A review of Ascodipterinae (Diptera: Strebllidae) of the Oriental and Australasian regions with a description of three new species of Ascodipteron Adensamer and a key to the subfamily

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Abstract

The Ascodipterinae of the Oriental and Australasian regions are reviewed. Three new species, each known only from dealate females, are described: 1) Ascodipteron egeri sp. nov. from Malaysia, ex. Megaderma spasma (Linnaeus) attached in urogenital area; 2) Ascodipteron longissacus sp. nov. from southern China, ex. Hipposideros armiger (Hodgson), attachment site unknown; and 3) Ascodipteron wenzeli sp. nov. from Vietnam and Malaysia, ex. Rhinolophus spp. attached in urogenital area. A neotype and lectotype are designated for Ascodipteron phyllophorinae Adensamer and Ascodipteron speiserianum Muir, respectively. A neotype is designated for Ascodipteron archboidii Ma and a lectotype for Ascodipteron emballonurae Banks; the former an objective synonym of A. phyllophorinae and the latter a junior synonym of A. phyllophorinae. A neotype is also designated for Ascodipteron australiansis Muir which is regarded as a junior synonym of A. speiserianum. Ascodipteron lophotes Monticelli, A. megastigmatus Tolbing, A. siamense Speiser and A. tabulatum Speiser are considered nomina dubia. The genus Paraascodipteron is tentatively referred to the subfamily

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Brachytarsininae. The distribution of *Maabella stomalata* Hastriter and Bush is extended from China and Vietnam to Borneo, Java, Malaysia, Myanmar, Papua New Guinea, Philippine Islands, and West Papua on numerous species of *Hippodoceros* and *Rhinolophus*. A key to the recognized species of Ascodipterinae is provided. There are fifteen valid species of *Ascodipteron*.

**Key words:** bat flies, *egeri*, *longiuscus*, *Maabella*, *wenzeli*

**Introduction**

These unique bat parasites belonging to the subfamily Ascodipterinae (Stryblidae) occur only in the tropical and subtropical areas of the Old World. Muir (1912) first described the life cycle of these pupiparous flies while describing *Ascodipteron speiserianum* from Amboina, Indonesia. Males have been described for only four species of Ascodipterinae as cited in Hastriter and Bush (2006: 28). Consequently, the taxonomy of the group is based almost entirely on dealate (wingless) endoparasitic females.

Currently there are two recognized genera in the subfamily Ascodipterinae: *Ascodipteron* Adesamer, 1896 and *Maabella* Hastriter and Bush, 2006. A third genus, *Paraascodipteron* Advani and Vazirani, 1981 (known from a single winged male from Rajasthan, Jadhur, India) was not available for examination. Based on Advani and Vazirani's description and meager illustrations, Hastriter et al. (2006) and Hastriter and Bush (2006) argued that the placement of *Paraascodipteron* in the subfamily Ascodipterinae was inappropriate. Although Hastriter et al. did not specify a subfamily, Brachytarsininae is the only other subfamily in the Old World. A definitive answer to the placement of *Paraascodipteron* will require study of the male type specimens (now unavailable) and females (currently unknown) from the type locality. Maa (1965a) revised the African species of *Ascodipteron* and Theodor (1968) subsequently enhanced some descriptions based on material from the Afrotropical Region and the Palaearctic Region (Mediterranean Subregion). Twelve species of *Ascodipteron* have previously been recognized from the Afrotropical Region and the Palaearctic Region (Mediterranean Subregion), four from the tropical areas of the Oriental Region, and two from the Australasian Region. About 67% of the described species occur in the Palaearctic (Mediterranean Subregion) and the Afrotropical regions. The descriptions of most were described from only a few specimens. The collection of additional material to substantiate, support and understand the taxa from the Afrotropical Region and the Mediterranean Subregion is an area for future research. The ascodipterine fauna of tropical and semitropical India also remains essentially unexplored. As a result of nomenclatural changes and the description of three new species, the number of *Ascodipteron* species recognized herein is 15.

During the course of examining material from China and Vietnam (Hastriter et al. 2006; Hastriter & Bush 2006), it became evident that species from the Oriental and Australasian regions are extremely poorly defined. Approximately 900 specimens preserved in ethanol were obtained from the Bernice P. Bishop Museum (BPBM). These materials had been amassed by the late Professor T.C. Maa. The material is representative of the entire tropical and subtropical areas of the Oriental and Australasian regions. Some of the BPBM material had been on loan from various other museums. Additional material was also obtained from The Bohart Museum, University of California, Davis. These specimens made it possible to clarify the systematics of the Ascodipterinae endemic to the Oriental and Australasian regions, provide a key to the species of the subfamily Ascodipterinae, and enhance our understanding of their biology and host/parasite relationships. Although this paper does not address taxa west of the Indian Subregion, a comparison of these taxa relative to Oriental and Australasian species was considered and is discussed herein.
Material and methods

Specimen preparation and preservation details were discussed in Hastriter and Bush (2006). Additional morphological peculiarities were mentioned in Hastriter et al. (2006). Some of the material obtained from the Bishop Museum and the Bohart Museum were preserved in alcohol for many decades (the oldest dating 1864). Because of the long exposure to various alcohols, traditional clearing with Potassium Hydroxide (KOH) and mounting (Hastriter & Bush 2006) did not produce suitable slide mounts. Specimens that KOH would not adequately clear were placed in micro-vials containing a 1:5 dilution of Protease K: Tissue Lysis Buffer, incubated at 55° F for 6 to 24 hours, rinsed in 10% ethanol for several minutes, and serially dehydrated and mounted on microscope slides per Hastriter and Bush (2006).

The genital aperture (g.a.; Figs. 3E, 5F–G, 10A–G) has important diagnostic features. There are 4–5 terminal annular rings arranged roughly into rows comprised of variable types of setae (abbreviated R1–5, with R1 the proximal and R5 the distal row; Fig. 10E). The proximal row may not be represented on the ventral area but may have supernumerary setae on the dorsal area. R2 through R4 (when present) each always forms a complete annular ring, whereas R5 is represented only by a semi-circular row on the ventral half (Fig. 3E). R1 and R2 always bear modified short spiniform setae (sometimes arising from a sclerotized base plate or from an elevated tubercle) (Fig. 10E). Setae in R3 and R4 are represented by either spiniform setae, or long slender setae, while those of R5 are always long and slender (Figs. 10E, G). Three additional groupings of long slender setae may be taxonomically useful: 1) ventral spiracular setae (VSS) situated in a ventral arching row or grouping between spiracles #7 (Figs. 3E, 10A and D and F), 2) medial spiracular setae (MSS) with paired symmetrical groups situated between spiracles #6 and #7 (Figs. 3E, 5E, 10A and F), and 3) dorsal spiracular setae (DSS) situated in a single dorsal arching row between spiracles #5 (Figs. 3E, 10A and D). Additionally useful landmarks include the paired cerci, anus, and vaginal orifice. A genital plate bearing 2–4 setae between the anus and the vaginal orifice is present in species of Madabella and on rare occasions, a homologous structure is represented sporadically in Ascodipteron as a single thin seta lacking any remnant of a basal sclerite.

Illustrations and measurements were completed in accordance with procedures outlined by Hastriter & Bush (2006). The genital aperture is generally round; however, this terminal structure may become distorted during mounting. The diameter of the genital aperture was therefore obtained by averaging two measurements across the widest and the narrowest diameters. A comparison of measurements may be viewed in Table 1.

**TABLE 1.** Average measurements of anatomical features of six species of Ascodipterinae occurring in the Oriental and Australasian regions.

<table>
<thead>
<tr>
<th>Structures</th>
<th><em>M. stomalata</em></th>
<th><em>A. egeri</em></th>
<th><em>A. longiascus</em></th>
<th><em>A. phyllorhinae</em></th>
<th><em>A. speriserianum</em></th>
<th><em>A. wenzeli</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Head/Thorax (Length)</td>
<td>1091 (5)*</td>
<td>1052 (2)</td>
<td>1457 (2)</td>
<td>1435 (26)</td>
<td>1227 (25)</td>
<td>1141 (4)</td>
</tr>
<tr>
<td>Labial Theca (Width, )</td>
<td>413 (6)</td>
<td>349 (2)</td>
<td>560 (3)</td>
<td>484 (28)</td>
<td>464 (25)</td>
<td>467 (9)</td>
</tr>
<tr>
<td>Labial Theca (Length)</td>
<td>483 (5)</td>
<td>443 (3)</td>
<td>566 (3)</td>
<td>449 (28)</td>
<td>422 (25)</td>
<td>517 (9)</td>
</tr>
<tr>
<td>Genital Aperture (Diam.)</td>
<td>632 (14)</td>
<td>1155 (2)</td>
<td>896 (4)</td>
<td>1163 (24)</td>
<td>917 (24)</td>
<td>919 (8)</td>
</tr>
<tr>
<td>Neosome (Length)</td>
<td>2500 (53)</td>
<td>3200 (3)</td>
<td>7800 (4)</td>
<td>4500 (56)</td>
<td>3740 (86)</td>
<td><strong>none</strong></td>
</tr>
</tbody>
</table>

* Measurement in microns (number of specimens included in measurements).

Bat synonyms follow those of Simmons (2005). Entries under the heading “Materials examined” include: locality, host [host verification, when known, is indicated by (V) (host voucher numbers)], date, collector, number of dealate females, specific site of attachment [when known], specimen identification number of slide mounted material, and repository). All validated host species names are noted with a (V) on applicable slide labels. Host identifications without institutional voucher numbers were obtained only from alcohol labels representing original field identifications and the accuracy of those should be interpreted with caution.
Acronyms used for institutional repositories: AMNH—American Museum of Natural History, New York; ANIC—Australian National Insect Collection, CSIRO, Canberra, Australia; BMNH—Natural History Museum (formerly British Museum of Natural History), London, United Kingdom; BPBM—Bernice P. Bishop Museum, Honolulu, Hawaii; BOHART—The Bohart Museum, University of California, Davis, California; BYU—Brigham Young University Insect Collection, Provo, Utah; CNHM—Chicago Natural History Museum, Chicago, Illinois (prior name for FMNH; acronym cited in text for label data or specimen identifications in literature); FMNH—Field Museum of Natural History, Chicago, Illinois; MWH—Michael W. Hastriter Collection, Provo, Utah; MHNG—Muséum d'Histoire Naturelle, Geneva, Switzerland; RMNH—Rijksmuseum van Natuurlijke Historie, Leiden, The Netherlands; ROM—Royal Ontario Museum, Toronto, Ontario, Canada; USNM—National Museum of Natural History, Smithsonian Institution, Washington, DC.


**List of Old World species of the subfamily Ascodipterinae**

Original descriptions of all species were based on dealate female flies. Unless otherwise noted, holotypes were located in their cited repositories.
Ascodipteron Adensamer, 1896


*africanum africanum* Jobling, 1939.—Kenya, Sao Tomé.


*africanum rhinolophi* Jobling, 1958.—South Africa, Yemen.


*brachytheicum* Theodor, 1968.—Cameroon, Congo, Sudan, Tanganyika, Uganda.

Ascodipteron brachytheicum Theodor, 1968: 366. Holotype (originally in Theodor Collection, Hebrew University, Jerusalem; Theodor collection later transferred to BMNH. Holotype not located in either institution). Type locality: Uganda, Ankole district, Kaina Tin mine. Host: *Hipposideros caffer centralis* Andersen = *Hipposideros ruder* (Noack), upper arm or at base of forearm.

*brevior* Maa, 1965.—Congo, Gabon, Namibia, South Africa (Transvaal), Sudan.


*egeri* Hastirter sp. nov.—Malaysia.

Ascodipteron egeri Hastirter sp. nov. Holotype, slide BM-1001A (BPBM). Type locality: Malaysia, Perlis, Kaki Bukit. Host: *Megaderma spasma* (Linnaeus), around anus.

*jonesi* Jobling, 1952.—Bochuanaland, Ghana, Sierra Leone.


*longiascus* Hastirter sp. nov.—China.

Ascodipteron longiascus Hastirter sp. nov. Holotype, slide BM-1034D (BPBM). Type locality: China, Yunnan Province, Shweli River. Host: *Hipposideros armiger* (Hodgson).

*lophotes* Monticelli, 1898.—Eritrea.

Ascodipteron lophotes Monticelli, 1898: 203. Holotype (thought to have been deposited in the Museo Zoologico, Università degli Studi de Napoli Federico, Naples, Italy, but not located in that collection and possibly lost). Type locality: Eritrea, Assab. Host: *Rhinolophus clivosus* Cretzschmar, base of ear. *Nomen dubium.*

*mesostigmatos* Jobling, 1956.—Ivory Coast.


*minor* Theodor, 1973.—Tanzania.


*namrui* Maa, 1965.—Afghanistan, Egypt.


*phyllorhinae* Adensamer, 1896.—Australia, Borneo, China, Indonesia, Malaysia, Myanmar, Papua New Guinea, Philippine Islands, Solomon Islands, Thailand, Vietnam, West Papua.


Syn. Ascidioperon emballonurae Banks, 1911: 149. Lectotype designated herein, slide USNM-13730A (USNM). Type locality: Borneo, Klumpang Bay. Host: *Emballonura alecto* (Eydoux & Gervais), taken from bodies of museum alcohol specimens. **New synonymy.**

**Rhinopomatidae**

**Rhinopomatidae** Jobling, 1992.—Egypt, Palestine.


**Semiramus** Maa, 1965.—Bechuanaland, Kenya.


**Siamense** Speiser, 1903.—Thailand.

Ascidioperon siamense Speiser, 1903: 125. Holotype (not located; type repository not designated). Type locality: Thailand, Biserat (Bukit Besar). Host: *Hipposideros bicolor* (Temminck). **Nomen dubium.**

**Speiserianum** Muir, 1912.—Australia, China, Indonesia, Japan, Myanmar, Papua New Guinea, Philippine Islands, Taiwan, Thailand, West Papua.

Ascidioperon speiserianum Muir, 1912: 352. Lectotype designated herein, slide A-103B/British Museum #1911-122 (BMNH). Type locality: Indonesia, Amboina. Host: host and site of attachment not listed [presumably *Miniopterus schreibersi*, under skin at base of ear].


**Tabulatum** Speiser, 1908.—Madagascar.


**Theodori** Maa, 1965.—Congo, South Africa (Cape Province, Transvaal).

Ascidioperon theodori Maa, 1965a: 325. Holotype (originally in Hebrew University, Jerusalem; Theodor collection transferred to BMNH, type not located and presumed lost). Type locality: South Africa, Transvaal, Rooiberg. Host: *Miniopterus schreibersi*.

**Varisetosum** Maa, 1965.—Gabon, Ghana, Liberia.


**Wenzel** Hasriteria sp. nov.—Malaysia, Vietnam.

Ascidioperon wenzeli Hasriteria sp. nov. Holotype, slide ROM-107622/F42598C (ROM). Type locality: Vietnam, Tuyen Quang Province, Na Hang Nature Reserve, 22°20'N, 105°25'E. Host: *Rhinolophus paradoxolophus* (Bourret) (F42598), urogenital area.

**Maabella** Hastrim & Bush, 2006


**Stomalata** Hastrim & Bush, 2006.—Borneo, China, Indonesia, Myanmar, Papua New Guinea, Philippine Islands, Vietnam, West Papua.

Key to recognized species of world Ascodipterinae based on dealate females

1 Labial theca expanded laterally at apex, cheliceral blades mostly hidden. Gena fused at venter as a continuous solid sclerotized band; adorned with long, slender setae. Trochanters with long apical setae. Genital aperture with genital plate bearing 1–3 setae .......................................................... Maubella stomalata

Labial theca narrow at apex, not laterally expanded; cheliceral blades nearly fully exposed (Fig. 2A). Gena separated at venter (Fig. 5C). Trochanters without long apical setae. Genital aperture without a genital plate (Genus Ascodipteron) ........................................................................................................................................ 2

2 Hind coxae longer than wide in ventral view. Cerci small, of irregular form, not projecting from the surface, with 2–3 longer and several short setae; spines of R1–R3 not thicker than setae on more posterior rows (on species of Rhinopomatidae, Middle Eastern species) .................................................................................................................. 3

Width and length of hind coxae subequal in ventral view. Cerci projecting from the surface or not. Proximal rows of spines markedly thicker than those in more posterior rows (Fig. 10E) (on species of Hippo-

sideridae, Megadermatidae, Rhinolophidae and Vespertilionidae) .............................................................................................................. 4

3 Larger species (4–5 mm). Theca in dorsal view markedly narrower anteriorly, truncate-triangular, with straight sides, 470–550µ long, 400–450µ wide postad. Gena broad, broadly rounded anteriorly, with 40–55 pigmented peg-like spiniform setae (R. microphylum).................................................................................................................. A. namrui

Smaller species (3.5–4 mm). Theca broader anteriorly, sides slightly curved, 400–480µ long, 300–320µ wide postad. Gena narrow, triangular, with only 15–28 non-pigmented peg-like spiniform setae (Rhinopoma hardwickii Gray) .............................................................................................................. A. rhinopomatos

4 Medial spiracular setae (MSS) (between pair of spiracles #6 and #7) forming a complete row (may erroneously appear complete in shriveled or old material) ................................................................. 5

MSS interrupted; single or grouped, but not arranged in a defined row ........................................................................................................... 6

5 Labial theca about as long as posterior width, ventral surface covered with peg-like spiniform setae extending near the posterior margin. No microtrichia on ventral surface of theca. Mesosternum and metasternum with pigmented pegs (H. caffer, H. commersoni) .................................................................................................................. A. semirasum

Labial theca shorter than posterior width. Peg-like setae on ventral surface only in lateral medial third, middle with setae and microtrichia anteriorly, bare on posterior area. Mesosternum and metasternum without pegs (H. commersoni) .................................................................................................................................................. A. variisettosum

6 Mesosternum and metasternum with numerous, short spiniform setae (Fig. 9A) .................................................................................. 7

Setae on mesosternum and metasternum absent, or with long slender, or papilla-like setae, but never spin-

iformal setae (Figs. 3C, 6F) ............................................................................................................................................................................. 8

7 Dorsal and ventral surface of theca densely covered with thick, sharp, pigmented setae throughout (Figs. 8B–C). Coxa 1 with stout pigmented spiniform setae. Dorsal apex of gena acute (Fig. 9B) [R. paradoxol-

opus; urogenital area, Malaysia and Vietnam] ............................................................................................................................... A. wenzeli sp. nov.

Setae on labial theca less numerous and not thick, sharp, or pigmented. Coxa 1 without spiniform setae but slender hairs only. Dorsal apex of gena truncate (Fig. 5E). Neosome exceedingly long (>7 mm) (Figs. 1B–C) (H. armiger; China) ............................................................................................................................. A. longiscrus sp. nov.

8 Coxa 1 with setae only, without peg-like spiniform setae (Fig. 5A) (Africa) ................................................................................................. 9

Peg-like pigmented spiniform setae present on coxa 1 (Fig. 7E) .................................................................................................................. 10

9 Theca slightly longer than wide postad. Vinculum longer than wide, with rounded sides. Four to five annular rows (R1–R5) on genital aperture (Fig. 10E) .......................................................................................................................... A. jonesi

Theca very short, wider postad than long. Vinculum as long as wide, with rounded lateral angles. Only 2–

3 annular rows (R3–R5) on genital aperture ................................................................................................................................. A. brachyhecum

10 Dorsal labial theca with small papilla-like non-pigmented setae (Fig. 7A), or setae long and thin (Fig. 2B); unlike those on gena (Fig. 7C) ........................................................................................................... 11

Labial theca with sharp, pigmented peg-like spiniform setae similar to those on gena (Figs. 6B–C) ...... 12
11 Setae on dorsal surface of labial theca not spiniform, but long thin hairs (Fig. 2B). Labial theca extremely short (Figs. 2B–C). Genital aperture: spiracles small (inside diameter <35µ) (Fig. 3E) (M. spasma, uro-genital area, Malaysia) A. egeri sp. nov.
Setae on dorsum of labial theca papilla-like appearing as round circles, few are longer than wide (Figs. 7A–B); distinctly smaller than the spiniform setae on gena (Figs. 7B–C). Genital aperture: spiracles large (inside diameter 40–55µ) (Miniopterus sp., base of ears, from Japan, to Myanmar to Queensland, Australia). ......................................................... A. speiserianum

12 Labial theca distinctly longer than width at widest point (M. schreibersi, Africa) A. africanum africanaum (Rhinolophus, Africa) ................................................................. A. africanum rhinolophi
Length and width of labial theca subequal ......................................................... 13

13 Spiniform setae on labial theca large and pigmented (Figs. 6A–B). MSS comprised of two or more setae (Fig. 3E). R1 may or may not be present ................................................................. 14
Spiniform setae smaller and not pigmented; MSS comprised of one seta, or none ........................................ 15

14 MSS comprised of three setae; two adjacent to spiral #6 and one ca. midway between spiracles #5 and #7 (Fig. 10A). R1 through R5 present. (Hipposideros, usually on wing, SE China to Solomons Islands) ....
.................................................................................................................. A. phyllorhinae
MSS comprised of two setae grouped adjacent to spiral #6. R1 absent. (Rhinolophus, Africa) A. brevior

15 MSS comprised of one seta. R1 and R2 absent (M. schreibersi, Africa) .................................................. A. theodorii
MSS lacking setae. R1–R3 present; with short, triangular spines (M. schreibersi, Africa) .............. A. minor

Descriptions of Oriental and Australasian Ascodipterinae

Ascodipteron egeri sp. nov.
(Figs. 2–3)


Diagnosis. The labial theca is distinctly wider basally than it is long, and is readily distinguished from that of other taxa by the presence of numerous long, thin setae on its dorsal surface (Figs. 2A–B). Few minute peg-like spiniform setae are found on the dorsal surface of the labial theca, whereas the ventral surface is adorned with many equally minute peg-like spiniform setae that are equal in size and nature to those found on gena (Fig. 2C).

Description. Head (Figs. 2A–C, 3A, D). Labial theca distinctly wider than long. Dorsal labial theca: ca. 80 long slender setae (length equal width of epipharynx), with 2–4 minute peg-like setae towards posterior; medial area over epipharynx devoid of setae. Ventral labial theca: anteromedial patch of long thin setae, posterolateral group of ca. 50 minute sharp, peg-like setae, posterior margin convex. Gena with ca. 20 non-pigmented peg-like spiniform setae, each slightly larger than those on ventral surface of labial theca; anterior margin broadly rounded, broad sclerotization along entire posterior margin. Frons thick and blunt at lateral margins. Antenna with two basal segments adorned with minute sharp tubercles, multi-branched arista arising subapically from distal segment (2st) and single long seta near apex of basal segment (1st). Lateral vertex with 30–34 long setae. Two anterior lobes of occipital sclerite rounded, central anterior margin broadly concave.

Thorax (Figs. 2A, 3A–D). Scutum with numerous long setae, especially numerous along posterolateral margins; devoid of setae along mid-line. Scutellum quadrate, bearing 2 long setae along posterior margin. Mesopleuron with 3 slender setae anterior to large round spiracle; setae posterior to spiracle of three varieties: 4–5 ventral short, peg-like spiniform setae (ventral), 8–10 longer, sharp spiniform setae (median), 19–20 long,
slender setae (along posterior margin and dorsal). Pteropleuron with 10–14 long setae in dorsal half of sclerite; ventral half devoid of setae. Hypopleuron and sternopleuron without setae (Fig. 3A). Coxa 1 with 5–6 peg-like spiniform setae on proximal half. Coxae 2 and 3 each with cluster of 6–8 contiguous minute setae (alveoli more pronounced than setae). Coxa 3 with 7–10 setae on mesal surface and 3–4 setae at lateral apex (ventral view). Trochanters 1 and 2 each with 3–4 minute spiniform setae on anterior apex; 2–3 slender setae on posteroapical margins. Prosternum devoid of setae, mesosternum with 2–3 slender setae, metasternum with horizontal line of 4 slender setae and posterolateral margins distinctly concave (Fig. 3C). Genital Aperture
(Fig. 3E). R1 and R2 with at most indistinct tubercles; R4 with minute thick setae arising from slightly sclerotized basal plate, R3 and R5 with long setae (R5 with 19–20 setae). VSS of 9 long setae (end setae nearly at right angle from gently curved row of 7). MSS with 1 seta near spiracle #7 and 1–2 near spiracle #6. DSS with a dorsally arched row of 6 long setae (Fig. 3E). Diameter of cercus ca. 45μ, with 3 setae.

**Dimensions.** Head and thorax: 1052μ (n = 2, range: 1134–1070μ); Labial theca, length: 349μ (n = 2, range: 340–458μ); width: 443μ (n = 3, range: 432–455μ), genital aperture, diameter: 1155μ (n = 2, range: 989–1321μ), neosome, length: 3200μ (Table 1).


**Etymology.** This species is named in honor of Judith L. Eger, Senior Curator of Mammals, Royal Ontario Museum, Toronto, Ontario, Canada for her contributions to bat research and for her untiring responses to numerous queries regarding my studies on these intriguing bat endoparasites.

**Remarks.** Ascodipteron egeri is the first record of an Ascodipterinae parasitizing the bat family Megadermatidae. The clustering of all three specimens around the anus on a single male host that roosts entirely away
from other bat species would suggest that this bat species might represent the primary host for this parasite. Its distribution likely follows that of its host. Bat researchers encountering *M. spasmoda* throughout its range from India, to eastern Indonesia and the Philippine Islands should examine this host species for this new and little understood taxon.

**Ascodipteron longiascns** sp. nov.
(Figs. 4–5)

*Type material.* Holotype, dealate female; China: Yunnan Province, Shweli River, *ex. Hipposideros armiger* (AMNH #44993–44994, #45007–45008), 10 IV 1917, R.C. Andrews and E. Heller (Asiatic Expedition) (slide BM-1034D) (BPBM). Paratypes: 3 dealate females, same data as holotype (slides BM-1034A, C) (BPBM) and (slide BM-1034B) (MWH).

*Diagnosis.* Distinguished from all other species of *Ascodipteron* by the combination of 1) a truncate dorsal margin on the gena, 2) the presence of only 3–4 VSS, and 3) the absence of spiniform setae on coxa 1.

Description. Head (Figs. 4A–C). Length and width of labial theca nearly equal; short-headed species. Posterior margin concave dorsad and convex ventrad. Anterior dorsal margin convex with two long setae to each side of midline; caniculi leading from each. About 30 short, non-pigmented peg-like setae on mediolateral dorsal surface of labial theca; ventral surface with same pattern and similar number of setae. Peg-like setae are identical to those on gena. Ventral surface with 14–16 thin setae confined to anterior apical area.
Arista branching near apex. Width and length of lateral vertex subequal, with 30–35 papilla-like setae. Gena very broad and truncate dorsally; 40+ non-pigmented, sharp setae on dorsal half. Thorax (Figs. 4A, 5A–E). Scutum with lateral pattern of papilla-like setae (similar to lateral vertices). Scutellum quadrato-quadrate with two groups of 4–5 setae on dorsal lateral aspects. Prespiracular setae on mesopleuron of 5 sharp setae and postspiracular setae of 22–26 stout, non-pigmented peg-like spiniforms ventrad and 8-10 slender, sharp, stout setae towards dorsal margin. Pteropleuron with 20–22 stout, sharp setae. Hypopleuron and sternopleuron without setae. Mesosternum and metasternum with short, stout, non-pigmented spiniform setae. Coxa 1 with 4–5 slender setae (spiniform setae absent). Trochanters 1 and 2 with spiniform setae; latter twice length of coxa 2. Setae on coxa 3 with 8–10 long slender setae on mesal surface and single long seta on lateral apex. Genital Aperture (Figs. 5F–G). Setae in R3–R5 long and slender, each on conical tubercle; R2 short, darkly pigmented, broad at base, sharp, and arising from lightly sclerotized plate; R1 of short fine setae subequal in length to that of R2. VSS of 3–4 long, slender setae; MSS with 2 slender setae; and DSS with 5 slender setae. Cercus 18µ in diameter, with 3 long setae, and several punctate alveoli.

Dimensions. Head and thorax: 1457µ (n = 2, range: 1451–1463µ); Labial theca, length: 560µ (n = 3, range: 538–573µ); width: 566µ (n = 3, range: 549–600µ); Genital aperture, diameter: 1195µ (n = 4, range: 771–1096µ), neosome length: 7800µ (n = 4, range: 7000–9300µ) (Table 1).

Etymology. The species name A. longiascus is derived from the exceedingly long (Gr. lang) character of the sac-like (Gr. askos) neosome that is 2-4 times the length of the sac-like structure formed by the neosomatic growth of other species.

Remarks. The four specimens were obtained from a single specimen of H. armiger. The neosomes are exceedingly long (Figs. 1B–C) and reddish brown. Unfortunately, the site of attachment was not recorded. The genital apertures were not tilted away from the long axis of the vermiform neosomatic abdomen. This might indicate that the specimens were located in the deeper tissues of the body of the animal, facilitating deeper encystment. The genital aperture of species occurring on the thin wing membranes, or along the wing phalanges tend to tilt away from the long axis to achieve a more perpendicular posture to the skin surface.

Ascodipteron phyllorhinae Adensamer, 1896
(Fig. 6)


Neotype designation for Ascodipteron phyllorhinae Adensamer. Described from a single dealate female collected in Java, Indonesia from “Phyllorhina”, a bat genus now recognized as Rhinolophus (see remarks). The holotype was either sacrificed during sectioning for Adensamer’s internal study of this species, or the sole specimen on which the species was based was dissected. His description provided detailed illustrations of the internal anatomy of the species but external characteristics were confined to a rather generic view of the neosome and the genital aperture. These features did not provide detailed diagnostic criteria; however, Adensamer’s illustrations demonstrated external anatomical features consistent with those of A. archboldi and A. emballonurae. The chief justifications for establishing a neotype for A. phyllorhinae based on a paratype of A. archboldi are the similarities of the neosome and genital aperture, specificity of the host, site of attachment, and sympatric distribution. The material examined may prove to represent more than one species; however, the differences are minimal and do not justify recognition of multiple species at this time. Of the hundreds of specimens studied across the entire Oriental and Australasian regions, it was concluded that there are only two previously described sympatric Ascodipteron species, A. phyllorhinae and A. speiserianum. Therefore, the
neotype designated below for A. archboldi was selected as the neotype for A. phyllorhinae, thereby establishing the two names as objective synonyms. NEOTYPE, male, Australia: Queensland, Chillagoe Caves, ex. H. diadema reginae = H. diadema, 19 VII 1959, R.F. Peterson, (slide AMNH 5006B, AMNH).

Lectotype designation for Ascodipteron emballonurae Banks. Described from an unspecified number of female syntypes removed from the “skin of the body” of an unspecified number of museum preserved Emballonura alecto in the USNM. Three mounted specimens and five alcohol preserved neosomes were located in the USNM. I mounted four neosomes (only the genital aperture available for one of these), an additional neosome was retained in alcohol, and a lectotype was selected from one of the four newly mounted neosomes. LECTOTYPE, male, Borneo: Klumpang Bay, ex. Emballonura alecto (mammal no. 152093-102) (V), “skin of body”, II 1908, W.L. Abbott, slide USNM-13730A, USNM. Paralexotypes: 3 male females bearing red USNM labels, same data as lectotype; 3 male females, same data as lectotype, USNM-13730B–D, and one neosome preserved in alcohol, same data as lectotype, USNM-13730E, USNM.

Neotype designation for Ascodipteron archboldi Maa. Described from nine female syntypes, all from Hippidosideros diadema. Maa’s (1971: 16) type series consisted of one specimen from Australia, Queensland, Gordon Mine [Cape York, Zion Range, 250 km west of Cairns] and eight specimens from Australia, Queensland, Chillagoe Caves [Cape York, Zion Range, 250 km west of Cairns]. Data contained in the vial of the latter (containing six neosomes in alcohol) indicated that two of the original eight specimens had been mounted as slides #1179 and #1201. [Note: neosomes in alcohol can only be tentatively identified to species] The holotype female presumed to be one of the mounted slide preparations (not stated by Maa) was reportedly deposited in the ANIC. Neither slide #1179 or #1201 could be located. NEOTYPE, male, (originally a paratype of A. archboldi and designated herein as neotype of A. phyllorhinae), Australia: Queensland, Chillagoe Caves, ex. H. diadema reginae = H. diadema, 19 VII 1959, R.F. Peterson, (slide AMNH 5006B, an objective synonym of A. phyllorhinae, AMNH).


**Diagnosis.** Separable from *A. wenzeli* by the presence of long setae on the mesosternum and metasternum, from *A. speiserianum* by the presence of sharp and robust peg-like spiniform setae on the labial theca that equal those on gena, from *A. egeri* by numerous hairs on the dorsum of the labial theca, from *A. longiascus* by the pointed apex of the gena, and from all extralimital species by characters noted in key.


**Description.** **Head** (Figs. 6A–D). Dorsal labial theca with 18–20 lightly pigmented peg-like spiniform setae on lateral 1/3; equal in appearance to those on gena. Anterior, medial, and posterior areas without spiniforms or other setae. Posterior margin of dorsal labial theca gently concave, ventral margin convex. Ventral surface with two patches of 46–50 similar spiniform setae separated by 18–20 scattered fine setae between the
patches. Lateral vertex with convex anterior medial margin; adorned with 30–34 long setae (excluding anterior marginal setae, most appear papilla-like, or broken off); length about twice width. Gena with 40–44 lightly pigmented spiniform setae on dorsal half; anterior margin convex. Occipital sclerite variable; with two anterior lobes (triangular to lobate) separated by a broad to angular cleavage medially. **Thorax** (Figs. 6E–F). Scutum with many long slender setae along lateral 1/3 of the margin; setae absent in medial 2/3. Scutellum with pair of setae on dorsolateral margins. Chaetotaxy of mesopleuron highly variable; prespiracular setae of 8–9 fine setae and postspiracular setae with ca. 20 setae comprised of 3 ventral small pigmented spiniform setae (smaller than those on gena or labial theca) and 17 long slender setae dorsal [number of spiniform versus slender setae variable from specimen to specimen]. Pteropleuron with 30 sharp setae; longer setae more dorsal. Hypopleuron and sternopleuron without setae. Mesosternum and metasternum each with numerous long slender setae. Coxae 1 with 8–10 small darkly pigmented spiniform setae on anterior margin; Coxae 2 with long setae on posterior margin (in lateral aspect). Trochanters 1 and 2 club-shaped with 6–8 and 4 dark spiniform setae, respectively. Coxae 3 with many setae on mesal surface; 8–10 on lateral margin. **Genital Aperture** (Figs. 10A–C). R1–R2 spiniform setae shorter than lightly pigmented basal plate. R3–R5 of fine setae. VSS of 10 similar setae; 8 arranged in a row with the end setae set at a right angle to those in the row. MSS with 2 setae near spiracle #6 and one seta more ventrolateral. DSS with 4 setae. All setae except those on R1–R2 arise from sclerotized basal papillae, are fine and ca. 3x as long as width of sclerotized papilla. Cercus 60µ in diameter, with 5–6 long setae.

**Dimensions.** Head and thorax: 1435µ (n = 26, range: 1149–1732µ); Labial theca, length: 484µ (n = 28, range: 385–566µ), width: 449µ (n = 28, range: 382–560µ); Genital aperture, diameter: 1163µ (n = 24, range: 831–1549µ); nesosome, length: 4500µ (n = 56, range: 2000–6000µ) (Table 1).

**Remarks.** The preferred hosts of *A. phyllorhinae* are species of *Hipposideros*, particularly *H. diadema*. Therefore, the Javanese specimen described by Adensamer may have been collected from a *Hipposideros* species that was misidentified as “Phyllorhina”.

*Ascodipteron archboldi* and *A. phyllorhinae* are now objective synonyms sharing the same neotype, providing a concrete means of re-evaluating *A. emballonurae* collected only from Borneo. A comparison of the neotype with the lectotype and paralectotypes of *A. emballonurae* clearly justifies placing the latter as a junior synonym of *A. phyllorhinae*. It should be noted that specimens referred to as *A. emballonurae* by Hastriter et al. (2006: 64–65) represent *A. phyllorhinae*.

It is puzzling how Maa (1965a) assigned two African species and a third species from the Oriental Region, *A. phyllorhinae*, to the “phyllorhinae group”, in the absence of an adequate description of external morphology, and without the type of *A. phyllorhinae* being available for examination. Equally questionable might be the listing by Theodor (1973) of three specimens of *A. phyllorhinae* collected by A.J. Beck from *H. diadema* from Batu Caves, Selangor, Malaysia. Although he did not discuss on what he based his identification, Theodor evidently based his taxonomic conclusion on geography, host specificity, and site of attachment. These and other material collected by A.J. Beck from Batu Caves and additional material collected by David Stiller from the same caves from *H. diadema* were examined. Although Stiller (1976) thought his specimens represented a new species (never described), a comparison of the collections of Beck and Stiller with the neotype of *A. archboldi* and lectotype of *A. emballonurae* proved they were conspecific and indeed synonymous with *A. phyllorhinae*.

With exception of *E. alecto* (Borneo) and *R. pearsonii* (China), *A. phyllorhinae* is restricted to four confirmed species of *Hipposideros* (*H. cervinus*, *H. diadema*, *H. larvatus*, and *H. pomona*) and three other species (*H. armiger*, *H. bicolor* and *H. calcaratus*) whose field identifications were not verifiable. Preferential attachment sites are on the wing (upper and lower arms and phalanges) with infrequent occurrence on the urogenital area and at base of the ears.
Ascodipteron siamense Speiser, 1903


Remarks. Speiser described A. siamense from three syntypes, none of which could be located and are presumed lost. The brevity of Speiser’s description, lack of illustrations, and missing type material, renders an identification of A. siamense impossible. The name is therefore considered a nomen dubium.

Ascodipteron speiserianum Muir, 1912
(Fig. 7)


Ascodipteron australiensis. Stiles and Nolan, 1931: 659 (incorrect subsequent spelling).

Ascodipteron sp. Hughes, 1960: 183 (not examined, referred to this species based on host, locality, and site of attachment).

Lectotype designation for Ascodipteron speiserianum Muir. Muir clearly examined many specimens of A. speiserianum during his studies in Ambonina, Indonesia; however, he did not designate a holotype, nor did he specify a repository in his original description. He was a noted entomologist at the British Museum (Natural History) and two specimens were obtained from that museum in alcohol from Ambonina. The vial contained the label “Syntype of Ascodipteron ? speiserianum Muir”. One specimen represented a whole neosome, whereas the genital aperture of the second specimen had been cut off and was missing. Both neosomes were mounted by me. The following lectotype and paratype are based on these specimens. LECTOTYPE, dealate female, Indonesia: Ambonina, host and site of attachment not listed [presumably M. schrebersi (under skin at base of ear)], VI 1909, F. Muir (slide A-103/British Museum #1911-122) (BMNH). Paratype, dealate female; same data as lectotype (slide A-103A/British Museum #1911-122) (BMNH).

Neotype designation for Ascodipteron australiensis Muir. Described from a single dealate female collected at the base of the ear of M. schrebersi from the Mossman district of North Queensland, Australia. Repository was not designated and holotype could not be located. Maa (1971: 18) examined 10 dealate females attached to the base of the ears of M. schrebersi blepotis (Tenninick) = M. schrebersi and Miniopterus australis from New South Wales and Queensland. The Rockhampton, Queensland specimen was selected as the neotype of A. australiensis because of its condition and the clarity of its characters. NEOTYPE, dealate female, Australia: Queensland, Rockhampton, ex. Miniopterus australis, IV 1969, O. Kemp, (base of ear, BM-1055, BPBM). The neotype of A. australiensis is considered conspecific with the lectotype of A. speiserianum, and hence A. australiensis is treated as a junior synonym of A. speiserianum.

Material examined. Australia: New South Wales, Cangai, ex. M. australis, V 1962, P.D. Dwyer, (one neosome in alcohol was labeled “A. australiensis” by Maa, 1, A-100, ANIC); Queensland, Cave of Mungana, ex. Miniopterus australis australis = M. australis (V) (AMNH #183480), 19 VII 1959, R.F. Peterson, (1, base of ear, AMNH-5012, AMNH); Queensland, Phoenician mine, Mt. Amos, ex. Miniopterus schrebersi oceanensis = M. schrebersi (V) (AMNH #1506912), 27 VII 1950, J. Roberts, (3, base of ear, AMNH-5013A-B, AMNH-5014, data in vial AMNH-5013A-B indicated slide #1177 as 1 of 3 specimens. Slide #1177 not examined, AMNH); latter seven specimens (6 identified in alcohol) were identified by Maa 1971: 18 as “A. australiensis”. China: Nooda, Hainan Island, ex. Miniopterus schrebersi fuliginosus (Hodgson) = M. schrebersi (V) (AMNH #85246/85247), 21 XII 1922, C.H. Hope (3rd Asiatic Expedition) (3, base of ear, AMNH-5011A–

REVIEW OF ASCODIPTERINAE

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Diagnosis. Blunt papilla-like, non-pigmented setae on the labial theca, which differ from those on gena, separates A. speiserianus from other species.

Description. Head (Figs. 7A–D). Labial theca ca. equal in length and width; usual peg-like spiniform setae reduced to ca. 40 non-pigmented minute tubercles on dorsal surface and ca. 50+ similar tubercles on ventral surface. Dorsal surface without thin setae; anterodorsal surface with medial patch of ca. 15 minute setae. Caudal margin of dorsal labial theca concave; ventral margin convex. Posterior margin of frons trilobed. Arista with multiple fine branches; basal antennal segment with single long seta. Length of lateral vertex 2x width; antero-medial surface strongly concave; surface adorned with ca. 30 minute tubercles, most with canals extending from bases. Gena with 25–30 lightly pigmented peg-like spiniform setae; grossly differing from tubercles on labial theca. Thorax (Figs. 7E–F). Scutum covered laterally with setiferous tubercles; medial area without tubercles. Scutellum with single seta at each side. Prespiracular setae of mesepisternum with 3–8 pigmented peg-like setae; postspiracular setae of 4–6 slender dorsal setae and 10–12 pigmented peg-like ventral setae. Pteropleuron with 18–20 minute sharp, nonpigmented papilla-like setae (as on labial theca). Hypopleuron and sternopleuron without setae. Coxa 1 with 8 lateral minute spiniforms; trochanters 1 and 2 club-shaped, each with combination of minute and robust spiniform setae. Coxa 3 with fine setae along lateral and mesal margins. Mesosomentum and metasternum with 7–8 and 3–4 long slender setae, respectively. Genital Aperture (Figs. 10D–E). R1 and R3 comprised of darkly pigmented peg-like spiniforms. Setae on dorsum of R2 similar to those of R1 and R3; ventral setae of R2 long and slender (5x length of width of aveoli), R4 and R5 same as ventral setae of R2. VSS of 16 setae; MSS of 2 pairs, each between cercus and spiracle #5; DSS of 11–12 setae. Spiracular setae all long and slender as those in R1 and R3. Cercus 20µ in diameter, 2–3 fine long setae.

Dimensions. Head and thorax: 1227µ (n = 25, range: 998–1398µ); Labial theca, length: 464µ (n = 25, range: 411–541µ), width: 422µ (n = 25, range: 341–477µ); Genital aperture, diameter: 917µ (n = 24, range: 659–1193µ); Neosome, length: 3740µ (n = 86, range: 2500–5000µ) (Table I).
Remarks. Muir (1912) did not designate a repository for either *A. australiansi* or *A. speiserianum* and his illustrations did not focus on reliable characters to differentiate them. The material examined herein from Australia, represents the same material cited and discussed by Maa (1971: 18). Maa (1971) attempted to distinguish between *A. australiansi* and *A. speiserianum* by noting differences in the setae between the interspaces of spiracle 7 (herein referred to as VSS). It should be noted that Maa’s interpretation of VSS in reality represented R5 (Maa 1971: 17, fig. 36 vs. 39). The VSS are occasionally hidden within a crypt between R5 and the ventral margin of the genital opening. Although the setae of each appear shorter in *A. australiansi* (Australia) than in *A. speiserianum* (Indonesia), this character is highly variable from specimen to specimen.
even from the same host specimen. For example, AMNH-5013A and 5013B represent conspecific material with that examined by Maa (1971) as slide #1177 (Maa’s fig. 36) and BM-1090A–C are conspecific with Maa’s slide #1178 (Maa’s fig. 39). Slides #1177 and #1178 are from Australia and Indonesia, respectively (neither slide could be located for examination). Maa compared only one mounted specimen each from two widely separated geographical areas. After comparison of the above material, I concluded that the length of the metaterna of each species was not discernibly different and the “narrowness” of the lateral vertices was a highly variable character. The lateral vertices are subject to immense distortions from the pressures exerted by host tissues during the endoparasitic life of the neosome and from distortions induced in slide mounted preparations. I did not find the Australian specimens (considered by Maa 1971 as A. australiensis) to differ significantly from the syntypes of A. speiserianum (lectotype and paralectotype) from Ambonina, Indonesia. The neotype of A. australiensis was collected within about 200 km of those from the Phoenician mine from the same bat species (M. schreibersi) and from the same site of attachment (base of ear). The Rockhampton specimens were collected from the base of the ears also, but from A. australis.

Ascodipteron wenzeli sp. nov. (Figs. 8–9)


preservation (some specimens were received from ROM in fragments and others could be identified only tentatively in alcohol).

**Diagnosis.** Distinguished from all other species by the diameter of the terminal spiracles that are less than 25 microns, the presence of only 2 annular rings of setae on genital aperture, and the dorsal and ventral surfaces of the labial theca densely covered with robust pigmented peg-like spiniform setae.


**Description.** **Head** (Figs. 8A–C). Labial theca short, broad, angulate at posterior lateral margins; dorsal and ventral surfaces densely covered with sharply pointed spiniform setae to include medial areas. Spiniforms on anterior dorsal theca smaller, with canaliculi running postad; sparse slender seta restricted along anterior margin. Ventral theca with slender setae at anterior margin, some distributed postad medially; thin plate
extending beyond ventral apex. Four ventral, 6 dorsal, and 4 lateral (2 each side) cheliceral blades. Vinculum broad basally. Anterior margin of frons bifurcate; posterior dorsal margin with medial projection. Arista of antenna finely plumose; first segment with single strong seta. Lateral vertex with clear membranous area at anterior lateral margin; surface with 26–27 alveoli (setae not noted), some with canalculi. Lateral margins sclerotized. Genae with 24–45 sharp, peg-like spiniform setae, ventral 1/4 without setae; posterior margin sclerotized. Occipital sclerite with two broadly rounded anterior lobes. Thorax (Figs. 8A, 9A–D). Scutum lacking setae medially, with 32–35 minute setae laterally. Quadrade depression at posterior medial area of scutum. Scutellum broadly quadrate; two to three setae on each side. Prespiracular group of setae on mesopleuron with 4–5 setae (3–4 spiniform, 1–2 slender); postspiracular group of 3–6 ventral spiniforms and dorsal group of 15–17 slender setae. Dorsal margin of pteropleuron angular; group of 2–3 spiniform setae and dorsal group of 12–14 setae. Hypopleuron and sternopleuron without setae. Prosternum absent medially; present laterally; without setae. Mesosternum divided by suture. Metasternum with partial suture anteriorly. Both with short, sharp, peg-like spiniform setae. Coxal 1 three times as long as wide, with 13–14 sharp spiniform setae, two thin setae at base. Coxal 2 with two to three thin setae. Coxal 3 broader than long, with thin setae on medial and lateral margins. Trochanters 1 and 2 with 7–8 and 4 spiniform setae, respectively, 3 with 3–4 slender setae. Genital Aperture (Figs. 10F–G). Spiracles small (15 μ, inside diameter). Setae on genital aperture overall extremely minute. Annular rows reduced to three rows (R3, R4, and R5), each difficult to distinguish (presumably R1 and R2 missing). R3 comprised of a few papillae with minute setae, R4 and R5 with short setae (length 2x or less width of alveoli); R5 all ventral to spiracle #5. DSS of 6 minute setae; MSS of 1 minute seta each side, and VSS with 6 minute setae. Cercus 37 μ in diameter; 6–8 short setae (less than diameter of cercus).

Dimensions. Head and thorax: 1141 μ (n = 4, range: 1116–1167 μ); Labial theca, length: 467 μ (n = 9, range: 439–493 μ), width: 517 μ (n = 9, range: 491–555 μ); Genital aperture, diameter: 919 μ (n = 8, range: 759–1026 μ) (Table 1).

Etymology. This species is named in honor of the late Rupert L. Wenzel, Field Museum of Natural History, Chicago, for his significant contributions as a noted North American dipterist and specialist of the families Nyerteribiidae and Strebilidae.

Remarks. Twenty-four specimens of _A. wenzeli_ were collected from eight _R. paradoxorolophus_ examined from Vietnam. With the exception of three dealate females collected from the urogenital area of a single _R. affinis_ from Malaysia, the species appears quite specific to Bouret’s Horseshoe bat, _R. paradoxorolophus_, also from the urogenital area where there is little fur. This is the first record of an _Ascodipteron_ species collected from _R. paradoxorolophus_. In one instance, it was also collected on the same host animal with a single specimen of _M. stomalata_. Its occurrence on _R. affinis_ in Malaysia was unexpected, since many _R. affinis_ from Vietnam were examined that were negative for _A. wenzeli_ and _R. paradoxorolophus_ has been documented neither in northern Kedah State, Malaysia, nor in southern Thailand. Although recorded herein only from Vietnam and Malaysia, it most likely occurs in unison with _R. paradoxorolophus_, which also occurs in Thailand, Laos, and southwest China (Eger and Fenton 2003). Scanning electron micrographs of this species presented as “Ascodipteron species A” in Hastriter et al. (2006) can be compared with digital images (Figs. 8–9).

**Ascodipteron sp.**

**Material examined.** Thailand: Chaiyaphum Province, Khon San Thung Kam Mang, 850 m, ex. _R. paradoxorolophus_ (KT-2784), 18 I 1972, Kam Mang, (2, BM-1009A–B, BPBM).

Remarks. Two specimens appear to represent an undescribed species closely related to _A. wenzeli_. The primary differences are in the shape of the labial theca and the smaller and more sparsely distributed spiniform setae. These characters may represent an anomalous condition. Additional topotypic material from _R. paradoxorolophus_ should be collected and studied to determine the taxonomic status of these specimens.

*Maabella stomalata* Hastriter and Bush, 2006
(See Figs. 1–3 in Hastriter and Bush, 2006)

**Material examined.** Specimens listed in Hastriter and Bush 2006 are not presented here. The following new records greatly expand the heretofore known range of this species. **Borneo:** Ex. *Rhinolophus borneensis*

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**Diagnosis and description.** see Hasstri and Bush (2006).

**Dimensions.** These are provided in Hasstri and Bush (2006) except for those of the neosome and genital aperture, which are provided herein: Length of neosome: 2500 µ (n = 53, range: 2000–4000 µ). Genital aperture, diameter: 632 µ (n = 14, range: 464–803 µ) (Table 1).

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**Remarks.** The description of *M. stomalata* was based on material limited to China and Vietnam. In this study, additional material was examined from Malaysia, Borneo, Myanmar, Java, Moluccas Islands, Philippines, West Papua, Papua New Guinea and several of the archipelagos east of Papua New Guinea. Several taxa may be represented across this broad range; however, I have chosen to refrain from describing additional species because of the extreme morphological variation and difficulty in distinguishing between various populations. Separate diagnoses could not be formulated for any of the populations studied. The genus is restricted almost exclusively to bat host species of *Rhinolophus* and *Hipposideros* and all specimens (when noted by collectors and/or removed *in situ* from alcohol preserved material) were removed from the wings with the exception of two specimens that were removed from the urogenital area (penis) of *R. affinis*. A preference for species of either *Rhinolophus* or *Hipposideros* could not be demonstrated, as species of each genus are commonly infested. It is unique (and possibly an incorrect record or a transcription error) that an ascodipterine was found on *R. amplexicaudatus*, a member of the family Pteropodidae (Old World fruit bats).

The origin of the subfamily Ascodipterinae appears to be the Afrotropical Region with subsequent easterly radiation to Asia and Australia. This is supported by the greater species diversity of *Ascodipteron* seen in the Afrotropical Region. *Maabella* evolved much later from *Ascodipteron* stock and is of recent origin. This evolutionary trend can be seen in the variable external morphology of this monotypic genus across its range.

The head (labial theca, gena, and lateral vertices) is similar across the range of this species; however, the size, abundance, and distribution of the setae differ. In general, the abundance of spiniform setae on the labial theca were greater among specimens from mainland Asia (SE China, Myanmar, Vietnam, Thailand, and Malaysia) than those from Borneo, Java, the Moluccas, Philippine Islands, West Papua, Papua New Guinea (PNG), and archipelagos east of PNG; however, the labial thecae of some material from Malaysia and Myanmar (some from the same host specimens) had fewer and smaller spiniform setae. The number and length of setae were variable on the gena, the mesopleuron and the pteropleuron. Material from Java, the Islands in the Moluccas, and Borneo tend to have shorter and less numerous setae on these structures than specimens from all other areas. The chaetotaxy of the genital aperture was within the acceptable range of variation for the species (MSS: 1–5; VSS: 4–9; and genital plate: 1–3, usually 3). Setae in the R5 were identical for specimens throughout the region, with the exception of specimens from Java, which were vestigial or stumpy-like. The apical setae on trochanter were truly parallel only in Chinese populations, whereas the setae were more divergent and generally fewer in number in other populations, especially those from the oceanic islands. These differences could not be attributed to different host species; however, the variability of so many characters in this monotypic genus would imply that speciation is actively occurring among different populations parasitizing several rhinolophid host genera and species.

**Notes on extralimital species**

*Ascodipteron lophotes* Monticelli, 1898


**Remarks.** *Ascodipteron lophotes* was described from eastern Madagascar from two deulate females taken from *R. clivosus*. Monticelli (1896: 2) stated that he completely damaged one specimen and dissected the other for the description of the internal anatomy. Neither of the specimens could be located in the Museo Zoológico, Università degli Studi di Napoli Federico, Naples, Italy and possible associated bat specimens of *R. clivosus* were destroyed by bombings during World War II. Monticelli’s description was general and illustrations of internal anatomical structures and external characters were not diagnostic. Most of the references
were literature citations only (Bezzi 1916, Stiles & Nolan 1931; Jobling 1939; Maa 1965b; and Hutson & Oldroyd 1980), while only two references (Maa 1965a and Theodor 1968) actually examined specimens. None of those examined were based on the type or topotypic material. The identity of *A. iophotes* is in my opinion a nomen dubium.

**Ascodipteron megastigmatico** Jobling, 1956


**Remarks.** The holotype of *A. megastigmaticos* could not be located in the Museum d'Histoire Naturelle, Geneva, Switzerland. Jobling described *A. megastigmaticos* from a single specimen from *Hipposideros caffer guineensis* = *H. ruber*, Ivory Coast. Both Maa (1965a) and Theodor (1968) expressed doubts on the validity of this species suggesting that it was a possible synonym of *A. jonesi* whose primary type specimen was collected from Sierra Leone on *H. abae*. In addition, a large series of *A. jonesi* was collected from *H. caffer* from Ghana. The characters used by Jobling (1956) to distinguish *A. jonesi* and *A. megastigmaticos* included the relative position of the post-gena and mesopleuron and the differing position of the humeral callos of each. These characters are variable from specimen to specimen within the same species and the former character is particularly subject to distortion in mounted material. Maa (1965a) never examined the holotype of either species, nor was the holotype of *A. mesostigmaticos* ever examined by Theodor (1968). Since the holotype of *A. mesostigmaticos* is missing and additional topotypic material is unavailable, this species is considered a nomen dubium.

**Ascodipteron tabulatum** Speiser, 1908


**Remarks.** *Ascodipteron tabulatum* was described from Madagascar and this species is clearly an unidentifiable taxon. Speiser’s description provides only generic characters, no illustrations, and a type specimen and a repository were not designated. All citations following the original description are restricted to literature citations. The type could not be located and *A. tabulatum* is considered a nomen dubium.

**Biology and Host-Parasite relationships**

Other than the basic life cycle, little is known about the biology or behavior (fecundity, physiology, mating, resting habits, flight ability of males and females, longevity, host acquisition, etc.) of ascodipterine bat flies. Each species is rather specific in the selection of a site of attachment and the respective type of tissue in which they embed therefore influences the shape of the neosome. Neosomes are easily distorted by the pressure of host tissues in which they are embedded. For example, *M. stomalata* embeds in the leading wing margins and over bones of the phalanges, often closely associated with underlying bony tissues. These neosomes are extremely small and the host tissues surrounding the parasite are hard, often appearing as calcified extensions of the bone. In addition, Fig. 4A illustrates the excessive neosomatic growth in the form of a “saddle” of tough fibrous tissue that affords protection to the underlying thorax and head. This saddle is present in some, but not all specimens of the same species (even from the same host and site of attachment). A second example of
adaptation is that of A. longiascus (Figs. 1B–C) where the abdomen is excessive in length compared to all other species of Ascodipterinae. Unfortunately, the tissue type from which the four specimens were removed was not identified. One might speculate that these long species occur in deep tissues opposed to thin tissues such as those found on the wings, since the genital aperture is not tilted in a right angle to the long axis of the neosome as is frequently the case with species that parasitize the thin membranous wings. Species that typically embed at the base of the ear and on the urogenital area are less restricted by the pressures of the host’s tissue, are robustly pear-shaped (Fig. 1D), and protrude vertically into the air instead of being horizontally flattened under the skin. They are also larger species. The host reaction to the embedded parasite is usually manifest by development of a fibrous cyst that presumably wails off the parasite. An example of a neosome that was removed from such a cyst is illustrated in Fig. 1E. Although there have been no studies on the host’s immune response to these endoparasites, formation of a fibrous cyst wall surrounding the neosome would suggest a host mechanism to minimize the inflammatory response to surrounding tissues.

The bizarre morphological specialization of the head and mouthparts, the presence of neosomatic abdominal tissue growth, and shedding of wings and appendages are unique among the streblid bat flies and occur only in the subfamily Ascodipterinae. The adaptive advantage of each is clear, but the evolution of these features has neither been proposed, nor studied. The act of attachment, shedding of wings and appendages, and embedment is apparently very rapid for the parasite to avoid being eaten by the host, since most species embed at sites fully accessible during the preening behavior of the host. An exception would be those species parasitizing the ear and head region.

Sufficient collecting across the range of the Ascodipterinae clearly defines the evolutionary origin of the subfamily as discussed by Hastriter and Bush (2006). Members of the subfamily parasitize a narrow range of insectivorous colonial Old World chiropteran taxa. Availability of suitable bat hosts is limited to colonial roosting bat genera. Colonial aggregations of bats provide ample opportunities for access for newly emerged females to seek new hosts at repeatedly-used roosting sites. Fruit eating bats, although highly gregarious, roost high in trees and are not confined to closed spaces, e.g. caves, hollow trees, etc., necessary for easy access to the feeble flying ascodipterines. Bat genera other than those belonging to the Hipposideridae Lydekker (Hipposideros Gray), Rhinolophidae Gray (Rhinolophus Lacépède), Rhinopomatidae Bonaparte (Rhinopoma E. Geoffroy), and Vespertilionidae Gray (Miniopterus Bonaparte) are rarely parasitized and such associations are probably accidental, e.g., R. amplexicaudatus (Pteropodidae). The discovery of the new streblid Ascodipteron egeri (described herein) occurring on a carnivorous megadermatid bat, M. spasma, was puzzling and additional collections of this ascodipterine are needed.

Based on the broad geographical range and diversity of bat hosts that have been sampled historically, combined with a dearth of species diversity in the well sampled Oriental and Australasian regions (reported herein), the discovery of additional new taxa may predictably be minimal in these areas and in the Palaearctic (Mediterranean Subregion) and Afrotropical regions.

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