

## Description of a new species of *Caenotus* Cole (Diptera: Scenopinidae) from Baja California Sur, Mexico, with a review of the genus

MARK A. METZ

Department of Entomology, The Pennsylvania State University, State College, 16802, USA. mametz@aol.com

### Abstract

A new species of *Caenotus* Cole is described from Baja California. The current knowledge of the systematics and states of morphological characters with putative phylogenetic importance within the genus are discussed and summarized. One species *Caenotus thompsonii* Evenhuis is placed in synonymy with *Brachylinga baccata* Coquillett (Diptera: Therevidae).

**Key words:** window fly, stiletto fly, revision, Scenopinidae, Therevidae, systematics, taxonomy

### Introduction

The family Scenopinidae (Insecta: Diptera: Asiloidea) or window flies, so named because the adults of the common species *Scenopinus fenestralis* (L.) are sometimes collected at windows in homes where larvae feed on larval carpet beetles (Coleoptera: Dermestidae), is worldwide in distribution, but is most rich and abundant in arid to semiarid ecosystems. Scenopinids are characterized by the presence of a patch of morphologically distinct setae (Fig. 2) of unknown function on the dorsal surface of the second abdominal segment (absent in *Caenotoides californicus* Hall). The biology is unknown for most species with less than ten percent of the known species having associated biological information (Kelsey 1969), but larvae are assumed to be uniformly predaceous on other arthropods and their larvae. Notes of adult behaviour are non-existent, but several species exhibit mouth-part morphology (i.e., elongation; Fig. 1) suggestive of nectar feeding.

Understanding the species and morphological diversity is a crucial step towards understanding the relationships among and between Asiloidea and this research attempts to build one of these steps and make such information available in the literature thus increasing the accuracy for potential higher level analyses (i.e., Yeates 2002). This paper includes

taxonomic and morphological notes on the species in the genus *Caenotus* Cole, describes a new species collected from Baja California, Mexico, and removes one junior synonym of a species of Therevidae.

## Methods

General morphology follows McAlpine (1981) with additional terminology from Irwin and Lyneborg (1981a, b). Some structures of the male genitalia follow terminology from Nagatomi et al. (1994) and Winterton et al. (1999a). Terminology for structures of the female terminalia follows Irwin (1976) as modified by Winterton et al. (1999a, b) and Lyneborg (2001). Each specimen was given a unique specimen code on an orange label in the format SCENOPINIDAE/M. E. Irwin/Specimen #/999999. These codes facilitate entry and manipulation of data into a systematic database within the architecture of MANDALA (Kampmeier et al. 1998) and are recorded as "MEI 999999" with their associated specimens throughout the text. All material examined is listed after the description.

## Taxonomy of *Caenotus*

Cole (1923) first described the genus in the family Therevidae based on two new species, *C. inornatus* Cole and *C. minutus* Cole, noting, "The genus is not closely related to any other described from North America." Melander (1928) transferred the genus to the family Bombyliidae in the subfamily Heterotropinae and later (Melander 1950) described two new species, *C. canus* Melander and *C. hospes* Melander. A fifth species, *C. thompsonii* Evenhuis, was described (Evenhuis 1977), then *Caenotus* was placed in Proratinae (Evenhuis 1991), a bombyliid subfamily described for the genus *Prorates* Melander (Theodor 1983). Yeates (1992) addressed the familial placement of the proratine genera with morphological cladistic analysis and removed the subfamily from Bombyliidae, placing these genera (sans *Apystomyia* Melander) in Scenopinidae and described a new scenopinid subfamily, Caenotinae, for the genus *Caenotus*.

Nogatomi et al. (1994) treated the genus extensively as a member of the Proratinae. They described a new genus, *Aceaenotus* Nagatomi & Yanagida, for *C. canus* and described a new species, *C. mexicanus* Nagatomi & Yanagida, collected from San Luis Potosi, Mexico. They examined all the described species, except *C. thompsonii*, and had only male specimens of *C. minutus* and only female specimens of *C. inornatus* available.

Yeates (1992) demonstrated two non-homoplasious synapomorphies for the genus as a result of his phylogenetic analysis, which included the two species *C. inornatus* (the type species) and *C. hospes*. Both species possessed a membranous connection between the prosternum and the propleuron (Character 6. Prosternum separate from the propleuron) and a pair of anteriorly projecting, dorsal structures originating from the dorsum of the

phallus (Character 25. Male genitalia with a long, narrow apodeme [phallus sheath apodeme] extending anteriorly and parallel to the ejaculatory apodeme and gonocoxal apodemes). The presence of wing vein  $M_3$  in *C. inornatus* was considered a plesiomorphic retention (present in the outgroup taxa) thus making the loss of vein  $M_3$  a homoplasious forward change in *C. hospes* and in the rest of Scenopinidae (Yeates 1992, Fig. 65).

Nagatomi et al. (1994) listed putative synapomorphies for their hypothesis of the genus without support from a tree hypothesis based on a data matrix. These included: antennal segment 1 longer than segment 2, mesonotum and scutellum without bristles, vein  $R_5$  ending below wing apex, female abdomen longer and roughly 3 times as long as mesonotum + scutellum, and basiphallus with a pair of anterolateral dorsal processes. They did not include the species *C. thompsonii* in their treatment of the genus. The argumentation for the removal of the species *C. canus* is indirect, but several morphological similarities to the species in Proratinae *sensu stricto* suggest this hypothesis will withstand cladistic scrutiny.

The new species described herein possesses the synapomorphies supported by Yeates' (1992) analysis. The anteriorly projecting structures of the aedeagus apparently originate from the phallus itself, rather than the parameral sheath, suggesting that these structures might be homologous with lateral ejaculatory sclerites. Dissections of preserved adult males would provide definitive support as these structures provide the origin of muscle M32 (Ovtshinnikova & Yeates 1998). The new species also possesses the characteristics listed by Nagatomi et al. (1994), but I do not consider these diagnostic or synapomorphic for the genus.

### **Taxonomic Status of *Caenotus thompsonii* Evenhuis**

Shortly after his original description in 1977 and with the subsequent publication of the Genera of Nearctic Therevidae (Irwin & Lyneborg 1981a), Evenhuis pointed out (in litt.) the need to transfer *Caenotus thompsonii* to the newly erected genus *Brachylinga* Irwin & Lyneborg, 1981 (Therevidae). Study of the genus *Brachylinga* verified that the species *Caenotus thompsonii* Evenhuis is a junior synonym of *Brachylinga baccata* Coquillett and is herein synonymized as such and removed from combination with *Caenotus*.

### ***Caenotus* Cole**

*Caenotus* Cole, 1923: 14. Type species: *Caenotus inornatus* Cole, 1923: 16 by original designation.  
*hospes* Melander, 1950: 149 Type locality Organ Pipe Cactus National Monument, Arizona, USA.  
*inornatus* Cole, 1923: 16 Type locality Alamogordo, New Mexico, USA.  
*mexicanus* Nagatomi & Yanagida, 1994: 159 Type locality 18 miles S.W. Santa Catarina, San Luis Potosi, Mexico.

*minutus* Cole, 1923: 15 Type locality Alamogordo, New Mexico, USA.

*tanyrhynchus* **spec. nov.** Type locality Arroyo San Gregorio, Baja California Sur, Mexico.

***Caenotus tanyrhynchus* spec. nov.**

**Etymology.** *tany-* (Greek, adjective) = long + *rhynchus* (Greek, noun, masculine) = snout, muzzle; “long mouth” referring to the extremely elongate proboscis of the species.

**Diagnosis.** This species is readily distinguished by the extremely elongate mouthparts. Other species of *Caenotus* have mouthparts that barely extend out from the oral cavity, while *C. tanyrhynchus* has mouthparts as long as the head is high. *C. tanyrhynchus* is also covered with very long, filiform setae whereas other species of *Caenotus* are covered with much shorter setae.

**Male. Head.** Shiny black; covered with extremely fine and short pruinose-like setae, except along dorsal and posterior margin of compound eye. Ocellar tubercle raised on vertex, 1.33 times wider than high. Nearly holoptic, eyes separated by less than the width of one ommatidium above narrow frontal triangle. Inner eye margin smoothly curved around base of antenna, but not sharply indented. Ommatidia of compound eye subequal in size with no horizontal line demarcating upper and lower regions of ommatidia. Postocellar macrosetae long, most as long as and many longer than the length of the scape; filiform; black. Gena and ventral oral margin slightly extended ventrally; long, filiform black setose. Postgena long, filiform black setose. Occiput covered with fine and short setae; with long black setae laterally and ventrally. Antenna black, gold pruinose. Scape and pedicel with long black setae, setae 1.5 times longer than width of scape. Basal flagellomere much longer than wide, longer than scape; medial side extending longer than lateral; black; gold pruinose; infrequently setose dorsally at base. Style two segmented; first segment apical, length and width subequal, cylindrical; black; gold pruinose; lacking setae; second segment apical, sharply acuminate, three times longer than wide. Maxillary palpus black; one segmented; elongate, length  $\approx$  height of head; cylindrical; gold pruinose; with long, filiform, black setae. Labrum and labium elongate; together subequal in length to height of head; black; black setose. Labellum not enlarged; circular, slightly longer than wide; ventral surface filiform, black setose.

**Thorax.** Shiny black; gold pruinose except scutum, dorsal scutellum, anepisternum, and anepimeron only shiny black. Pronotum, proepisternum, prosternum, scutum, dorsal anepimeron, and scutellum with long yellow, fine filiform setae admixed with long brown setae. Joint between prosternum and propleuron large and membranous. Scutal and scutellar macrosetae undifferentiated, if present. Legs. Dark brown, sparsely gold pruinose. Fore- and midcoxae with long, filiform, brown setae anteriorly; hindcoxa with long, filiform, brown setae anterolaterally to posterolaterally; hindcoxal knob extremely reduced, present as a low rounded point. Wing. Membrane mostly hyaline, slightly brown tinged along veins; microtrichiose throughout; pterostigma pale brown; costa apparently circu-

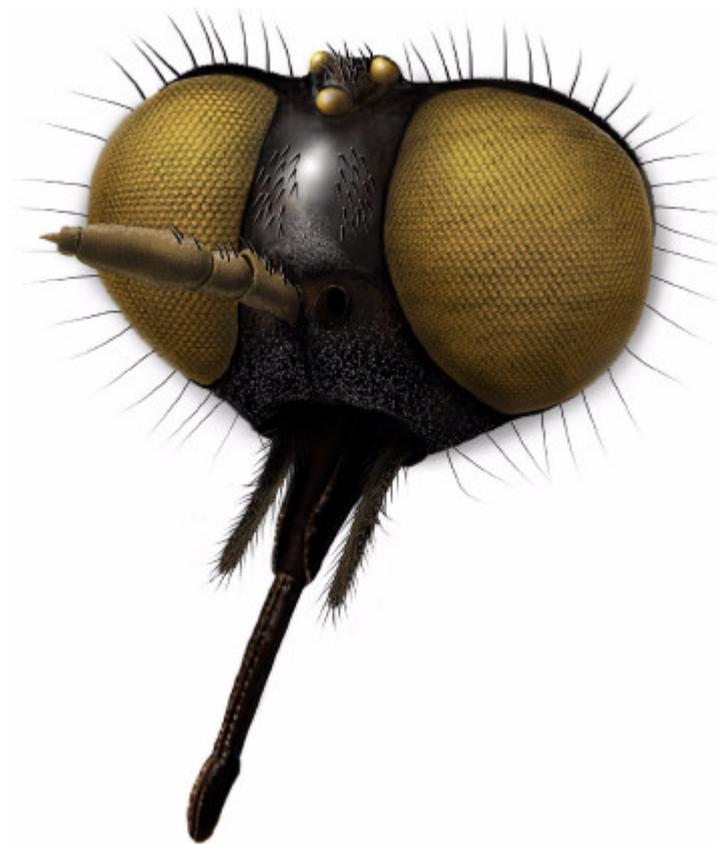
mambient; veins  $M_1$  and  $M_2$  arising separately from discal cell; vein  $M_3$  absent. Halter light, very pale gold, darker at base of stalk.

Abdomen. Tergites and sternites black, sparsely gold pruinose; long, fine filiform golden setose, with lateral setae and setae on basal segments longer. Modified setae on tergite 2 (Fig. 2) composed of a single patch of shortly acuminate setae arranged in an ovoid pattern, longer than wide; some specimens with patch medially divided forming two bilaterally symmetrical, semicircular patches.

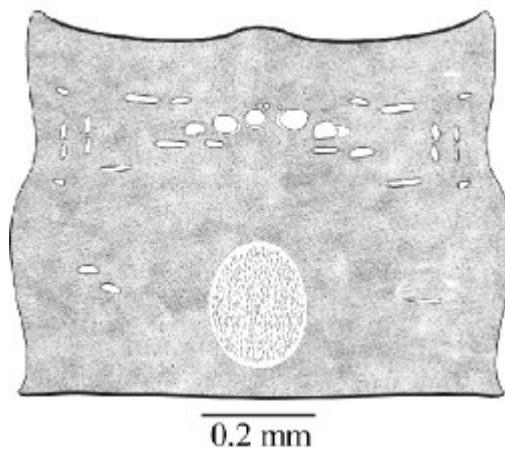
Terminalia. Tergite 8 unmodified, similar to previous segments; wider than long; anterior margin slightly narrower than posterior; with one pair of sensory setae; dark brown; sparsely gold pruinose; golden setose. Sternite 8 quadrate, wider than long, anterior and posterior margins subequal in width; dark brown; sparsely gold pruinose; fine filiform golden setose. Tergite 9, epandrium, (Fig. 3) divided medially, right and left halves connected only by weakly sclerotized membrane; each half with a posteromedial flange of cuticle lacking setae; ventral surface sclerotized posterolaterally; dark brown, lateral edges dark yellow; sparsely gold pruinose; filiform black setose. Cercus (Fig. 3) extending slightly beyond extension of hypoproct; black setose dorsally and apically. Hypoproct (Fig. 3) truncate; setose ventrally and apically. Subepandrial sclerite strongly sclerotized laterally, otherwise membranous. Hypandrium large, minimal reduction from size of sternite 8; triangular, acuminate posteriorly; fused to gonocoxite posterolaterally, otherwise connection membranous; black, filiform setose ventrally. Gonocoxite (Fig. 4-5) with a ventrolateral, acuminate projection; area of articulation with epandrium oriented vertically such that articulating surface faces laterally; dark brown; black, filiform setose ventromedially. Gonocoxal apodeme (Fig. 4) extending anteriorly beyond anterior border of gonocoxite. Gonostylus (Fig. 5) crescent-shaped when viewed laterally; curved dorsally at apex; apex dorsoventrally flattened, but acuminate when viewed dorsally; setose dorsally at base, otherwise ventrally setose. Aedeagus (Fig. 4-5) brown with parameral sheath and apodemes reduced anteriorly; dorsal apodeme extremely short, essentially absent; ventral apodeme broadened laterally, short and truncated anteriorly, with lateral carinae; fused by a strongly sclerotized connection to gonocoxite laterally at base of gonocoxal apodeme; phallus with pair of dorsolateral projections anteriorly. Distal parameral sheath (Fig. 4) bifurcate at base. Aedeagal apodeme (Figs. 4-5) robust, roughly cylindrical, anterior end broadened laterally; posterior end broadened laterally and ventrally creating a basket-shaped posterior face; with a sclerotized ring dorsally as connection for vas deferens; dorsally, ventrally, and laterally carinate from middle to anterior end.

Female same as the male except as follows.

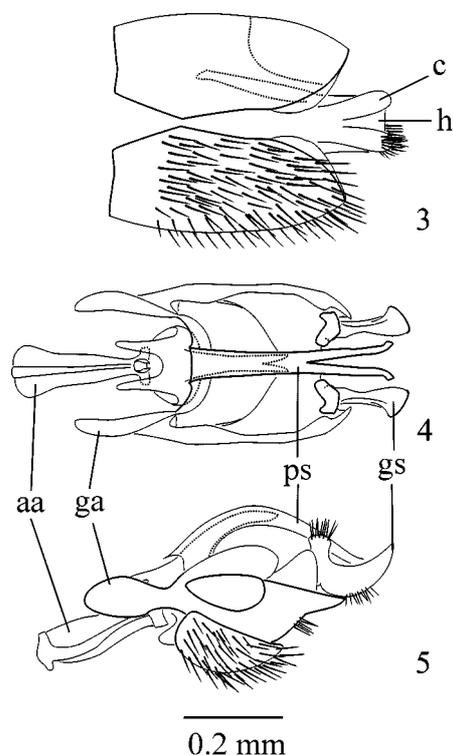
Head (Fig. 1). Dichoptic, frons at its narrowest width 2X that of the ocellar tubercle. Frons shiny black, small triangular area dorsad of antennae pruinose; short black setose. Parafacial shiny black adjacent to eye margin. Gena and postgena with some pale yellow setae. Proboscis longer, approaching 1.5 X height of head.



**FIGURE 1.** *Caenotus tanyrhynchus* spec. nov., three quarter view of female head.



**FIGURE 2.** *Caenotus tanyrhynchus* spec. nov., dorsal view of male tergite 2 showing circular patch of specialized setae.

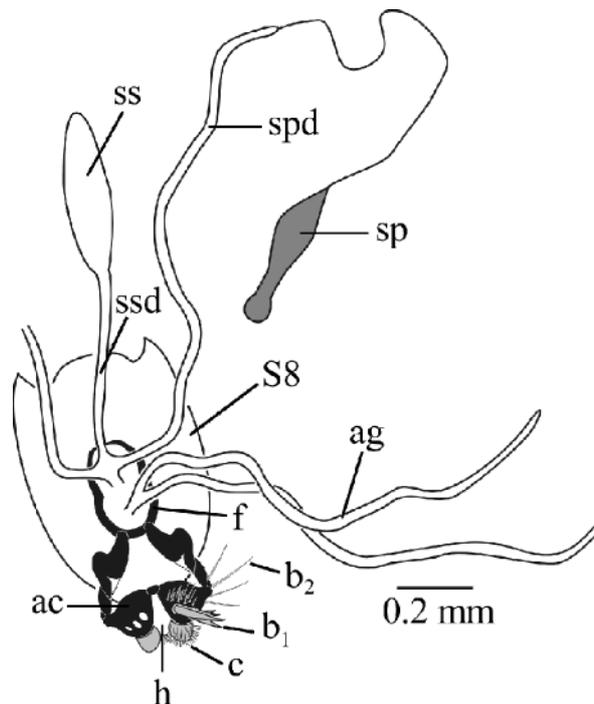


**FIGURES 3-5.** *Caenotus tanyrhynchus* spec. nov., male genitalia. 3, Dorsal view of male epanandrium, setae not illustrated on left side for clarity; 4, Dorsal view of gonocoxite and aedeagal apparatus, setae on dorsal gonostylus not illustrated for clarity; 5, Lateral view of gonocoxite and aedeagal apparatus. aa, aedeagal apodeme; c, cercus; ga, gonocoxal apodeme; gs, gonostylus; h, hypoproct; ps, parameral sheath.

Thorax. Some specimens with more robust setae on postalar callous and scutellar margin, approaching the thickness of thoracic macrosetae.

Terminalia (Fig. 6). Tergite 8 with length and width subequal; anterior margin straight; posterior margin with a narrow strip of cuticle connecting to tergite 9; dark brown; sparsely gold pruinose; black, filiform setose. Membrane between tergite 8 and tergite 9 glabrous. Sternite 8 (Fig. 6) longer than wide; anterior margin straight, but anterolateral corners extended anteriorly; posterior lobe sclerotized, but short; black, filiform setose; posterior setae spaced more densely. Acanthophorites (Fig. 6) joined narrowly at dorsum by narrow strip of tergite 9; 5 pairs of apically spatulate, robust  $b_1$  spines; 4 pairs of acuminate, fine  $b_2$  spines; short, black, filiform setose. Sternite 10 broader anteriorly, triangular; weakly sclerotized medially; posterior membranous, acuminate; ventrally brown; short, black fine filiform setose. Cerci (Fig. 6) and hypoproct bulbous and membranous; minutely setose. Furca (Fig. 6) hour-glass shaped with the anterior and posterior ends

rounded. Spermathecal ducts and spermathecal sac duct (Fig. 6) arising from a common gonopore on the membrane of the furca. Spermathecal duct wider basally, narrowing before terminating at the spermatheca; total length approximately nine furcal lengths. Spermatheca (Fig. 6) longer than wide, wider basally; apically capitate; sclerotized; brown. Spermathecal sac (Fig. 6) duct subequal in width to the base of the spermathecal duct basally, but flaccid, narrowing apically before spermathecal sac; total length approximately 1.5 furcal lengths. Spermathecal sac (Fig. 6) membranous, longer than wide; length subequal to length of furca. Accessory glands originating from a common duct on furcal membrane; approximately 5 furcal lengths; flaccid, ribbon like.



**FIGURE 6.** *Caenotus tanyrhynchus* spec. nov., female terminalia. ac, acanthophorite; ag, accessory gland;  $b_1$ , robust spines of the acanthophorite;  $b_2$ , fine spines of the acanthophorite; c, cercus; f, furca; h, hypoproct; S8, sternite 8; sp, spermatheca; spd, spermathecal duct; ss, spermathecal sac; ssd, spermathecal sac duct.

Distribution. Baja California Sur, Mexico.

Ecology. All specimens were labeled as collected in Malaise traps except two (MEI 143926, MEI 143923) without a collecting method associated with the labels and one (MEI 143928) taken in a “cereal bowl pit trap”. The very elongate mouthparts (Fig. 1) suggest flower feeding and some specimens had several pollen grains on their bodies from at least two plant species.

Type material. Holotype male (MEI 143931), “MEXICO:Baja Calif. Sur. Rcho. Tablon 13km. S. Guillermo Prieto, IV-16/18-1983”, “M.S. Wasbauer Collector.”

Paratypes: Mexico, Baja California Sur: 1 male (MEI 143923), 6 females (MEI 143924 – 143929) same data as holotype; IV-14/18-1983; 2 females (MEI 143921 - 143922) Arroyo San Gregorio, 13 air km WNW La Purissima, IV-24/26-1983, all collected by M.S. Wasbauer and deposited in the California State Collection of Arthropods at the California Department of Food and Agriculture: 1 male (MEI 143920) Arroyo San Gregorio, 13 air km WNW La Purissima, IV-24/26-1983 collected by M.S. Wasbauer and 2 females (143932 – 143933) same data as holotype except one female (MEI 143933) collected by C & E Slansky deposited in the United States National Museum of Natural History: 1 male (MEI 143930) 9.2 mi. SE Guerrero Negro, III-23-1981, D. Faulkner & F. Andrews; deposited in the San Diego Natural History Museum.

### Additional morphological notes

I have examined specimens of the other species in the genus and have provided morphological information currently unavailable in the literature for future workers (Table 1).

**TABLE 1.** Distribution of character states in the species of *Caenotus*.

Species	Male Ommatidia	Eye Margin Near Antenna	Hindcoxal Knob	Vein M <sub>3</sub>	Modified Tergite 2 setae
<i>hospes</i>	Smaller ventrally with a line of demarcation	Straight or only slightly indented	Anterior surface of hindcoxa slightly raised, broadly rounded	Absent	Pair of small circular, bristle-like patches
<i>inornatus</i>	Smaller ventrally with a line of demarcation	Straight or only slightly indented	Present, apically acuminate	Present or Absent	Pair of much longer than wide bilaterally symmetrical, semicircular, bristle-like setae patches
<i>mexicanus</i>	Smaller ventrally with a line of demarcation	Straight or only slightly indented	Present, apically acuminate	Present or Absent	Large oval patch of granule-like setae sometimes divided medially into two halves
<i>minutus</i>	Smaller ventrally, with a line of demarcation	Slightly indented	Present, apically acuminate	Absent	Pair of small circular, bristle-like patches
<i>tanyrhynchus</i>	Fairly uniform, size difference not noticeable	Slightly indented	Anterior surface of hindcoxa slightly raised, broadly rounded	Absent	Large oval patch of bristle-like setae or pair of much longer than wide semicircular patches

## Acknowledgments

I would like to thank Dr. Neal L. Evenhuis for his help in obtaining specimens of several species of Scenopinidae for descriptive and comparative purposes; Dr. Donald W. Webb for his help in obtaining and examining the type material of *C. thompsonii* from the California Academy of Sciences; my wife, J. Marie Metz for making the female head figure much more aesthetically pleasing than I could have ever done; the California State Collection of Arthropods and the San Diego Natural History Museum for the loan of their material; and Dr. Marius S. Wasbauer (retired, California State Collection of Arthropods) for collecting these rarely collected flies.

## Literature cited

- Cole, F.R. (1923) A revision of the North American two-winged flies of the family Therevidae. *Proceedings of the United States National Museum*, 62, 1-140.
- Evenhuis, N.L. (1977) New North American Bombyliidae (Diptera) with notes on some described species. *Entomological News*, 88, 121-126.
- Evenhuis, N.L. (1991) World catalog of genus-group names of bee flies (Diptera: Bombyliidae). *The Bishop Museum Bulletin of Entomology*, 5, 1-105.
- Hall, J.C. (1972) New North American Heterotropinae (Diptera: Bombyliidae). *The Pan-Pacific Entomologist*, 48, 37-50.
- Irwin, M.E. (1976) Morphology of the terminalia and known ovipositing behaviour of female Therevidae (Diptera: Asiloidea), with an account of correlated adaptations and comments on cladistic relationships. *Annals of the Natal Museum*, 22, 913-935.
- Irwin, M.E. & Lyneborg, L. (1981a [1980]) The genera of Nearctic Therevidae. *Bulletin of the Illinois Natural History Survey*, 32, 193-227.
- Irwin, M.E. & Lyneborg, L. (1981b) Therevidae. In: McAlpine, J.F., Peterson, B.V., Shewell, G.E., Teskey, H.J., Vockeroth, J.R. & Wood, D.M. (Ed): *Manual of Nearctic Diptera Volume 1*, Research Branch, Agriculture Canada, Ottawa, Ontario, Canada, 513-523.
- Kampmeier, G.E., Irwin, M.E. & Thompson, F.C. (1998) MANDALA: a database weaving together information on specimens, nomenclature, and literature for systematics research. *Fourth International Congress of Dipterology, Oxford, England, Abstract Volume*, pp. 98-99.
- Kelsey, L.P. (1969) A revision of the Scenopinidae (Diptera) of the world. *Bulletin of the United States National Museum*, 277, 1-336.
- Lyneborg, L. (2001) The Australian stiletto-flies of the *Anabarhynchus* genus-group (Diptera: Therevidae). *Entomonograph Volume 13*, Stenstrup, Apollo Books.
- McAlpine, J.F. (1981) Morphology and terminology – Adults. In: McAlpine, J.F., Peterson, B.V., Shewell, G.E., Teskey, H.J., Vockeroth, J.R. & Wood, D.M. (Ed): *Manual of Nearctic Diptera Volume 1*, Research Branch, Agriculture Canada, Ottawa, Ontario, Canada, 9-63.
- Melander, A.L. (1928) Diptera. Family Empididae. Fascicle 185. In: Wytzman, P. (Ed) *Genera Insectorum*, Louis Desmet-Verteneuil, Bruxelles, 434 pp.
- Melander, A.L. (1950) Taxonomic notes on some smaller Bombyliidae (Diptera). *The Pan-Pacific Entomologist*, 26, 139-156.
- Nagatomi, A., Liu, N. & Yanagida, K. (1994) Notes on Proratinae (Diptera: Scenopinidae). *South Pacific Study*, 14 (2), 137-222.

- Ovtshinnikova O.G. & Yeates, D.K. (1998) Male genital musculature of Therevidae and Scenopinidae (Diptera: Asiloidea): structure, homology and phylogenetic implications. *Australian Journal of Entomology*, 37, 27-33.
- Sinclair, B.J., Cumming, J.M. & Wood, D.M. (1994) Homology and phylogenetic implications of male genitalia in Diptera – Lower Brachycera. *Entomologica Scandinavica*, 24, 407-432.
- Theodor, O. (1983) The genitalia of Bombyliidae (Diptera). *Jerusalem: The Israel Academy of Sciences and Humanities*.
- Winterton, S.L., Irwin, M.E. & Yeates, D.K. (1999a) Systematics of *Nanexila* Winterton & Irwin, gen. nov. (Diptera: Therevidae) from Australia. *Invertebrate Taxonomy*, 13, 237-308.
- Winterton, S.L., Merritt, D.J., O'Toole, A., Yeates, D.K. & Irwin, M.E. (1999b) Morphology and histology of the spermathecal sac, a novel structure in the female reproductive system of Therevidae (Diptera: Asiloidea). *International Journal of Insect Morphology and Embryology*, 28, 273-279.
- Yeates, D.K. (1992) Towards a monophyletic Bombyliidae (Diptera): the removal of the Proratinae (Diptera: Scenopinidae). *American Museum Novitates*, 3051, 1-30.
- Yeates, D.K. (2002) Relationships of extant lower Brachycera (Diptera): a quantitative synthesis of morphological characters. *Zoologica Scripta*, 31, 105-121.