION. This distinctive species has a unique, elongate dorsal sclerite that extends backward over the right side of the aedeagus (Fig. 29), as well as cerci with several short and one or two long setae (Figs. 15, 16).

DESCRIPTION. Body length 1.6–2 mm. Mean frontal ratio 1.15. Frontal setation 0–0–4. Flagellomere 1 round, dark brown. Palpus brown, with long apical setae. Mean costal length 0.47 wing length, range 0.45–0.49. Mean costal sector ratio 8.35:2.16:1, range 5.60–9.67:1.60–2.67:1. Costal thickening present. Halter brown.

Male abdomen. Left side of epandrium without broad, posterior process; without ventromedial process. Right side of epandrium deeper, with posteroventral notch. Left hypandrial lobe without dorsal process; without broad, posterior process. Basiphallus slightly broader dorsally. Outer left arm

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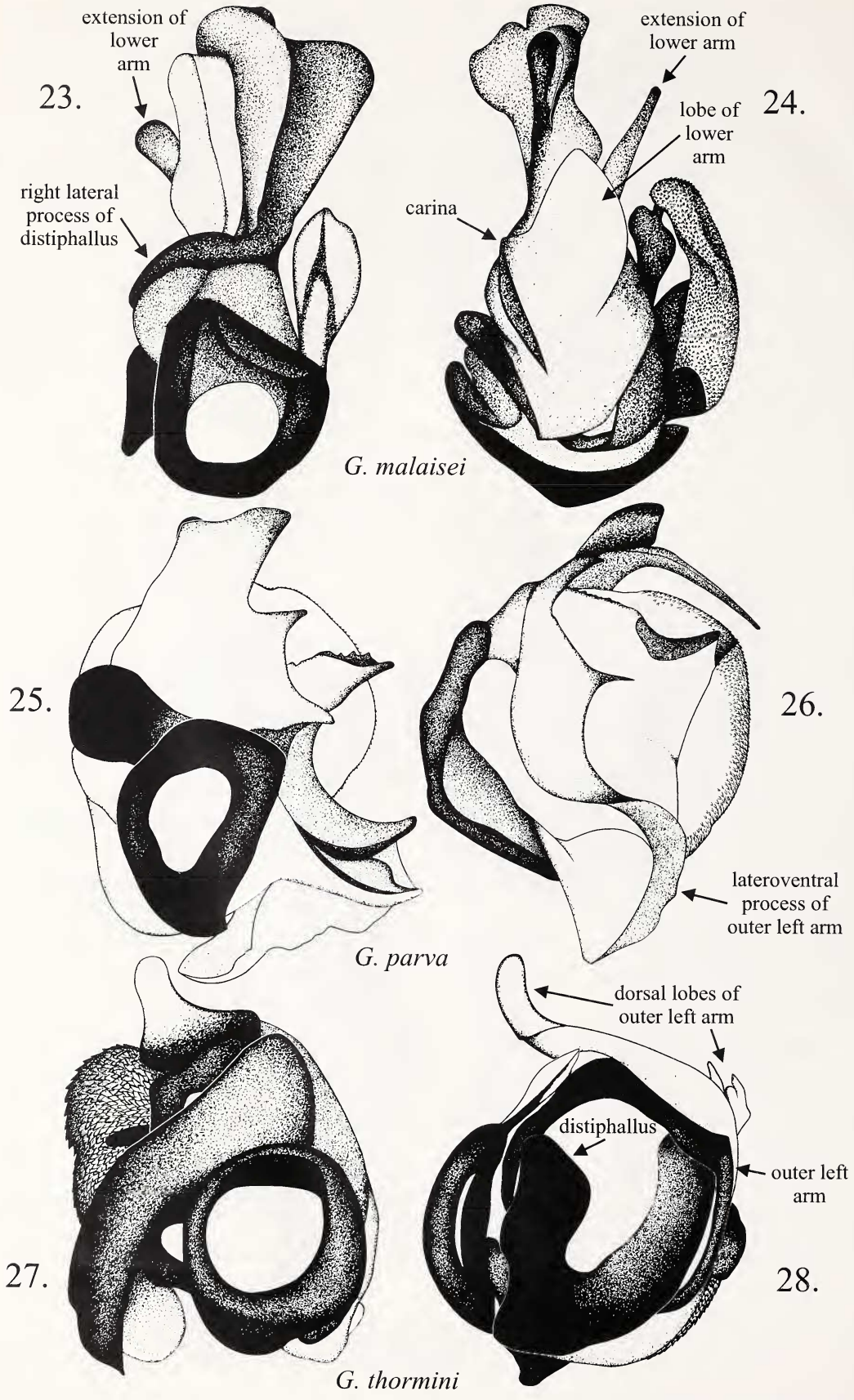
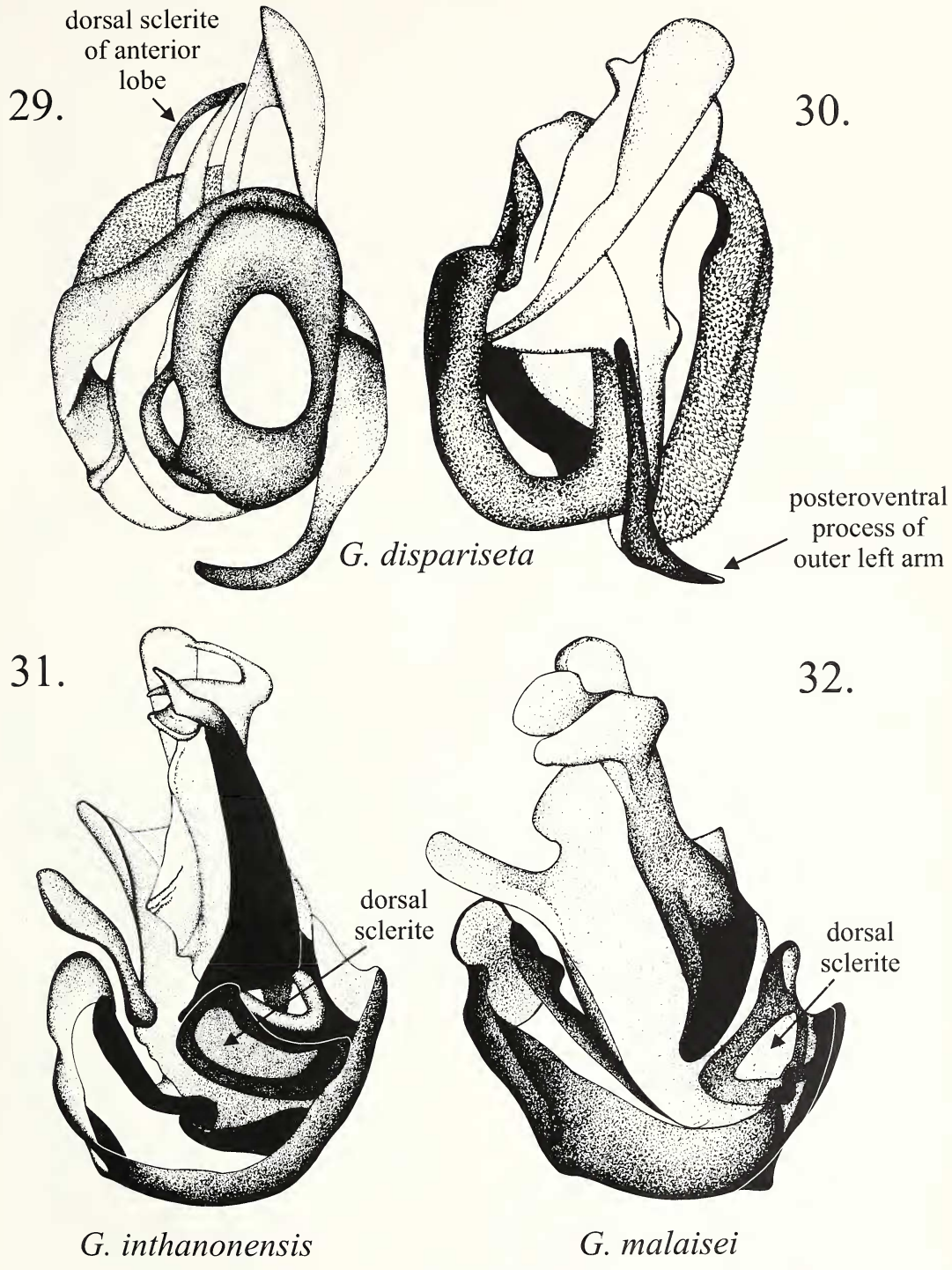
Figures 17–22. Aedeagus, frontal, left lateral.


23.
extension of lower arm
right lateral process of distiphallus
24.
extension of lower arm
lobe of lower arm
carina
G. malaisei
25.
26.
lateroventral process of outer left arm
G. parva
27.
dorsal lobes of outer left arm
distiphallus
outer left arm
28.
G. thormini



Figures 29–32. Aedeagus. **29, 30.** Frontal, left lateral. **31, 32.** Right lateral.

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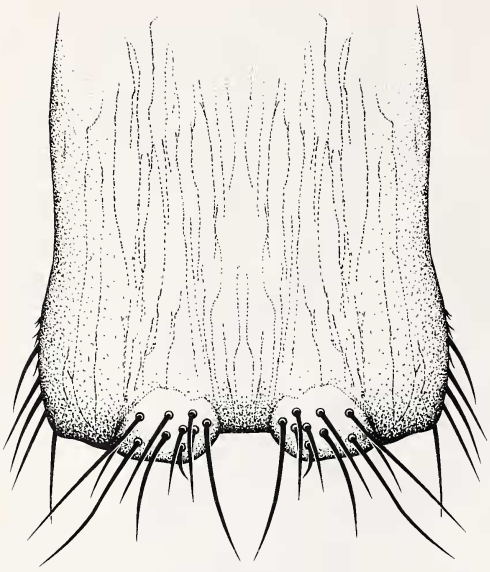
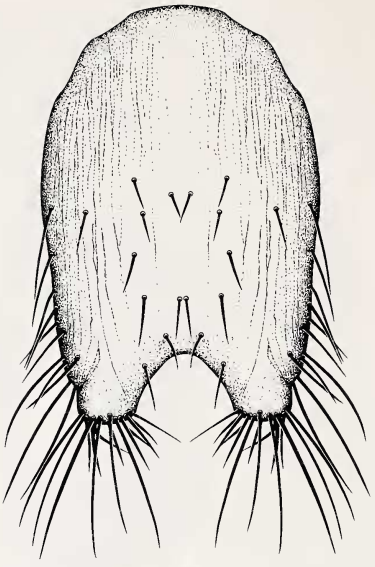
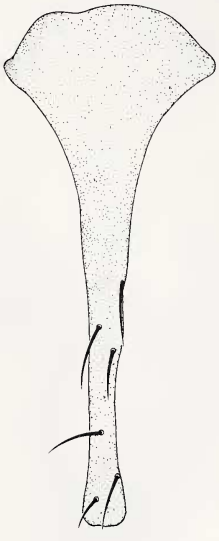
Figures 23–28. Aedeagus, frontal, left lateral.



33.

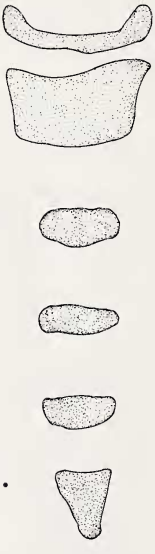


34.

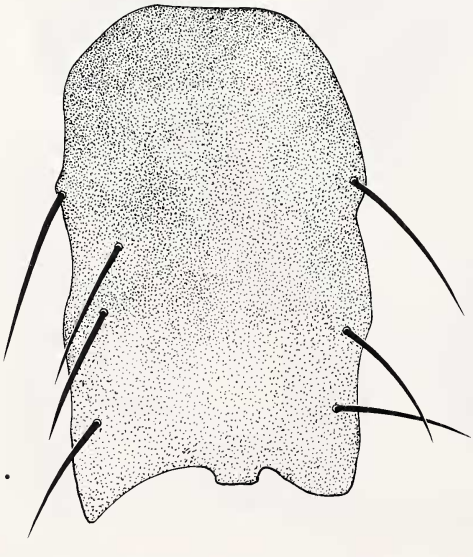


35.

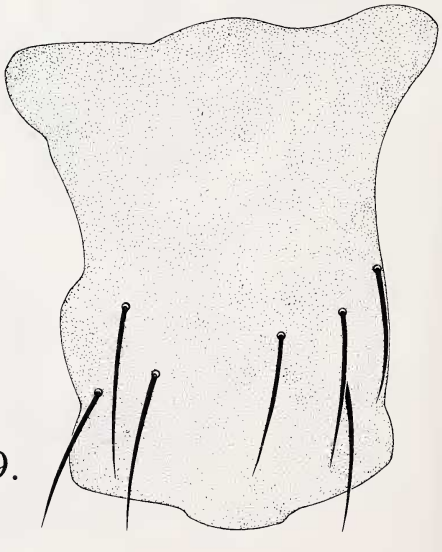
36.



37.



38.



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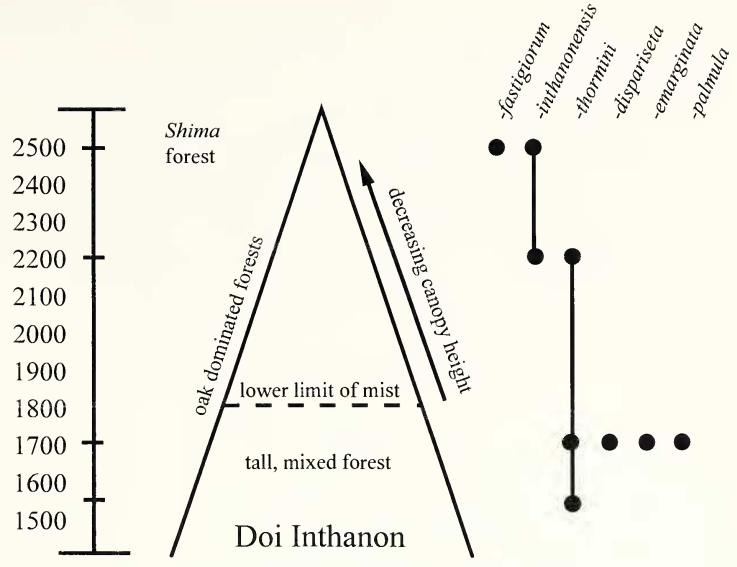

Figure 40. Biotic profile of Doi Inthanon, with *Gymnophora* species ranges plotted. Crossbars on the elevation scale are collecting sites.

elongate, with a posteroventral process; broadly fused to basiphallus. Anterior lobe consisting of membrane only. Dorsal sclerite of anterior lobe long, narrow, extending posteriorly over right side. Right arm ending at dorsal apex of basiphallus. Distiphallus membranous. Lateral arm short, thick. Lower arm a single process, apically expanded into membrane. Cercus short. Hypoproct short.

Female abdomen. Tergites 3–5 absent. Tergite 7 narrow, almost linear, except slightly broader at anterior apex (Fig. 36); sternite 7 wedge-shaped, posteriorly expanded, light brown. Tergite 8 broad rectangular (Fig. 39); venter of abdominal segment 8 with two small sclerites separated by a broad emargination (Fig. 34). Internal, sclerotized loop round, flat.

DISTRIBUTION. Doi Inthanon in northwestern Thailand.

DERIVATION OF SPECIFIC EPITHET. The name is based on a Latin word for different, referring to the different lengths of setae on the cercus.

HOLOTYPE. ♂, THAILAND: Chiang Mai, Doi Inthanon National Park, 30.iv.1990, B.V. Brown [hand collected], 1,700 m [LACM ENT 003056] (LACM).

PARATYPES. THAILAND: Chiang Mai, Doi Inthanon National Park, 1♂, 1♀ [in copula pair], 27.iv.1990, 9♂, 1♀ [female from an in copula pair], 29.iv.1990, 3♂, 30.iv.1990, B.V. Brown [hand collected], 1,700 m (LACM, MCZC, NHRS, THAI, USNM). 1♂, 27.iv–3.v.1990, 1♂, 3–12.v.1990, B.V. Brown, Malaise trap, 1,700 m (LACM).

Key to Males of Southeast Asian *Gymnophora* Species

Note: This key should be used to identify specimens of *Gymnophora* from Thailand, Myanmar, and possibly some neighboring countries.

1 Aedeagus reduced, without prominent dorsal projections in frontal view (see Brown, 1987b, fig. 11); basiphallus with prominent left lateral projection (see Brown, 1989, figs. 25–28); epandrium with small posteroventral surstylar crest (Fig. 2); cercus short . . . . . *G. fastigiorum* Schmitz[2]

– Aedeagus with dorsally projecting structures; basiphallus ring-shaped, without long lateral projection; surstylar crest various; cercus long or short 2

2 Venter of left side of epandrium with large, distinctive process (Figs. 4, 6) 3

2. The key to all species of the *G. nigripennis*-subgroup (in Brown, 1989) should be consulted to confirm this identification.

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Figures 33–39. Female abdomen. 33. *Gymnophora parva* new species, venter of segment 8. 34. *Gymnophora dispariseta* new species, venter of segment 8. 35. *Gymnophora parva* new species, tergite 7. 36. *Gymnophora dispariseta* new species, tergite 7. 37. *Gymnophora parva* new species, tergites 1–6. 38. *Gymnophora parva* new species, tergite 8. 39. *Gymnophora dispariseta* new species, tergite 8.

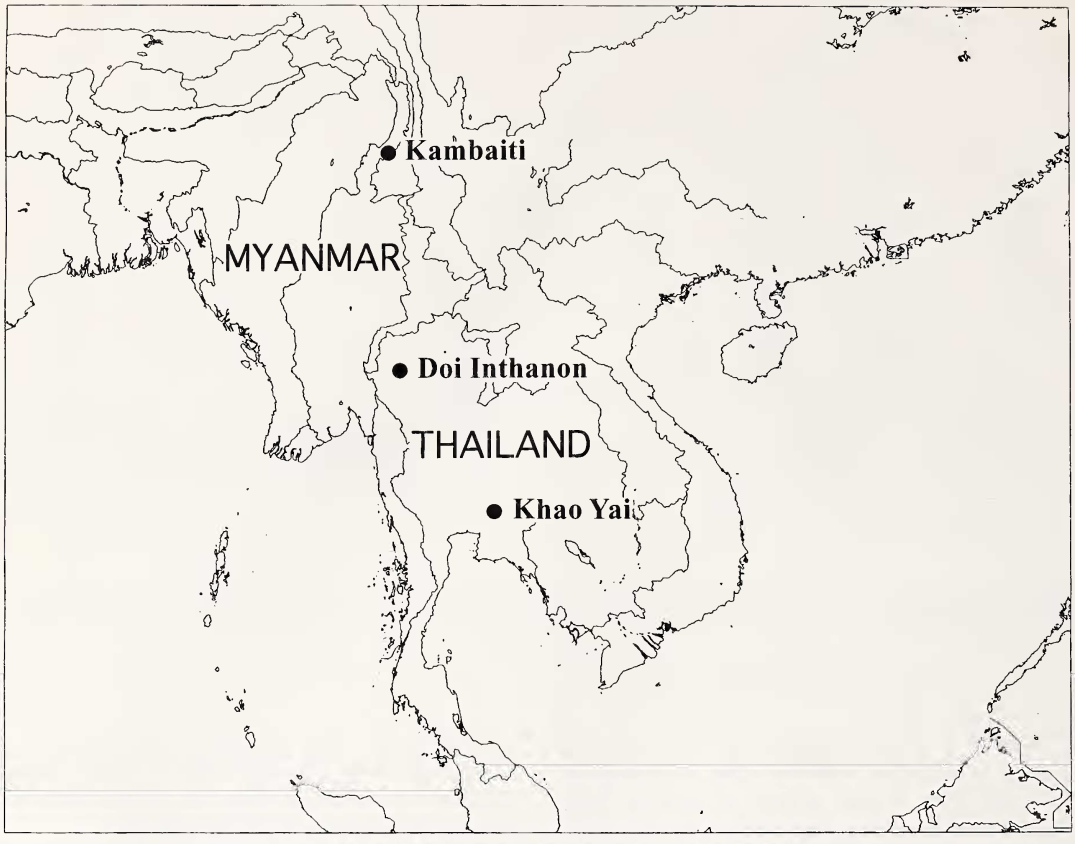

Figure 41. Map of collecting localities cited in this paper.

– Venter of left side of epandrium without large process 4

3 Posterodorsal process of left side of epandrium broad (Fig. 4); left side of aedeagus with a prominent dorsal arm with a posterior point and ventral process (Fig. 18) . . . . . *G. palmula* new species

– Posterodorsal process of left side of epandrium narrow, pointed (Fig. 6); left side of aedeagus with a prominent ventral arm with posterodorsal process (Fig. 20) . . *G. emarginata* new species

4 Left side of hypandrium with distinctive, dorsal, rounded process (Fig. 8); posterior margin of left side of epandrium a large, rounded lobe that is narrower than anterior portion of epandrium (Figs. 8, 10); right surstylus elongate and narrow (Figs. 7, 9) 5

– Left side of hypandrium without such a process; posterior margin of left side of epandrium about as tall as anterior portion (Figs. 12, 14, 16); right surstylus broader (Figs. 11, 13, 15) 6

5 Dorsal apex of distiphallus with pointed finger-like processes (Fig. 22); dorsal sclerite elongate, extending about midway back the right side of aedeagus (Fig. 31) . . . . . *G. inthanonensis* new species

– Dorsal apex of distiphallus broadly rounded (Fig. 24); dorsal sclerite short (Fig. 32) . . . . . *G. malaisei* new species

6 Epandrium with a small, posteroventral process on left side (Fig. 12); in frontal view, outer left arm of aedeagus with three dorsal peaks (Fig. 25) . . . . . *G. parva* new species

– Epandrium without small, posteroventral process on left side (Figs. 14, 16); in frontal view aedeagus various, but not with three dorsal peaks 7

7 Epandrium broadly produced posteriorly on left side (Fig. 14); aedeagus extremely distinctive in lateral view, with large, curved processes from posterior part projecting anteriorly (Fig. 28) . . . . . *G. thormini* new species

– Epandrium not or only slightly produced posteriorly on left side (Fig. 16); aedeagus clearly not as above 8

8 Epandrium not greatly inflated, without dorsal groove; apical seta of cercus clearly longer than other cercal setae (Fig. 16) . . . . . *G. dispariseta* new species

– Epandrium greatly inflated, with cerci in shallow groove on dorsum of epandrium (Brown, 1989,

fig. 1); cercal setae not as above . . . . . *G. inexpectata* Beyer

GYMNOPHORA DISTRIBUTION

At Doi Inthanon in Thailand there is a remarkable co-occurence of at least six species of *Gymnophora*; so far, all except one are known only from this mountain. Although sampling has been limited (and concentrated mostly at 1,700 m elevations), it is interesting to examine the preliminary distribution patterns of species (Fig. 40).

HIGHER ELEVATIONS. In spite of relatively more intensive collecting at lower elevations, two species were found only at higher elevations. The species with the largest worldwide range, *G. fastigiorum,* was found only at the highest site, 2,500 m, near the top of the mountain. Also found at the highest site, and at a 2,200-m site, was *G. inthanonensis.*

LOWER ELEVATIONS. The widest-ranging species at Doi Inthanon was *G. thormini,* collected from the lowest oak forests to the 2,200-m site. All other species, *G. dispariseta, G. emarginata,* and *G. palmula,* were found at 1,700 m. Further collecting is necessary to determine the full elevational range of each species. Unfortunately, at the time of my field work in Thailand, I was unaware of the number of species I was encountering and did not collect even more specimens.

DIVERSITY. In Borgmeier's (1968) catalog of world Phoridae, only 21 species of *Gymnophora* were listed. The species described since, including those described herein, raise this total to 60. There are at least three more species in various stages of description by other workers and probably many more to be discovered.

Much of this discovery could take place in the Oriental Region. It is notable that even between sites that are relatively close together, such as Kambaiti and Doi Inthanon (which are about 800 km apart; see Fig. 41), there is no overlap of species. Furthermore, species from Nepal, which is roughly as far from Kambaiti as is Doi Inthanon, are again totally different. It would be interesting to intensively survey many mountainous sites in the Oriental Region to determine where faunas turn over, and how much endemicity there is in each mountain range. As a preliminary measure, further collecting is especially needed in mountains near Doi Inthanon and at Doi Inthanon itself.

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LITERATURE CITED

Arnett, R.H., G.A. Samuelson, and G.M. Nishida. 1993. *The insect and spider collections of the world.* Gainesville, Florida: Sandhill Crane Press.

Borgmeier, T. 1968. A catalogue of the Phoridae of the World (Diptera, Phoridae). *Studia Entomologica* 11: 1–367.

Brown, B.V. (1985) Revision of *Gymnophora* Macquart (Diptera: Phoridae) of the Holarctic Region. M.Sc. thesis, University of Guelph.

———. 1987a. Classification, reconstructed phylogeny and geographic history of the Neotropical phorid flies of the genus *Gymnophora* (Diptera: Phoridae). *Journal of Natural History* 21:1477–1524.

———. 1987b. Revision of the *Gymnophora* (Diptera: Phoridae) of the Holarctic Region: Classification, reconstructed phylogeny and geographic history. *Systematic Entomology* 12:271–304.

———. 1989. Testing phylogenetic hypotheses: New species of *Gymnophora* Macquart (Diptera: Phoridae) from Japan and Nepal, with an updated world classification. *Canadian Journal of Zoology* 67:2543–2556.

———. 1992. Generic revision of Phoridae of the Nearctic Region and phylogenetic classification of Phoridae, Sciadoceridae and Ironomyiidae (Diptera: Phoridea). *Memoirs of the Entomological Society of Canada* 164:1–144.

Brues, C.T. 1950. Family Phoridae. In *Guide to the insects of Connecticut,* part 6: Diptera, 4th fascicle, 33–85. Hartford: The State of Connecticut.

Buck, M. 1997. Untersuchungen zur ökologischen Einnischung saprophager Dipteren unter besonderer. Berücksichtigung der Phoridae und Sphaeroceridae (Brachycera/Cyclorrhapha). Ph.D. thesis, University of Ulm, Germany.

Disney, R.H.L. 1989. A key to Australasian and Oriental *Woodiphora* (Diptera: Phoridae): Affinities of the genus and description of new species. *Journal of Natural History* 23:1137–1175.

———. 1994. *Scuttle flies: The Phoridae.* London: Chapman and Hall.

Joswig, W. (1985) Untersuchungen zur Konkurrenz und Koexistenz necrophager Dipteren in toten Gehäuseschnecken. Ph.D. thesis, University of Bayreuth, Germany.

Macquart, J. 1835. Histoire naturelle des Insectes. Diptères, Tome deuxième. In *Collection des suites à Buffon,* ed. N.E. Roret, 703 p. Paris.

Malaise, R. 1937. A new insect-trap. *Entomologisk Tidskrift* 58:148–160.

Meigen, J.W. 1830. *Systematische Beschreibung der bekannten europaeischen zweifluegeligen Insecten,* volume 6. Hamm.

Robbins, R.G., and T. Smitinand. 1966. A botanical ascent of Doi Inthanon. *Natural History Bulletin of the Siam Society* 21:205–227.

Schmitz, H. 1926. Neue Gattungen und Arten europaeischer Phoriden. *Encylopédie Entomologique,* Série B: *Mémoires et Notes. Diptera* 2:73–85.

———. 1952. Neue Arten von *Gymnophora* und *Megaselia* aus U.S.A. *Brotéria* 48:177–88.

Smitinand, T. 1968. Vegetation of Khao Yai National Park. *Natural History Bulletin of the Siam Society* 22:289–305.

Thompson, F.C. 1994. Bar codes for specimen data management. *Insect Collection News* 9:2–4.

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