

## A Revision of the Shore-fly Genus *Trimerogastra* Hendel (Diptera: Ephydriidae)

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### Abstract

The species of *Trimerogastra* Hendel, which occur along maritime coasts of the Oriental and Australasian Regions, are revised. Included are 5 species of which two are newly described and one is recognized but not named for lack of a male. The new species are (type locality in parenthesis): *T. hardyi* (Australia. Queensland: Cairns) and *T. mc Alpinei* (Australia. New South Wales: Cornullia (34°2.1'S, 151°9.1'E)). Illustrations and descriptions are provided for structures of the male terminalia for all species for which males are available. One new synonym, *Pseudopelina setosa* Miyagi (= *Tetramerogastra fumipennis* Hendel), is also documented. In addition to description of the genus and species, the tribe Gymnomyzini is diagnosed and a key to genera is included.

### Introduction

Many shore-fly genera are notable for their ability to tolerate and proliferate in inimical environments such as pools of crude petroleum, hypersaline lakes, or the hot effluent of geysers (Foote, 1995; Oldroyd, 1964). Other ephydrid genera include numerous species that are often abundant or are geographically widespread and are thus also relatively well known. A few genera, however, largely remain unstudied, being represented by one or just a few species and frequently by few specimens. The latter conditions characterize the genus *Trimerogastra* Hendel, which is being revised for the first time in this paper. We dedicate this revision to the memory and friendship of D. Elmo Hardy, our colleague and mentor, and who encouraged our research in dipteran systematics.

Hendel (1914) described *Trimerogastra* in the beginning of the 20th century. Aside from Hendel's original description and Cresson's faunal review (1945), which included the synonymy of *Tetramerogastra* Hendel with *Trimerogastra*, the genus received scant attention or even mention, except for its inclusion in recent catalogs (Cogan & Wirth, 1977; Cogan, 1984; Mathis, 1989; Mathis & Zatwarnicki, 1995). Miyagi (1977) described *Pseudopelina*, later found to be congeneric with *Trimerogastra* (Zatwarnicki, 1991), in his faunal review of the Ephydriidae of Japan. Nothing has been published about the immature stages or natural histories of the species included in *Trimerogastra*, and what we know about the morphology of the genus is limited primarily to external features. With the availability of additional specimens, sometimes representing new species from more widespread localities, we are revising this genus to complement our ongoing research on genera of the tribe Gymnomyzini (Mathis *et al.*, 1993, *Mosillus* Latreille; Mathis, 1986, *Placopsidella* Kertész; Mathis & Zatwarnicki, 1990a, *Chlorichaeta* Becker; Mathis & Zatwarnicki, 1993, *Athyroglossa* Loew from the western Palearctic).

As part of our revisionary treatment, we are also including structures of the male terminalia, which have not been generally well studied. Miyagi (1977) provided the only genitalic illustrations available, and these are limited to external structures (posterior view of epandrium, cerci, and sur-

styli) of the single species treated in his faunal review of Japanese shore flies.

Prior to this revision, 4 names were available in *Trimerogastra* (Mathis & Zatwarnicki, 1995). These species-group names in chronological order are: (1) *T. cincta* Hendel (1914), the type species of *Trimerogastra*, (2) *T. fumipennis* (Hendel, 1914), the type species of *Tetramerogastra*, (3) *Trimerogastra longivena* Bezzi (1928), which was subsequently transferred to *Allotrichoma* (Mathis, 1989), and (4) *T. setosa* (Miyagi, 1977), the type species of *Pseudopelina* Miyagi and herein reported to be the junior synonym of *Tetramerogastra fumipennis*. We also add herein 2 new species and a third species, which will remain unnamed, making a total of 5 species currently in the genus.

### Methods and Materials

The descriptive terminology, with the exceptions noted in Mathis (1986) and Mathis & Zatwarnicki (1990a), follows that published in the Manual of Nearctic Diptera (McAlpine, 1981). Because specimens are small, usually less than 3.5 mm in length, study and illustration of the male terminalia required use of a compound microscope. Although here we follow the terminology for most structures of the male terminalia that other workers in Ephydriidae have used (see references in Mathis, 1986; Mathis & Zatwarnicki, 1990a, 1990b), Zatwarnicki (1996) now uses alternative terms (gonostylus, medandrium) that are based on the "hinge" hypothesis for the origin of the eremoneuran hypopygium. The terminology for structures of the male terminalia is provided directly on Figs. 1–2, 5–10 and is not repeated for comparable illustrations of other species. The species descriptions are composite and not based solely on the holotypes. One head and two venational ratios that are used in the descriptions are defined below (all ratios are based on three specimens (the largest, smallest, and one other). Gena-to-eye ratio is the genal height measured at the maximum eye height divided by the eye height. Costal vein ratio: the straight line distance between the apices of  $R_{2+3}$  and  $R_{4+5}$ /distance between the apices of  $R_1$  and  $R_{2+3}$ . M vein ratio: the straight line distance along vein M between crossveins (dm-cu and r-m)/distance apicad of dm-cu.

Although many specimens for this study are in the National Museum of Natural History, Smithsonian Institution, Washington, D.C. (USNM), we also studied numerous specimens that are deposited in the following collections:

AMS	Australian Museum, Sydney, Australia.
ANSP	Academy of Natural Sciences of Philadelphia, Pennsylvania, USA.
BMNH	The Natural History Museum, London, England.
DEI	Deutsches Entomologisches Institut, Eberswalde, Germany.
HNHM	Hungarian Natural History Museum, Budapest, Hungary.
HUS	Hokkaido University, Sapporo, Hokkaido, Japan.
KBIN	Royal Belgian Institute of Natural Sciences, Brussels, Belgium.
NMW	Naturhistorisches Museum, Vienna, Austria.

### Systematics

#### Tribe Gymnomyzini Latreille

Gymnomyzini Latreille, 1829: 536 (as Gymnomyzides). Type genus: *Gymnomyza* Fallén, 1810 (= *Mosillus* Latreille, 1804).

Gymnopini Cresson, 1922: 326. Type genus: *Gymnopa* Fallén, 1820 (= *Mosillus* Latreille, 1804). Mathis, 1986: 4–5 [diagnosis].

**Diagnosis.** The tribe Gymnomyzini is distinguished from other tribes of the subfamily Gymnomyzinae by the following combination of characters: Body extensively shiny black, although with some gray to whitish microtomentum on dorsum; posterior margin of gena sharply angulate; gena with fine pale setulae. Scutellum with 2 pairs of marginal setae. Foreleg normally developed, slender. Abdominal tergites 2–4 subequal in width, microtomentose, but more or less smooth.

**Description.** Small to moderately large shore flies, body length 1.20–4.30 mm; body extensively shiny black, although with some gray to whitish microtomentum on dorsum.

*Head:* Fronto-orbital setae reclinate and proclinate or absent; reclinate fronto-orbital seta usually inserted slightly anterior to larger, proclinate fronto-orbital seta. Arista either bare to macropubescent, if pectinate, rays shorter than 1/2 height of flagellomere or arista pectinate dorsally. Median facial area and lower facial margin without setae; facial setae inserted in more or less vertical series, parallel with parafacial. Posterior margin of gena sharply angulate; gena with fine pale setulae. Subcranial cavity small to large.

*Thorax:* Presutural or sutural dorsocentral seta inconspicuous or absent; prescutellar acrostichal setae small (about 1/2–2/3 length of posterior dorsocentral seta), inserted close together (distance between about 1/2 that between either prescutellar and the posterior dorsocentral seta on the same side) and behind or aligned with intra-alar seta; notopleural setae near ventral margin, either bearing 2 or with a single notopleural seta, inserted near posterior angle; scutellum with 2 pairs of marginal setae. Foreleg usually normal, forefemur slender (swollen in *Stratiothyrea* de Meijere), foretibia not ended in a large spur.

*Abdomen:* Abdominal tergites 2–4 subequal in width, microtomentose, but more or less smooth. Male terminalia: Epandrium generally as an inverted U; cercus well developed, lunate to ovate, generally bearing some setulae; surstylus well developed (lacking a presurstylus), longitudinal, pointed or emarginate apically, articulated ventrally with epandrium or partially fused to epandrium, usually bearing setulae; subepandrial sclerite lacking; gonites (pre and post) either separate with a small pregonite near base of postgonite or pregonite fused with lateral arm of hypandrium and postgonite usually an elongate structure; aedeagus usually simple, wider basally, apex often somewhat pointed; phallapodeme in lateral view roughly triangular with a conspicuous keel, usually asymmetrical; ejaculatory apodeme present; hypandrium usually elongate, not pouchlike.

#### Key to Genera and Subgenera of the Tribe Gymnomyzini

1. Both anterior and posterior notopleural setae present ..... 2
- . Anterior notopleural seta lacking, posterior seta present ..... 7
2. Pseudopostocellar setae well developed, length subequal to inner vertical seta; arista with several short hairs along dorsum, none longer than basal arista width ..... *Chaetomosillus* Hendel
- . Pseudopostocellar setae either greatly reduced or lacking; arista bearing 3–8 longer hairs along dorsum, longest hairs longer than width of anterior ocellus ..... 3
3. Anal lobe of wing almost straight ..... *Hoploaegis* Cresson
- . Anal lobe of wing distinct, forming a rounded angle ..... 4
4. Alula well developed, height greater than subcostal cell, and auriculate; face below antennal grooves evenly convex and completely transversely wrinkled to form series of depressions ..... *Cerometopum* Cresson
- . Alula weakly developed, height less than subcostal cell; face usually with a mid facial prominence or if convex not wrinkled as above ..... 5
5. Forefemur lacking any stout setae along ventral surface; a prescutellar acrostichal seta present or absent ..... *Trimerogastra* Hendel
- . Forefemur with a stout seta along posteroventral surface toward apical 1/3; lacking prescutellar acrostichal setae (*Athyroglossa* Loew) ..... 6

6. Mesonotal setulae in regular rows; forefemur without posteroventral, spinelike setulae; arisal rays relatively short, length of longest rays about 1/2 or less width of 1st flagellomere ..... Subgenus *Parathyroglossa* Hendel
- Mesonotal setulae in irregular rows; forefemur bearing 3–7, short, posteroventral, spinelike setulae; arisal rays relatively long, length of longest rays equal or greater than 1/2 width of 1st flagellomere ..... Subgenus *Athyroglossa* Loew
7. Arista bearing 3–9 moderately long hairs along dorsum, length of hairs considerably greater than basal arisal width; alula short ..... 8
- Arista appearing essentially bare, any hairs present short, length less than basal arisal width; alula high, auriculate ..... 11
8. Face in lateral view concave, lacking a median facial projection; lateral margin of abdomen creased ..... *Platygympopa* Wirth
- Face in lateral view protuberant, with a median facial projection; lateral margin of abdomen rounded ..... 9
9. Forefemur greatly swollen, width twice that of mid- and hindfemora, bearing a ventral keel-like ridge; halter knob whitish ..... *Stratiothyrea* de Meijere
- Forefemur at most slightly enlarged, not twice width of mid- and hindfemora, ventral surface not with a keel-like ridge ..... 10
10. Knob of halter black; dorsal fronto-orbital seta well developed, latero-clinate; outer vertical seta present, well developed ..... *Trimerogastra* Hendel
- Knob of halter white or whitish; no fronto-orbital setae well developed, setulae proclinate; outer vertical seta lacking ..... *Gymnopiella* Cresson
11. Forefemur unarmed, lacking row of stout setae along posteroventral surface at apical 1/4; outer vertical seta absent; mesonotum with several setae in oblique row between postalar seta and base of scutellum ..... *Placopsidella* Kertész
- Forefemur bearing 5–10 stout setae along posteroventral surface at apical 1/3; inner and outer vertical setae present; mesonotum lacking setae between postalar seta and base of scutellum ..... 12
12. Gena short, gena-to-eye ratio 0.20; parafacial narrow, less than width of anterior ocellus; wing generally faintly infuscate, light brown ..... species related to "*Gymnopa*" *beckeri* Cresson
- Gena high, gena-to-eye ratio 0.45 or greater; parafacial moderately to very wide, width greater than that of anterior ocellus; wing generally appearing milky white ..... 13
13. Face appearing spotted and pitted, pits with silvery gray microtomentum; anterior surface of midfemur rounded, bare of microtomentum, shiny; forefemur with posteroventral margin produced ventrally to a pointed ridge bearing setae ..... *Chlorichaeta* Becker
- Face microsculptured but either bare or microtomentum in vertical stripes, unspotted; midfemur with anterior surface flat, densely microtomentose, microtomentum silvery white; forefemur bearing row of stout setae along apical half of posteroventral margin, these not arising from a pointed ridge ..... *Mosillus* Latreille

### *Trimerogastra* Hendel

*Trimerogastra* Hendel, 1914: 110. Type species: *Trimerogastra cincta* Hendel, 1914, original designation. Hendel, 1934: 14 [compared with *Chaetomosillus*]. Cresson, 1925: 241 [discussion of status and subfamily]; 1945: 51–52 [review, synonymy]. Cogan & Wirth, 1977: 323–324 [Oriental catalog]. Mathis & Zarnicki, 1995: 142 [world catalog].

*Tetramerogastra* Hendel, 1914: 111. Type species: *Tetramerogastra fumipennis* Hendel, 1914, original designation. Cresson, 1945: 51 [synonymy].

*Pseudopelina* Miyagi, 1977: 64. Type species: *Pseudopelina setosa* Miyagi, 1977, original designation. Zatwarnicki, 1991: 296 [synonymy].

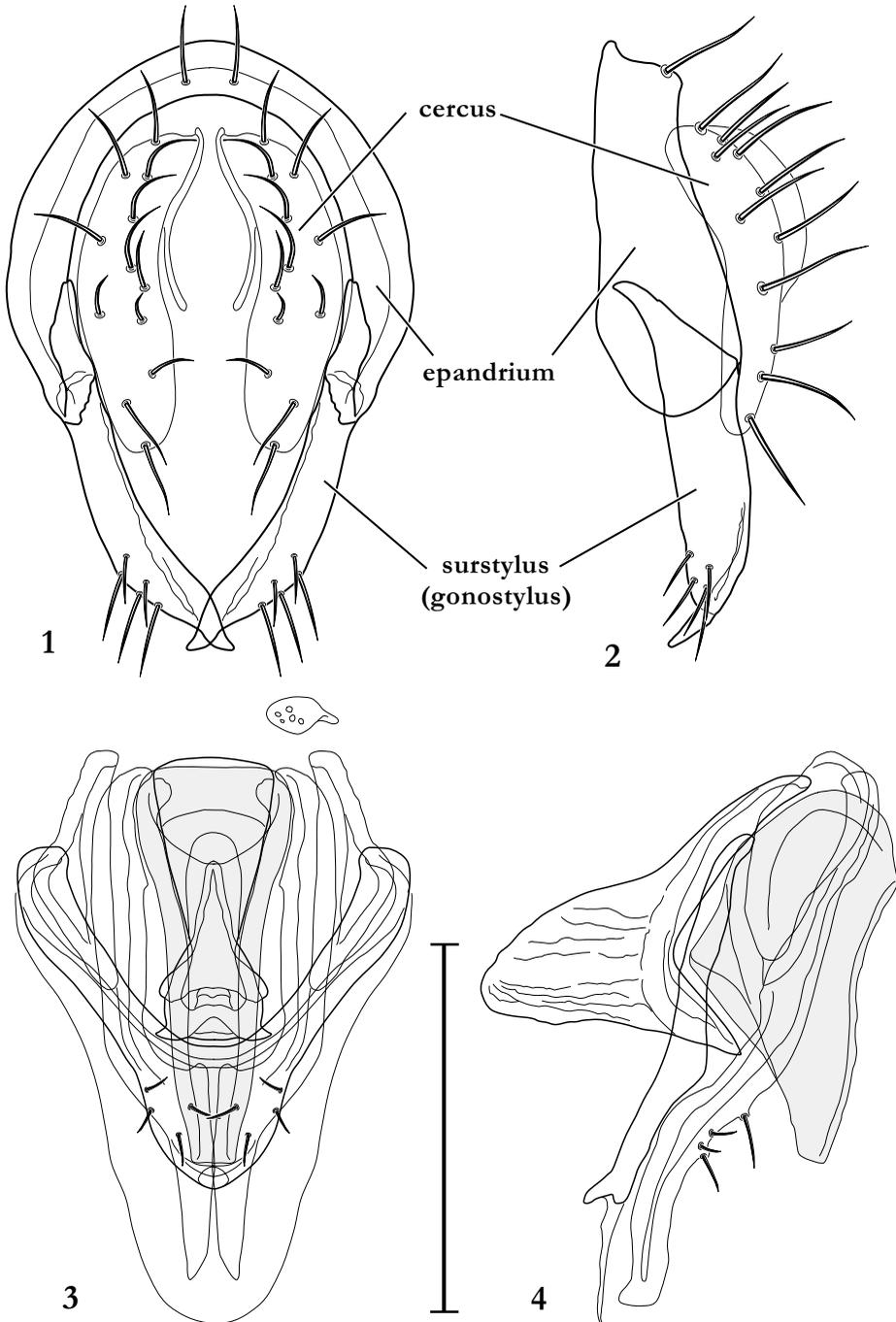
**Diagnosis.** *Trimerogastra* is distinguished from related genera of the tribe Gymnomyzini by the following combination of characters: Body mostly brownish microtomentose, especially on dorsum; setation generally well developed; posterior fronto-orbital seta latero-clinate or obliquely latero-clinate; middle facial conical protuberance moderately large; parafacial relatively narrow, lacking vertical row of furrows; gena moderately high to moderately low, about 1/4–1/3 height of eye; apical scutellar setae usually not arising from basal tubercles; wing faintly brownish hyaline; alula of wing narrow, bandlike; halter knob blackish brown to black; forefemur only slightly more swollen than mid- or hindfemora, lacking large ventral setae or keel-like process; midtibiae similar to fore- and hindtibiae, lacking anterodorsal surface flattened and invested with silvery white microtomentum; 2nd tergite lacking a median depression, linear to narrowly triangular; fifth tergite of males and to a lesser degree in females with median dorsal depression towards posterior margin; surstylus longitudinal, bearing setulae on distal portion; gonites very elongated, 1/3–1/2 longer than aedeagus.

**Description.** Small to moderately small shore flies, body length 1.35–2.30 mm, mostly black, many surfaces subshiny to shiny; dorsum, especially thorax, sometimes somewhat microtomentose, appearing subshiny to dull.

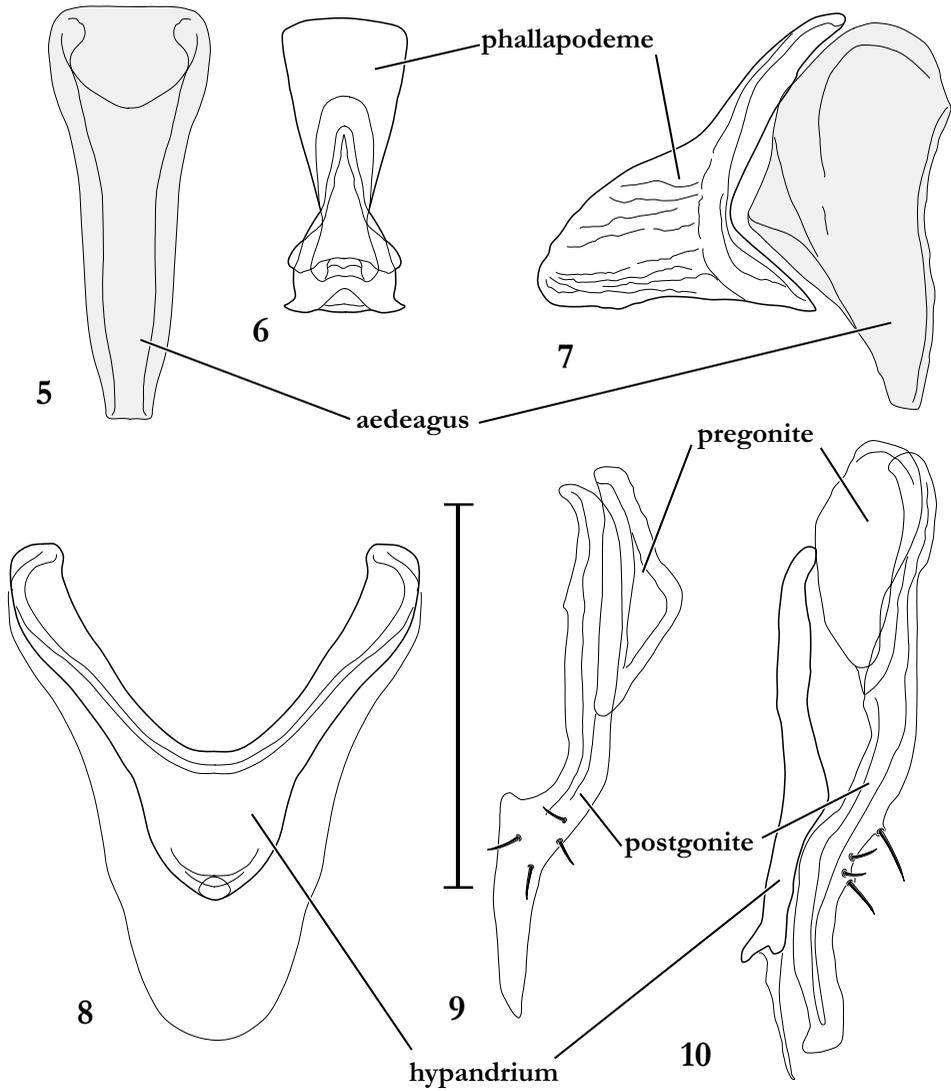
**Head:** Setation moderately well developed. Frons relatively wide, as wide or usually wider than long; ocelli arranged in isosceles triangle, distance between posterior ocelli greater than that between either posterior ocellus and anterior ocellus; ocellar setae well developed, generally proclinate, slightly divergent, inserted laterad of anterior ocellus; pseudopostocellar seta greatly reduced or lacking; 2 fronto-orbital setae, posterior fronto-orbital seta longer, obliquely latero-clinate to latero-clinate; anterior fronto-orbital setae proclinate; 1–3 smaller setulae between larger fronto-orbital setae, 1 setula usually larger, proclinate; both inner and outer vertical setae present, with outer seta slightly smaller than inner seta. Antenna normally developed; 1st flagellomere reddish brown, broadly rounded apically; arista comparatively long, longer than combined length of first 3 antennal segments, thickened basally, thereafter very gradually tapered to apex, bearing 3–8 dorsal hairs. Face with dorsal half vertically and shallowly carinate with distinct but shallow and wide antennal grooves; midfacial, conical protuberance moderately prominent; parafacial moderately narrow, becoming wider posteroventrally, width conspicuously greater than width of anterior ocellus; parafacial immediately adjacent to face lacking vertical row of horizontal grooves; gena generally bare and moderately high to moderately short, height about 1/4–1/3 eye height; posterior margin sharply angulate and marginate.

**Thorax:** Mesonotum black but densely invested with grayish brown to brown micro-tomentum, sometimes in longitudinal pattern. Only posteriormost dorsocentral seta and postalar seta well developed on scutum (a prescutellar acrostichal seta present in *T. cincta*); lacking row of prominent setae between postalar seta and base of scutellum; scutellum bearing well-developed apical setae, basal marginal setae moderately or weakly developed, these not arising from tubercles; notopleuron with 1 large posterior seta, anterior seta usually lacking, if present weakly developed; 2 anepisternal setae, ventral seta slightly larger, both at posterior margin; 1 katepisternal seta. Scutellum more or less rectangular or trapezoidal, posterior margin usually truncate, not pointed; disc densely setose; only apical scutellar setae well developed, these more or less approximate. Wing faintly brownish hyaline, basal color sometimes much darker; vein  $R_{2+3}$  moderately long, with length of costal section II about 1.5–2 × section III; vein  $CuA_1$  not extended to wing margin; alula narrow, bandlike, alular marginal setulae much shorter than alular width. Halter knob blackish brown to black. Forefemur only slightly more swollen than mid- or hindfemora, lacking ventral processes or enlarged setae; midfemora with row of 6–8 stout setae on anterior surface; midtibia somewhat rounded, similar to fore- and hindtibiae, lacking flattened anterior surface that appears silvery white; femora and tibiae black, basitarsomere yellow, apical 1–2 tarsomeres usually blackish brown.

**Abdomen:** Generally blackish brown, thinly to moderately heavily microtomentose, microtomentum gray to grayish brown, lacking evident microsculpturing; anterior margin of tergites 2–4



**Figures 1-4.** Structures of the male terminalia of *Trimerogastra cincta* Hendel (Thailand, Sakla, Samut Prakan). 1. Epandrium, cerci, and surstylus, posterior view; 2. Same, lateral view; 3. Aedeagus (shaded), phallapodeme, gonites, hypandrium, ejaculatory apodeme, ventral view; 4. Same (not including ejaculatory apodeme), lateral view. Scale bar = 0.1 mm.



**Figures 5-10.** Structures of the male terminalia of *Trimerogastra cincta* Hendel (Thailand. Sakla, Samut Prakan). 5. Aedeagus, ventral view; 6. Phallapodeme, ventral view; 7. Aedeagus and phallapodeme, lateral view; 8. Hypandrium, ventral view; 9. Postgonite and pregonite, ventral view; 10. Hypandrium, postgonite, and pregonite, lateral view. Scale bar = 0.1 mm.

with microtomentose bands, especially medially; tergites well sclerotized, continued laterally and ventrally, lateral margin rounded; 2nd tergite lacking median depression; sternites of male relatively weakly developed, usually as small sclerotized rectangular plates, 1st sternite of male oriented perpendicular to plane of body, sternites 2–4 parallel to plane of body; 5th sternite divided into 2 sternites, each longer than wide and oriented to form a V, with anterior vertex, sometimes fused at vertex; 5th tergite exposed but shorter than 4th, usually triangular or trapezoidal, with 2 dorsal pits toward posterior margin. Male terminalia: Epandrium in lateral view dorsoventrally elongate, wider ventrally, in posterior view widest at level of cerci; cercus ovate to semihemispherical, bearing short setae; surstylus simple, rodlike, 3–4 × longer than wide, bearing setulae apically; ejaculatory apodeme small, spatulate; aedeagus in ventral view wider basally, tapered to narrower apex, lateral margin even or sinuous, in lateral view wide basally, apical 1/2 tapered to blunt to acutely narrowed point; phallopodeme in lateral view asymmetrical, extended keel skewed to attachment with hypan-drium; postgonite elongate, bearing setulae along posterior surface; pregonite a small, lateral sclerite near base of postgonite; hypan-drium much longer than wide, narrow, linear.

**Distribution.** Australasian, Oriental, and eastern Palaearctic (Japan) Regions.

**Natural history.** Although one or two species of *Trimerogastra* occur inland in association with salt pans or in freshwater habitats (the undescribed species), most species are associated primarily with coastal mangrove or other brackish-water habitats where specimens can be relatively abundant. Nothing is known about the immature stages or life history of the genus.

#### Key to Species of *Trimerogastra* Hendel

1. Dorsal aristal rays 5–8. Vein  $R_{2+3}$  long, nearly straight, length of costal section II about twice section III ..... *fumipennis* (Hendel)
  - Dorsal aristal rays 3–5. Vein  $R_{2+3}$  short, shallowly arched, especially subapically, length of costal section II only slightly longer than section III..... 2
2. Tergites, especially 3 and 4, uniformly sparsely microtomentose, lacking dense microtomentose fascia toward anterior half ..... *mcalpinei* n.sp.
  - Tergites, especially 3 and 4, either with fasciate pattern of dense microtomentose toward anterior 1/2, contrasted with sparsely microtomentose posterior half or uniformly thinly whitish microtomentose ..... 3
3. Tergites 3–5 thinly and more or less uniformly whitish microtomentose, microtomentum toward anterior margin slightly denser but not distinctly fasciate. Gena moderately high, about 1/3 eye height; arista bearing 4–5 hairs, longest longer than height of 1st flagellomere. Scutellum rectangular, posterior margin wide, bluntly rounded, surface grossly sculptured ..... *hardyi* n. sp.
  - Tergites 3–4 with distinct fasciate pattern of microtomentum toward anterior margin of tergite. Gena relatively short, about 1/4 eye height; arista bearing 3–4 hairs, longest shorter than height of 1st flagellomere. Scutellum trapezoidal, posterior margin relatively narrow, surface similar to scutum ..... 4
4. Gena moderately short, about 1/4 eye height; arista bearing 3–4 hairs, longest shorter than height of 1st flagellomere; prescutellar acrostichal seta present. Tergites 3–4 fasciate, anterior portion whitish gray microtomentose, posterior portion very sparsely brownish microtomentose; femora and tibiae essentially concolorous ..... *cincta* Hendel
  - Gena very short, about 1/8 eye height; arista bearing 4 hairs, longest at least equal to height of 1st flagellomere; prescutellar acrostichal seta lacking. Tergites 3–4 with microtomentum in small, separate, more lateral patches toward anterior margin; tibiae conspicuously lighter in color than femora ..... *Trimerogastra* sp.

***Trimerogastra cincta* Hendel**

(Figs. 1–10)

*Trimerogastra cincta* Hendel, 1914: 111. Cresson, 1925: 241 [discussion of status]; 1945: 51 [review]. Cogan & Wirth, 1977: 323 [Oriental catalog]. Mathis & Zatwarnicki, 1995: 142 [world catalog].

**Diagnosis.** This species is distinguished from congeners by the following combination of characters: Small shore flies, body length 1.35–1.90 mm.

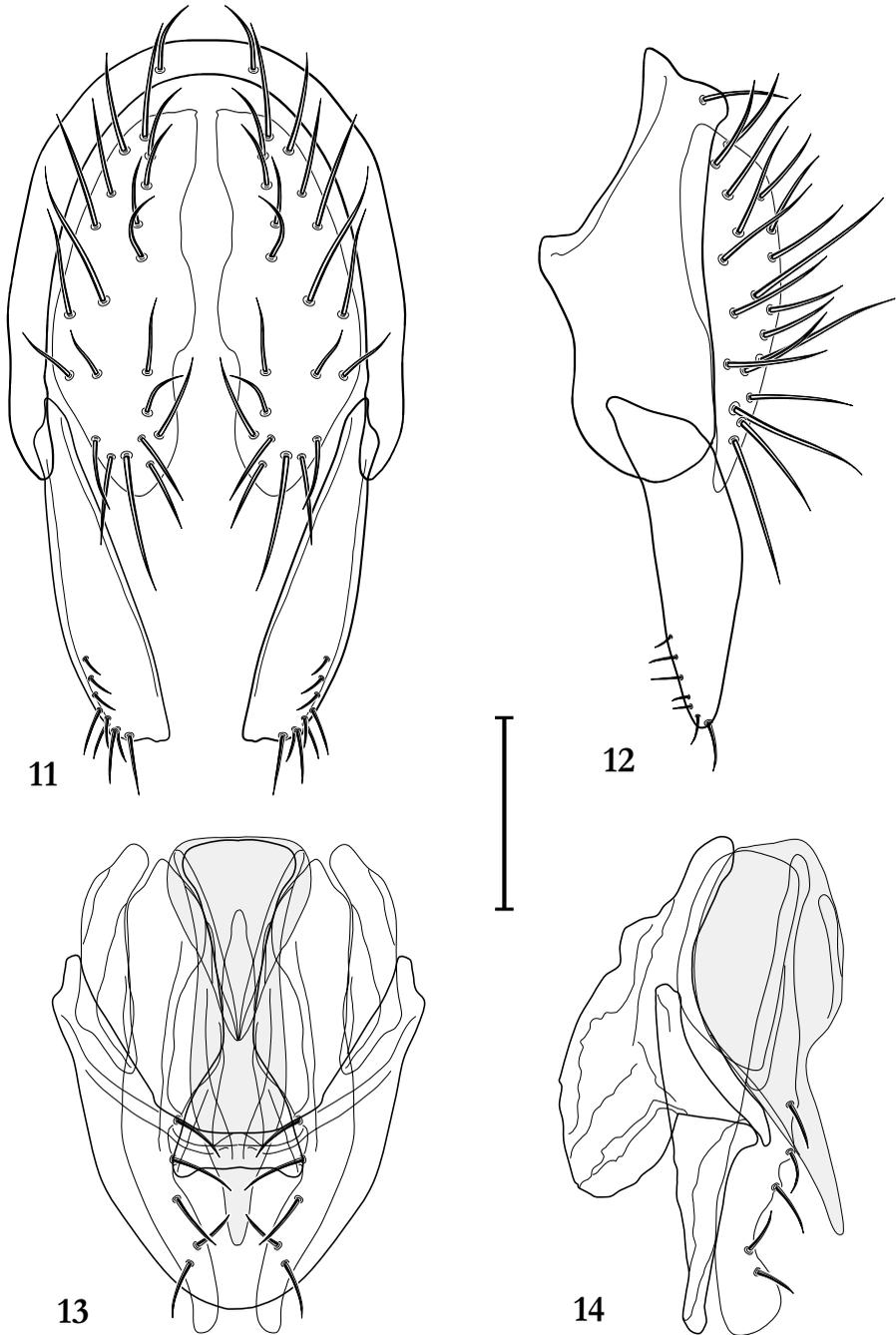
**Head:** Posterior fronto-orbital seta obliquely posterolatero-clinate to latero-clinate, length conspicuously longer than anterior proclinate seta; distance between anterior and posterior seta greater than distance between posterior ocelli. Arista bearing 3–4, short hairs, longest hair shorter than height of 1st flagellomere. Gena relatively short, about 1/4 eye height and less than height of 1st flagellomere; gena-to-eye ratio 0.25–0.28.

**Thorax:** Prescutellar acrostichal seta present; scutellum broadly trapezoidal, wider than long, posterior margin relatively narrow, surface similar to scutum; apical setae long, length subequal to scutellar length. Vein  $R_{2+3}$  shallowly arched, especially subapically, moderately short; length of costal section II about  $1.4 \times$  longer than section III; costal vein ratio 0.70–0.71; M vein ratio 0.44–0.48. Femora and tibiae black, essentially concolorous with katapisternum.

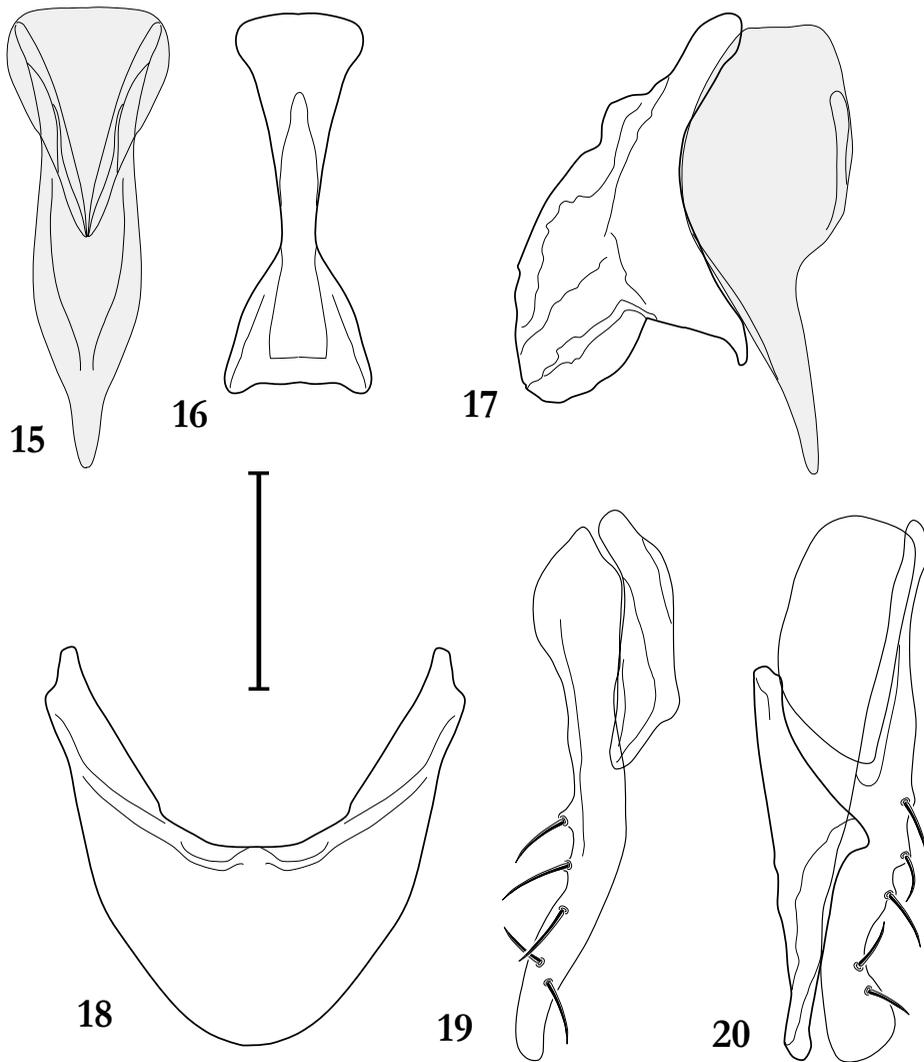
**Abdomen:** Tergites 3–4 fasciate, anterior portion whitish gray microtomentose, posterior portion very sparsely microtomentose. Male terminalia (Figs. 1–10): Epandrium in posterior view (Fig. 1) as an inverted U, rounded, in lateral view (Fig. 2) gradually becoming wider ventrally, ventral margin rounded; cercus in posterior view (Fig. 1) semihemispherical, slightly more sclerotized dorsomedially and with a dorsomedial, short projection, otherwise parallel sided, shallowly curved; surstylus in posterior view long and narrow, as long as height of epandrium, apical 1/3 turned medially, this portion bearing longer setulae, acutely pointed apically; aedeagus in ventral view (Figs. 3, 5; shaded) with base about twice width of apex, apex truncate, in lateral view (Figs. 4, 7) wide basally, apical half tapered to narrow and truncate apex; phallapodeme in lateral view (Figs. 4, 7) with extended keel asymmetrically triangular, rounded, projected erectly; postgonite in lateral view (Figs. 4, 10) elongate, narrow, step-curved medially, bearing 3–4 setulae at midlength, apex truncate, in ventral view (Figs. 3, 9) curved medially just beyond midlength, more sharply angulate medially; pregonite linearly triangular in ventral view (Figs. 3, 9), irregularly oval in lateral view (Figs. 4, 10); hypandrium in ventral view (Figs. 3, 8) V- to Y-shaped, with wide extended anteromedial process and narrow, posterolateral arms, in lateral view (Figs. 4, 10) elongate and narrow.

**Type Material.** The lectotype male, here designated to stabilize and make more universal the use of this name, is labeled “Anping Formosa [Taiwan] H. Sauter, VI. 1912 [Jun 1912]/TYPUS [pink]/*Trimerogastra cincta* H. det.Hendel [species name and “H.” handwritten]/Eberswalde coll. DEI/LECTOTYPE ♂ *Trimerogastra cincta* Hendel By Mathis and Zatwarnicki [handwritten except for “LECTOTYPE” and “By”; black sub-border].” The lectotype is double mounted (minuten in a rectangular block of plastic foam), is in good condition (some scutellar setae are missing), and is deposited in the DEI. There are also 13 paralectotypes that are deposited in DEI (4♂, 3♀), ANSP (1♂, 1♀), and NMW (2♂, 2♀).

**Other Specimens Examined.** Oriental. **INDIA.** Tamil Nadu: Madras, Guindy, 17 Aug 1913, Fletcher (1♀; ANSP). **MALAYSIA.** Sedili kecil (mangrove), 11–12 Oct 2000, P. Grootaert (7♂, 5♀; KBIN, sample no. 20043-47). **SINGAPORE.** Changi (mangrove), 14 Aug 1976, D.H. Murphy (1♂; BMNH). **SRI LANKA.** Eastern Province. Batticaloa: Batticaloa, 2 May 1980, L. Jayawickrema, W. N. Mathis, T. Wijesinhe (7♂, 6♀; USNM); Panichchankeni, 2 May 1980, L. Jayawickrema, W. N. Mathis, T. Wijesinhe (1♂; USNM). Tricomalee: Mutur, 2 May 1980, L. Jayawickrema, W. N. Mathis, T. Wijesinhe (1♀; USNM). Southern Province. Hambantota: Bundala, 25 Apr 1980, L. Jayawickrema, W. N. Mathis, T. Wijesinhe (3♂, 2♀; USNM); Kirinda, 25 Apr 1980, L. Jayawickrema, W. N. Mathis, T. Wijesinhe (1♂, 1♀; USNM). **TAIWAN.** Takao, 2 May 1907, H. Sauter (1♂; ANSP). **THAILAND.** Hat Chandamri, Ranong (beach), 9 May 1998, P. Grootaert (4♂, 1♀; KBIN, sample no. 98038-43). Kanchanadit, Surat Thani (river bed, pools), 12 May 1998, P. Grootaert (1♂; KBIN, sample no. 98051). Laem Son, Ranong (mangrove), 10 May 1998, P. Grootaert (5♂, 1♀; KBIN, sample no. 98046). Pak Bara, Satun (mangrove), 28 Oct 1997, P. Grootaert (4♂, 2♀; KBIN, sample no. 97132). Prachuap Khiri Khan: Prachuap Khiri Khan, 2 Apr 1996, P. Grootaert (1♂, 2♀; KBIN, sample no. 96006).



**Figures 11–14.** Structures of the male terminalia of *Trimerogastra fumipennis* Hendel (Taiwan, Tainan). **11.** Epandrium, cerci, and surstylus, posterior view; **12.** Same, lateral view; **13.** Aedeagus (shaded), phallapodeme, gonites, and hypandrium, ventral view; **14.** Same, lateral view. Scale bar = 0.1 mm.



**Figures. 15-20.** Structures of the male terminalia of *Trimerogastra fumipennis* Hendel (Taiwan, Tainan). **15.** Aedeagus, ventral view; **16.** Phallapodeme, ventral view; **17.** Aedeagus and phallapodeme, lateral view; **18.** Hypandrium, ventral view; **19.** Postgonite and pregonite, ventral view; **20.** Hypandrium, postgonite, and pregonite, lateral view. Scale bar = 0.1 mm.

Sakla, Samut Prakan (mangrove), 20 May 1998, P. Grootaert (60♂, 23♀; KBIN, sample no. 98060). Sam Roi Yot, Prachuap Khiri Khan (rocks on beach, mangrove), 2 Apr 1996, P. Grootaert (3♂, 2♀; KBIN, sample no. 96001-02). Su-Saan Hawy, Krabi (sandy beach), 24 Oct 1997, P. Grootaert (1♂; KBIN, sample no. 97111). Takua Pa, Phang-Nga (river, estuary), 8 May 1998, P. Grootaert (1♀; KBIN, sample no. 98031). Tha Po, Surat Thani (mangrove creek), 12 May 1998, P. Grootaert (28♂, 7♀; KBIN, sample no. 98052).

**Distribution.** Oriental: India (Tamil Nadu), Malaysia, Singapore, Sri Lanka, Taiwan, Thailand.

**Remarks.** Although originally described from specimens collected in Taiwan, this species is much more widespread, occurring throughout much of the Oriental Region along maritime coasts.

***Trimerogastra fumipennis* (Hendel)**

(Figs. 11–20)

*Tetramerogastra fumipennis* Hendel, 1914: 111.

*Trimerogastra fumipennis*. Cresson, 1945: 51 [generic combination]. Cogan & Wirth, 1977: 324 [Oriental catalog]. Mathis & Zatwarnicki, 1995: 142 [world catalog].

*Pseudopelina setosa* Miyagi, 1977: 65. **New Synonym.**

*Trimerogastra setosa*. Zatwarnicki, 1991: 297 [generic combination]. Mathis & Zatwarnicki, 1995: 142 [world catalog].

**Diagnosis.** This species is distinguished from congeners by the following combination of characters: Small to moderately small shore flies, body length 1.90–2.25 mm.

**Head:** Posterior fronto-orbital seta laterocline, long, over twice length of anterior, procline seta; distance between anterior and posterior setae less than distance between posterior ocelli. Arista bearing 5–8 short, dorsal hairs, none greater in length than height of 1st flagellomere. Gena moderately high to high, about 1/3 eye height and greater than height of 1st flagellomere; gena-to-eye ratio 0.36.

**Thorax:** Prescutellar acrostichal seta absent; scutellum trapezoidal, length subequal to width, disc similar to scutum, apical setae as long as scutellar length. Vein  $R_{2+3}$  nearly straight, long, only apex sometimes shallowly curved; length of costal section II about twice section III; costal vein ratio 0.47–0.50; M vein ratio 0.54–0.60. Femora and tibiae yellowish brown, tawny, distinctly lighter in color than katepisternum to blackish brown.

**Abdomen:** Tergite 2 generally with fine, lacteous microtomentum, tergites 3–4 with denser lacteous microtomentum anterolaterally, otherwise sparsely microtomentose except for sparsely microtomentose lateral margins. Male terminalia (Figs. 11–20): Epandrium in posterior view (Fig. 11) as an inverted U, rounded, in lateral view (Fig. 12) widest at midlength, ventral half almost parallel sided, ventral margin broadly rounded; cercus in posterior view (Fig. 11) semihemispherical, medial margin irregular, lateral margin more evenly curved; surstylus in posterior view long and narrow, nearly straight, as long as height of epandrium, gradually becoming wider ventrally, apical 1/3 bearing setulae; aedeagus in ventral view (Figs. 14–15, 17; shaded) with base about twice width as apex, apex narrowly pointed, lateral margins sinuous, in lateral view (Figs. 14, 17) wide basally, apical half tapered to narrowly formed apex; phallopodeme in lateral view (Figs. 14, 17) with extended keel asymmetrically triangular, rounded, inclined or skewed toward end that attaches with hypandrium; postgonite in lateral view (Figs. 14, 20) elongate, with shallowly angulate at midlength, narrow, apex rounded, bearing 3–4 setulae along posterior margin, in ventral view (Figs. 13, 19) tapered evenly to rounded apex, curved slightly along length; pregonite in ventral view (Figs. 13, 19) about 1/2 length of postgonite, slightly tapered at apices, generally linear, in lateral view (Figs. 14, 20) irregularly rectangular with apical margin slightly extended and pointed; hypandrium in ventral view broadly V-shaped with wide base and narrow, posteriorly directed arms, in lateral view (Figs. 14, 20) elongate and narrow, tapered to nearly digitiform apex.

**Type Material.** The lectotype male of *Tetramerogastra fumipennis*, here designated to stabilize and make more universal the use of this name, is labeled “Anping Formosa [Taiwan] H. Sauter, V. 1912 [May 1912]/TYPUS [pink]/Tetramerogastra fumipennis H. det. Hendel [species name and “H.” handwritten]/Eberswalde coll. DEI/LECTOTYPE ♂ Tetramerogastra fumipennis Hendel By Mathis and Zatwarnicki [handwritten except for “LECTOTYPE” and “By”; black sub-border].” The lectotype is double mounted (mounted in a rectangular block of plastic foam), is in fair condition (head missing), and is deposited in the DEI. Two male paralectotypes (1♂; DEI (head missing), 1♂; NMW) bear the same label data as the lectotype.

The holotype male of *Pseudopelina setosa* Miyagi is labeled “Iriomote[-jima] 16-IV-1962 [16 Apr 1962]/RYUKYU IS. I. Miyagi/-type Pseudopelina setosa I. Miyagi [red; all except “-type” handwritten].” The holotype is double mounted (mounted in a narrow, rectangular card), is in good condition (left wing largely missing, only base present, some setae missing or misoriented), and is deposited in the HUS.

**Other Specimens Examined.** TAIWAN. Kanchize, H. Sauter (1♀; DEI). Tainan, Nov 1909, H. Sauter (1♀; ANSP).

**Distribution.** Oriental: Japan (Ryukyu Islands), Taiwan. Palearctic: Japan (Kyushu).

**Remarks.** We propose the synonymy of *Pseudopelina setosa* with *T. fumipennis* after direct comparison of the respective holotype and lectotype specimens. Although there is very slight variation in structures of the male terminalia, we are confident that the specimens are conspecific.

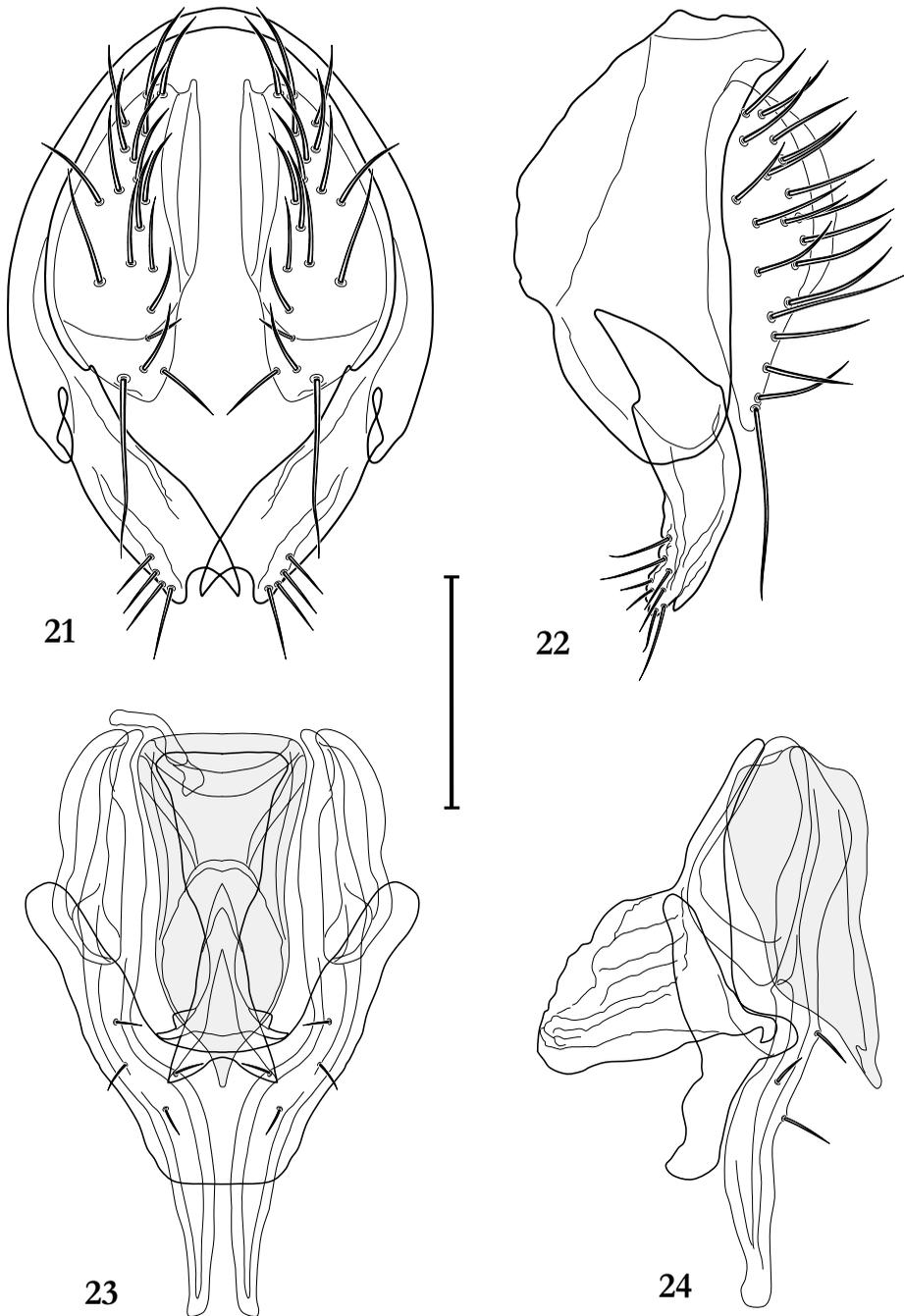
***Trimerogastra hardyi* Mathis & Zatwarnicki, new species**  
(Figs. 21–30)

**Diagnosis.** This species is distinguished from congeners by the following combination of characters: Small to moderately small shore flies, body length 1.45–2.30 mm.

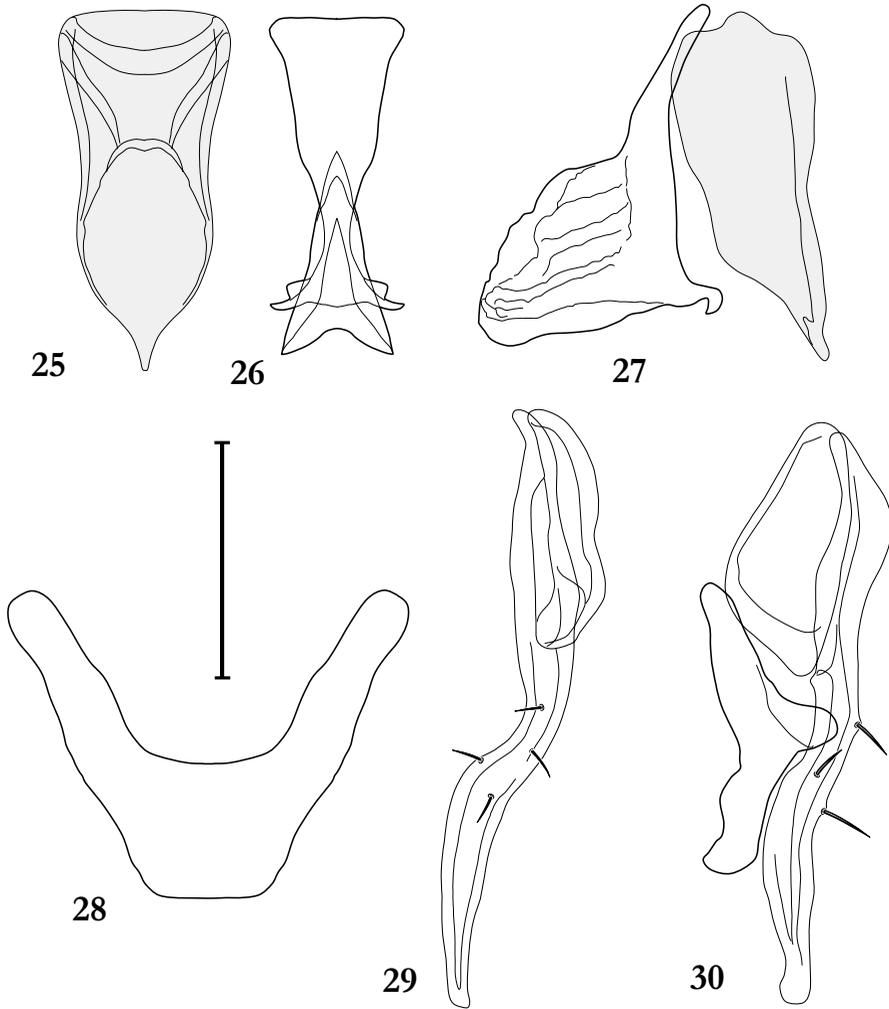
**Head:** Posterior fronto-orbital seta longer than anterior seta, laterocline; distance between anterior and posterior setae about equal to that between posterior ocelli. Arista bearing 4–5 long hairs, longest hair greater than height of 1st flagellomere. Gena moderately high, about 1/4–1/3 eye height, conspicuously higher than height of 1st flagellomere; gena-to-eye ratio 0.25–0.31.

**Thorax:** Prescutellar acrostichal seta absent; scutellum subquadrate, posterior margin wide, shallowly and bluntly rounded, disc grossly sculptured; apical setae conspicuously shorter than scutellar length. Costal vein ratio 0.90–0.95; vein R<sub>2+3</sub> shallowly arched, especially subapically, short, making length of 2nd costal section only slightly longer than 3rd section; M vein ratio 0.55–0.64. Femora and tibiae black, essentially concolorous with katapisternum.

**Abdomen:** Tergites 3–4 generally invested with whitish gray microtomentum, contrasted with sparsely microtomentose posterior half. Male terminalia (Figs. 21–30): Epandrium in posterior view (Fig. 21) as a rounded, inverted U, in lateral view (Fig. 22) widest at midlength, ventral half wide, slightly tapered (almost parallel sided), ventral margin broadly rounded; cercus in posterior view (Fig. 21) semihemispherical, medial margin irregular, lateral margin more evenly curved; surstylus in posterior view long and narrow, nearly straight, almost as long as height of epandrium, gradually becoming wider ventrally, apical 1/3 bearing setulae laterally, apex concave, forming a medial point; aedeagus in ventral view (Figs. 23, 25; shaded) somewhat hour-glass shaped, with truncate base and narrowly pointed apex, and slightly concave laterally, in lateral view (Figs. 24, 27) wide basally, apical half tapered to narrowly formed apex; phallopodeme in lateral view (Figs. 24, 27) with extended keel asymmetrically triangular to trapezoidal, rounded, inclined or skewed toward end that attaches with hypandrium; postgonite in lateral view (Figs. 24, 30) elongate, shallowly sinuous, bearing setulae near midlength, in ventral view (Figs. 23, 29) tapered evenly to rounded apex, with an elbow curve at midlength; pregonite in ventral view (Figs. 23, 29) about 1/3 length of postgonite, slightly tapered at apices, generally linear, in lateral view (Figs. 24, 30) irregularly rectangular with apical margin slightly extended and bluntly pointed; hypandrium broadly V-shaped in ventral view (Figs. 23, 28), in lateral view (Figs. 24, 30) elongate but with a short process at midlength, apex bluntly rounded.



**Figures 21–24.** Structures of the male terminalia of *Trimerogastra hardyi* n. sp. (Australia. Queensland: Cairns). 21. Epandrium, cerci, and surstylus, posterior view; 22. Same, lateral view; 23. Aedeagus (shaded), phallopodeme, gonites, and hypandrium, ventral view; 24. Same, lateral view. Scale bar = 0.1 mm.



**Figures. 25–30.** Structures of the male terminalia of *Trimerogastra hardyi* n. sp. (Australia, Queensland: Cairns). **25.** Aedeagus, ventral view; **26.** Phallapodeme, ventral view; **27.** Aedeagus and phallapodeme, lateral view; **28.** Hypandrium, ventral view; **29.** Postgonite and pregonite, ventral view; **30.** Hypandrium, postgonite, and pregonite, lateral view. Scale bar = 0.1 mm.

**Type Material.** The holotype male is labeled “AUSTRALIA: [Queensland] Cairns[,] 18–21 Dec 1976[,] Gary F. Hevel/HOLOTYPE *Trimerogastra hardyi* W.N. Mathis & T. Zatwarnicki USNM [red; USNM crossed out; species name, gender symbol, and “& T. Zatwarnicki” handwritten].” The holotype is double mounted (minuten in a block of polyporus), is in good condition (one apical scutellar seta missing), and is deposited in the AMS. Four paratypes (2♂, 2♀; USNM) bear the same label data as the holotype. Other paratypes are as follows: PAPUA NEW GUINEA. Central: Lea Lea, 23 Feb 1986, J. W. Ismay (1♂, 3♀; USNM).

**Distribution.** Australasian/Oceanian: Australia (Queensland), Papua New Guinea (Central).

**Etymology.** The species epithet, *hardyi*, is a Latin patronym to honor and recognize the voluminous contributions of our friend, D. Elmo Hardy, to dipterology, including his personal encouragement of us in our various studies of true flies.

***Trimerogastra mcalpinei* Mathis & Zatwarnicki, new species**

(Figs. 31–40)

**Diagnosis.** This species is distinguished from congeners by the following combination of characters: Small to moderately small shore flies, body length 1.70–2.10 mm.

**Head:** Posterior fronto-orbital seta conspicuously longer than proclinate, anterior seta, lateroclinate; distance between anterior seta and posterior seta about equal to that between posterior ocelli. Arista bearing 4–5 hairs, longest hairs subequal to height of 1st flagellomere. Gena moderately high, about 1/4 eye height and greater than height of 1st flagellomere; gena-to-eye ratio 0.25–0.27.

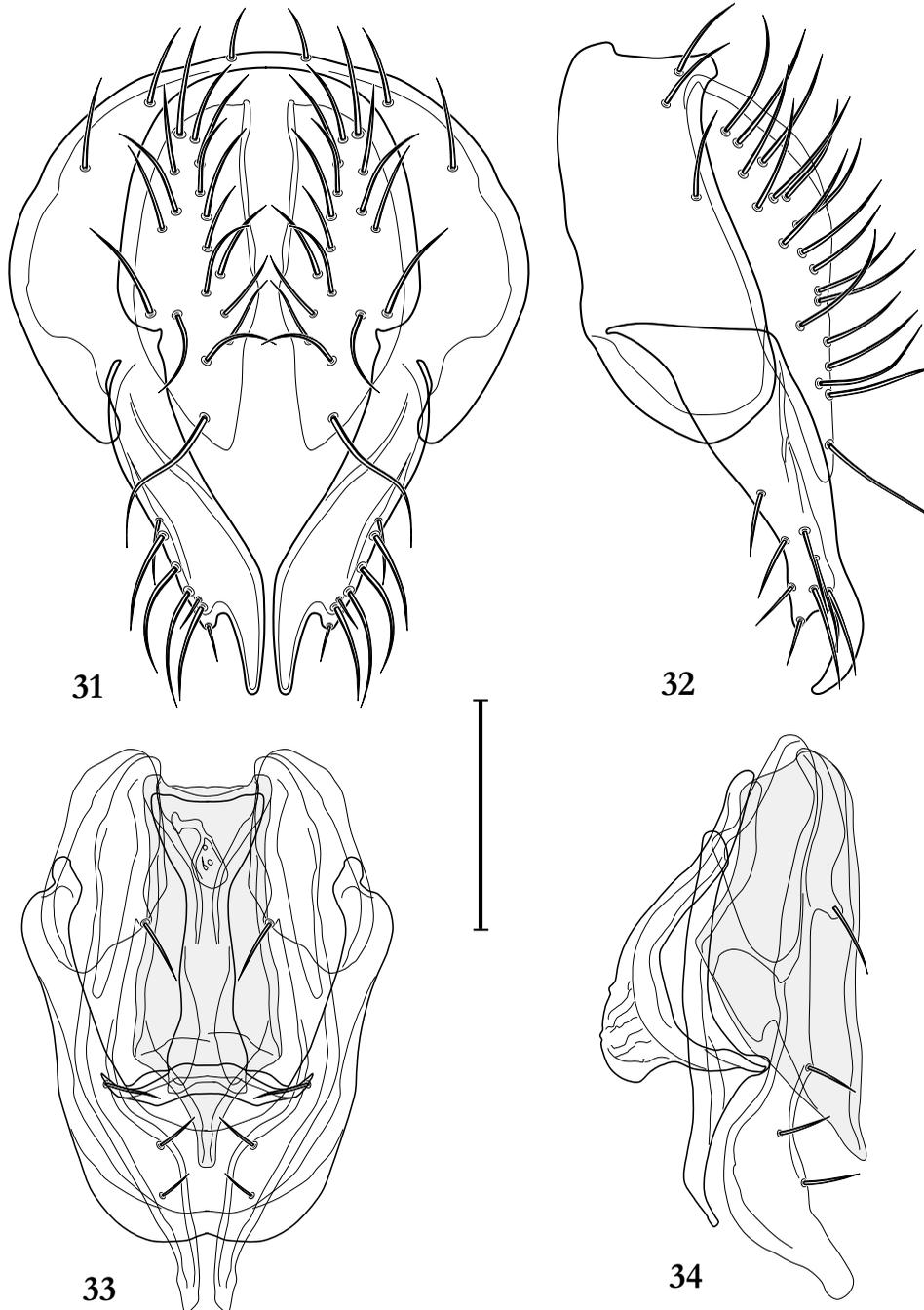
**Thorax:** Prescutellar acrostichal seta absent; scutellum trapezoidal, length subequal to width, disc similar to scutum, apical setae as long as scutellar length. Costal vein ratio 0.67–0.76; vein  $R_{2+3}$  moderately straight and long; costal section II about  $1.5 \times$  section III; M vein ratio 0.50–0.53.

**Abdomen:** Tergites, especially 3 and 4, uniformly sparsely microtomentose, lacking dense, microtomentose fascia toward anterior half. Male terminalia (Figs. 31–40): Epandrium in posterior view (Fig. 31) as a broadly rounded, inverted U, in lateral view (Fig. 32) essentially parallel sided with broadly rounded ventral margin; cercus in posterior view (Fig. 31) semihemispherical, medial margin irregular, lateral margin more evenly curved; surstylus in posterior view long and narrow, nearly straight, almost as long as height of epandrium, gradually becoming wider ventrally, apical 1/2 bearing setulae laterally, apex narrowly concave, forming an extended, medial point, apex sickle shaped in lateral view (Fig. 32); aedeagus in ventral view (Figs. 33, 35; shaded) with basal 2/3 rectangular with truncate base and apical 1/3 tapered to narrow point, in lateral view (Figs. 34, 37) moderately wide basally, becoming wider at midlength, thereafter tapered to narrowly formed apex; phallapodeme in lateral view (Figs. 34, 37) relatively narrow with short extended keel asymmetrically and shallowly trapezoidal, rounded, inclined or skewed toward end that attaches with hypandrium; postgonite in lateral view (Figs. 34, 40) elongate, shallowly sinuous, with a subbasal papilla that bears a setula, becoming widest subapically, bearing setulae near midlength, in ventral view (Figs. 33, 39) tapered nearly parallel sided, with sinuous medial margin and more evenly curved lateral margin; pregonite in ventral view (Figs. 33, 39) about 1/3 length of postgonite, irregularly oval in both ventral (Figs. 33, 39) and lateral (Figs. 34, 40) views; hypandrium broadly U-shaped in ventral view (Figs. 33, 38) with wide basal portion and thinner, posteriorly directed arms, in lateral view (Figs. 34, 40) elongate but with a short process at midlength, apex narrow and narrowly truncate.

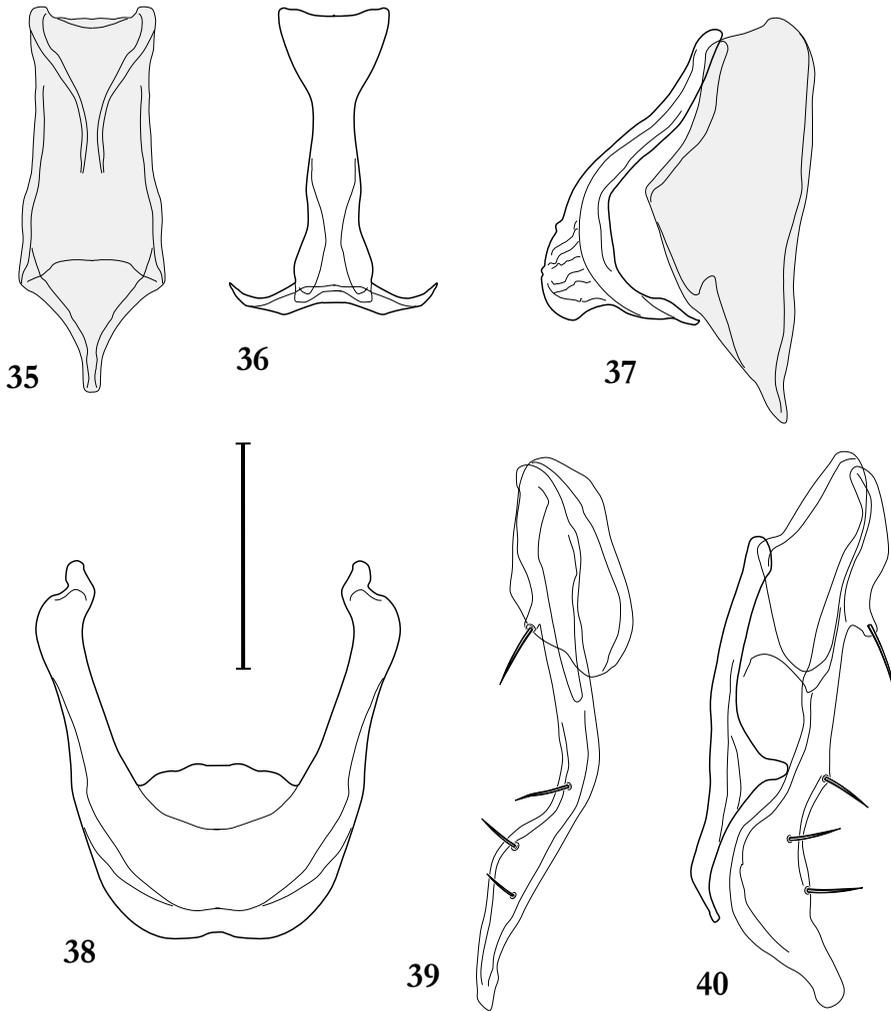
**Type Material.** The holotype male is labeled “AUSTRALIA. N[ew].S[outh].W[ales]. Cornulla (34°2.1'S, 151°9.1'E), 22 Feb 1998, W. N. Mathis/USNM ENT 00084102 [plastic bar code label]/HOLOTYPE *Trimerogastra mcalpinei* W.N. Mathis & T. Zatwarnicki USNM [red; USNM crossed out; species name, gender symbol, and “& T. Zatwarnicki” handwritten].” The holotype is double mounted (minuten in a block of plastic), is in good condition (some setae not aligned correctly), and is deposited in the AMS. A female paratype (USNM) has the same label data as the holotype. Other paratypes are as follows: AUSTRALIA. New South Wales. Careel Bay, Avalon (mangrove), 15 Dec–14 Mar 1953, 1964, D.K. McAlpine (1♂ (head missing), 1♀; AMS, USNM). Queensland: Yorkey's Knob (16°48.1'S, 145°43.1'E; mangrove), 26 Sep 2002, D. and W.N. Mathis (1♂; USNM).

**Other Specimens Examined.** PAPUA NEW GUINEA. Central: Lea Lea (saltpans), 23 Feb 1986, J.W. Ismay (1♀; USNM).

**Distribution.** Australia (New South Wales, Queensland), Papua New Guinea (Central).



**Figures. 31–34.** Structures of the male terminalia of *Trimerogastra mcalpinei* n. sp. (Australia. New South Wales: Cornulla). **31.** Epandrium, cerci, and surstylus, posterior view; **32.** Same, lateral view; **33.** Aedeagus (shaded), phallapodeme, gonites, and hypandrium, ventral view; **34.** Same, lateral view. Scale bar = 0.1 mm.



**Figures 35–40.** Structures of the male terminalia of *Trimerogastra mcalpinei* n. sp. (Australia. New South Wales: Cornulla). **35.** Aedeagus, ventral view; **36.** Phallopodeme, ventral view; **37.** Aedeagus and phallopodeme, lateral view; **38.** Hypandrium, ventral view; **39.** Postgonite and pregonite, ventral view; **40.** Hypandrium, postgonite, and pregonite, lateral view. Scale bar = 0.1 mm.

**Etymology.** The species epithet, *mcalpinei*, is a Latinized, genitive patronym to honor Dr. David K. McAlpine, one of the collectors of the type series.

***Trimerogastra* sp.**

**Diagnosis.** This species is distinguished from congeners by the following combination of characters: Small shore flies, body length 1.50–1.60 mm.

**Head:** Posterior fronto-orbital seta reclinate, comparatively short, subequal to anterior, proclinate seta; distance between anterior and posterior setae relatively short, less than that between posterior ocelli. Arista with 4 long hairs, length of longest (basal) hairs greater than height of 1st flagellomere. Gena short, height less than height of 1st flagellomere; gena-to-eye ratio 0.14–0.15.

**Thorax:** Prescutellar acrostichal seta absent; scutellum trapezoidal to almost triangular, lateral margins very shallowly arched, posterior margin very narrow, truncate, disc moderately setose, apical setae with length slightly less than scutellar length. Costal section II only slightly longer than section III; costal vein ratio 0.89–0.92; M vein ratio 0.38–0.40.

**Abdomen:** Tergite 2 with sparsely, grayish brown microtomentum; tergites 3–4 with dense, transverse patches of whitish microtomentum anterolaterally, lateral margins thinly microtomentose, subshiny to shiny. Males unknown.

**Specimens Examined.** AUSTRALIA. Queensland: Iron Range (mushroom bait; rain forest), 4 Nov 1975, I. A. Bock, P. A. Parsons (1 ♀; USNM). PAPUA NEW GUINEA. Central: Brown River Bridge (5 km NW; forest), 18 May 1986, J. W. Ismay (1 ♀; USNM).

**Distribution.** Australasian/Oceanian. Australia (Queensland), Papua New Guinea (Central).

**Remarks.** We are not naming this species here because it is presently represented only by the two females noted above and we would prefer to have a male to characterize the species properly.

**Acknowledgments**

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Field work in Australia was expedited by the able and pleasant assistance of Daniel J. Bickel, David K. McAlpine, Dianne Mathis, and Gregory W. Courtney.

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