

Review of *Araeolepia* Walsingham, 1881 (Lepidoptera: Carposinoidea: Copromorphidae) With Descriptions of Three New Species and Comments of Its Phylogenetic Position

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Abstract

The previously monotypic genus *Araeolepia* is reviewed. As defined herein the genus includes four species: three from USA, *A. subfasciella* Walsingham, *A. leuschneri* n. sp., and *A. ustulana* n. sp.; and one from USA and Mexico, *A. triangula* n. sp. The systematic position of *Araeolepia* is revised based on comparisons of morphological characters with other lepidopterans. The thoracic and abdominal articulation and the presence of the cubital pecten on the hindwings indicate that *Araeolepia* are associated with the apoditrysiian superfamily Carposinoidea rather than Plutellidae in Yponomeutoidea as previously proposed. Similarities of the male and female genitalia among *Araeolepia*, *Ellabella*, and *Lotisma* suggest that they may belong to the same family, Copromorphidae. Photographs of adult habitus and genitalia, when available, are provided for all described species of *Araeolepia*.

Key words: Apoditrysia, *Araeolepia*, Copromorphidae, Nearctic Region, new species

The monotypic *Araeolepia* was described by Walsingham (1881) with *A. subfasciella* Walsingham designated as the type species. This genus was originally assigned to the old sense of Tineidae, which included several unrelated primitive micromoths. Walsingham (1881) further suggested that *Araeolepia* was allied to *Plutella* or *Plutelloptera* (= *Ypsolopha*). This statement led to the subsequent assignments of *Araeolepia* to Yponomeutidae (Dyar 1903) or Plutellidae (Barnes and McDunnough 1917). Busck (1922, 1925) transferred the genus to Glyphipterigidae, and this assignment was followed by McDunnough (1939). Heppner (1978) re-examined and supported the plutellid association of *Araeolepia*. This family assignment was reinforced by Heppner (1985) and accepted in at least two recent checklists (Heppner and Duckworth 1983, Poole and Gentili 1996). Kyrki (1990), however, excluded *Araeolepia* from Yponomeutoidea, but did not propose its alternative superfamily placement.

Araeolepia subfasciella is thus far the only known species of *Araeolepia*. This rare species occurs primarily in the Great Basin, but also extends to Oregon and Washington. The scanty collecting records of *A. subfasciella* have been attributed to their flight-time in early spring when few collectors are active (Heppner 1985). There is nothing known about the larval host plants and feeding habits for *A. subfasciella*.

The aims of this paper are to revise the systematic position of *Araeolepia* and to describe three new congeners from North America.

Materials and Methods

Specimens were obtained from the following institutions.

BMNH—Natural History Museum, London, United Kingdom (formerly known as the British Museum of Natural History);

EMEC—Essig Museum of Entomology, University of California, Berkeley, CA;

MCZ—Museum of Comparative Zoology, Harvard University, Cambridge, MA;

USNM—National Museum of Natural History, Washington, DC.

Genitalia slides were prepared following Clarke (1941), except that Chlorazol Black was used for staining and Euparal resin for permanent slide mounting. The wings were slide-mounted following Hodges (2005). Pinned specimens were photographed using a Nikon D30 digital camera (Nikon Corp., Japan). Slide specimens were photographed using a VDBK digital imaging system at the National Museum of Natural History, Washington, DC.

Label data are given verbatim only for primary types. In the label data, “|” indicates a line break. Nomenclature of genitalia follows Klots (1970). The eighth and ninth abdominal segments are abbreviated as A8 and A9, respectively. The ovipositor is defined as a complex comprising the ninth, tenth abdominal segments, and intersegmental membrane. Terms for wing venation follow Wootton (1979). In the specimen data, “GSN” in brackets indicates the number of the genitalia slide.

Nomenclature

This paper and the nomenclatural acts it contains have been registered in Zoobank (www.zoobank.org), the official register of the International Commission on Zoological Nomenclature. The LSID (Life Science Identifier) number of the publication is: urn:lsid:zoobank.org:pub:B22989D0-660A-433B-9420-A66C69274017

Systematic Accounts

Araeolepia Walsingham, 1881

Araeolepia Walsingham, 1881: 303 (Type-species: *Araeolepia subfasciella* Walsingham, 1881, by monotypy); Riley, 1891: 98; Dyar, 1903: 490; Kearfott, 1903: 107; Barnes and McDunnough, 1917: 182; Busck, 1925: 46; McDunnough, 1939: 84; Heppner, 1978: 51; 1982: 240, 278; 1984: 50; 1985: 110.

Diagnostic characters for this genus are given by Heppner (1985) based on *Araeolepia subfasciella*. Three new congeners described here share most of the characters. Additional characters include: scales on vertex and frons piliform; labial palpus with third segment shorter than second; vom Rath's organ present, with apical pit slightly below apex of labial palpus, extending into 1/3 length of third segment (Fig. 3); antennal flagellomere with two rows of scales dorsally in *A. triangula* or only dorsodistal row of scales in other three congeners; female hindwing frenular acanthi two in *A. subfasciella* and *A. ustulana*, three in *A. leuschneri* n. sp., four in *A. triangula*; sternite II with dentiform apodeme and sclerotized anterolateral process; anterolateral process as long as apodeme (Figs. 21–22, 24) or reduced (Figs. 23, 25); tergites (Figs. 21–23) with a pair of melanized bands along anterior margin except of *A. triangula*; sternites (Figs. 21–25) broadly melanized; subsclerophium in male genitalia present; ampulla on valva present (*A. subfasciella* and *A. leuschneri*) or absent (*A. triangula*); saccus trapezoidal (*A. subfasciella* and *A. leuschneri*) or elongate (*A. triangula*); male phallus with large coecum; cornuti present (*A. subfasciella* and *A. triangula*) or absent (*A. leuschneri*); female ninth abdominal segment sclerotized laterally and ventromedially, connected with ventral branch of basal Y-fork of apophyses posteriores, setose caudal-marginally; papillae anales small, semiglobular, slightly protruding dorsally, setose; apophyses posteriores with Y-fork basally, both branches of same length (*A. subfasciella*) or ventral branch longer than dorsal branch (*A. triangula*, *A. leuschneri*, and *A. ustulana*); signum as spinulate circular (*A. subfasciella*, *A. leuschneri*, and *A. ustulana*) or band-like (*A. triangula*) plate.

Key to the Species of *Araeolepia*, Based on External and Genital Characters

1. Scales on labial palpi piliform; one row of scales present on antennal flagellomeres *triangula* n. sp.
- Scales on labial palpi not piliform; two rows of scales present on antennal flagellomeres..... 2

2. Forewing mainly white; ductus bursae without sclerotized band..... *ustulana* n. sp.
- Forewing mainly gray or fuscous; ductus bursae with sclerotized band 3
3. Cornuti present in phallus; signum round..... *subfasciella* Walsingham
- Cornuti absent in phallus; signum elliptical *leuschneri* n. sp.

Araeolepia subfasciella Walsingham (Figs. 1, 3, 4, 7, 8, 13, 14, 19, 21)

Araeolepia subfasciella Walsingham, 1881: 303; Heppner, 1981: 278; 1985: 111.

Diagnosis

The forewing fasciae of this species resemble those of *Ypsolopha falciferella* (Walsingham), but both species are unrelated and differ in the scale tuft on the labial palpi (present only in *Y. falciferella*) and the socii in the male genitalia (present only in *Y. falciferella*). *Araeolepia subfasciella* is also similar to *Ellabella bayensis* Heppner in superficial appearance but distinguished from the latter in having the narrower ante- and postmedian lines on the forewings, the dentiform saccular process, the short saccus (absent in *E. bayensis*) in the male genitalia, and the sclerotized band on the ductus bursae of the female genitalia.

Types

Lectotype (designated by Heppner, 1978): male, “LECTO- | TYPE” (circular label with indigo edges), “Currant Creek | Grant Co | OREGON | 16.IV. 1872 | Wlsm.”, “Walsingham | Collection, | 1910-427.”, “B.M. ♂ | Genitalia Slide | No. 20209”, “LECTOTYPE [in red] ♂ | *Araeolepia* | *subfasciella* Wlsm | By [in red] Heppner ‘76”. Paralectotypes: 4♂, 2♀ in BMNH; 2♂ in USNM; 1♂ in MCZ. Walsingham (1881) described *A. subfasciella*, based on 17 specimens collected at the same locality. Of the type series, only 10 specimens have been examined.

Material Examined

7♂, 1♀, USA, California, San Bernadino Co., South of Cima, Mid Hills, 2-IV-1994 (R & J Robertson), USNM; 1♂, USA, California, Los Angeles Co., Littlerock, 28-III-1964 (PA Opler), USNM; 1♂, USA, California, Inyo Co., Argus Mts., 13-V-1935 (GH & JL Sperry), USNM, [GSN] USNM-96384; 1♀, USA, Oregon, Umatilla, Hat Rock State Park, 7-IV-1971; 1♂, USA, Washington, Wenatchee, 9-IV-1931 (JF Clarke), USNM.

Distribution

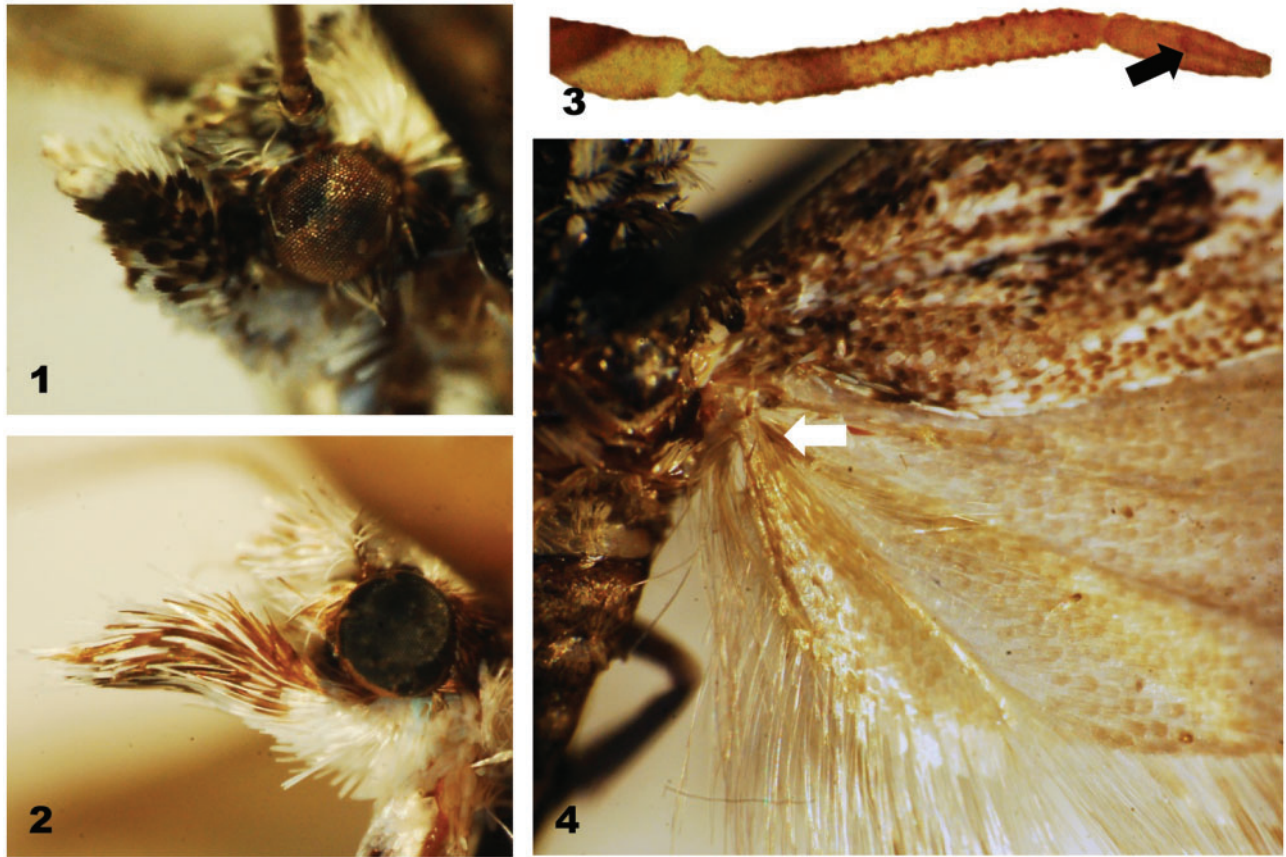
USA (California, Nevada, Oregon, Utah, Washington).

Araeolepia leuschneri n. sp. (Figs. 5, 6, 11, 12, 17, 22)

(urn:lsid:zoobank.org:act:F0918938-A87A-4472-A830-F42CCBAEC769)

Diagnosis

This species is similar to *Araeolepia subfasciella* but differs from the latter in having longitudinal antemedian bar (oblique line in *A. subfasciella*), the narrower valva and uncus in the male genitalia, the more coiled sclerotized band and the elliptical signum (round in



Figs. 1–4. Generic characteristics of *Araeolepia*. (1) Head vestiture of *A. subfasciella*. (2) Head vestiture of *A. triangula* n. sp. (3) Labial palpus of *A. subfasciella*, unscaled (black arrow: vom Rath's organ). (4) Hindwing of *A. subfasciella* (white arrow: cubital pecten).

A. subfasciella) in the female genitalia, and lacking the cornuti in the male phallus.

Adults

Head. Vertex white, sparsely intermixed with dark brown scales medially; frons dark brown, intermixed with white scales on upper 1/3. Antenna 2/3 as long as forewing; scape dark brown; flagellomere with dorsodistal row of gray scales. Labial palpus dark brown, sparsely intermixed with pale gray scales.

Thorax. Patagium and mesoscutellum dark brownish gray; tegula and mesonotum dark brown, intermixed with white or pale gray scales. Foreleg with coxa dark brown dorsally, dark brownish gray ventrally; femur dark brown, sparsely intermixed with white scales; tibia dark brown, intermixed with white scales dorsally, white ventrally; tarsomeres dark grayish brown. Midleg with coxa, femur and tibia dark brown, sparsely intermixed with white scales; first tarsomere dark brown, densely intermixed with white scales ventrally; remaining tarsomeres dark brown, intermixed with white scales. Hindleg with coxa dark brownish gray on basal 3/4, pale yellowish gray on distal 1/4; femur and tibia dark brownish gray dorsally, pale yellowish gray ventrally; tarsomeres dark grayish brown with white ring distally. Forewing length 7.2–10.1 mm ($n = 10$), brownish gray, darkened to base, intermixed with white scales on distal 1/3 and above CuP fold; four oblique, dark brown bars present on distal 1/3 of costal area; one dark brown bar on apex; two elongate, dark brown markings present above basal 2/3 of CuP; submarginal line dark brown; in certain individual, all dark brown markings and line

faded away (Fig. 6); fringe white on basal half; dark brownish gray on distal half. Hindwing and fringe pale brownish gray.

Abdomen. Terga dark brownish gray; sterna dark yellowish gray. Male genitalia (Figs. 11–12) with uncus elongate-triangular, obtuse apically, densely setose. Tegumen trapezoidal; subsacphium as long as uncus; gnathos with lateral arms curved upward, continuous medially, medial band arched. Valva 2× longer than uncus, digitate, setose; sacculus 1/2 as long as valva, enlarged to base, slightly convex at middle, dorsal margin with dentiform process at middle. Juxta U-shaped, broadened laterally. Vinculum V-shaped; saccus elongate, truncate apically, 1/3 as long as uncus. Phallus slightly angulate medially, tapered from middle to apex; carina 1/7 as long as phallus; cornuti absent. Female genitalia (Fig. 17) with ovipositor 1.8× longer than corpus bursae; sclerotized medial area on A9 linguiform. Apophyses posteriores 1.3× longer than apophyses anteriores. Ductus bursae 1.5× longer than corpus bursae, slightly broadened near ostium bursae, coiled five times, with sclerotized band along caudal four coils; inception of ductus seminalis on posterior 1/10 of ductus bursae. Corpus bursae elliptical; signum elliptical along width, scobinate.

Types

Holotype: male, "HOLOTYPE | *Araeolepia* | *leuschneri* | SOHN" [red label with black marginal lines], "Pinyon Crest, 4,400 ft. | Riverside Co., CALIF. | Ron Leuschner, coll. | 4 FEB. 1984", EMEC. Paratypes (33♂, 1♀): California, Riverside Co., Pinyon Crest, 4000–4400 ft., 1♂, 29-I-1965 (RH Leuschner), EMEC; 1♂, 20-II-1965 (RH Leuschner), EMEC; 3♂, 1-II-1970 (RH Leuschner),



Figs. 5–10. Adults of *Araeolepia*. (5) *A. leuschneri* n. sp., male, holotype. (6) *A. leuschneri* n. sp., male, paratype. (7–8) *A. subfasciella*, male. (9) *A. ustulana* n. sp., female, holotype. (10) *A. triangula* n. sp., male, holotype. Scale bars = 5 mm.

EMEC; 6♂, 22-I-1972 (RH Leuschner), EMEC; 1♂, 11-II-1972 (RH Leuschner), EMEC, [GSN] EMEC-JCS-196; 1♀, 20-II-1977 (RH Leuschner), EMEC, [GSN] EMEC-JCS-198; 2♂, 4-II-1978 (RH Leuschner), EMEC; 2♂, 18-II-1979 (RH Leuschner), EMEC, [GSN] EMEC-JCS-197; 5♂, 2-II-1980 (RH Leuschner), EMEC; 12♂, 4-II-1984 (RH Leuschner), EMEC.

Distribution

USA (California).

Etymology

This species is named in honor of R. H. Leuschner who collected the type series.

Araeolepia ustulana n. sp.

(Figs. 9, 20, 23)

(urn:lsid:zoobank.org:act:9627214E-B273-4C2A-A3CF-F2C068EB8D3D)

Diagnosis

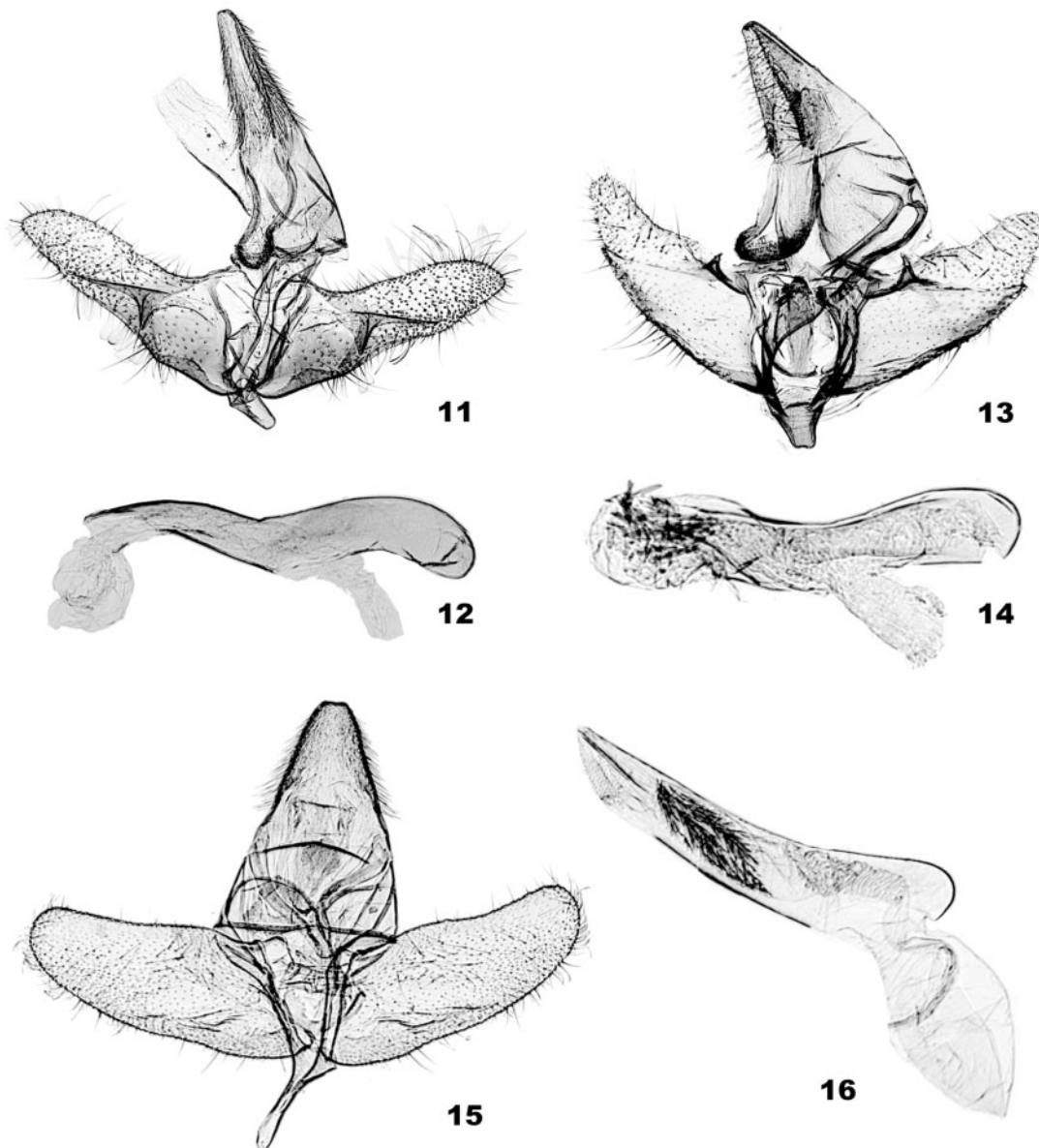
This species is similar to *Araeolepia subfasciella* but differs from the latter in having the paler forewings and lacking the sclerotized band

on the ductus bursae and a signum on the corpus bursae in the female genitalia.

Adults

Head. Vertex white, intermixed with dark brown scales anteromedially; frons white, sparsely intermixed dark brown scales. Antenna 1/2 as long as forewing, filiform in both sexes; scape white, with dark brown band distally; flagellomere white, with dark brown band posteroventrally. Labial palpus with first segment white, narrowly dark brownish gray dorsally; second segment dark brown on exterior surface, white on interior surface; third segment white.

Thorax. Patagium, tegula, mesonotum white, intermixed with dark brownish gray and black scales; mesoscutellum white. Foreleg with coxa dark brown, white at base and distal end; femur to tibia dark brown on exterior surface, white on interior surface; tarsomeres white, with dark brownish gray ring distally. Midleg with coxa pale brown; femur white; tibia white, with dark brown band at distal 1/3; tarsomeres white, with dark brownish gray ring distally. Hindleg pale reddish brown dorsally, white ventrally. Forewing length 8.6–9.4 mm ($n=4$), white, speckled with dark brownish gray and dark brown; subbasal line narrow, with dark brown peppering,



Figs. 11–16. Male genitalia of *Araeolepia*. (11–12) *A. leuschneri* n. sp., paratype (12: phallus). (13–14) *A. subfasciella* (14: phallus). (15–16) *A. triangula* n. sp., paratype (16: phallus).

arched; median line dark brownish gray, oblique, broadened on discal cell; subterminal area suffused with dark brownish gray; fringe white, intermixed with dark brown. Hindwing dark yellowish gray, paler to base; fringe yellowish gray.

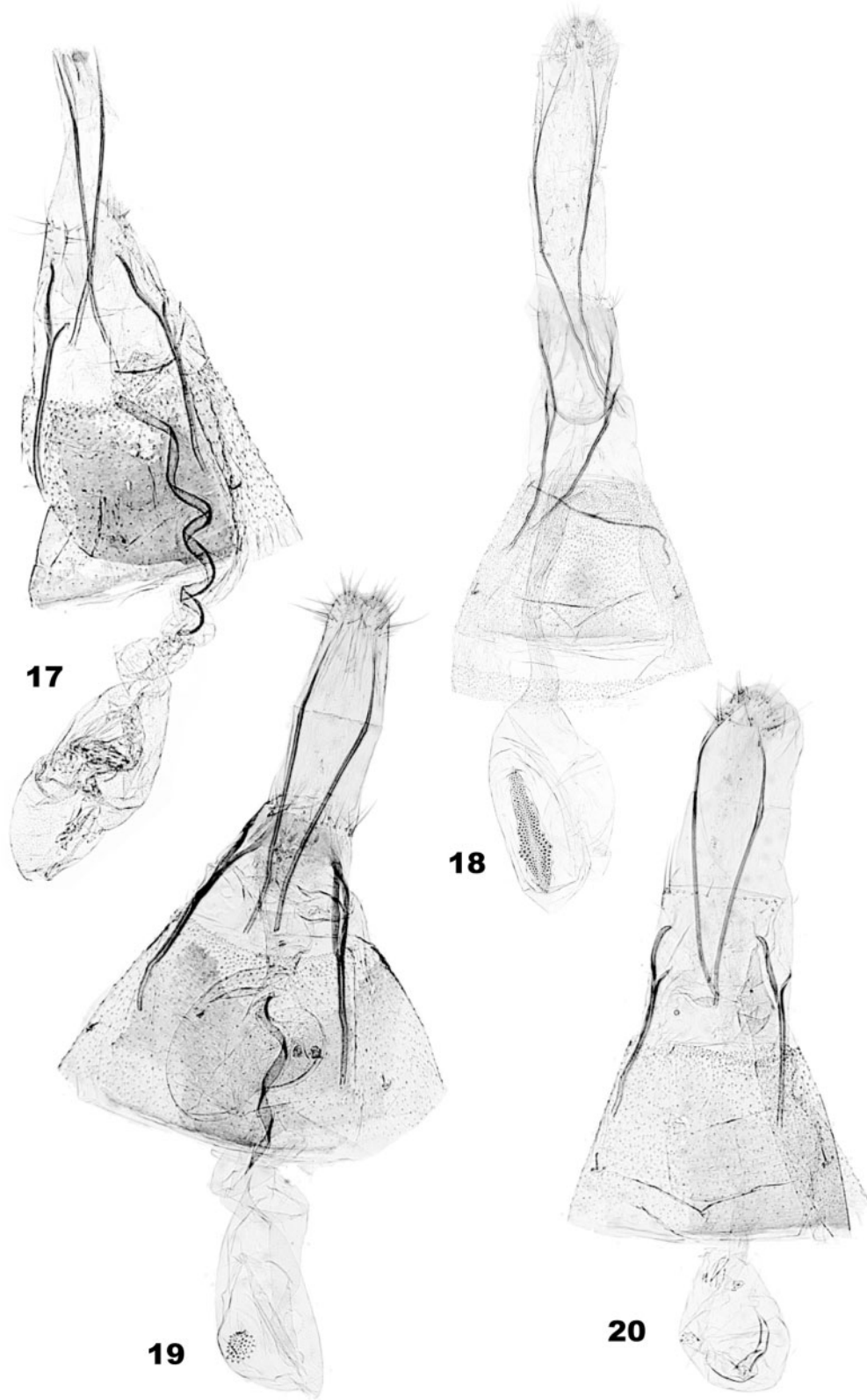
Abdomen. Terga lustrous pale yellowish gray; sterna lustrous pale yellow. Male genitalia unknown. Female genitalia (Fig. 20): Ovipositor as long as ductus plus corpus bursae; A9 lateral sclerotization inverted-triangular. Apophyses posteriores 1.3 × longer than apophyses anteriores. Ostium bursae at middle of intersegmental membrane between A9 and A8. Ductus bursae 1.7 × longer than corpus bursae; antrum bowl-shaped; inception of ductus seminalis from near collar. Corpus bursae oval; signum at middle of corpus bursae, small, semicircular, scobinate.

Types

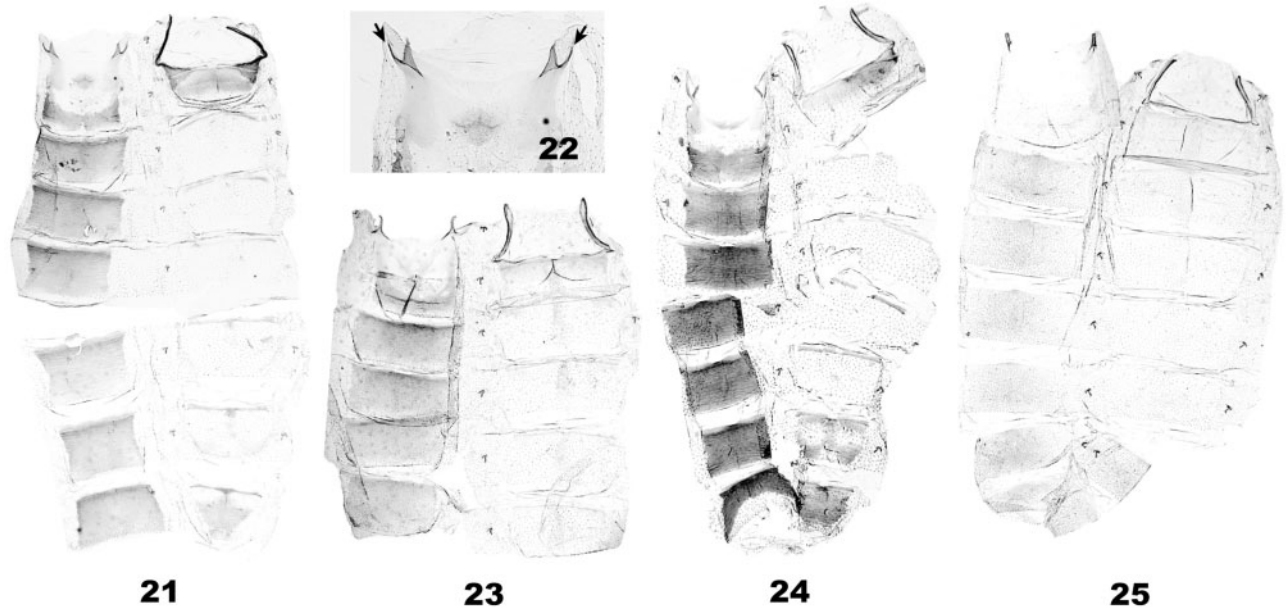
Holotype: female, “HOLOTYPE | *Araeolepia* | *ustulana* | SOHN 2014” [red label with black marginal lines], “Calif: 2 mi. NW | Valyermo, L. | A. Co. V-1-68”, “J. A. Chemsak | Collector”, “J. Powell | Collector”, EMEC. Paratypes (6♀): same as holotype, 1♀, EMEC; California, Los Angeles Co., Mojave Desert, Bob’s Gap, Pearblossom, 1♀, 19-V-1971 (RH Leuschner), 1♀, 17-V-1981 (RH Leuschner), EMEC; USA, California, Inyo Co., 7 mi NE, Panamint Springs, 1♀, 16-V-1969 (PA Rude); USA, California, San Bernardino Co., 12 mi SE, Ivanpah, 2♀, 1-V-1956 (J Powell), EMEC & USNM, [GSN] EMEC-JCS-047, USNM-96385.

Distribution

USA (California).



Figs. 17–20. Female genitalia of *Araeolepia*. (17) *A. leuschneri* n. sp. (18) *A. triangula* n. sp., paratype. (19) *A. subfasciella*. (20) *A. ustulana* n. sp., paratype.



Figs. 21–25. Unscaled abdominal segments of *Araeolepia*. (21–22) *A. subfasciella*, male. (22: enlarged view of second sternite). (23) *A. ustulana* n. sp., female, paratype. (24) *A. leuschneri* n. sp., male, paratype. (25) *A. triangula*, male, paratype.

Etymology

The species name is derived from the Latin ‘*ustulo*’, meaning “to scorch”, and refers to the dark faciae on the forewing of this species.

Araeolepia triangula n. sp.

(Figs. 2, 10, 15, 16, 18, 24)

([urn:lsid:zoobank.org:act:90617F50-07D3-4B4B-8AEE-0D25FDD9B748](https://zoobank.org/act:90617F50-07D3-4B4B-8AEE-0D25FDD9B748))

Diagnosis

This species strikingly resembles to an unrelated species, *Ypsolopha striatella* (Busck), but differs from the latter in having the darker hindwings and a triangular patch along the termen of the forewings. *Araeolepia triangula* is distinguished from all other congeners in having the piliform scales on the labial palpi and the narrower, dark brown streaks along the venation of the distal part of the forewing, and the band-like signum on the corpus bursae of the female genitalia.

Adults

Head. Vertex white, intermixed with dark brown scales medially; frons white, dark brownish gray laterally. Antenna $2/3$ as long as forewing; scape dark brown, speckled with white; flagellomere white on basal half, pale gray on distal half. Labial palpus first segment gray dorsally, white ventrally; second and third segments with mixture of dark brown and white piliform scales.

Thorax. Patagium, tegula, mesonotum white, speckled with dark brown; mesoscutellum white. Foreleg dark brown, sparsely intermixed with white scales on exterior surface, white on interior surface; tarsomeres dark brown, with white ring distally. Mid- and hindleg white, intermixed with dark brownish gray scales dorsally, brownish gray ventrally. Forewing length 8.5–11.1 mm ($n = 10$) white, scattered with black scales roughly along veins and costa; an oblique, black bar at the middle of CuP; a triangular, black patch in

distal area; fringe white, intermixed with brownish black. Hindwing brownish gray; fringe yellowish gray.

Abdomen. Terga dark brownish gray; sterna lustrous pale gray. Male genitalia (Figs. 15–16): Uncus triangular, truncate apically, densely setose. Tegumen trapezoidal; subscaphium as long as uncus; gnathos with lateral arms curved upward, medial band narrowly arched. Valva $2 \times$ longer than uncus, round apically, sparsely setose, with small, digitate, setose process basally; costa nearly straight, slightly convex at basal $1/3$; sacculus $3/5$ as long as valva, narrower distally, slightly convex at basal $2/5$, dorsal margin slightly emarginated at middle. Juxta U-shaped, broadened laterally. Vinculum V-shaped; saccus elongate, slightly broadened apically, $1/3$ as long as valva. Phallus slightly curved, broadened to coecum, with longitudinal ridge $1/4$ as long as phallus; cornutal zone spinulate, $1/3 \sim 1/2$ as long as phallus. Female genitalia (Fig. 18): Ovipositor $2 \times$ longer than corpus bursae; sclerotized medial area on A9 emarginated posteriorly, tapered anteriorly, with a pair of diverging branches laterally; intersegmental membrane between A9 and A8 with narrow, crescentiform sclerite. Apophyses posteriores $2 \times$ longer than apophyses anteriores. Ductus bursae $1.3 \times$ longer than corpus bursae, slightly narrower in posterior $1/8$, with longitudinal pleats in anterior $6/7$; inception of ductus seminalis at posterior $1/8$ of ductus bursae. Corpus bursae elliptical; signum elongate, broadened at anterior $1/3$, scobinate.

Types

Holotype: male, “HOLOTYPE | *Araeolepia* | *triangula* | SOHN 2014” [red label with black marginal lines], “CA: San Diego Co. | Boulder Oak Camp | Ground 3200’ bl[ack light] | VIII-9-1991”, “J. Powell | collector”, “Genitalia slide | By JC Sohn | USNM 96380” [green label with black marginal lines], USNM. Paratypes (16♂, 8♀): same as holotype, 3♂, 2♀, EMEC; USA, California, Inyo Co., Argus Mts., 1♂, 1-VI-1940 (D Meadows), USNM; California, Los Angeles Co., Piñon Hills (1280 m), 7♂, 4♀, 20-VI-2014 (J Powell), EMEC; USA, California, San Bernardino Co., San Bernardino Mts., Cactus

Flats N of Baldwin Lake, 2♂, 1♀, 21-V-1997, [GSN] EMEC-JCS-084 (♂), 085 (♀); USA, California, San Diego Co., Jacumba, 1♀, 23-VI-1924, EMEC; Mexico, Baja California, Norte 30.8 mi E., San Telmo (near Meling), 3♂, 3–6-VI-1987 (N Bloomfield), EMEC, [GSN] EMEC-JCS-045.

Distribution

USA (California) and Mexico (Baja California).

Etymology

The species name is derived from the Latin ‘*triangulus*’, meaning “having three angles”, and refers to the triangular patch on the forewing of this species.

Discussion

An enigmatic genus, *Araeolepia* is currently assigned to Plutellidae (e.g., Poole and Gentili 1996), although Kyrki (1990) contradicted its association with Yponomeutoidea. There exist a few observations (Busck 1925; Heppner 1984, 1985) recognizing the resemblance among *Araeolepia*, *Ellabella* Busck, 1925, and *Lotisma* Busck, 1925. Nevertheless, *Araeolepia* has taken a separate path in family assignment from the other two. For example, Fletcher (1929) placed *Ellabella* and *Lotisma* in Yponomeutidae and *Araeolepia* in Plutellidae. *Lotisma* was later transferred to Copromorphidae (Heppner 1978) as was *Ellabella* (De Benedictis 1984). The copromorphid associations of *Ellabella* and *Lotisma* have been strengthened with evidence from their immature stages (De Benedictis 1985, Heppner 1986). Heppner (1985) suggested that *Araeolepia* resembles *Ellabella* in genital structures, but it is phenetically closer to Plutellidae. He emphasized two shared characters in the wing venation of *Araeolepia* and Plutellidae, i.e., the presence of the areole on the forewing and the widely spaced cubital veins on the hindwing, over the shared characters between *Araeolepia* and *Ellabella*. Those two characters supposedly associating *Araeolepia* with Plutellidae are in fact homoplastic over the entire Lepidoptera.

Kyrki (1990) defined Plutellidae with two apomorphies: the lamellae postivaginales consisting of two setose lobes and the largely meshed cocoon. The former character is in fact homoplastic within Yponomeutoidea and it is not found in *Araeolepia*. Further, *Araeolepia* do not share two synapomorphies for Yponomeutoidea (Kyrki 1990): the posterior expansion of the male pleuron VIII and the transverse ridge near the posterior margin of the sternum II. All these lines of evidence suggest that *Araeolepia* do not belong to Plutellidae nor Yponomeutoidea. Heppner (1978) indicated that the thoracic and abdominal articulation for *Araeolepia* was the tineoid type with the broadened apodemes. This observation is incorrect, as at least two species of *Araeolepia* (*A. leuschneri* and *A. subfasciella*) possess the apparent lateral rods on the anterolateral corners of the second sternite (Fig. 22, indicated by arrows), a main character of the tortricoid abdominal articulation. This character state indicates that *Araeolepia* belong to Apoditrysia. The lateral rods are, however, reduced in *A. ustulana* (Fig. 23) and nearly absent in *A. triangula* (Fig. 25).

The systematic position of *Araeolepia* within Apoditrysia remains uncertain, as they lack any characteristic that unambiguously associate them with one of the apoditrysiian superfamilies. The male genitalia of *Araeolepia* are similar to Cossioidea or two genera of Carposinoidea, viz. *Ellabella* and *Lotisma*. Differing from *Araeolepia*, Cossioidea usually possess pectinate antennae in males and reduced proboscis (Patricia Gentili-Poole 2015, personal

communication). Carposinoidea can be defined by the following apomorphies: 1) forewing with raised scale-tufts (Minet 1986); 2) hindwing with basal fringe of piliform scales, also known as “cubital pecten” (Minet 1986, Nasu et al. 2004); 3) anterolateral process on sternite II usually sclerotized, long, and curved (Kyrki 1983); 4–5) two larval characters (Common 1990), i.e., the slightly protruding spiracles and the largest and dorsally positioned spiracles on the abdominal segment VIII. The first apomorphy is often lost within Carposinoidea (Dugdale et al. 1998), which is also the case in *Araeolepia*. The larval characters cannot be evaluated for *Araeolepia* whose immature stages are unknown.

It is noteworthy that *Araeolepia* possess cubital pecten on the hindwings (Fig. 4). Another striking similarity between *Araeolepia* and carposinoids is the sclerotized anterolateral processes on the sternite II, although these are somewhat reduced in size in the former. Carposinoids, in general, have a well-developed coecum in the phallus (Dugdale et al. 1998). This is also the case in *Araeolepia*, but the character repeatedly occurs in other unrelated lepidopterans. Carposinoidea currently comprise two families, Carposinidae and Copromorphidae. The taxonomic boundary of two families, however, remains unsatisfactory (Dugdale et al. 1998). Heppner (1987) mentioned about a shared character among some carposinoid genera, i.e., the presence of the flap-like protrusion on the postlabium or stipes in larvae, among *Lotisma* and three carposinid genera, *Bondia* Newman, *Carposina* Herrich-Schäffer, and *Commatarcha* Meyrick. This character is, however, not found from *Copromorpha* Meyrick, *Ellabella*, and *Phycomorpha* Meyrick (Nasu et al. 2004). Carposinidae lack a vein M₂ on the hindwing, which was suggested as a possible autapomorphy for the family (Dugdale et al. 1998). This character is not found in *Araeolepia*. This genus may better fit Copromorphidae, considering its similarities to *Ellabella* and *Lotisma*, i.e., the tegumen of the male genitalia with “⊥” shape of bulges and the female sterite IX with a broad triangular sclerite connecting both apophyses anteriores. Copromorphidae are currently defined by one larval and one pupal character (Nasu et al. 2004). The immature stages of *Araeolepia* are currently unknown, but such information is essential to confirm their carposinoid association.

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References Cited

- Barnes, W., and J. H. McDunnough. 1917. Check List of the Lepidoptera of Boreal America. 392 pp. Herald Press, Decatur, Illinois.
- Busck, A. 1922. Microlepidoptera from British Columbia. Can. Entomol. 53: 276–280.
- Busck, A. 1925. A new North American genus of Microlepidoptera (Glyphipterigidae). Proc. Ent. Soc. Wash. 27: 46–48.
- Clarke, J.F.G. 1941. The preparation of slides of the genitalia of Lepidoptera. Bull. Brooklyn Entomol. Soc. 36: 149–161.

- Common, I.F.B. 1990. Moths of Australia. Melbourne University Press, Carlton.
- De Benedictis, J. A. 1984. On the taxonomic position of *Ellabella* Busck, with descriptions of the larva and pupa of *E. bayensis* (Lepidoptera: Copromorphidae). *J. Res. Lepid.* 23: 74–82.
- De Benedictis, J. A. 1985. The pupa of *Lotisma trigonana* and some characteristics of the Copromorphidae (Lepidoptera). *J. Res. Lepid.* 24: 132–135.
- Dugdale, J. S., N. P. Kristensen, G. S. Robinson, and M. J. Scoble. 1998. The smaller Microlepidotera-grade superfamilies, pp. 217–232. *In* N. P. Kristensen (ed.), *Handbook of Zoology*, Vol. 4, Part 35, Lepidoptera, Moths and Butterflies 1, Walter de Gruyter, Berlin.
- Dyar, H. G. 1903. A list of North American Lepidoptera and key to the literature of this order of insects. *Bull. United States Natl. Mus.* 51: 1–723.
- Fletcher, T. B. 1929. A list of the generic names used for Microlepidoptera. *Mem. Dep. Agric. India (Ent.)* 11: 1–244.
- Heppner, J. B. 1978. Transfers of some Nearctic genera and species of Glyphipterigidae auctorum to Oecophoridae, Copromorphidae, Plutellidae, and Tortricidae. *Pan-Pac. Entomol.* 54: 48–55.
- Heppner, J. B. 1982. A catalogue of genera associated with the Glyphipterigidae auctorum (Lepidoptera). *J. NY. Ent. Soc.* 89: 220–294.
- Heppner, J. B. 1984. Revision of the Oriental and Nearctic genus *Ellabella* (Lepidoptera: Copromorphidae). *J. Res. Lepid.* 23: 50–73.
- Heppner, J. B. 1985. Review of the North American genus *Araeolepia* (Lepidoptera: Plutellidae). *Pan-Pac. Entomol.* 61: 110–117.
- Heppner, J. B. 1986. Revision of the new world genus *Lotisma* (Lepidoptera: Copromorphidae). *Pan-Pac. Entomol.* 62: 273–288.
- Heppner, J. B. 1987. Copromorphidae, Alucitidae, Carposinidae, Epermeniidae (Copromorphoidea); Glyphipterigidae, Plutellidae (Yponomeutoidea). pp. 399–405. *In* F. W. Stehr (ed.), *Immature Insects*. Kendall/Hunt, Dubuque.
- Heppner, J. B., and W. D. Duckworth. 1983. Yponomeutoidea. pp. 26–28. *In* R. W. Hodges, T. Dominick, D. R. Davis, D. C. Ferguson, J. G. Franclemont, E. G. Munroe, and J. A. Powell (eds.), *Check List of the Lepidoptera of America North of Mexico*. E. W. Classey Ltd. & The Wedge Entomological Research Foundation, London.
- Hodges, R. W. 2005. Order Lepidoptera, pp. 571–647. *In* C. A. Triplehorn, and N. F. Johnson (eds.), *Borror and DeLong's Introduction to the Study of Insects*, 7th edition. Thomson Books/Cole, Belmont.
- Kearfott, W. D. 1903. Yponomeutidae. pp. 107–108. *In* J. B. Smith (ed.), *Check List of the Lepidoptera of Boreal America*, 2nd ed. American Entomological Society, Philadelphia.
- Klots, A. B. 1970. Lepidoptera, pp. 115–130. *In* S. L. Tuxen (ed.) *Taxonomist's Glossary of Genitalia in Insects*. Munksgaard, Copenhagen.
- Kyrki, J. 1983. Adult abdominal sternum II in ditrysian tineoid superfamilies—morphology and phylogenetic significance (Lepidoptera). *Annl. Ent. Fenn.* 49: 89–94.
- Kyrki, J. 1990. Tentative reclassification of holarctic Yponomeutoidea (Lepidoptera). *Nota lepid.* 13: 28–42.
- McDunnough, J. H. 1939. Checklist of the Lepidoptera of Canada and the United States of America. Part II. Microlepidoptera. *Mem. S. California Acad. Sci.* 2: 1–171.
- Minet, J. 1986. Ébauche d'une classification moderne de l'ordre des Lépidoptères. *Alexanor* 14: 291–313.
- Nasu, Y., T. Saito, and F. Komai. 2004. Discovery of the previously unrecorded family Copromorphidae Meyrick (Lepidoptera) in Japan, with description of a new species and autapomorphies for the family. *Entomol. Sci.* 7: 73–83.
- Pooler, R. W., and P. Gentili. 1996. *Nomina Insecta Nearctica: Check List of the Insects of North America*, Vol. 3: Diptera, Lepidoptera, Siphonaptera. Entomological Information Service, Rockville, Maryland.
- Riley, C. V. 1891. Tineina. pp. 94–111. *In* J. B. Smith (ed.), *List of the Lepidoptera of Boreal America*. American Entomological Society, Philadelphia.
- Walsingham, T. de G. 1881. On some North American Tineidae. *Proc. Zool. Soc. Lond.* 1881: 301–325.
- Wootton, R. J. 1979. Function, homology and terminology in insect wings. *Syst. Entomol.* 4: 81–93.