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TAXONOMIC STATUS OF THE AUSTRALIAN MAYFLY GENERA *JAPPA* AND *ULMEROPHLEBIA* (EPHEMEROPTERA: LEPTOPHLEBIIDAE)[1]

Y. J. Bae,[2] K. J. Finlay,[3] and I. C. Campbell[3]

ABSTRACT: The Australian burrowing mayfly genera *Jappa* and *Ulmerophlebia* are confirmed as monophyletic groups. Their adult and larval stages are redescribed and their egg stages are newly described. Additional taxonomic and phylogenetic discussions are provided.

KEY WORDS: Ephemeroptera, Letophlebiidae, *Jappa, Ulmerophlebia,* Australia.

The Australian mayfly genera *Jappa* Harker and *Ulmerophlebia* Demoulin (Leptophlebiidae) are unique among Ephemeroptera because of the convergent adaptation with the burrowing mayflies (Ephemeroidea) from the Northern Hemisphere (Campbell, 1990; Bae and McCafferty, 1991, 1995). Members of the Ephemeroidea do not occur in Australia, and these are the genera of Ephemeroptera most closely adapted to hyporheic habitats in Australia. The larvae are generally found under cobble- or boulder-sized stones embedded in sand and silt substrate in mid-sized to large lowland streams (Riek, 1970; Peters and Campbell, 1991; Edmunds and McCafferty, 1996).

The larvae of *Jappa* possess a characteristic head with a two-pronged frontal process or "cephalic tusks" (Fig. 1) that is analogous to the mandibular tusks of Ephemeroidea, in particular those of Potamanthidae (see Bae and McCafferty, 1991: Figs. 11-14), while the larvae of *Ulmerophlebia* lack such structure (Fig. 2). Despite this morphological difference, the generic distinction of the genera has been continuously questioned by mayfly taxonomists not only because their general morphology in adult and larval stages is similar, but because generic concepts have not been well defined.

Harker (1954) established the genus *Jappa* based on adult and larval stages. At that time, forewing length to width ratio and "a burrowing type larva" with tusk-like head frontal processes or "horns" were used as the major defining characteristics. Demoulin (1955) erected the genus *Ulmerophlebia* to include a species, *Euphyurus mjobergi* Ulmer, described (as an adult only) by Ulmer (1916), but did not compare it with *Jappa.* Previously, Ulmer (1920) recombined *E. mjobergi* with *Deleatidium* Eaton; and Demoulin (1955) distinguished *Ulmerophlebia* from *Deleatidium* mainly by wing and genital characters.

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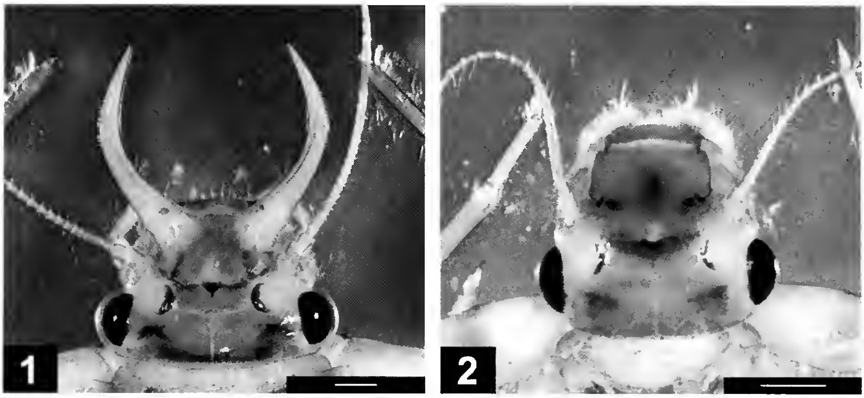


Figs. 1-2. Larval head: 1. *Jappa kutera* (bar = 0.5mm). 2. *Ulmerophlebia mjobergi* (bar = 0.5mm).

Williams (1968) mentioned a possible congeneric status of *Jappa* and *Ulmerophlebia* based on personal communication with E. F. Riek. Riek (1970), in the Ephemeroptera chapter of the textbook "The Insects of Australia," placed all burrowing Australian leptophlebiids, i.e. *Jappa* and *Ulmerophlebia,* into *Jappa* without any explanations. Peters and Campbell (1991) also followed the previous classification by Riek (1970) in the second edition of the textbook. Suter (1986) provided a historical background of *Ulmerophlebia* and described the larval stage of *Ulmerophlebia* for the first time based on a second species, *U. pipinna* Suter, but was conservative in clarifying the generic status of the *Ulmerophlebia* and *Jappa.* Dean (1999) gave larval diagnoses of *Jappa* and *Ulmerophlebia* when he provided larval keys to three nominal and four unnamed species of *Jappa* and four unnamed species of *Ulmerophlebia,* but still did not resolve the generic status.

For the above reasons, the generic concepts of *Jappa* and *Ulmerophlebia* have not been fully resolved. The purpose of this study is to clarify and delineate the genera and provide detailed redescriptions of adult, larval, and egg stages.

Type and voucher specimens and additional fresh materials of all previously known species of *Jappa* and *Ulmerophlebia* (see Species included, pp. 5, 7) are housed mainly in the Museum of Victoria, Australian National Insect Collection in Canberra, and Monash University and were examined for this study. Terminology, measurement, and other general methods are after Bae and McCafferty (1991).

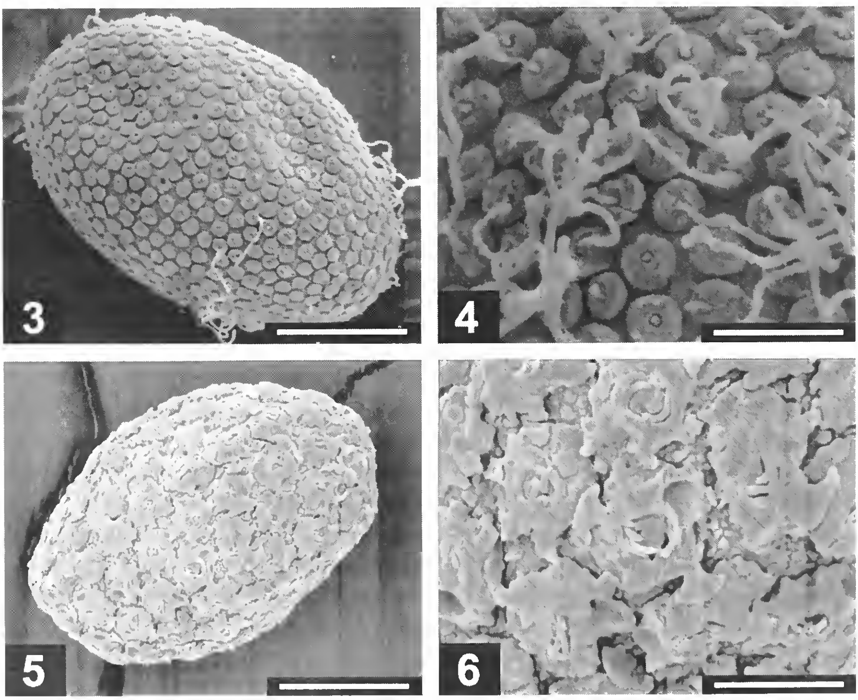
Jappa Harker

Jappa Harker, 1954: 257 [Type species: *Jappa kutera* Harker, by original designation; M & L]; Williams, 1968: 170 (L key); Dean and Suter, 1996: 44 (L); Dean, 1999: 34 (L).

Adult. Male body length 9.4-11.3 mm; female body 12.0-16.5 mm; caudal filaments 14.0-19.1 mm. General body color light yellow with dark purplish brown markings. *Head:* Male dorsal compound eyes 1.10-1.43 mm in length, 1.00-1.19 mm in width, 0.48-0.68 mm in height, broadly meeting posteromedially (B/D = 0), dome-shaped, dorsally oval, and with anterior margin round and posterior margin somewhat attenuating from lateral view ("bicycle helmet" shaped); basal compound eyes anteroventrally pronounced, invisible to slightly visible from dorsal view, 0.67-0.87 mm in length, 0.43-0.58 mm in height, and anteriorly oriented from lateral view. Female compound eyes 0.33-0.47 mm in width and 1.53- 1.67 mm in distance between compound eyes (B/D = 3.50-4.70). *Thorax:* Forewings transparent, often with dark purplish brown markings at basal, central, and apical areas, 8.8-15.6 mm in length, and 2.9-5.3 mm in width; longitudinal veins light brown to dark purplish brown; crossveins light brown to dark purplish brown (basally and anteriorly located crossveins often darker and more heavily infuscated); crossveins C-Sc 20-30, Sc-R1 16-20, and R1-R2 13-15 in number; crossveins in stigmatic area not anastomosed; MP2 basally connected to MP1 and CuA; ICu1 basally connected to CuA and CuP (angle between ICu1 and crossvein ICu1-CuP larger than angle between ICu1 and crossvein ICu1-CuA). Hindwings transparent, 2.3-2.9 mm in length, and 1.2-1.4 mm in width; longitudinal veins white to light yellow; crossveins C-Sc, Sc-R1, and some in distal part sometimes dark brown; Sc ending relatively distally (length of Sc / distance from base of Sc to apex of distal margin = 0.89); crossveins C-Sc 9-11, more or less evenly distributed (in one species, C-Sc crossveins apically concentrated); costal margin round, with weakly developed costal projection at midlength; Rs 0.48-0.68 mm; R1 0.64-0.98 mm; MPs 0.25-0.48 mm; MP1 1.11-1.37 mm. Male forefemora 2.10-2.27 mm, foretibiae 2.90-3.25 mm, foretarsal segments 1, 2, 3, 4, and 5 0.13-0.14 mm, 1.08-1.27 mm, 1.00-1.18 mm, 0.76-0.89 mm, and 0.38-0.44 mm (foretarsal segment 2>3>4> 5>1), and foreclaws 0.15-0.24 mm. Female foretibiae>forefemora>foretarsi. Claws dissimilar. *Abdomen:* Abdominal segment 9 with moderately to well developed posterolateral projections. Penes Y-shaped or V-shaped, relatively long (height of penis / height of forceps segment 1 = 0.45-0.56); forceps 3-segmented, with segment 1 0.92-1.03 mm, segment 2 0.10-0.13 mm, and segment 3 0.08-0.12 mm in length; forceps segment 1 basally broad and apically slender, with relatively abrupt constriction (constriction angle 80-110°) at mid-length to 3/4 apically; forceps segments 2 and 3 often indistinctly demarcated. Caudal filaments light yellow, often with purplish brown to dark brown stripes, often with maculation at joints; cerci 1.3-1.7x length of body; terminal filament as long as cerci.

Larva. Male body length 10.4-16.9 mm; cephalic tusks 1.0-2.0 mm; caudal filaments 5.9-10.9 mm. Female body length 10.4-23.8 mm; cephalic tusks 1.4-3.5 mm; caudal filaments 5.9-18.1 mm. Body surface glassy and heavily setose. General body color light yellow to light brown with dark purplish brown markings. *Head:* Head (Fig. 1) 1.30-2.38 mm in length and 1.75-4.13 mm in width. Male compound eyes dorsally 0.56-0.60 mm in width and 0.65-1.06 mm in distance between compound eyes (B/D = 1.08-1.76). Female compound eyes dorsally 0.23-0.56 mm in width and 1.38-2.86 mm in distance between compound eyes (B/D = 4.75-6.11). Antennae 4.4-6.3 mm in length, with whorls of hairlike setae at each segment. Cephalic tusks arched and attenuating, apically convergent and upward, 1.32-2.30 mm in inner length and 1.58-2.88 mm in outer length, 14.9-26.5° in curvature; each cephalic tusk with rudimentary to distinct dorsal ridge, with small to large basodorsal tubercle, with fields of 6-20, 5-15, and 10-20 hairlike setae at basomedial, basosublateral, and apicodorsal areas (in two species apicodorsal setal field lacking), respectively, sometimes with lateral row of 1-4 spines (in one species lateral spine single and prominent), and sometimes with additional dorsolateral row of 6-13 spines. Labrum distally wider (maximum length 0.30-0.38 mm; basal width 0.59-0.87 mm; distal maximum width 0.75-1.06 mm); dorsal surface heavily setose, with basal and subapical hairlike setal fringes (basal setae longer than subapical setae); subapical setal fringe laterally longer and 8-15 setae densely arranged medially; anterior and lateral margins with hairlike setal row; anterior margin concave, with prominent median tubercle, and with three pairs of rudimentary submedian denticles; ventral surface with dense hairlike setal field along anterior margin, with row of 10-20 stout setae on subanterior margins, and with fields of 20-50 hairlike setae at submedian areas.

Mandible dorsolateral margins with very long hairlike setal row; ventral surface with transverse row of 10-20 hairlike setae; inner incisors slightly smaller to as large as outer incisors; incisors with 2-3 apical teeth and 0-4 lateral denticles; prostheca rudimentary, with well-developed fringe. Hypopharynx superlinguae laterally curved and apically pointed. Maxillae with dense hairlike setal field medially 3/4 on galealacinial crown, mixed with rowed comblike setae medially 1/2 on galealacinial crown, with one pronounced comblike seta medioapically, and with rowed dense hairlike setae on medial margin; maxillary palp segment 1 0.27-0.52 mm, segment 2 0.37-0.48 mm, and segment 3 0.19-0.37 mm in length; segment 1 and 2 with sparse hairlike setae alone outer margin; segment 3 indistinctly demarcated from segment 2, with pronounced outer margin, and with strongly developed setal field along outer margin. Labial glossae dorsoventrally elongated and ventrally stalked, with dense hairlike setae; paraglossae with dense hairlike setal field dorsoapically; labial palp segment 1 0.28-0.59 mm, segment 2 0.31-0.40 mm, and segment 3 0.22-0.32 mm in length; segment 3 indistinctly demarcated from segment 2, apically pointed, with dense hairlike setal field along outer margin, and with stout setal row along inner margin. *Thorax:* Pronotum anterolateral margins round; lateral margins with row of sparse to dense hairlike setae. Forefemora 1.67-4.88 mm, foretibiae 1.67-5.63 mm, foretarsi 0.71-1.63 mm, and foreclaws 0.24-0.63 mm in length (foretibiae≥forefemora>foretarsi>foreclaws); forefemora with long hairlike setal fields along anterior and posterior margins and basomedial area on dorsal surface; foretibiae with dense hairlike setal field (filtering setae) rowed along inner and outer margins (dorsomedially bare), with stout setal field (raking setae) on 2/3 apical to entire inner margin; foretarsi with dense hairlike setae on dorsal and lateral surfaces; foreclaws apically darker, with 10-15 tiny teeth 3/4 basally. Midlegs and hindlegs heavily setose; length femora>tibiae>tarsi>claws. *Abdomen:* Terga light brown to light purplish brown, mostly with submedian and sublateral dark purplish brown stripes, with very long hairlike setae covered on 1/2-3/4 dorsal area along median line, and with hairlike setal row along lateral margins; abdominal segment 8-9 with moderately to well developed posterolateral projections. Sterna bare (sterna 9-10 sometimes with hairlike setae). Gills on abdominal segment 1-7, double; both lamellae with indistinct to distinct



Figs. 3-6. Eggs: 3. *Jappa kutera* (bar = 38μm). 4. *J. kutera*, in part (bar = 10μm). 5. *Ulmerophlebia mjobergi* (bar = 43μm). 6. *U. mjobergi*, in part (bar = 17.6μm).

tracheae, with single apical filament; gill lamella inner part strongly expanded apicolaterally, and with fine setae on 1/5-1/2 apical margin; gill lamella outer part with fine setae on entire margin; apical filament attenuating, marginally with fine setae; gills 4 1.38-2.86 mm in length, 0.78-1.83 mm in width, and 1.38-2.38 mm in filament length, with weakly to strongly developed apical expansion. Caudal filament segments with whorls of setae.

Egg. Egg (Fig. 3) oval; long axis 124 μm; short axis 80 mm. Color light yellow in nature, white in alcohol. Egg surface (Fig. 4) with ca. 780 knob-terminated coiled threads relatively evenly distributed throughout egg surface; diameter of knob-terminated coiled threads 3.9-4.5 mm. Polar caps absent. Micropyles several, scattered, tagenoform; sperm guide circular, 2.6-3.3 μm in diameter.

Diagnosis. Adults of *Jappa* possess greater numbers of C-Sc crossveins (20-30) in the forewings and more or less evenly distributed C-Sc crossveins in the hindwings (excluding one species), while those of *Ulmerophlebia* possess fewer C-Sc crossveins (12-19) in the forewings and apically concentrated C-Sc crossveins in the hindwings. The hindwing vein Sc of *Jappa* ends relatively distally (length of Sc / distance from base of Sc to apex of distal margin = 0.89) comparing with that of *Ulmerophlebia* (0.76). The penes of *Jappa* are relatively longer (height of penis / height of forceps segment 1 = 0.45-0.56) than those of *Ulmerophlebia* (0.08-0.31). The constriction in the medial margin of forceps segment 1 of *Jappa* is relatively abrupt (angle 80-110°), while that of *Ulmerophlebia* is relatively gradual (angle 135-150°). The larvae of *Jappa* can easily be distinguished from those of *Ulmerophlebia* and any other leptophlebiid genera by the cephalic tusks (Fig. 1). In addition, the body size of *Jappa* in both of the adults and larvae (adult 9.4-16.5 mm, larva 10.4-23.8 mm) is generally larger than that of *Ulmerophlebia* (adult 6.9-8.7 mm, larva 5.5-10.0 mm).

Species included. *Jappa kutera* Harker (1954), *J. edmundsi* Skedros and Polhemus (1986), *J. serrata* Skedros and Polhemus (1986), *Jappa* AV1 (Dean, 1999), *Jappa* AV2 (Dean, 1999), *Jappa* AV3 (Dean, 1999), and *Jappa* AV4 (Dean, 1999).

Distribution. NSW, NT, northern WA, QLD, and VIC.

Remarks. There are several other species previously considered as, or assigned to, *Jappa*. *Jappa tristis* Harker (1954) [Holotype stage: M; locality: Tasmania, Cradle Mt.; deposition: British Museum (Natural History)] was subsequently identified as *Tillyardophlebia* Dean by Dean (1999). *Jappa* is not considered present in Tasmania.

Leptophlebia furcifera Eaton (1871) [Type stage: M; locality: Melbourne; deposition: Melbourne Museum = Museum of Victoria], recombined with *Atalophlebia* Eaton by Eaton (1884), was considered in *Jappa* by Dean (1999). However, the type specimen was not preserved in the Museum of Victoria when YJB checked in 2001 and there is little evidence that this species belongs to *Jappa* based on Eaton's original description (Eaton, 1871) and redescription (Eaton, 1884).

Leptophlebia strigata Eaton (1871) [Type stage: F; locality: North Australia; deposition: McLachlan Collection in British Museum (Natural History)], recombined with *Atalophlebia* by Eaton (1884) and *Deleatidium* by Ulmer (1920), was also considered in *Jappa* by Dean (1999). The original description (Eaton, 1871) and redescription (Eaton, 1884) of the species do not clearly substantiate the generic position, and it is crucial that the types be reexamined before generic placement can be confirmed.

Ulmerophlebia Demoulin

Ulmerophlebia Demoulin, 1955: 228 [Type species: *Euphyurus mjobergi* Ulmer, by original designation; A]; Suter, 1986: 352 [M & L]; Dean and Suter, 1996: 44 [L]; Dean, 1999: 74 [L].

Adult. Male body length 6.9-8.7 mm; female body 6.3-8.6 mm; caudal filaments 7.5-9.5 mm. General body color light yellow with dark purplish brown markings. *Head:* Male dorsal compound eyes 0.92-0.98 mm in length, 0.78-0.87 mm in width, 0.44-0.56 mm in height, 0-0.05 mm in distance between compound eyes (B/D = 0-0.06), dome-shaped, dorsally oval, and with anterior margin round and posterior margin somewhat attenuating from lateral view ("bicycle helmet" shaped); basal compound eyes anteroventrally pronounced, invisible to slightly visible from dorsal view, 0.52-0.66 mm in length, 0.29-0.36 mm in height, and anteriorly oriented from lateral view. Female compound eyes 0.22-0.29 mm in width, and 0.83-1.03 mm in distance between compound eyes (B/D = 3.11-4.91). *Thorax:* Forewings transparent, often with dark purplish brown markings at basal, central, and apical areas, 6.6-8.5 mm in length, and 2.2-3.2 mm in width; longitudinal veins light brown to dark purplish brown; crossveins light brown to dark purplish brown (basally and anteriorly located crossveins often darker and more heavily infuscated); crossveins C-Sc 12-19, Sc-R1 12-16, and R1-R2 10-14 in number; crossveins in stigmatic area not anastomosed; MP2 basally connected to MP1 and CuA; ICu1 basally connected to CuA and CuP (angle between ICu1 and crossvein ICu1-CuP larger than angle between ICu1 and crossvein ICu1-CuA). Hindwings transparent, 1.3-1.9 mm in length, and 0.7-1.0 mm in width; longitudinal veins white to light yellow; crossveins C-Sc, Sc-R1, and some in distal part sometimes dark brown; Sc ending relatively proximally (length of Sc / distance from base of Sc to apex of distal margin = 0.76); crossveins C-Sc 4-10, apically concentrated; costal margin round, with weakly developed costal projection at 1/3 basally to midlength; Rs 0.27-0.40 mm; R1 0.56-0.75 mm; MPs 0.20-0.31 mm; MP1 0.47-1.06 mm. Male forefemora 0.45-1.67 mm, foretibiae 2.22-2.83 mm, foretalsal segments 1, 2, 3, 4, and 5 0.10-0.13 mm, 0.68-0.97 mm, 0.70-0.93 mm, 0.55-0.70 mm, and 0.25-0.30 mm (foretarsal segment $2 \geq 3 > 4 > 5 > 1$), and foreclaws 0.13-0.15 mm. Female foretibiae> forefemora>foretarsi. Claws dissimilar. *Abdomen:* Abdominal segment 9 with moderately to well developed posterolateral projections. Penes Y-shaped or V-shaped, relatively short or rudimentary (height of penis / height of forceps segment 1 = 0.08-0.31); forceps 3-segmented, with segment 1 0.63-0.68 mm, segment 2 0.06-0.09 mm, and segment 3 0.06-0.08 mm in length; forceps segment 1 basally broad and apically slender with relatively gradual constriction (constriction angle > 135-150°) at midlength to 2/3 apically; forceps segments 2 and 3 often indistinctly demarcated. Caudal filaments light yellow, often with purplish brown to dark brown stripes, often with maculation at joints; cerci 1.1-1.7x length of body; terminal filament as long as or slightly longer than cerci.

Larva. Male body length 6.2-9.8 mm; caudal filaments 5.5-10.0 mm. Female body length 6.8-11.2 mm; caudal filaments 6.3-13.2 mm. Body surface glassy and relatively less setose. General body color light yellow to light brown with dark purplish brown markings. *Head:* Head (Fig. 2) light brown, 1.27-1.40 mm in length and 1.59-1.75 mm in width. Male compound eyes dorsally 0.48-0.58 mm in width and 0.43-0.56 mm in distance between compound eyes (B/D = 0.74-1.10). Female compound eyes dorsally 0.20-0.24 mm in width and 1.10-1.35 mm in distance between compound eyes (B/D = 4.67-6.00). Antennae 4.0 mm in length, with whorls of hairlike setae at each segment. Cephalic tusks absent. Clypeus greatly developed, 0.38-0.45 mm in length, 0.68-0.90 mm in basal width, 0.64-0.83 mm in apical width, with pronounced sublateral tubercles, and with fields of 8-10 hairlike setae subapicolaterally and 4-15 hairlike setae subbasolaterally. Labrum slightly narrower than clypeus (0.92x width of clypeus), slightly wider distally (maximum length 0.28 mm; basal width 0.56 mm; distal maximum width 0.60 mm); dorsal surface moderately setose, with basal and subapical hairlike setal fringes (basal setae as long as subapical setae); subapical setal fringe laterally longer (setae curved forward) and without dense arrangement; anterior and lateral margins with dense hairlike setal row; anterior margin slightly concave, with prominent median tubercle, and with three pairs of rudimentary submedian denticles; ventral surface with dense hairlike setal field along anterior margin, with row of 15-18 stout setae on subanterior margins, and with fields of 10-15 hairlike setae at submedian areas. Mandible dorsolateral margins with very long hairlike setal row; ventral surface without setal row; inner incisors slightly smaller to as large as outer incisors; incisors with 2-

3 apical teeth and 0-4 lateral denticles; prostheca rudimentary, with well developed fringe. Hypopharynx superlinguae laterally curved and apically pointed. Maxillae with dense hairlike setal field, mixed with row of comblike setae almost entirely on galealacinial crown, without medioapical comblike seta, and with row of dense hairlike setae on medial margin; maxillary palp segment 1 0.26 mm, segment 2 0.29 mm, and segment 3 0.12 mm in length; segment 2 with sparse hairlike setae along outer margin; segment 3 indistinctly demarcated from segment 2, with moderately developed outer margin, and with moderately developed setal field along outer margin. Labial glossae dorsoventrally elongated and ventrally stalked, with dense hairlike setae; paraglossae with dense hairlike setal field dorsoapically; labial palp segment 1 0.38 mm, segment 2 0.27 mm, and segment 3 0.20 mm in length; segment 3 indistinctly demarcated from segment 2, apically pointed, with dense hairlike setal field along outer margin, and with stout setal row along inner margin. *Thorax:* Pronotum anterolateral margins round; lateral margins with row of sparse hairlike setae. Forefemora 1.15-1.50 mm, foretibiae 1.00-1.38 mm, foretarsi 0.43-0.55 mm, and foreclaws 0.15-0.25 mm in length (forefemora≥ foretibiae>foretarsi>foreclaws); forefemora with a few hairlike setae on dorsal and ventral surfaces, and with hairlike setal field along posterior margin (anterior margin with few hairlike setae); foretibiae with relatively sparse hairlike setae (filtering setae) dorsally and along outer margin (inner margin with few hairlike setae), with stout setal field (raking setae) 5/6 apically on inner margin; foretarsi with relatively sparse hairlike setae on dorsal and lateral surfaces; foreclaws apically darker, with rowed tiny teeth basally. Midlegs and hindlegs moderately setose; length femora>tibiae> tarsi>claws. *Abdomen:* Terga light yellow to light brown, mostly with broad submedian dark brown stripes, without long hairlike setal field along median line, and with hairlike setal row along lateral margins; abdominal segment 8-9 with moderately to well developed posterolateral projections. Sterna bare. Gills on abdominal segment 1-7, double; both lamellae with indistinct to distinct tracheae, with single apical filament; gill lamella inner part strongly expanded apicolaterally, and with fine setae on 1/10-1/2 apical margin; gill lamella outer part with fine setae on apically 1/10 to entire margin; apical filament attenuating, marginally with fine setae; gills 4 1.11-1.67 mm in length, 0.56-0.89 mm in width, 0.95-1.43 mm in filament length, with weakly to strongly developed apical expansion. Caudal filament segments with whorls of setae.

Egg. Egg (Fig. 5) oval; long axis 149 μm; short axis 100 μm. Color light yellow in nature, white in alcohol. Egg surface (Fig. 6) with ca. 116 knob-terminated coiled threads nearly evenly distributed throughout egg surface, with 0.4-2.1 μm tiny granules throughout egg surface; diameter of knob-terminated coiled threads 8.6-10.3 μm. Polar caps absent.

Diagnosis. The adults and larvae of *Ulmerophlebia* can be distinguished from those of *Jappa* as specified above, in the diagnosis of *Jappa*. The larvae of *Ulmerophlebia* can be distinguished from other leptophlebiid genera by the following combination of characters: possessing a prominent median tubercle anteriorly on the labrum, lacking cephalic tusks, and possessing a somewhat enlarged clypeal margin with sublateral tubercles and subapicolateral and subbasolateral hairlike setal fields.

Species included. *Ulmerophlebia mjobergi* (Ulmer, 1916), *U. pipinna* Suter (1986), *Ulmerophlebia* AV2 (Dean, 1999), *Ulmerophlebia* AV3 (Dean, 1999), and *Ulmerophlebia* AV5 (Dean, 1999).

Distribution. NSW, QLD, and VIC.

Remarks. *Deleatidium annulatum* Harker (1950) [Holotype: M; locality: NSW, Point Lookout, Serpentine; deposition: Australian Museum, Sydney (destroyed)] was considered as *Ulmerophlebia* by Dean (1999), but the original description of the adult (e.g. wings) by Harker (1950) does not support placement in *Ulmerophlebia* and the description of the larva (e.g. maxillary palp) by Harker (1954) does not meet the generic concept of *Ulmerophlebia.*

Atopopus spadix Harker (1950) [Holotype: M; locality: NSW, Armidale; deposition: Australian Museum, Sydney (destroyed)] was also considered as

Ulmerophlebia by Dean (1999), but the original description of the adult (e.g. wings) by Harker (1950) does not support its placement in *Ulmerophlebia.*

DISCUSSION

In the phylogeny of the Atalophlebiinae (Leptophlebiidae), the genera *Jappa* and *Ulmerophlebia* have been hypothesized to constitute a basal clade, including *Hapsiphlebia, Atalophlebia, Atalomicria, Acanthophlebia, Aprionix,* and *Kalbaybaria* (Pescador and Peters, 1980; Towns and Peters, 1980, 1996; Campbell, 1993; Christidis, 2001). This clade, also known as the *Hapsiphlebia* lineage, was defined by the synapomorphies of lateral setae of the larval abdomen and incisor denticulation of the right mandible (Pescador and Peters, 1980).

From our comprehensive examinations of the species of *Jappa* and *Ulmerophlebia* and the species of related outgroup genera, we recognize an additional clade consisting of *Jappa* and *Ulmerophlebia.* This clade is defined by the synapomorphies of 1) a setose body, 2) gills marginally clothed with fine setae, 3) a median denticle anteriorly on the labrum, 4) submedian setal fields ventrally on the labrum, and 5) lateral spines on the larval abdomen.

Jappa and *Ulmerophlebia* are thus distinct monophyletic sister groups. *Jappa* is defined by the synapomorphies of 1) cephalic tusks, 2) a hairlike setal field ventrally on the mandible, 3) double rows of hairlike setae (filtering setae) dorsally on the tibiae, and 4) a long hairlike setal field along median abdomen. The cephalic tusks (Fig. 1) are unique in Leptophlebiidae. The cephalic tusks are arched and apically convergent and upward. They also bear basodorsal tubercles and setal fields at basomedial, subbasolateral, and apicodorsal areas. The body setation in *Jappa* is more specialized in having double rows of filtering setae on inner and outer margins of tibiae and broad setal fields on forefemora and along the median line of dorsal abdomen.

The monophyly of the *Ulmerophlebia* is supported by the synapomorphy of the unique "shovel-like" clypeal development (Fig. 2). The clypeus of *Ulmerophlebia* is flattened and somewhat elongated and possesses sublateral tubercles and hairlike setal fields in the subbasolateral and subapicolateral areas.

Although the adults of *Jappa-Ulmerophlebia* clade retain many plesiomorphic characters shared with other *Hapsiphlebia* lineage groups, the larvae are quite specialized as shown herein. The hairy body is associated with the fossorial habit of the members of *Jappa -Ulmerophlebia* clade and the cephalic tusks and shovel in *Jappa* and *Ulmerophlebia,* respectively, are evidently burrowing devices. In particular, the cephalic tusks of *Jappa* are analogous to the mandibular tusks of the Potamanthidae in Ephemeroidea, their Laurasian counterpart (Bae and McCafferty, 1991, 1995), in terms of functional morphology and burrowing behavior.

As evidenced above, the genera *Jappa* and *Ulmerophlebia* are distinct monophyletic groups that are here recognized at the generic level. Presumably, this will confirm with a strict phylogenetic classification if indeed the *Jappa-*

Ulmerophlebia clade, which is unique among Australian leptophlebiids being a burrowing mayfly group, is recognized as a distinct tribe as suggested for groupings under the subfamilies of Leptophlebiidae by Peters (1980). That classification can be adopted when the generic phylogenies of the Australian Leptophlebiidae are completed.

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A NEW SPECIES OF *PLATYCEPHALA* FROM CHINA (DIPTERA: CHLOROPIDAE: CHLOROPINAE)[1]

Shuwen An[2] and Ding Yang[3]

ABSTRACT: The genus *Platycephala* is newly recorded from Guangxi, with the description of a new species *P. guangxiensis*. Remarks on its relationships with the close species *P. zhejiangensis* Yang and Yang, 1995, are given.

KEY WORDS: Diptera, Chloropidae, Chloropinae, *Platycephala*, China.

The genus *Platycephala* Fallén belongs to the subfamily Chloropinae, and is characterized by the following features: Body large; head distinctly longer than high; frontal triangle occupying large part of frons, reaching anterior margin of frons with broadened apex; arista slender with short pubescence (Kanmiya, 1983). Until now the genus *Platycephala* contained seventeen species worldwide, of which eleven are known from the Oriental Realm (Sabrosky, 1977; Cherian, 1978; Kanmiya, 1983; Yang and Yang, 1994, 1995, 1997; An and Yang, 2003) and six from the Palaearctic Realm (Nartshuk, 1984). Eight species are known from China (An & Yang, 2003). The major references dealing with *Platycephala* are as follows: Andersson (1977), Cherian (1978), Kanmiya (1983).

In this paper, one species of the genus *Platycephala* from Guangxi is described as new to science. Types are deposited in the Insect Collections of the China Agricultural University, Beijing.

Platycephala guangxiensis An and Yang, NEW SPECIES
(Figs.1-8)

Diagnosis: Head triangular in profile, about 1.5 times as long as high. Frontal triangle trapezoidal, polished brownish yellow with two blackish lateral spots. Thorax black; propleuron brown with dark brown spot at posterior margin; pteropleuron blackish brown with pale upper part. Legs pale yellow.

Description: Male: Body length 5.5-6.5 mm, wing length 3.8-4.6 mm.

Head (Figs 1-2) blackish brown, triangular in profile, about 1.5 times as long as high; frons strongly produced beyond anterior level of eye, in profile about 0.35 times as long as long axis of eye; gena prominently broadened posterad, anteriorly strongly narrowed below eye; parafacial about 0.07 times as broad as long axis of eye. Frontal triangle trapezoidal, polished brownish yellow, occupying most of frons and reaching its anterior margin, semicircular anteriorly with two blackish lateral spots, and with many transverse grooves occupying median longitudinal area in front of ocelli; ocellar triangle black; area between eye and frontal triangle depressed and brownish. Occiput subshiny and punctured; gena and frons (in front of eye) brownish. Hairs and bristles on head brownish black. Antenna (Fig 3) brown with pale gray pollen; pedicel 0.8 times as long as flagellum; flagellum nearly rectangular, 1.6 times as long as wide, rounded apically, with blackish brown anterior and

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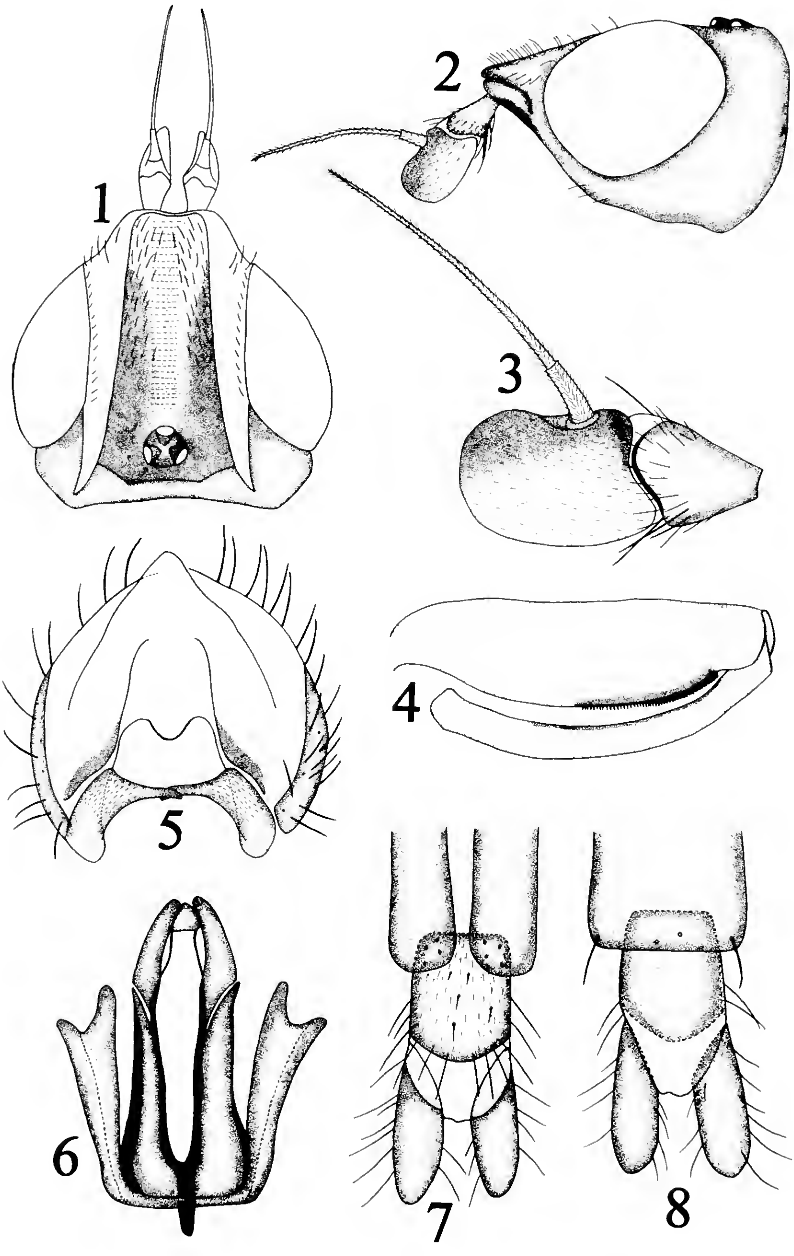

Figs. 1-8. *Platycephala guangxiensis*, n. sp. (male and female). 1, head, dorsal view; 2, head, lateral view; 3, antenna, outer lateral view; 4, hind femur, lateral view; 5, epandrium, posterior view; 6, hypandrium and phallic complex, ventral view; 7, female abdominal terminalia, ventral view; 8, female abdominal terminalia, dorsal view.

dorsal margins; arista pale yellow with brownish basal segment, pale short pubescent. Proboscis and palpus pale yellow with pale hairs.

Thorax black, slightly narrower than head; propleuron brown with dark brown spot at posterior margin; pteropleuron blackish brown with pale upper part; mesonotum 1.3 times as long as wide, with prominent setigerous punctures; scutellum pale pollinose, 1.5 times as wide as long and brown at posterior margin. Hairs on thorax pale, bristles black; apical scutellar bristles convergent posteriorly and nearly as long as scutellum; subapical scutellar bristles about 0.2 times as long as scutellum; sternopleuron with some long thin hairs. Legs pale yellow and pollinose except hind femur and basal part of hind tibia brownish. Hind femur (Fig 4) distinctly thickened, about 3.4 times as long as wide and 3 times as thick as fore femur; hind tibia somewhat curved and black ventrally. Hairs on legs pale, but tarsi with brown hairs. Wing hyaline; veins mostly brown. Relative lengths of costal sections 2nd: 3rd : 4th =2.2 : 3.2 : 2.2; relative lengths of ultimate and penultimate sections of veins R_{2+3} (4.4:1), R_{4+5} (5.3:1.5), M (4:2.2), CuA_1 (1:3.2); penultimate section of M about 7.3 times as long as *r-m*; R_{4+5} and M nearly parallel; *dm-cu* and *r-m* convergent posteriorly. Squama yellow with brownish yellow hairs. Halter pale yellow with white knob.

Abdomen dark brown; tergites 1-2 black and rugose; tergite 7 and following tergites brownish; venter yellow. Hairs on abdomen pale; dorsum with some long thin hairs laterally. Male genitalia (Figs 5-6): epandrium blackish, nearly as long as wide, with some long hairs; surstyli brown, attached to epandrium at base, narrow and crossing apically; hypandrium blackish, higher than wide; gonites well demarcated by oblique suture; pregonites parallel-sided with distal ends acute; postgonites oblique, distal ends convergent.

Female: Body length 6.3-7.3 mm, wing length 4.1-4.3 mm. Similar to male. Female genitalia (Figs 7-8): yellow; tergite 10 nearly rectangular, distinctly longer than wide, distal portion narrowing toward tip and membranous; sternite 10 nearly quadrate, shorter than tergite 10. Hairs on genitalia brown, short, but sternite 10 with one row of long hairs on apical margin; tergite 10 and cerci also with some long hairs.

Type Data: Holotype, male, CHINA: Guangxi, Tianlin, Cengwanglaoshan, 2002. VIII. 15, Ding Yang, deposited in the Insect Collection of China Agricultural University, Beijing. Paratypes: 2 males, 2 females. Same data and repository as holotype.

Etymology of specific epithet: The species is named after the type locality Guangxi.

DISCUSSION

The new species is somewhat similar to *Platycephala zhejiangensis* Yang *et* Yang, 1995 from Zhejiang in having the blackish brown head and brown antenna, but can be separated from the latter by the brown propleuron with dark brown spot at posterior margin, blackish brown pteropleuron with pale upper part and pale yellow hind tibia. In *P. zhejiangensis,* the thorax is wholly black, and the hind tibia is black (Yang and Yang, 1995).

Nine species of the genus *Platycephala* are known to occur in China. Among them seven species (*P. guangxiensis* An and Yang, *P. guizhouensis* An and Yang, *P. lii* An and Yang, *P. maculata* An and Yang, *P. sichuanensis* Yang and Yang, *P. xanthodes* Yang and Yang, as well as *P. zhejiangensis* Yang and Yang) are scattered in the central and southern regions of China: Western Mountain subregion (Sichuan), Min-Guang subregion (Guangxi), East Hilly Plain subregion (Zhejiang), Guizhou Plateau province (Guizhou), and Southern Yunnan subregion (Yunnan). All these regions are part of the Oriental Realm. Two other species [*P. sinensis* Yang and Yang, *P. umbraculata* (Fabricius)] are distributed in the Neimeng-Xinjiang region and the North China region (Beijing, Neimeng, Shaanxi) which are part of the Palaeraretic Realm. *Platycephala umbraculata* is also distributed in other parts of Asia (Japan and Mongolia) and Europe.

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REVIEW OF THE NEOTROPICAL GENUS *TRACHELIUM* HERRICH-SCHAEFFER, WITH THE DESCRIPTION OF SIX NEW SPECIES (HETEROPTERA: ALYDIDAE: MICRELYTRINAE: MICRELYTRINI)[1]

Harry Brailovsky[2]

ABSTRACT: Six new species of *Trachelium* Herrich-Schaeffer from Argentina, Bolivia, Brazil, Colombia, French Guiana, Panama, Trinidad, and Venezuela are described. New distributional records are given for: *T. alboapicatus* Distant, *T. bicolor* Herrich-Schaeffer, *T. fulvipes* Herrich-Schaeffer, *T. mimeticum* Breddin, *T. spectabile* Bergroth, and *T. tessellatus* Distant. A diagnosis for previously known species is provided, *T. spectabile* is redescribed, a key for the known species is given, and *T. fulvipes* is resurrected from his synonym under *T. bicolor.*

KEY WORDS: Insecta, Hemiptera, Alydidae, Micrelytrinae, *Trachelium,* new species, Central and South America

This paper attempts to summarize our knowledge of the genus *Trachelium* Herrich-Schaeffer. *Trachelium,* a typically myrmecomorphic and exclusively Neotropical genus, is characterized by having the humeral angles of the pronotum and the apex of the scutellum strongly spinose, the head elongate before eyes, the head behind eyes tapering and narrowed, and the hind femora unarmed. Schaefer (1996) discussed the relationship with *Cydamus* Stål, the most closely related, and recently Schaefer (2004) added a key to the new world Alydidae.

Trachelium is placed in the tribe Micrelytrini based on having rostral segment II longer than maximal length of segments III and IV together, rostral segment III less than half as long as IV, and a distinct evaporative area ridge. Previously only six species were known. In this contribution, six new species collected in Argentina, Bolivia, Brazil, Colombia, French Guiana, Panama, Trinidad and Venezuela are described, and new distribution records for *T. alboapicatus, T. bicolor, T. fulvipes, T. mimeticum, T. spectabile,* and *T. tessellatus* are included. *Trachelium fulvipes* is resurrected from the synonymy under *T. bicolor.*

The following abbreviations are used for the institutions cited in this paper: AMNH (The American Museum of Natural History, New York, USA); BMNH (The Natural History Museum, London, England); BYU (Brigham Young University, Monte L. Bean Life Sciences Museum, Provo, Utah, USA); CAS (California Academy of Sciences, San Francisco, California, USA); CMNH (Carnegie Museum of Natural History, Pittsburgh, PA, USA); CUIC (Cornell University, Insect Collection, Ithaca, New York, USA); DEU (Deutsches Entomologisches Institut, Eberswalde, Germany); FMNH (Field Museum of Natural History, Chicago, Illinois, USA); HMNH (Hungarian Natural History Museum, Buda-

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pest, Hungary); INBIO (Instituto Nacional de Biodiversidad, Heredia, Costa Rica); INPA (Instituto de Pesquizas da Amazonia, Manaus, Brazil); MNHN (Museum National D'Histoire Naturelle, Paris, France); MNRJ (Museum National, Rio de Janeiro, Brazil); RNHL (Rijksmuseum van Naturlijke Histoire, Leiden, Netherlands); UNAM (Instituto de Biología, Universidad Nacional Autónoma de México, Colección Nacional de Insectos); USNM (United States National Museum, Smithsonian Institution, Washington, D.C., USA); USUL (Utah State University, Logan, Utah, USA).

KEY TO THE SPECIES OF *TRACHELIUM*

1. Head dorsally, pronotum, and scutellum black to dark reddish brown 2
1a. Head dorsally, pronotum, and scutellum shiny orange to chestnut orange 7
2. Antennal segment IV reddish brown to chestnut orange, with basal third or basal half yellow 3
2a. Antennal segment IV entirely reddish brown to black 4
3. Scutellar spine reddish brown; metathoracic scent gland auricle bilobed, and raised; tubercle of calli exposed and acute .... *Trachelium ventus* NEW SPECIES
3a. Scutellar spine reddish brown with base yellow; metathoracic scent gland auricle elongate, flat and not bilobed; tubercle of calli short and stout .... *Trachelium alvarengai* NEW SPECIES
4. Femora black to dark reddish brown and with or without yellow ring near middle third; metathorax black with or without posterior margin yellow; abdominal sternite III black with or without longitudinal yellow stripe at middle third 5
4a. Femora, metathorax, and abdominal sternite III shiny orange .... *Trachelium bicolor* Herrich-Schaeffer
5. Hemelytral membrane with basal half brown and the angle white, and apical half pale ambarine; scutellar spine dark reddish brown .... *Trachelium spectabile* Bergroth (in part)
5a. Hemelytral membrane pale ambarine with basal angle white; scutellar spine dark reddish brown with base yellow........................ 6
6. Foreacetabulae, metacetabulae, posterior border of propleura, and basal joint of hind femur black to dark reddish brown .... *Trachelium tessellatus* Distant
6a. Foreacetabulae, metacetabulae, posterior border of propleura, and base of hind femur yellow to shiny orange........................ *Trachelium fulvipes* Herrich-Schaeffer
7. Hemelytral membrane with basal half brown and the angle white, and apical half ambarine; dorsal abdominal segments black........................ 8
7a. Hemelytral membrane pale ambarine, with basal angle white; dorsal abdominal segments orange 9
8. Pronotum and scutellum black to dark reddish brown; thorax black with anterior margin of prothorax, acetabulae, and upper and posterior margin of metathorax yellow .... *Trachelium spectabile* Bergroth (in part)
8a. Pronotum, scutellum, and thorax shiny orange to chestnut orange .... *Trachelium mimeticum* Breddin
9. Spines of humeral angles of pronotum short, hooklike, directed backward, with apex recurved backward (Fig. 2)........................ *Trachelium formosus* NEW SPECIES

9a. Spines of humeral angles of pronotum elongate, acute, needlelike, directed upward or obliquely backward (Fig. 1) 10
10. Antennal segment IV reddish brown to brownish orange 11
10a. Antennal segment IV brownish orange with basal third or basal half yellow 12
11. Scutellar spine shiny orange; length of antennal segment IV longer than 4.80 mm (♂) or 3.45 mm (♀); total body length longer than 11.00 mm (♂) or 9.80 mm (♀) .... *Trachelium secularis* NEW SPECIES
11a. Scutellar spine shiny orange with basal joint yellow; length of antennal segment IV shorter than 4.00 mm (♂) or 3.40 mm (♀); total body length shorter than 9.00 mm (♂), or 9.20 mm (♀) .... *Trachelium lepidus* NEW SPECIES
12. Metathoracic scent gland auricle creamy yellow, tuberculate, and conspicuously raised above the body surface; scutellar spine elongate, needlelike, and directed upward .... *Trachelium alboapicatus* Distant
12a. Metathoracic scent glad auricle yellow, elongate, and flat; scutellar spine iny, reduced to small conical expansion .... *Trachelim limitatus* NEW SPECIES

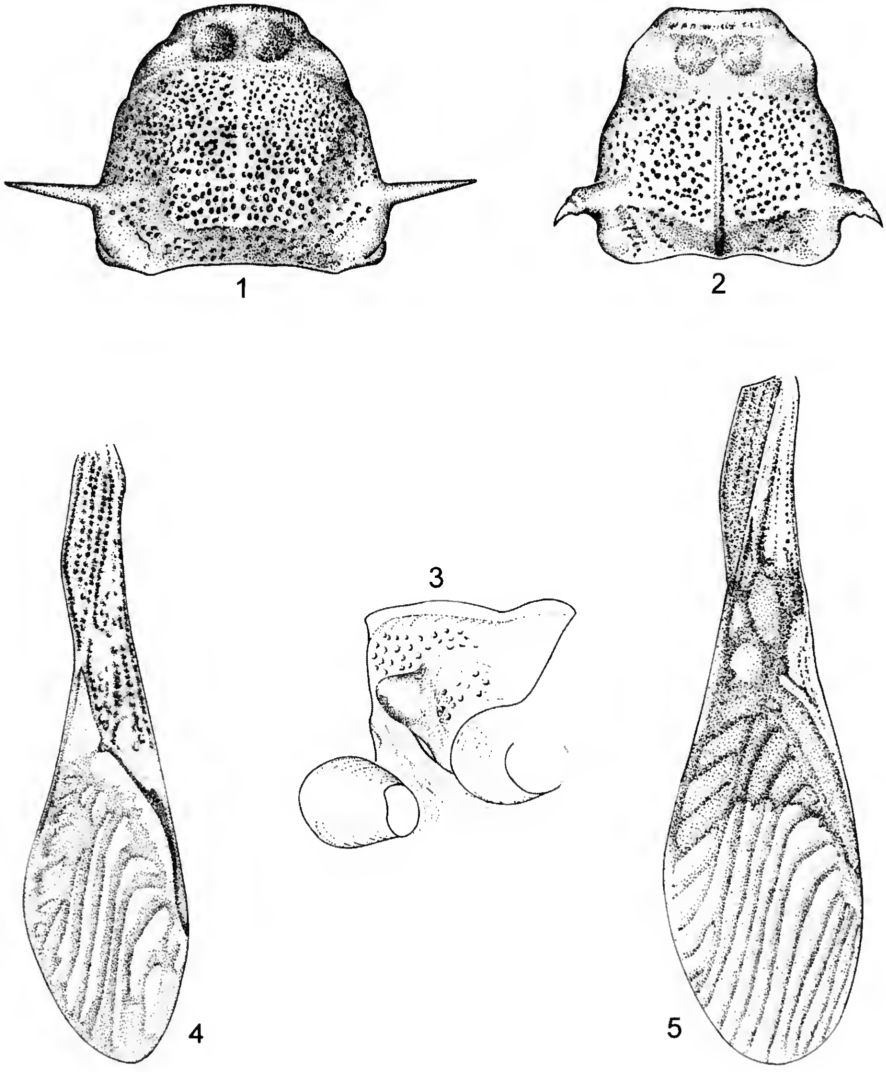
Trachelium alboapicatus Distant
(Fig. 3)

Trachelium alboapicatus Distant, 1881: 159.

Diagnosis. This species is characterized by having the head, antennal segments I to III, legs, and dorsal abdominal segments shiny orange to chestnut orange, the metathoracic scent gland auricle creamy yellow, tuberculate, and raised above the body surface (Fig. 3), antennal segment IV with the anterior third creamy yellow and the posterior third dark brown, the humeral spines of pronotum large, elongate, needlelike, entirely shiny orange and directed obliquely backward, and the scutellar spine entirely shiny orange, and directed upward with apex curving backward; hemelytral membrane including the basal angle pale ambarine, calli raised forming a hemispheric or convex lobe, and maximal length of antennal segment IV longer than maximal length of antennal segments II and III together.

Distribution. The present species was described from Guatemala (San Gerónimo, and Tamahu) and has been subsequently reported from México (Veracruz: Atoyac, and San Luis Potosi: Tamazunchale) and Panama (Volcan de Chiriqui) (Distant 1881-1893, and Brailovsky and Zurbia 1979).

Material examined. Holotype: male, Guatemala, San Gerónimo, Champion. Deposited in BMNH. **New country records.** Costa Rica: 1 male, 3 females, 20 km S of Upala, 11-15-V-1990, 13-XII-1990, 10-I-1991, F. D. Parker. Deposited in USUL. 1 male, Alajuela, Chachahua, 24-II-1982, H. Brailovsky and E. Barrera. Deposited in UNAM. Guatemala: 1 female, Alta Vera Paz, Trece Aguas, IV-1925, Schwartz and Barber. Deposited in AMNH. México: 1 female, Veracruz, San Andres Tuxtla, Laguna Escondida, 21-IV-1989, J. L. Colin. Deposited in UNAM. 1 male, Veracruz, Peñuelas, 15-VII-1941, H. S. Dybas. Deposited in FMNH.



Figures 1-5. *Trachelium* spp. 1-2. Pronotum. 1. *T. spectabile* Bergroth. 2. *T. formosus* NEW SPECIES. 3. Metathoracic scent gland auricle of *T. alboapicatus* Distant. 4-5. Hemelytra. 4. *T. formosus* NEW SPECIES. 5. *T. spectabile* Bergroth.

Trachelium alvarengai, NEW SPECIES

Description. Male (holotype). Dorsal coloration. Head, pronotum including humeral spines, scutellum (base of scutellar spine yellow), and clavus shiny black to shiny reddish brown; antennal segments I to III chestnut orange, IV chestnut orange with basal third yellow; corium yellow with apical margin creamy white, and punctures, middle third of exocorium and endocorium, and apical angle black to dark reddish brown; hemelytral membrane dark ambarine with basal angle grayish to white; connexival segments III-IV yellow, V-VI brown with posterior margin yellow, and VII brown with posterior border yellow; dorsal abdominal segments orange. **Ventral coloration.** Head shiny pale reddish brown; rostral segments I to III shiny pale chestnut orange, IV dark chestnut orange with apex black; propleura shiny black with acetabulae and prosternum yellow to shiny orange; mesopleura shiny black with acetabulae, posterior margin, and mesosternum yellow to shiny orange; metathorax including metathoracic scent gland auricle shiny chestnut orange; legs shiny chestnut orange; abdominal sternite III chestnut orange, IV shiny pale reddish brown with wide yellow longitudinal stripe running at middle third, and V to VII shiny pale reddish brown with posterior margin of V yellow; pleural abdominal margins III-IV and VII yellow, and V-VI shiny pale reddish brown with posterior margin yellow. **Structure:** Maximal length of antennal segment IV longer than maximal length of antennal segments II and III together; rostrum reaching middle third of metasternum; each callus raised into short, stout, conical acute tubercle; spines of humeral angles large, needlelike, recurved backward; scutellar spine long, erect, needlelike, directed backward; metathoracic scent gland auricle elongate, flat, not bifurcate, curved anteriorly.

Male variation. 1. Rostral segment I dark brown with apical joint chestnut orange. 2. Hind femur shiny chestnut orange with pale yellow ring at middle third. 3. Thorax shiny black with acetabulae yellow. 4. Abdominal sterna shiny black to shiny reddish brown with longitudinal stripe at middle third of sternite III and posterior margin of V yellow.

Female. Dorsal coloration. Head, pronotum including humeral spines, scutellum (base of scutellar spine yellow), and clavus shiny black; antennal segments I to III shiny reddish brown, and IV dark reddish brown with basal third yellow; corium shiny black with two short yellow to creamy yellow transversal fascia, one anterior and near to middle third, the other posterior and close to apical angle; hemelytral membrane including basal angle dark ambarine; connexivum shiny black with posterior margin or posterior border yellow; dorsal abdominal segments black. Ventral coloration. Shiny black with following areas yellow: acetabulae, posterior margin of mesopleura and metapleura, longitudinal stripe and middle third of abdominal sternite IV, posterior margin of abdominal sternite V, and posterior margin of pleural abdominal margins IV and V; rostral segment I shiny black with apical joint chestnut orange, and II to IV shiny chestnut orange with apex of IV black; metathoracic scent gland auricle dark yellow; fore and middle legs with coxae, trochanters and femora shiny black to shiny reddish brown, tibiae dark yellow with apical third chestnut orange, and tarsi chestnut orange; hind leg with coxa and trochanter shiny black to shiny reddish brown, femur shiny black with basal joint yellow, and tibiae and tarsi like fore and middle legs.

Female variation. 1. Basal angle of hemelytral membrane grayish. 2. Hind femur with yellow ring near middle third.

Measurements. Male given first, followed in parenthesis by those of female. Head length: 2.14 mm (2.44 mm); width across eyes: 1.68 mm (1.78 mm); interocular space: 0.74 mm (0.88 mm); interocellar space: 0.22 mm (0.30 mm); preocular distance: 1.22 mm (1.44 mm); antennal segments lengths: I, 1.48 mm (1.44 mm); II, 1.76 mm (1.64 mm); III, 1.52 mm (1.40 mm); IV, 4.24 mm (3.52 mm). Pronotal length: 1.48 mm (1.44 mm); maximum width of anterior lobe: 1.20 mm (1.44 mm); maximum width of posterior lobe (without humeral spines): 1.64 mm (1.64 mm). Scutellar length: 0.92 mm (1.04 mm); width: 0.56 mm (0.62 mm). Total body length: 9.23 mm (9.77 mm).

Type material. Holotype: male, Brazil, Amazonas, Manaus, 22-IV-1954, Elias and Roppa. Deposited in MNRJ. **Paratypes:** 1 female, Brazil, Para, Jacareacanga, XII-1968, M. Alvarenga. Deposited in AMNH. 1 male, Brazil, Amazonas, Manaus, Ponte de Bolivia, 29-XI-1969, Evangelistas. Deposited in UNAM. 3 females, Brazil, Rondonia, 62 km SW Ariquemes, Fzda Rancho Grande, 30-III-10-IV-1992, J. E. Eger. Deposited in USNM (Drake Collection).

Discussion. Of the known species of *Trachelium* with the head, pronotum, scutellum, and clavus shiny black to shiny reddish brown only *T. alvarengai* has antennal segment IV bicolored. In *T. bicolor* Herrich-Schaeffer, *T. fulvipes* Herrich-Schaeffer, and *T. tessellatus* Distant, antennal segment IV is entirely black to reddish brown.

Trachelium alboapicatus Distant has antennal segment IV bicolored, both the head, pronotum, scutellum, and clavus are shiny orange to shiny chestnut orange, and the metathoracic scent gland auricle is conspicuously tuberculiform (Fig. 3). This new species exhibits a clearly dimorphic color, which is explained in the description of each sex.

Etymology. Named after Moacir Alvarenga, who collected one of the paratypes of this species.

Trachelium bicolor Herrich-Schaeffer

Trachelium bicolor Herrich-Schaeffer, 1853: 274-275.

The type species of the genus *Trachelium* is distinguished by having the head, pronotum, and scutellum (base of scutellar spine yellow) black, antennal segment IV black to dark reddish brown, dorsal abdominal segments dark yellow with segment VII black, and following areas shiny orange to shiny chestnut orange: femora, metathorax, and abdominal sternite III.

Distribution. This attractive species was originally described from Brazil (Rio de Janeiro, and Santa Catarina: Nova Teutonia) and subsequently reported from Argentina (Misiones: Pindapoy, Iguazu, Presidente Perón, and Ciervo Petizo) and Bolivia (Yungas and Coroico) (Herrich-Schaeffer 1853, Stål 1870, and Kormilev 1953).

Material examined. New country records. Brazil: 4 males, 2 females, Minas Gerais, Pedra Azul, XI-1970, I-1971, F. M. Oliveira. Deposited in AMNH and UNAM. 4 males, Minas Gerais, Carmo do Rio Claro, VI-1943, Carvalho and I-1978 Carvalho and Schaffner. Deposited in MNRJ. 12 males, Chapada, I-XII (without data), S. M. Klages. Deposited in CMNH 1 male, Para, Benevides, X-1918, S. M. Klages. Deposited in CMNH. 1 female, Mato Grosso, Itaum, Dourados, III-1974, M. Alvarenga. Deposited in AMNH. 1 male, Goyaz, Campinas, XII-1935, Aorgmeier, Lopes and Carvalho. Deposited in MNRJ. 1 male, Para, Belem, Mocambo, 31-I-1980, M. F. Torres. Deposited in INPA. Ecuador: 2 males, Coca on Rio Napo, Napo-Pastaza Prov., V-1965. Deposited in AMNH. 1 male, Napo-Pastaza, Shushufindi SE of Aguarico, 150-200 m, 2-X-1977, L. E. Peña. Deposited in AMNH. Paraguay: 1 female, Villarica, X (without data), F. Schade. Deposited in AMNH. Peru: 1 male, Departamento Junin, Estancia Naranjal, San Ramón, 1000 m, 20-27-VII-1965, P. and B. Wygodzinsky. Deposited in AMNH. 1 male, Departamento Junin, San Ramón de Pangoa, 2-III-1972, R. T. and J. C. Schuh. Deposited in UNAM. 1 male, Vilcanota (without data). Deposited in HMNH. Trinidad: 1 male, Arima, Blanchisseuse Rd., 16 km N Arima, 650 m, 30-III-1987, M. E. Carter, E. R. Hoebeke and J. K. Liebherr. Deposited in CUIC. 1 male, Cumoto (without data), W. S. Brooks. Deposited in AMNH. Suriname: 2 males, Sipaliwini, 12-VI-1963, P. H. van Doesburg. Deposited in RNHL. Venezuela: 1 male, Bolivar, km 143 El Dorado-Santa Elena, 1200 m, 18-X-1972, J. and B. Bechyne. Deposited in UNAM.

Trachelium formosus, NEW SPECIES
(Figs. 2, 4, 6)

Description. Male (holotype). Dorsal coloration. Head, pronotum, scutellum, and clavus shiny chestnut orange; antennal segments I to III orange, IV dark brown with basal joint dark yellow; humeral spines black, scutellar spine creamy yellow with apex black; corium dull chestnut orange with veins paler; hemelytral membrane light ambarine with basal angle white (Fig. 4); connexival segments III to V and VII reddish brown with posterior margin creamy yellow, and VI reddish brown with anterior border and posterior margin creamy yellow; dorsal abdominal segments pale orange. **Ventral coloration.** Shiny chestnut orange with apex of rostral segment IV black, and following areas yellow to creamy yellow: collar, anterior border of prothorax, lower margin of acetabulae, posterior border of mesopleura and metapleura, middle third of abdominal sterna III and IV, posterior margin of abdominal sternite V, posterior border of pleural sterna III to V and VII, and anterior border and posterior margin of VI; metathoracic scent gland auricle dull chestnut orange. **Structure:** Maximal length of antennal segment IV shorter than maximal length of antennal segments II and III together; rostrum reaching posterior margin of metasternum; each callus raised forming a conical acute tubercle; spines of humeral angles of pronotum hooklike, stout, directed upward, with apex curved backward (Fig. 2); metathoracic scent gland auricle elongate, slender, short, flat, not projecting beyond upper third of metacetabulae; scutellar spine straight, directed upward (Fig. 2).

Female. Coloration. Similar to male (holotype). **Dorsal coloration:** Connexival segments VIII and IX reddish brown with posterior third of IX dull yellow; dorsal abdominal segments VIII and IX, and posterior margin of VII reddish brown. Ventral coloration: Head, rostral segments (apex of IV black), mesothorax, and metathorax shiny chestnut orange with acetabulae, and posterior margin of mesopleura, and metapleura yellow; prothorax shiny pale orange with collar, acetabulae, and anterior border yellow; abdominal sterna shiny reddish brown, with middle third of abdominal sternite IV, and posterior margin of V creamy yellow; metathoracic scent gland auricle dull chestnut orange.

Variation. 1. Humeral spines shiny reddish brown with basal third chestnut orange. 2. Corium shiny chestnut orange. 3. Connexival segment VI reddish brown or chestnut orange. 4. Acetabulae entirely yellow. 5. Abdominal sterna III and IV entirely shiny chestnut orange.

Measurements. Male given first, followed in parenthesis by those of female. Head length: 2.28 mm (2.36 mm); width across eyes: 1.92 mm (1.88 mm); interocular space: 1.04 mm (1.08 mm); interocellar space: 0.42 mm (0.40 mm); preocular distance: 1.38 mm (1.40 mm); antennal segments lengths: I, 1.16 mm (1.08 mm); II, 1.72 mm (1.44 mm); III, 1.72 mm (1.48 mm); IV, 3.20 mm (2.88 mm). Pronotal length: 1.76 mm (1.52 mm); maximum width of anterior lobe: 1.48 mm (1.40 mm); maximum width of posterior lobe (without humeral spines): 1.88 mm (1.76 mm). Scutellar length: 1.12 mm (1.08 mm); width: 0.76 mm (0.72 mm). Total body length: 10.48 mm (9.80 mm).

Type material. Holotype: male, Brazil, Mato Grosso, Itaum, Dourados, III-1974, M. Alvarenga. Deposited in AMNH. **Paratypes:** 2 males, Brazil, Goyaz, Campinas, XII-1935, Borgmeier and Lopes. Deposited in MNRJ. 1 female, Brazil, Sao Paulo (without data). Deposited in HMNH. 3 males, 2 females, Brazil, Chapada, IV-VII (without data). Deposited in CMNH, and UNAM. 1 male, Bolivia, Santa Cruz de la Sierra, 450 m, XI-1910, J. Steinbach. Deposited in CMNH.

Discussion. *Trachelium alboapicatus* Distant and *T. mimeticum* Breddin are the only previous known species with the head, antennal segments I to III, and legs shiny chestnut orange to shiny orange. *Trachelium formosus* belongs to this group and is characterized by having the spines of humeral angles hooklike, stout, black to reddish brown, directed upward and curving backward (Fig. 2), antennal segment IV dark brown with basal third dark yellow or dark orange, the scutellar spine creamy yellow with apex black, and the corium without creamy yellow marks.

In *T. alboapicatus* and *T. mimeticum,* the humeral spines are needlelike, and shiny chestnut orange (Fig. 1), the scutellar spine shiny chestnut orange, and the apical margin of corium or the apical angle of corium creamy yellow to creamy white.

The abdominal segments of *T. mimeticum* are dark brown to black, and in *T. alboapicatus* and *T. formosus* orange. In *T. alboapicatus,* antennal segment IV has the anterior half of the segment creamy yellow and the posterior half dark brown, with metathoracic scent gland auricle creamy yellow, tuberculate, clearly exposed, and raised above the body surface. In *T. formosus,* the metathoracic scent glad auricle is dull orange and flat, and antennal segment IV dark brown with basal third dark yellow or dark orange (Fig. 6).

Etymology. From the Latin, *formosus,* meaning beautifully formed.

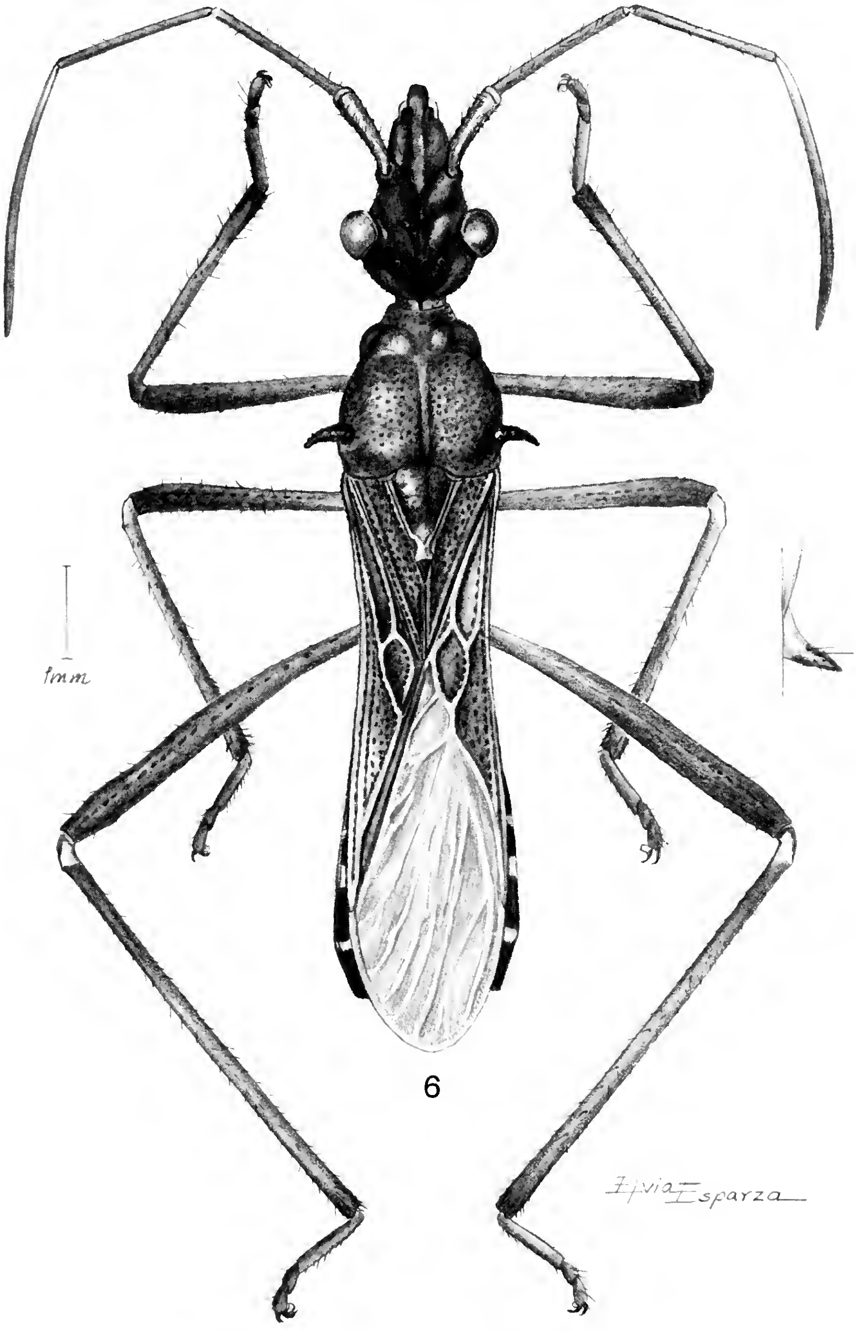


Figure 6. Dorsal view of *Trachelium formosus* NEW SPECIES.

Trachelium fulvipes Herrich-Schaeffer

Trachelium fulvipes Herrich-Schaeffer, 1853: 275.

Kormilev (1953) synonymized this species with *T. bicolor* Herrich-Schaeffer. On this contribution *Trachelium fulvipes* Herrich-Schaeffer is resurrected. They can be distinguished from one another by the color of the femora, which is black in *T. fulvipes,* and shiny orange in *T. bicolor.*

Distribution. This species was described and previously known only from Brazil (Rio de Janeiro).

Material examined. New country records. Brazil: 1 female, Goias, Jatai, XI-1972. Deposited in the AMNH. 1 female, Amazonas, Tabatine, V-1950, J. C. M. Carvalho. Deposited in MNRJ. 1 female, Minas Gerais, Carmo do Rio Claro, VIII-1975, J. C. M. Carvalho. Deposited in MNRJ. 1 macho, Mato Grosso, Itaum, Dourados, III-1974, M. Alvarenga. Deposited in the AMNH. Paraguay: 1 female, Gran Chaco, 260 km W Paraguay River, 10-VI-1936, A. Schulze. Deposited in the AMNH. Peru: 1 female, Puerto Bermudes, Rio Piohis, 12-VII-1920. Deposited in UNAM.

Trachelium lepidus, NEW SPECIES

Description. Male (holotype). Dorsal coloration. Head, antennal segments I to III, pronotum, scutellum, and clavus shiny orange; antennal segment IV reddish brown; scutellar spine yellow with apical third orange; corium dull orange with anterior third of exocorium, veins, apical margin, and quadrate spot near apical angle white; hemelytral membrane dark ambarine, with basal angle white; connexivum dark orange with posterior margin yellow; dorsal abdominal segments orange. **Ventral coloration.** Shiny orange, with apex of rostral segment IV black, and following areas yellow: posterior margin of mesopleura and metapleura, mesoacetabulae, middle third of abdominal sternite IV, posterior margin of V, and posterior margin of pleural sterna III to VII; metathoracic scent gland auricle dull orange. **Structure:** Maximal length of antennal segment IV longer than maximal length of antennal segments II and III together; rostrum reaching posterior margin of metasternum; each callus raised into conical acute tubercle; spines of humeral angles and scutellar spine, large, needlelike, and directed upward; metathoracic scent gland auricle elongate, slender, flat, curving anteriorly.

Female. Coloration. Similar to male (holotype). Connexival segments VIII and IX, dorsal abdominal segments VIII and IX, and genital plates shiny orange.

Measurements. Male given first, followed in parenthesis by those of female. Head length: 2.08 mm (2.32 mm); width across eyes: 1.58 mm (1.68 mm); interocular space: 0.82 mm (0.86 mm); interocellar space: 0.26 mm (0.24 mm); preocular distance: 1.08 mm (1.34 mm); antennal segments lengths: I, 1.40 mm (1.36 mm); II, 1.60 mm (1.56 mm); III, 1.32 mm (1.28 mm); IV, 3.92mm (3.36 mm). Pronotal length: 1.44 mm (1.52 mm); maximum width of anterior lobe: 1.08 mm (1.18 mm); maximum width of posterior lobe (without humeral spines): 1.44 mm (1.48 mm). Scutellar length: 0.80 mm (0.92 mm); width: 0.44 mm (0.52 mm). Total body length: 8.60 mm (9.00 mm).

Type material. Holotype: male, Panama, Canal Zone, Ft. Davis, 5-VII-1924, N. Banks. Deposited in AMNH. Paratypes: 2 females, Panama, Canal Zone, Ft. Davis, 5-9-VII-1924, N. Banks. Deposited in AMNH, and UNAM. 6 males, 5 females, Panama, Canal Zone, Margarita, 25-28-X-1972, L. H. Rolston. Deposited in the USNM, and UNAM. 1 male, Panama, Cerro Campana, 12-I-1974, J. A. Slater, and J. Harrington. Deposited in AMNH. 1 male, Panama, Canal Zone, Madden Forest Res., 9-I-1974, J. A. Slater, and J. Harrington. Deposited in AMNH. 2 males, Panama, Gamboa, 11-VIII-1986, C. Riley Nelson (Malaise Trap). Deposited in BYU. 1 female, Panama, Canal Zone, Barro Colorado Isl., 24-VII-1963, D. Q. Cavagnaro and M. E. Irwin. Deposited in CAS. 1 male, Panama, Canal Zone, Barro Colorado, 3-I-1929, C. H. Curran. Deposited in UNAM. 1 female, Colombia, Valle, Delfina, 400-500 m, 26-VIII-1967, P. y B. Wygodzinsky. Deposited in AMNH.

Discussion. *Trachelium lepidus,* like *T. alboapicatus* Distant, shares the following characters: head, antennal segments I to III, legs, and pronotum shiny orange. In *T. alboapicatus* the metathoraic scent gland auricle is creamy yellow, clearly tuberculate, and raised above the body surface (Fig. 3), the humeral spines of pronotum are large, needlelike, and directed obliquely upward, the scutellar spine is entirely shiny orange, the basal angle of the hemelytral membrane pale ambarine, and abdominal sternite V yellow, with anterior border shiny orange with brown marks. In *T. lepidus,* the metathoracic scent gland auricle is orange, flat, curving anteriorly, and never raised, the humeral spines are large, elongate, needlelike, and clearly directed upward, the scutellar spine yellow with apical third orange, the basal angle of the hemelytral membrane white, and abdominal sternite V shiny orange with only the posterior margin yellow.

Etymology. From the Latin, *lepidus,* meaning pleasant, elegant.

Trachelium limitatus, NEW SPECIES

Description. Male (holotype). Dorsal coloration. Head, antennal segments I to III, pronotum, clavus, connexivum, and dorsal abdominal segments shiny to dull orange; antennal segment IV brownish orange with basal third yellow; humeral spines reddish brown; corium dull orange with posterior third of costal margin and small dot at middle third of endocorium yellow; hemelytral membrane pale ambarine. **Ventral coloration.** Head, rostral segments (apex of IV black), and thorax orange with yellow reflections; metathoracic scent gland auricle yellow; legs and abdominal sterna orange. **Structure:** Maximal length of antennal segment IV longer than maximal length of antennal segments II and III together; rostrum reaching middle third of metasternum; each callus raised into conical acute tubercle; humeral spines large, needlelike, and directed obliquely backward; metathoracic scent gland auricle elongate, slender, flat, not projecting beyond upper third of metacetabulae; scutellar spine tiny, reduced to small conical expansion.

Female. Unknown.

Measurements. Male. Head length: 2.48 mm; width across eyes: 1.78 mm; interocular space: 0.96 mm; interocellar space: 0.34 mm; preocular distance: 1.50 mm; antennal segments lengths: I, 2.00 mm; II, 2.16 mm; III, 1.84 mm; IV, 4.20 mm. Pronotal length: 1.64 mm; maximum width of anterior lobe: 1.42 mm; maximum width of posterior lobe (without humeral spines): 1.94 mm. Scutellar length: 1.20 mm; width: 0.76 mm. Total body length: 11.63 mm.

Type material. Holotype: male, Argentina, Misiones, Bernardo de Irigoyen, 12-XI-1973, Escobar y Claps. Deposited in UNAM. **Paratype.** 1 male, Argentina, Misiones, Posadas, 1972, D. Carpintero. Deposited in UNAM.

Discussion. This species can be distinguished by the following combination of characters: dorsum of abdominal segments orange, scutellar spine tiny, reduced to small expansion, basal angle of hemelytral membrane pale ambarine, and metathoracic scent gland auricle elongate, and flat. In *T. mimeticum* Breddin the must similar species, the dorsal abdominal segments are black, the scutellar spine elongate, needlelike and directed upward, the basal angle of the hemelytral membrane white, and the metathoracic scent gland auricle is raised into a small rounded tubercle.

Etymology. Named for its limited known distribution.

Trachelium mimeticum Breddin

Trachelium mimeticum Breddin, 1904: 147.

This species is characterized by having the head, antennal segments I to III, and legs orange to chestnut orange; the metathoracic scent gland auricle dark yellow, tuberculate and raised above body surface; the humeral spine of pronotum reddish brown, large, needlelike and directed obliquely backward; the scutellar spine shiny orange and directed upward with the apex curving backward; the and dorsal abdominal segments black; hemelytral membrane pale ambarine, with pale blue reflections and with basal angle whitish, and each callus with an acute conical tubercle.

Distribution. This species was originally described from Bolivia and apparently has not been recorded since that time.

Material examined. Syntypes: 2 males, Bolivia, Yungas de la Paz. Deposited in DEU.

Trachelium secularis, NEW SPECIES

Description. Male (holotype). Dorsal coloration. Head, antennal segments I to III, pronotum, scutellum, and clavus shiny orange; antennal segment IV reddish brown; humeral spines of pronotum and scutellar spine reddish brown; corium pale orange brown, with following areas white: transversal fascia near middle third, small dot behind the fascia and close to apical margin, middle third of apical margin, and quadrate spot near apical angle; hemelytral membrane pale ambarine; connexival segments III and IV dark orange with upper margin yellow, V to VII dark orange; dorsal abdominal segments orange. **Ventral coloration.** Shiny orange with apex of rostral segment IV black, and mesoacetabulae, metacetabulae, posterior margin of metapleura, and posterior margin of abdominal sterna IV and V creamy yellow to yellow. **Structure:** Maximal length of antennal segment IV longer than maximal length of antennal segments II and III together; rostrum reaching posterior margin of metasternum; each callus raised into an acute conical tubercle; spines of humeral angles large, needlelike, directed obliquely backward; metathoracic scent gland auricle short, flat, straight, not projected beyond the upper third of metacetabulae; scutellar spine straight, needlelike, directed upward.

Female. Coloration. Similar to male (holotype). Connexival segment III and IV yellow to pale orange, V and VI yellow with anterior third dark chestnut orange, and VII to IX dark chestnut orange; abdominal segments VIII and IX dark chestnut orange; abdominal sterna yellow to pale orange with anterior margin of sternite IV and V, and genital plates chestnut orange.

Measurements. Male given first, followed in parenthesis by those of female. Head length: 2.72 mm (2.34 mm); width across eyes: 1.92 mm (1.72 mm); interocular space: 0.92 mm (0.88 mm); interocellar space: 0.40 mm (0.28 mm); preocular distance: 1.56 mm (1.22 mm); antennal segments lengths: I, 1.92 mm (1.48 mm); II, 1.68 mm (1.56 mm); III, 1.50 mm (1.52 mm); IV, 5.07 mm (3.56 mm). Pronotal length: 1.84 mm (1.60 mm); maximum width of anterior lobe: 1.36 mm (1.24 mm); maximum width of posterior lobe (without humeral spines): 1.88 mm (1.72 mm). Scutellar length: 1.04 mm (0.96 mm); width: 0.72 mm (0.60 mm). Total body length: 11.27 mm (10.05 mm).

Type material. Holotype: male, Trinidad, W. I., Arima Valley, 800'-1200', 10-22-IV-1964, Rozen and Wygodzinsky. Deposited in AMNH. Paratypes: 2 females, Panama, Canal Zone, Corozal, 22-I-1929, C. H. Curran. Deposited in AMNH, and UNAM. 1 male, Panama, Cocle, El Valle, 500-600 m, VII-1981, N. L. H. Krauss. Deposited in UNAM.

Discussion. This species resembles *T. alboapicatus*. Distant in having the head, antennal segments I to III, scutellum including the spine, and legs shiny orange; the humeral spines of pronotum large, needlelike, and directed obliquely upward; the basal angle of the hemelytral membrane pale ambarine; and the total length of antennal segment IV longer than length of antennal segments II and III together.

Trachelium secularis can be distinguished by having the humeral spines and antennal segment IV entirely reddish brown, and the metathoracic scent gland auricle orange, flat, straight, not curving anteriorly or posteriorly, and not raised above the body surface. In *T. alboapicatus,* the humeral spines are shiny orange, antennal segment IV is reddish brown with anterior third yellow, and metathoracic scent gland auricle creamy yellow and remarkably raised above the body surface.

Trachelium limitatus has the scutellar spine yellow with the apical third orange, the basal angle of the hemelytral membrane white, and the metathoracic scent gland auricle curving anteriorly.

Etymology. The specific epithet means "wordly," referring to the comparatively broad distribution of this species.

Trachelium spectabile Bergroth
(Figs. 1, 5, 7)

Trachelium spectabile Bergroth (in Poppius and Bergroth), 1920-1921: 68-69.

Redescription. Male. Dorsal coloration. Head shiny orange with interocular space mostly black; antennal segments I to III shiny chestnut orange, IV dark brownish orange; pronotum, scutellum, and clavus black; humeral spines and scutellar spine dark reddish brown; corium with basal third and apical angle dark yellow with punctures chestnut orange, middle third reddish brown with upper and lower area whitish and punctures chestnut orange; hemelytral membrane with basal half brown with angle white, and apical half pale ambarine, with veins darker (Fig. 5); connexival segments III and IV dark reddish brown with upper margin yellow, V to VII dark reddish brown with upper border yellow; dorsal abdominal segments black. **Ventral coloration.** Head shiny orange; rostral segments shiny chestnut orange with apex of IV black; thorax black with anterior margin of prothorax, acetabulae, and upper and posterior margin of metathorax yellow; legs dark reddish brown; metathoracic scent gland auricle dark orange brown; abdominal sterna dark reddish brown with posterior margin of abdominal sterna III to V, and middle third of VII yellow; pleural margin III, IV, and VII yellow, V dark reddish brown with two yellow spots at posterior third, VI reddish brown with one yellow spot near middle third. **Structure:** Maximal length of antennal segment IV clearly longer than maximal length of antennal segments II and III together; rostrum reaching posterior margin of metasternum; each callus raised into an acute conical tubercle; spines of humeral angles large, needlelike, directed obliquely backward (Fig. 1); scutellar spine large, needlelike, directed upward; metathoracic scent gland auricle short, broadening at distal end, not extending beyond the upper third of metacetabulae.

Female. Coloration. Similar to male. Connexival segments III to V yellow, VI and VII pale brown with upper border yellow, VIII and IX dark reddish brown; abdominal segments VIII and IX dark reddish brown; pleural margins III to VII yellow; genital plates dark reddish brown.

Variation. This species is quite variable in regards to head color. In some individuals the head is entirely black or shiny orange, or shiny orange with the interocular space black, and antennal segment IV dark brownish except in one specimen which is bicolored (black with basal third dark orange).

Measurements. Male given first, followed in parenthesis by those of female. Head length: 2.84 mm (2.96 mm); width across eyes: 2.10 mm (2.16 mm); interocular space: 1.10 mm (1.24 mm); interocellar space: 0.40 mm (0.38 mm); preocular distance: 1.52 mm (1.50 mm); antennal segments lengths: I, 2.20 mm (2.20 mm); II, 1.84 mm (2.12 mm); III, 1.76 mm (mutilated); IV, 6.20 mm (mutilated). Pronotal length: 1.88 mm (2.12 mm); maximum width of anterior lobe: 1.86 mm (1.90 mm); maximum width of posterior lobe (without humeral spines): 2.18 mm (2.20 mm). Scutellar length: 1.20 mm (1.28 mm); width: 0.82 mm (0.84 mm). Total body length: 12.15 mm (13.18 mm).

Distribution. This species was described from Peru, without any other reference.

Material examined. New country records.- 1 female, Bolivia, Nor Yungas, Caranavi, 9-VI-1931, P. Denier. Deposited in UNAM. 2 males, Brazil, Chapada, III-IV (without data). Deposited in CMNH and UNAM. 1 male, Peru, Marcapata (without data). Deposited in HMNH. 1 male, Peru, Pachitea (without data). Deposited in HMNH.

Discussion. Similar to *T. mimeticum* Breddin, with the dorsal abdominal segments black, head in ventral view shiny orange, and hemelytral membrane clearly bicolored, with basal half brown with angle white, and apical half pale ambarine.

In *T. mimeticum*, the head in dorsal view, the pronotum, scutellum, clavus, corium, legs, and ventral surface are almost entirely shiny orange and in *T. spectabile* Bergroth are almost black.

Trachelium tessellatus Distant

Trachelium tessellatus Distant, 1892: 373-374.

This species seems to be most closely related to the Brazilian T. bicolor Herrich-Schaeffer and *T. fulvipes* Herrich-Schaeffer, with which it agrees in the black color of head, pronotum and scutellum (base of scutellar spine yellow), plus the antennal segment IV black to dark reddish brown.

In *T. bicolor* the femora are shiny orange to shiny chestnut orange, whereas in the other two species the femora are black with or without a yellow median ring. In *T. tessellatus* Distant the basal joint of femora is black to dark reddish brown, the body size longer, and the distribution is from southern México to Colombia. *Trachelium fulvipes* is a shorter species, with the basal joint of femora yellow, and it is occurs throughtout Brazil, Paraguay, and Peru.

Distribution. This species was originally described from Panama (David, Bugaba, and Volcan de Chiriqui) and has been reported only from there.

Material examined. Syntype: male, Panama, Bugaba, Champion. Deposited in BMNH. New country records. Colombia: 1 male, 1 female, Minca, V-VI-1919 (without data). Deposited in CMNH. Costa Rica: 1 male, Provincia Puntarenas, Estación Bijagual, 500 m, V-1994, J. Saborio. Deposited in INBIO. 1 male, 2 females, Provincia Puntarenas, Estación Carara, Res. Biol. Carara, 200 m, I-II-1990, R. Zuñiga. Deposited in INBIO and UNAM. 2 females, Provincia Puntarenas, Estación Quebrada Bonita, Res. Biol. Carara, 50 m, XII-1992, R. Guzman. Deposited in INBIO. Panama: 1 male, 1 female, Canal Zone, Madden Forest Res., 7-I-1974, J. A. Slater and J. Harrington. Deposited in UNAM. 1 female, Cocle Prov., El Valle (La Mesa), 13-I-1974, J. A. Slater and J. Harrington. Deposited in UNAM.

Trachelium ventus, NEW SPECIES

Description. Female (holotype). Dorsal coloration. Head, pronotum including humeral spines, scutellum including scutellar spine, and clavus shiny dark reddish brown; antennal segments I to III shiny reddish brown, IV reddish brown with basal third yellow; corium dark brown with some central pale yellow white tessellate markings, apical margin white, and apical angle dark brown; hemelytral membrane pale ambarine with blueish green reflections, veins darker; connexival segments III, and V to VII reddish brown with posterior border yellow, IV yellow with basal border brown; dorsal abdominal segments reddish brown. **Ventral coloration.** Shiny reddish brown to black with collar, acetabulae, posterior margin of metapleura, metathoracic scent gland auricle, middle third of abdominal sternite III, and posterior margin of abdominal sternite V yellow; rostral segment I dark reddish brown with apical joint chestnut orange, and II to IV chestnut orange with apex of IV black; coxae, trochanter and femora reddish brown, and tibiae and tarsi dark chestnut orange; abdominal pleural margin III reddish brown with two spots, and posterior border yellow, IV yellow with anterior bor-

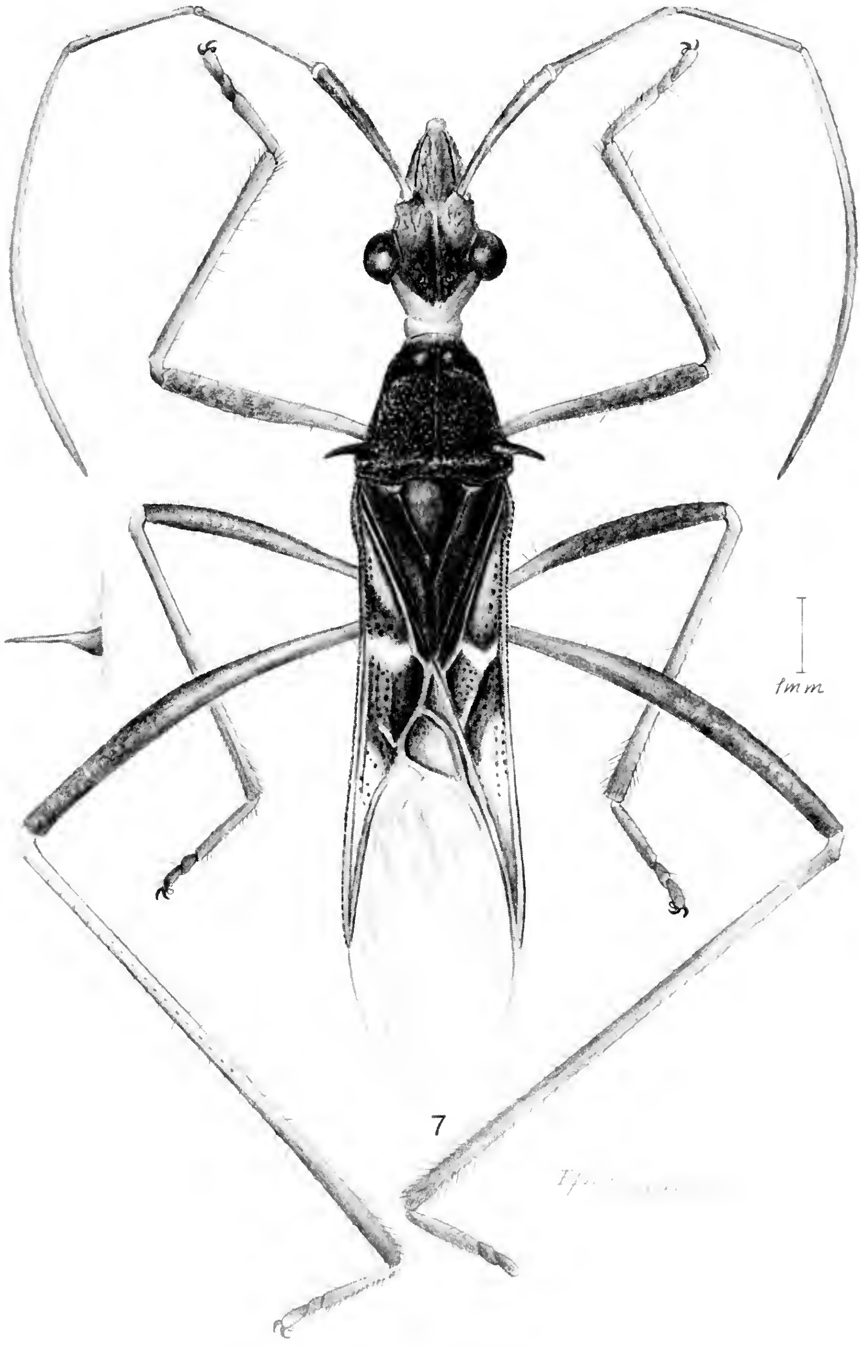


Figure 7. Dorsal view of *Trachelium spectabile* Bergroth.

der brown, V reddish brown with posterior margin yellow, VI and VII reddish brown with two yellow spots, and VIII and IX reddish brown. **Structure:** Maximal length of antennal segment IV longer than maximal length of antennal segments II and III together; rostrum reaching posterior margin of metasternum; each callus remarkably raised into a large acute needlelike spine; spines at humeral angles large, needlelike and recurved backward; scutellar spine long, erect, and needlelike; metathoracic scent gland auricle bilobate, and laterally raised above body surface.

Male. Unknown.

Measurements. Female. Head length: 2.40 mm; width across eyes: 1.92 mm; interocular space: 0.82 mm; interocellar space: 0.26 mm; preocular distance: 1.56 mm; antennal segments lengths: I, 2.12 mm; II, 2.20 mm; III, 1.80 mm; IV, 4.52 mm. Pronotal length: 1.88 mm; maximum width of anterior lobe: 1.38 mm; maximum width of posterior lobe (without humeral spines): 1.96 mm. Scutellar length: 0.82 mm; width: 0.68 mm. Total body length: 11.85 mm.

Type material. Holotype: female, French Guiana, Mana River, VI-1917. Deposited in CMNH. **Paratypes:** 1 female, French Guiana, V-1917. Deposited in UNAM. 1 female, French Guiana, Saul, 18-VIII-1881. Deposited in MNHN.

Discussion. This species is similar to *T. alvarengai* in having antennal segment IV bicolored and longer than the maximum length of antennal segments II and III combined, and the head, pronotum, and scutellum black to reddish brown. In *T. ventus,* the scutellar spine is entirely reddish brown, the metathoracic scent gland auricle bilobate and raised above the body surface, the tubercle of each calli remarkably exposed and acute, and the hind femur entirely reddish brown. *Trachelium alvarengai* has the scutellar spine black to reddish brown with basal joint yellow, the metathoracic scent gland auricle elongate, flat, not bilobate or bifurcate, the tubercle of each calli stout and short, and basal joint of hind femur yellow.

Etymology. From the Latin, *ventus,* meaning wind.

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CORRIGENDUM

On a recently published paper [Freytag, *Entomological News* 114(4): 181-186], the binomen *Agallia pecki*, was misspelled as *A. peck* only once, in the Abstract (page 181). Everywhere else in the paper, the binomen was spelled *Agallia pecki* or *A. pecki*, as intended by the author. The spelling "A. peck" is an incorrect original spelling and we are herein correcting it (Article 32.5, International Code of Zoological Nomenclature, Fourth Edition, 1999, "with effect from 1 January 2000").

REDESCRIPTION OF *NOTHOBRYA SCHUBARTI* ARLÉ, 1961 (COLLEMBOLA, ENTOMOBRYOMORPHA)[1]

Enrique Baquero[2], Rafael Jordana[2], and Kenneth Christiansen[3]

ABSTRACT: Three paratypes of *Nothobrya schubarti* Arlé, 1961 were examined in connection with a forthcoming description of a new genus of Entomobryidae. Some of the features observed by Arlé in 1961, appeared similar to those of the new genus. These included: small size, color, the presence of PAO, a falciform mucro, the trochanteral organ and the body setae. Observation of a specimen with SEM allowed us to see the PAO and the other characteristics described by Arlé in more detail, but other features not described by him were seen which indicate that the genus belongs in subfamily Orchesellinae.

KEY WORDS: Collembola, *Nothobrya*, Orchesellinae, Entomobryomorpha.

Arlé (1961) described the genus *Nothobrya* of the family Entomobryidae from Brazil which was characterized by a lack of scales, presence of a postantennal organ, and a falcate mucro. Although the genus was placed with other Entomobryidae, its taxonomic placement has remained unclear and no subsequent records of the genus have been made. Barra (1999) examined type specimens of *Nothobrya* and clearly showed it to be distinct from his genus *Capbrya*. Due to the kindness of Dr. Cleide de Mendonça (Museu Nacional, Departamento de Entomologia, Universidade Federal do Rio de Janeiro, Brazil) we were able to examine three paratypes of this unusual species and clearly establish that the genus belongs in the subfamily Orchesellinae of the family Entomobryidae.

METHODS

The specimens were preserved in ethyl alcohol, apparently in good condition (Fig. 1), but they were very fragile. One specimen was mounted on slide using Hoyer's medium; another, without cleaning due to its fragility, was dehydrated using an ethanol series followed by critical-point drying in CO_2, mounted on an aluminium SEM stub, and coated in Argon atmosphere with 16 nm of gold in an Emitech K550 sputter-coater. SEM observations were made in a Zeiss DSM 940A with a new digital image capture (Point Electronic GmbH, Germany). Although the animal is much wrinkled, the photographs have been included in this paper since they are informative. Some characteristics observed under both the light microscope and SEM are added to Arlé's 1961 description.

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Mailed on November 12, 2004

Genus *Nothobrya* Arlé, 1961

Diagnosis: The genus differs from other scaleless Orchesellinae by a combination of falcate mucro, postantennal organ and curved hook-like labral papillae.

Nothobrya schubarti Arlé, 1961

(Figs. 1-8)

Body length: Excluding appendages: 1.5-2.0 mm (according to Arlé), 0.95 mm and 1.16 mm respectively for the slide mounted and the ethyl alcohol preserved specimens we studied.

Color: Ground color of body pale yellow, with blue pigment on distal part of antennal segment I, final half of antennal segments II-III, distal two thirds of antennal segment IV, and bands on the anterior half of all tergites, coxae and trochanters (Fig. 1).

Cuticle: Body seen under SEM with dense reticular pattern (Fig. 7). Scales absent.

Head: Antennae six segmented with both the first and third segments very small (Figs. 2-3). Length in mm of segments 1-6: 0.02:0.05:0.01:0.09:0.12:0.17 respectively. Ommatidia 8+8, finely reticulated with A and B larger than the others. PAO is a vesicle (15 x 5 micrometers), narrowed in its inner side, situated in front and lateral to eyes A and B. In the specimens we saw the PAO is distorted as is the rest of the body (Fig. 4). Labral formula: 4/554 (Fig. 5), with labral papillae hook-like (Fig. 6).

Abdomen: Abdominal tergite IV 1.26, 1.8 times longer than abdominal tergite III.

Chaetotaxy: Large macrosetae present on head, thoracic segments and abdominal segment I, with pointed tips (type two of Christiansen, 1958). Macrosetae shorter and very robust on abdominal segment I-VI, with clear barbules. Mesosetae of different size, with barbs that give them a pubescent appearance. Bothriotricha 2-3-2 on abdominal segments II-IV respectively, as is characteristic of almost all Entomobryidae (Szeptycki, 1979).

Tenaculum: With 4 plus 4 teeth, and two setae on the corpus.

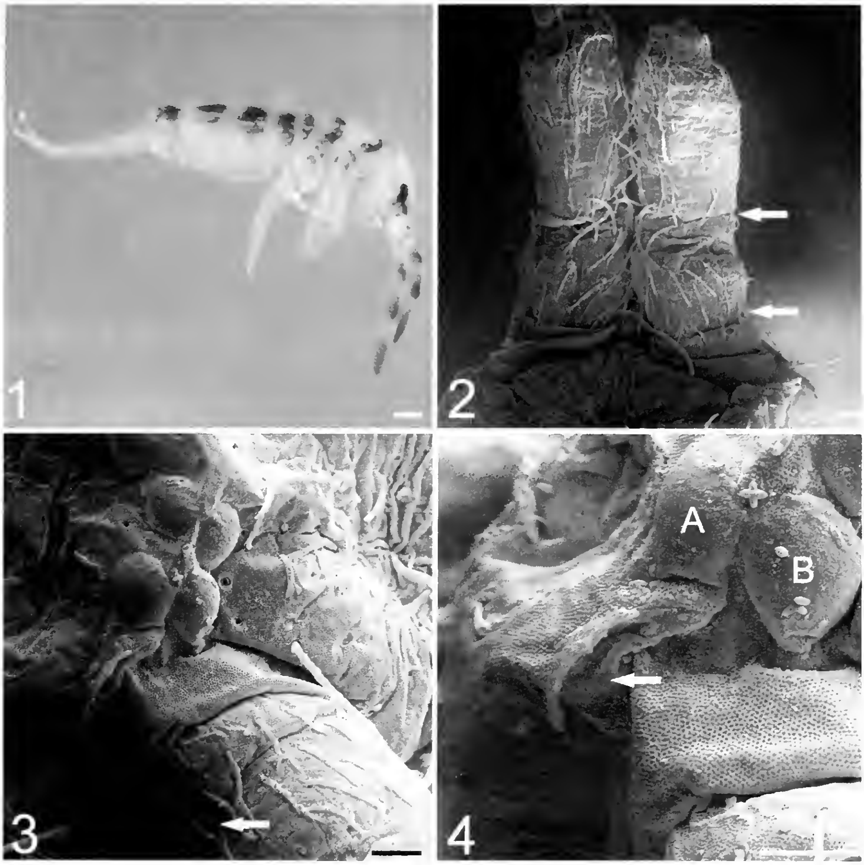
Furcula: Dentes ringed (Fig. 7) on basal three quarters, with the final portion narrowed and striated transversally. Mucro falcate without basal spine.

Leg: Trochanteral organ with three or four smooth setae.

Foot complex: Tenent hair truncate. Pretarsus with a single short blunt seta. Claw elongate, with the two teeth of the internal edges very basal, and without unpaired distal tooth in the two specimens we observed. Unguiculus with four lamellae but the external two are very narrow and fused about two thirds of the way from the base to the apex of the unguiculus. The two inner lamellae fused near the apex (Fig. 8).

Type-locality: Brazil, Parnaíba (Piauí), Fazenda Lama Prêta, "numerosos ex. sôbre a lama e no "mud-crack" em volta da lagôa", XI.1960. R. Arlé leg. Otto Schubart found three specimens from Pernambuco (Riacho Terra Nova, 5.IX.1937). Material deposited at Museu Nacional, Universidade Federal do Rio de Janeiro.

Remarks: The PAO of *N. schubarti* was described by Arlé as a vestigial vesicle. Barra (1999) described it as a vesicle with a cavity on the top, but probably this observation resulted from the poor condition of the material he saw, long in ethyl alcohol and collapsed. The SEM examination of a paratype revealed that the PAO is a vesicle larger than described by Arlé; Figure 4 shows clearly the outline of the vesicle and how it is partially collapsed inward. The chaetotaxy and smooth seta at the ventral side of the final whorl of leg III are similar to most genera of the Entomobryidae. The trochanteral organ is poorly developed, as mentioned by Arlé, with three or four short and smooth setae. Arlé mentioned an almost imperceptible unpaired ungual tooth but we saw none under the SEM. The "type five" setae (Christiansen, 1958) are similar to those seen in *Entomobrya* (Fig. 7). The peculiar hooked labral papillae are similar to those seen in some species of *Orchesellides, Heteromurus* and *Dicranorchesella* (Mari Mutt, 1985). The segmental ratios and the presence of 6 segmented antennae indicate that this genus is best placed in the subfamily Orchesellinae.



Figs. 1-4. *Nothobrya schubarti.* 1, Lateral habitus showing coloration, length of bar = 0.1 mm. Figs. 2-4 length of bars = 10 micra. 2, First two antennal segments, showing the basal subdivisions (SEM). The arrows point to the end of the two subsegments. 3, First antennal segment, PAO and first ommatidia (SEM). The arrow points to the end of the first subsegment. 4, Detail of collapsed PAO (arrow) and two first ommatidia (SEM).

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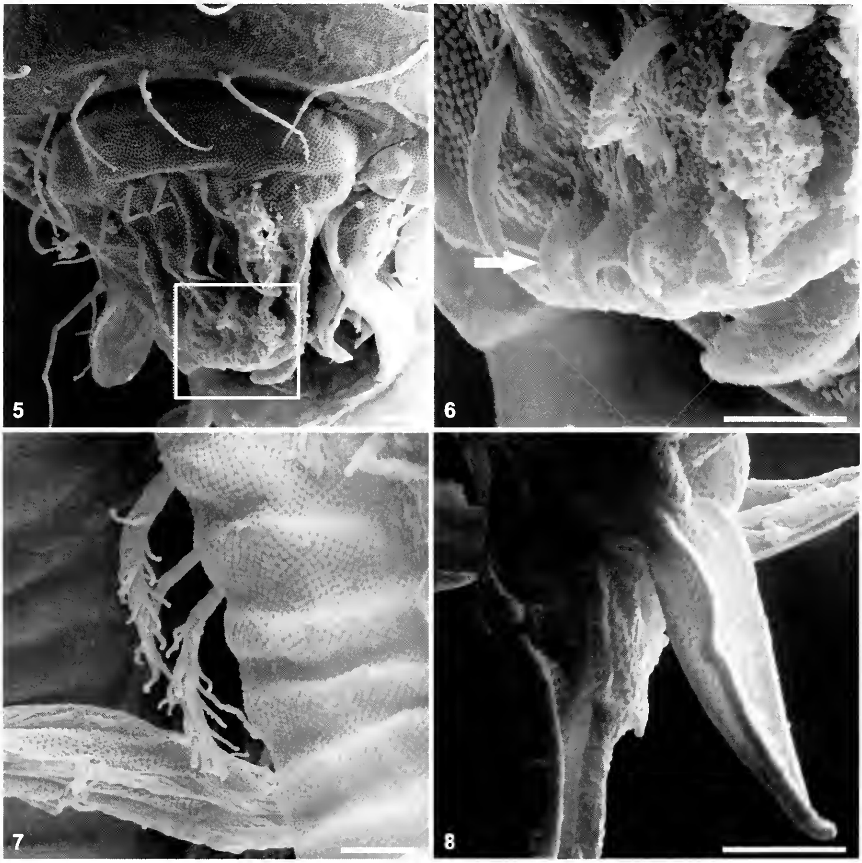

Figs. 5-8. *Nothobrya schubarti* (SEM), length of bars = 5 micra. 5, Labrum (square: Fig. 6). 6, Detail of hook-like labral papillae (arrow). 7, Partial view of the crenulate dens, with two setae to show their barbule morphology. 8, Unguiculus showing three of the four lamellae and basal part of the unguis.

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TWO NEW SPECIES OF *HERCOSTOMUS* FROM CHINA (DIPTERA: DOLICHOPODIDAE)[1]

Lili Zhang[2], Ding Yang[3], and Kazuhiro Masunaga[4]

ABSTRACT: Two species from China are described as new to science: *Hercostomus (Gymnopternus) huangi* sp. nov. and *Hercostomus (Hercostomus) maoershanensis* sp. nov. One new species-group, *Hercostomus (Gymnopternus) setifacies*-group, is proposed. Keys are provided for the species of the *setifacies*-group and the *longicercus*-group from China, and the geographic distribution of each species group is discussed. One new combination, *Hercostomus (Gymnopternus) zhejiangensis* (Yang, 1997) comb. nov. is created.

KEY WORDS: Diptera, Dolichopodidae, *Hercostomus*, China, new species.

The genus *Hercostomus* is the largest and most diversified genus in the Dolichopodidae with about 500 known species worldwide. There were 28 known species from China before 1995, of which only 11 species were recorded from continental China (Dyte 1975, Negrobov 1991). Since 1995, 218 species of *Hercostomus* have been added to the fauna of China, mainly based on the work of Wei (1997), Yang and Grootaert (1999), Yang and Saigusa (1999, 2000, 2001a-d, 2002), Yang and Yang (1995), Zhang and Yang (2003). Up to now, there are 246 known species in China.

In the present paper, two species are described as new to science. One new species-group, *H. (G.) setifacies*-group, is proposed. Keys are provided for the species of the *setifacies*-group and the *longicercus*-group from China. A geographic distribution map for each species group is also presented. One new combination *Hercostomus (Gymnopternus) zhejiangensis* (Yang, 1997) comb. nov. is created for *Phalacrosoma zhejiangensis* Yang, 1997.

The following abbreviations are used: acr-acrostichal, ad-anterodorsal, apv-apicoventral, av-anteroventral, dc-dorsocentral, LI-fore leg, LII-mid leg, LIII-hind leg, pd-posterodorsal, pv-posteroventral, v-ventral.

Hercostomus (Gymnopternus) setifacies group

Diagnosis: Postocular bristles black. Antenna black; first flagellomere elongated, at least 2.0 times longer than wide. Clypeus in both sexes with one pair of black strong bristles. Cercus long and thick, longer than epandrium.

This group includes the following 3 species: *H. (G.) huangi* sp. nov., *H. (G.) zonalis* Yang, Yang and Li and *H. (G.) wuyangensis* Wei. The geographical distribution of these species is shown on Figure 11.

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Key to the species of the *Hercostomus (Gymnopternus) setifacies* group from China

1. Cercus nearly straight. Yunnan .... *H. (G.) huangi* sp. n.
   Cercus rather thick, somewhat swollen and rounded apically 2

2. Fore and mid femora yellow. Guizhou .... *H. (G.) wuyangensis* Wei
   All femora black with dark yellow to yellow tips. Shaanxi, Sichuan, Henan, Guangdong .... *H. (G.) zonalis* Yang, Yang and Li

Hercostomus (Gymnopternus) huangi Zhang, Yang and Masunaga, NEW SPECIES

(Figs 1-5)

Diagnosis: Postocular bristles black. Antenna black; first flagellomere 2.0 times longer than wide. Cercus nearly straight and obtuse apically.

Description: Male. Body length 2.7-2.8 mm, wing length 2.4-2.5 mm. Head metallic green with pale gray pollen. Face narrowing downward, narrower than first flagellomere. Hairs and bristles on head black; postocular bristles (including postero-ventral hairs) black. Antenna (Fig 2) black; first flagellomere 2.0 times longer than wide, somewhat acute apically; arista black, minutely pubescent, with basal segment 0.6 times as long as apical segment. Proboscis dark yellow with black hairs; palpus dark yellow with black hairs and 1 black apical bristle. Clypeus with one pair of strong, black bristles.

Thorax metallic green with pale gray pollen. Hairs and bristles on thorax black; 6 strong dc, 8 paired acr; scutellum with 2 pairs of bristles (basal pair short and hair-like) and several short marginal hairs. Propleuron with 1 black bristle on lower portion. Legs yellow; fore coxa yellow, mid and hind coxae brownish to dark brown; hind femur with black tip; hind tibia with dark brown to black tip; fore tarsus from tip of tarsomere 1 onward brown, mid tarsus from tip of tarsomere 1 onward black, hind tarsus black. Hairs and bristles on legs black; mid and hind coxae with 1 outer bristle. Mid and hind femora each with 1 preapical bristle. Fore tibia with 1 ad and 2 pd, apically with 2 short bristles; mid tibia with 3 ad, 2 pd and 1 av, apically with 3 bristles; hind tibia with 3 ad, 4 pd and 1 av, apically with 4 bristles. Relative lengths of tibia and 5 tarsomeres LI 1.0 : 0.65 : 0.25 : 0.2 : 0.15 : 0.12; LII 1.55 : 0.65 : 0.5 : 0.45 : 0.25 : 0.2; LIII 1.9: 0.5 : 0.65 : 0.5 : 0.35 : 0.2. Wing (Fig 1) hyaline, tinged with grayish; veins brown, R_{4+5} and M parallel apically; CuAx ratio (length of m-cu/length of CuA distal section) 0.3. Squama pale yellow with black hairs. Halter pale yellow.

Abdomen dark metallic green with pale gray pollen. Hairs and bristles on abdomen black. Male genitalia (Fig 3-5): Epandrium distinctly longer than wide, with long finger-like lateral lobe bearing 3 long apical bristles; cercus nearly straight and obtuse apically; hypandrium acute apically in ventral view.

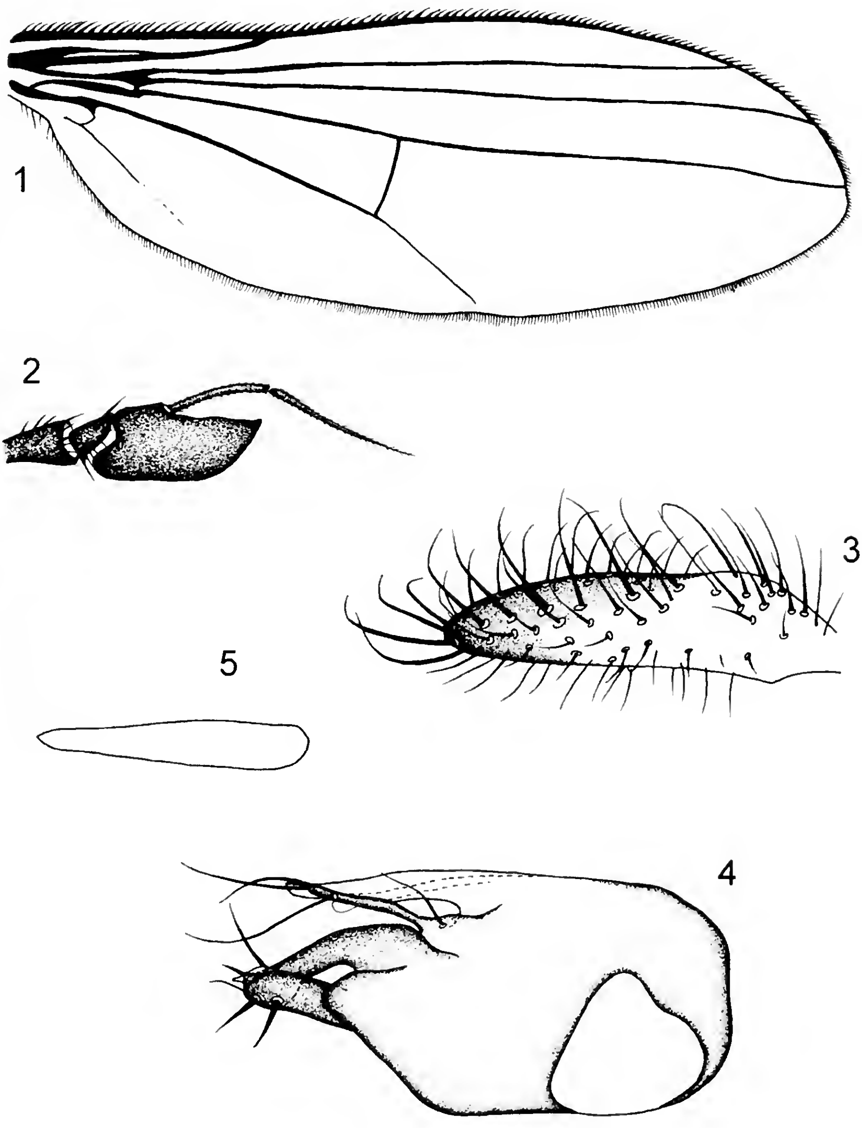
Female: Unknown.

Holotype: Male, Yunnan: Xishuangbanna, Jinghong (300 m, yellow pan trap), 2002. IV. 12, Wenquan Zhen, deposited in the insect collection of China Agricultural University, Beijing.

Distribution: China (Yunnan).

Etymology: The species named after Prof. Dawei Huang (Institute of Zoology, Beijing).

Remarks: The new species is similar to *H. setifacies* Stackelberg, but may be separated from the latter by the femora being yellow except the tip of the hind femur is black, and the cercus with an obtuse apex. In *setifacies,* the femora are black except the tips of the fore and mid femora are yellow, and the cercus has an acute apex (Stackelberg, 1934).



Hercostomus (Gymnopternus) huangi sp. nov.

Figures 1-5. *Hercostomus (Gymnopternus) huangi* sp. nov. 1. wing; 2. antenna, lateral view; 3. cercus, lateral view; 4. male genitalia (excluding cercus), lateral view; 5. hypandrium, ventral view.

Hercostomus (Hercostomus) longicercus group

Diagnosis: Antenna black; first flagellomere rather small, as long as wide, arista with very short basal segment (0.2 times as long as apical segment). acr biseriate, uniseriate or absent. Cercus slender and strap-like, usually longer than epandrium.

The group includes the following 8 species: *H. (H.) clavatus* Wei, *H. (H.) ebaeus* Wei, *H. (H.) filiformis* Yang and Saigusa, *H. (H.) longicercus* Yang and Yang, *H. (H.) modificatus* Yang and Saigusa, *H. (H.) pilifacies* Yang and Saigusa, *H. (H.) pilicercus* Yang and Saigusa, *H. (H.) maoershanensis* sp. nov. The geographical distribution of these species is shown on Figure 12.

Key to the species of the *Hercostomus (Hercostomus) longicercus* group from China

1. First flagellomere somewhat acute apically 2
   First flagellomere with acute upper and lower apical corners; face with 2-4 black hairs on lower portion (just above clypeus). Yunnan .... *H. (H.) pilifacies* Yang and Saigusa
2. Acr absent 3
   Acr present 4
3. Mid coxa blackish, hind coxa yellow. Yunnan .... *H. (H.) longicercus* Yang and Yang
   Mid and hind coxae black. Guangxi .... *H. (H.) maoershanensis* sp. n.
4. Acr uniseriate 5
   Acr biseriate 7
5. Femora entirely yellow 6
   Femora black with yellow tips. Shaanxi, Guizhou .... *H. (H.) clavatus* Wei
6. Cercus with swollen base. Guizhou .... *H. (H.) ebaeus* Wei
   Cercus without swollen base. Yunnan .... *H. (H.) filiformis* Yang and Saigusa
7. Face with pale hairs on lower portion; coxae yellow. Yunnan ....
   .... *H. (H.) pilicercus* Yang and Saigusa
   Face without pale hairs; mid and hind coxae black. Shaanxi ....
   .... *H. (H.) modificatus* Yang and Saigusa

Hercostomus (Hercostomus) maoershanensis Zhang, Yang and Masunaga, NEW SPECIES
(Figs 6-10)

Diagnosis: Mid and lower postocular bristles (including postero-ventral hairs) yellow. Antenna black; first flagellomere 1.3 times longer than wide. acr absent. Fore coxa brownish black, mid and hind coxae black. CuAx ratio 1.0.

Description: Male. Body length 2.8 mm, wing length 3.0 mm. Head metallic green with pale gray pollen. Hairs and bristles on head black; mid and lower postocular bristles (including postero-ventral hairs) yellow. Antenna (Fig 7) black; first flagellomere 1.3 times longer than wide, somewhat obtuse apically; arista black, nearly bare, with basal segment 0.23 times as long as apical segment. Proboscis black with black hairs; palpus black with black hairs and 1 black apical bristle.

Thorax dark metallic green with pale gray pollen. Hairs and bristles on thorax black; 6 strong dc, acr absent; scutellum with 2 pairs of bristles (lateral pair short and hair-like) and several short marginal hairs. Propleuron with 1 black bristle on lower portion. Legs yellow; fore coxa brownish black, mid and hind coxae black; fore femur blackish, mid and hind femora yellow with extremely black tip; tibia yellow with extremely black base and tips; fore tarsus dark brown to black, mid tarsus from tip of tarsomere 1 onward black, hind tarsus entirely black. Hairs and bristles on legs black; mid and hind coxae with 1 outer bristle. Mid and hind femora each with 1 preapical bristle. Fore tibia with 2 pd, apically with 2 short bristles and 1 black thin apv (about 0.4 times as long as fore tarsomere 1) ; mid tibia with 3 ad, 2 pd and 1 av, apically with 4 bristles; hind tibia with 3 ad, 3 pd and 1 av, apically with 3 bristles. Hind tarsomere 1 with 1 v at base. Relative lengths of tibia and 5 tarsomeres LI 1.0 : 0.6 : 0.25 : 0.2 : 0.15 : 0.15; LII 1.55 : 0.85 : 0.5 : 0.4 : 0.5 : 0.2; LIII 2.0: 0.53 : 0.7 : 0.5 : 0.3 : 0.25. Wing (Fig 6) hyaline, tinged with grayish; veins black, R4+5 and M parallel apically; CuAx ratio 1.0. Squama pale yellow with black hairs. Halter yellow.

Abdomen dark metallic green with pale gray pollen. Hairs and bristles on abdomen black. Male genitalia (Fig 8-10): Epandrium distinctly longer than wide, narrowing toward apex, with slightly curved lateral lobe bearing 2 long bristles and 1 short apical bristle; cercus slightly shorter than epandrium, and with long ventral bristles and hairs; hypandrium acute apically in ventral view.

Female. Body length 2.8-3.2 mm, wing length 3.0-3.2 mm. Similar to male.

Holotype: Male, Guangxi: Maoershan National Nature Reserve (2100m, light trap), 2003. VII. 5, Shuwen An, deposited in the insect collection of China Agricultural University, Beijing. **Paratypes:** 1 ♂, Guangxi: Maoershan National Nature Reserve (2100m, light trap), 2003. VII. 5, Shuwen An, deposited in the insect collection of China Agricultural University, Beijing; 3 ♂ 4 ♀, Guangxi: Maoershan National Nature Reserve, Sanjiangyuan (1900 m , light trap), 2003 VI 30, Xingyue Liu, deposited in the insect collection of China Agricultural University, Beijing.

Distribution: China (Guangxi).

Etymology: The specific name refers to the type locality, Maoershan.

Remarks. The new species is similar to *H. longicercus* Yang and Yang by having no acr, but may be separated from the latter by the black mid and hind coxae. In *H. longicercus,* the mid coxa is blackish, and the hind coxa is yellow (Yang and Yang, 1995).

GENERAL DISCUSSION

For the species of *Hercostomus (Gymnopternus) setifacies*-group, *H. (G.) huangi* is distributed in South China Region (Southern Yunnan Subregion: Yunnan, Xishuangbanna), *H. (G.) wuyangensis* Wei is scattered in Central China Region (Western mountain Subregion: Guizhou, Zhenyuan), *H. (G.) zonalis* is widely distributed in both Palaearctic part and Oriental part of China that including North China Region (Huang-hai Plains Subregion: Henan: Songxian, Luanchuan and Xixia), Central China Region (East hilly plain Subregion: Henan, Luoshan; Western mountain Subregion: Sichuan, Emeishan), South China Region (Min-Guang Subregion: Guangdong: Nanling and Shimentai).

The eight species of *Hercostomus (Hercostomus) longicercus*-group both are distributed in the Oriental part of China. *H. (H.) longicercus* Yang and Yang is distributed in Central China Region (East hilly plain Subregion: Zhejiang, Baishanzu); *H. (H.) clavatus* Wei, *H. (H.) ebaeus* Wei, *H. (H.) modificatus* Yang and Saigusa and *H. (H.) maoershanensis* sp. nov. are distributed in Central China Region (Western mountain Subregion: Guizhou, Fanjingshan; Shaanxi, Zuoshui; Guangxi, Maoershan); *H. (H.) filiformis* Yang and Saigusa, *H. (H.) pilicercus* Yang and Saigusa and *H. (H.) pilifacies* Yang and Saigusa are scattered in South China Region (Southern Yunnan Subregion: Yunnan).

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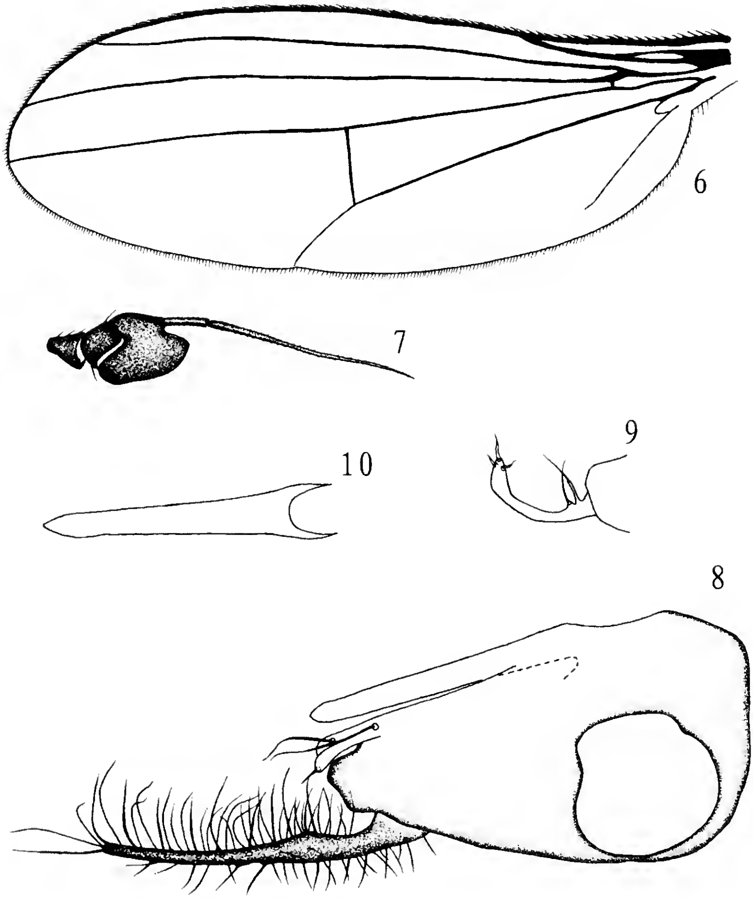

Hercostomus (Hercostomus) maoershanensis sp. nov.

Figures 6-10. *Hercostomus (Hercostomus) maoershanensis* sp. nov. 6. wing; 7. antenna, lateral view; 8. male genitalia, lateral view; 9. genital apical processes, lateral view; 10. hypandrium, ventral view.

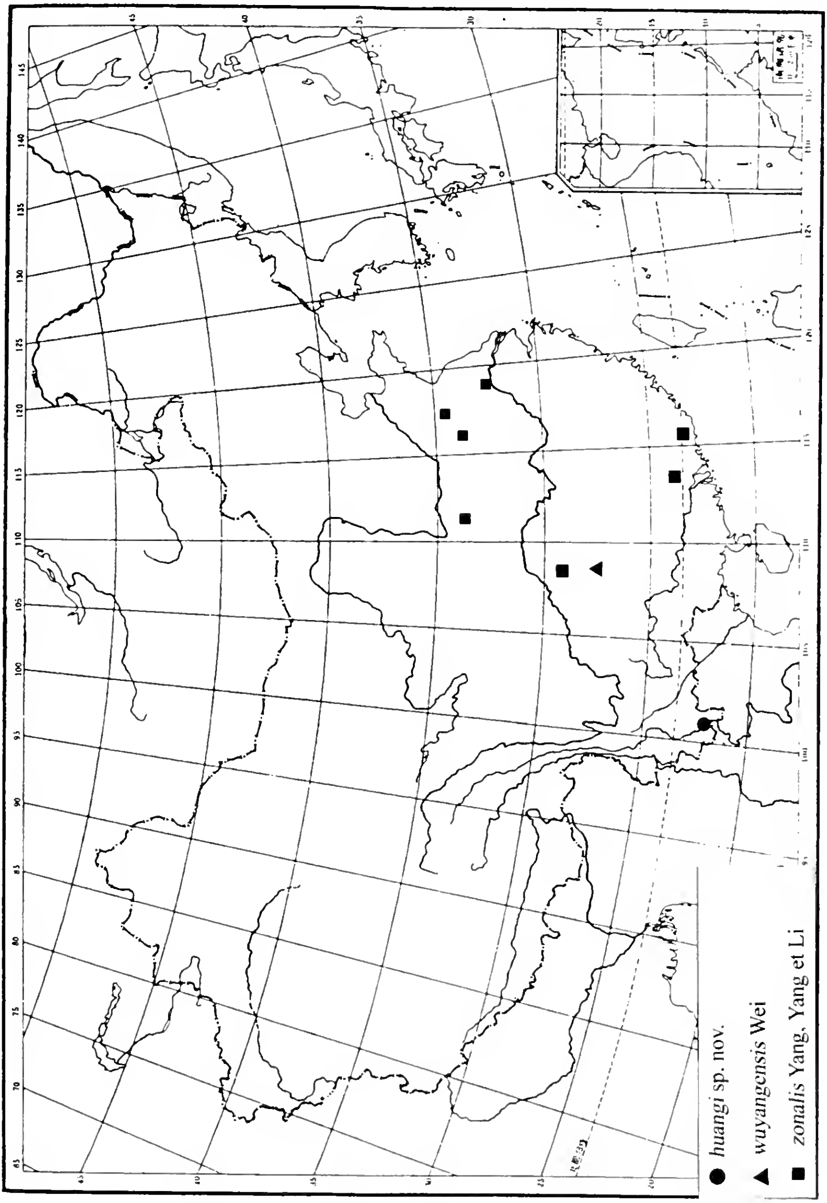

Figure 11. Distribution of *Hercostomus* (*Gymnopternus*) *setifacies*-group in China.

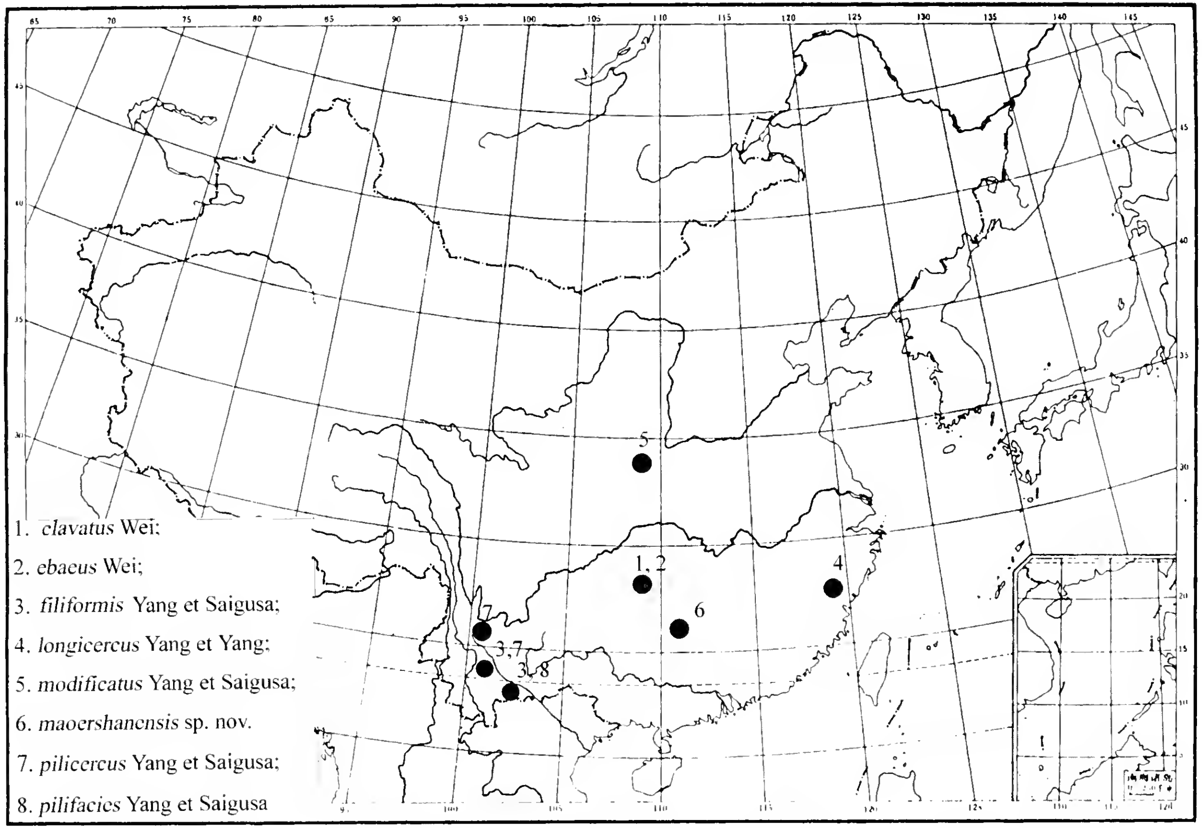

Figure 12. Distribution of *Hercostomus (Hercostomus) longicercus*-group in China.

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THE FEMALE OF *TENUIPHANTES CRACENS* (ARANEAE: LINYPHIIDAE) FROM NEWFOUNDLAND, CANADA[1]

J. R. Pickavance[2]

ABSTRACT: The female of *Tenuiphantes cracens* is described for the first time from specimens caught at Port au Choix, Newfoundland, Canada, in pitfall traps in spruce-fir woods at nearly sea level. The climatic severity of the location creates a suitable environment for this alpine species. To date, the species has only been caught during a brief summer period.

KEY WORDS: *Tenuiphantes cracens*, female, Araneae, Linyphiidae, Newfoundland, Canada.

Zorsch (1937) described the new species *Lepthyphantes cracens* (now *Tenuiphantes;* Saaristo and Tanasevitch, 1996) on the basis of two males: the holotype collected by C. R. Crosby in 1921 from Mount Whiteface, New York, and another male specimen from Mount Marcy, New York, collected by C. R. Crosby in 1930. The female was not described. As recently as 2001 no other location had been reported (Buckle et al., 2001). Then Paquin et al. (2001a, b) first mentioned the occurrence of males of the species in Canada in Quebec. Subsequently the species was included in a guide to Quebec spiders (Paquin and Dupérré, 2003). In 2000 pitfall trap collections in Newfoundland produced both males and the previously unknown female of *T. cracens.* The female is described here for the first time. Good reasons should always be provided for matching an unknown sex with its counterpart. Here, the unknown females are matched to male *T. cracens* for two reasons. First, because the females were taken in the same set of traps at the same time as males of the species, and second because the other *Tenuiphantes* species known from Newfoundland, *T. nigriventris* (L. Koch 1879), *T. tenuis* (Blackwall 1852) and *T. zebra* (Emerton 1882), have the identity of both sexes well established.

METHODS

All specimens of *T. cracens* reported here were caught in pitfall traps set in the litter of a stand of stunted, spruce-fir *(Picea spp., Abies balsamea)* woods (50° 42' N, 57° 20.9' W; about 8.9 m above sea level) on the eastern edge of the community of Port au Choix, Newfoundland. Twenty traps were installed in four groups of five, each group arranged in a one square metre quincunx. All traps were in place from June 24 to August 20, 2000. Trapped specimens were removed on July 8, July 24, August 2, August 11, and August 20. One quincunx for one trapping period is here referred to as a set. Contents of the five traps form-

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ing one set were lumped as one sample. A total of 5 female and 17 male *T. cracens* were caught as follows: August 2-11, 4♂ and 3♀ in the same set; August 11-20, 2♂ and 2♀ in the same set; August 11-20, 11♂ in a separate set with no females. Note that all females were taken in the same sets as 6 of the males. The remaining 11 males were caught in a separate set of traps from the same time period as one of the catches containing both males and females. An example of the males has been identified as *T. cracens* by Dr. C. D. Dondale of the Canadian National Collection of Insects and Arachnids, Ottawa (CNC). A male and a female have been deposited in the CNC. The remaining specimens (both male and female) are in the Biology Department (Pickavance collection), Memorial University of Newfoundland.

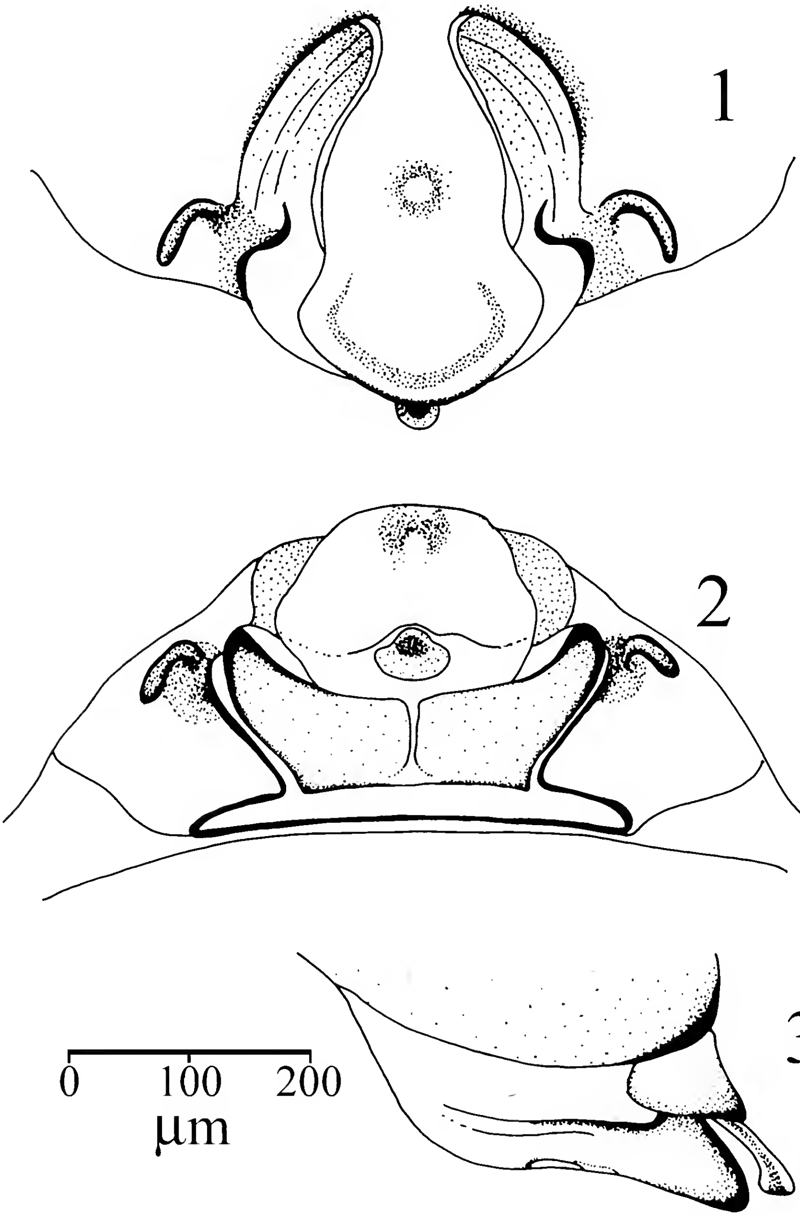
RESULTS

Diagnosis

The external genitalia of female *T. cracens* resemble in general form the other *Tenuiphantes* species known from northeastern North America. These species are distinguished as follows. The sides of the scape of *T. nigriventris* are approximately straight (Helsdingen et al., 1977) whereas the sides of the scape of *T. cracens* have a distinct concavity in the posterior half. The anterior portion of the scape of *T. tenuis* has distinctly concave sides (Helsdingen et al., 1977), whereas the anterior part of the scape of *T. cracens* has convex sides. The scape of *T. zebra* is not expanded posteriorly and is broadly rectangular or ovoid (Paquin and Dupérré, 2003), whereas the scape of *T. cracens* is expanded posteriorly into two lateral wings.

Description

Figures 1-3 illustrate the external female genitalia of *T. cracens*. The term "scape" is used here in the sense of Zorsch (1937) to mean a continuation of the middle part of the ventral wall of the epigynum which is folded under itself and out again so that the narrow tip appears as a rounded tubercle at the end of the widened visible part of the organ. Observations and measurements are based on five specimens. The external appearance is characteristic. Mean width of the epigynum at widest point is 272 μm (range 265 - 275 μm). The bell-shaped scape ends in a posteriorly projecting central process which lies dorsal to the principal part of the scape. Width of the scape at its widest point is 198 μm (no measurable variation in the specimens examined). Mean length of the scape (from narrowest part of neck to posterior edge; excluding posteriorly projecting process) is 266 μm (range 264 - 275 μm). The ventral surface of the principal part of the scape has a shallow central depression surrounded by a sclerotised area which presents a slightly different appearance in each of the specimens examined. The anterior neck of the scape joins the anterior and lateral margins of the epigynum through an acute angle. In three of the specimens this acute angle is rounded and the neck of the scape is not hidden under the anterior margin or seemingly shielded by a membrane. In the other two specimens the acute angle is sharp rather than rounded so that the anterior of the neck is slightly tucked under the anterior margin of the epigynum. The anterior and lateral margins of the epigynum are smoothly concave rather than sinuous. Although all the epigyna examined here display a general bilateral symmetry, all were slightly asymmetrical in detail. Typically this asymmetry was particularly evident in the margins of the epigynum, the shape of the scape, and the configuration of the central depression on the scape.



Figures 1 - 3. *Tenuiphantes cracens* female epigynum. 1. Ventral, 2. Postero-ventral, 3. Left lateral. All figures drawn to the same scale. Setae and bristles omitted for clarity.

DISCUSSION

Adults of the species are evidently only sufficiently active to be caught in pitfall traps for a limited period of time because all 17 specimens of this study were caught in only two of the trapping periods, covering the period August 2 to August 20, 2000. All other *T. cracens* specimens reported to date have been caught between July 7 and August 27. Paquin et al. (2001b) reported two specimens caught in 1991 from the Gaspé: one on July 8, the other between August 12 and 19. Zorsch (1937) reported two specimens from New York: one taken on August 25, 1921, the other on August 27, 1930. Clearly, future searches for this rarely collected species should focus on this time period.

The Port au Choix locality of *T. cracens*, at about 9 m above sea level, seems quite different from the other alpine-Appalachian (Paquin et al. 2001b) localities reported for this species: Mount Whiteface, Mount Marcy and the Gaspé. However, what Port au Choix lacks in altitude it makes up for in climatic severity. Port au Choix is at the northern end of the Northern Peninsula Ecoregion with its Atlantic high boreal ecoclimate and in many ways is similar to the Strait of Belle Isle Ecoregion immediately to the north with its Atlantic low subarctic ecoclimate (Ecological Stratification Working Group, 1995). Under either climatic regime, if *T. cracens* is indeed an alpine species then Port au Choix would provide its climatic ecological requirements.

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I am grateful to Dr. C. D. Dondale for both identifying the male of *L. cracens* and his general support of my arachnological endeavours. I wish to thank Drs. M. Colbo and D. Innes for critical appraisal of this manuscript, the Biology Department, Memorial University for facilities and support, and two anonymous reviewers whose thoughtful suggestions greatly improved this paper.

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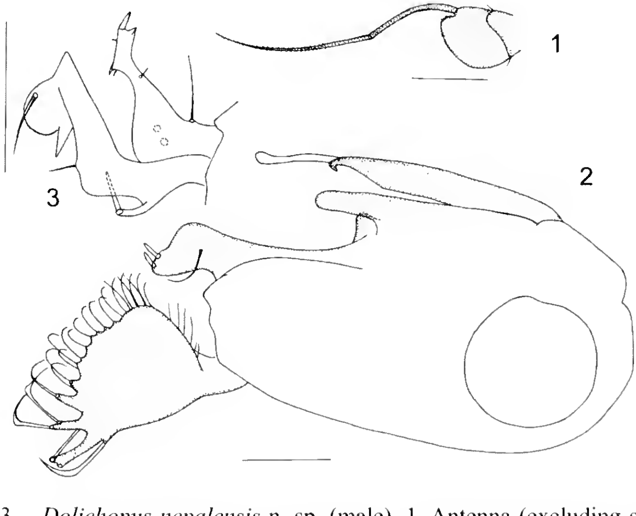
CORRIGENDUM

On a recent paper by Yang et al. (2003, mailed on September 30, 2004), Notes on *Dolichopus, Allohercostomus,* and *Phalacrosoma* from Nepal (Diptera: Dolichopodidae. *Entomological News* 114(5):271-274, figures 1-3 were misprinted. The correct images follow.



Figs 1-3. *Dolichopus nepalensis* n. sp. (male). 1, Antenna (excluding scape), lateral view; 2. genitalia, lateral view; 3, apical genital process, lateral view. Scale = 0.25 mm.

A LONG-LASTING METHOD FOR MARKING BEETLES (COLEOPTERA), WHICH DOES NOT ENHANCE MORTALITY[1]

A. J. Bates[2] and J. P. Sadler[2]

ABSTRACT: Mark-release-recapture studies require marking methods that are durable and do not enhance the rate of mortality. Paint from the Mark-Tex Tech-Pen® was used to mark two species of carabid *(Bembidion atrocaeruleum* and *B. decorum),* and an enhanced rate of mortality, due to paint toxicity, was tested for. No significant increase in the mortality was detected over a 37-day period when compared to unmarked beetles. It was concluded that the marking method did not enhance mortality over the period of study.

KEY WORDS: *Bembidion atrocaeruleum, Bembidion decorum,* Coleoptera, Carabidae, exposed riverine sediments (ERS), mark-release-recapture, mark-toxicity.

Mark-release-recapture (MRR) studies, whether for estimating population size or for studying movement dynamics, require methods of marking insects that allow the identification of recaptured individuals. The ideal marking method should satisfy a number of criteria (Southwood and Henderson 2000), which include: (1) the marks must be durable enough to last the duration of study, and (2) the marking method should not affect longevity. Wineriter and Walker (1984) tested the durability of 26 marking materials on the pronota of three species of insect, including the red flour beetle, *Tribolium castaneum* (Herbst). They found that ink extracted from the Mark-Tex Tech-Pen® was the only material sufficiently durable when applied to the flour beetle. Paint from the most modern version of this marker, the TexPen® (ITW Dymon, 805 E, Old 56 Hwy., Olathe, KS 66061), was used in the study of Bates et al. (in press). Despite the abrasive nature of the exposed riverine sediment (ERS, open gravel and sand by the edge of rivers) habitat in which the MRR investigation was implemented, the durability of marks was shown to be sufficient for the period of study (Bates et al. in press). To test the second criterion, that the marking method does not affect longevity, is the subject of this paper.

METHODS

The species from the MRR investigation chosen for the toxicity study were two species of carabid, *Bembidion atrocaeruleum* (Stephens) and *Bembidion decorum* (Zenker in Panzer). These are both relatively small, (4.5-5.5 and 5.6-6 mm, respectively), fast-running, nearly glabrous species, chosen for the study due to their abundance and close association with ERS.

Paint was removed from the pens and diluted at 5:1 (paint : thinner) with turpentine substitute. Beetles were controlled by dropping them into water, from where they could be picked from the surface and held immobile by firmly hold-

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ing their hind legs between thumb and forefinger. One dot of each of six colors of paint (red, yellow, orange, blue, green and white) were applied, three dots to each elytra, using a piece of 5-amp fuse wire.

Beetles were kept outdoors, in round white polypropylene paint kettles (internal diameter = 172 mm, height 150 mm), which had holes in the bottom to allow drainage and 20-25 mm of sand and gravel substrate in which the beetles could hide and forage. White nylon netting (~0.5 mm diameter) was secured across the top of the container with glue continuously along ~40 percent of the container's circumference and elastic bands for the remainder. This allowed easy access into the containers for feeding and counting purposes. The sediment, which was removed from the MRR site, was initially heated overnight at 140°C in order to kill beetle parasites. The beetles were fed with freeze-dried chironomids as required. The survival of marked beetles of both species was compared with the survival of unmarked beetles over a 36-day period in five replicate containers. Ten beetles were kept in each container and beetles were counted at two- to four-day intervals. Mann-Whitney U (Wilcoxon-Mann-Whitney) tests were used to determine if the number of marked and unmarked beetles surviving at each time period was significantly different.

RESULTS AND DISCUSSION

Figure 1 illustrates the results of the mark toxicity experiment. At almost every time period, for *B. atrocaeruleum* and *B. decorum,* the mean number of marked and unmarked beetles surviving were within 1 standard error of each other and none of the differences were significant at even the 10 percent level. It is concluded therefore that the handling and marking process used did not increase mortality in *B. atrocaeruleum* and *B. decorum* over the period of study. The toxicity experiment was run over a longer time window than those used for the MRR study of Bates et al. (in press), which were <22 days. We therefore conclude that the marking method was likely to have caused no extra mortality in this investigation. It seems highly unlikely that a toxic effect would occur after this 36-day period after marking. The marking method described is a quick, inexpensive method of marking small beetles and other insects, which, for the species tested is sufficiently durable and nontoxic. Given the findings of Wineriter and Walker (1984) it seems likely that the mark longevity on other insects will be longer than for *B. atrocaeruleum* and *B. decorum* when the species are pubescent, or when they live in less abrasive habitats.

ACKNOWLEDGEMENTS

We thank Richard Johnson for all his help and advice. We also thank the department of Geography, Earth and Environmental Sciences at the University of Birmingham, UK, and the Countryside Council of Wales for funding this research.

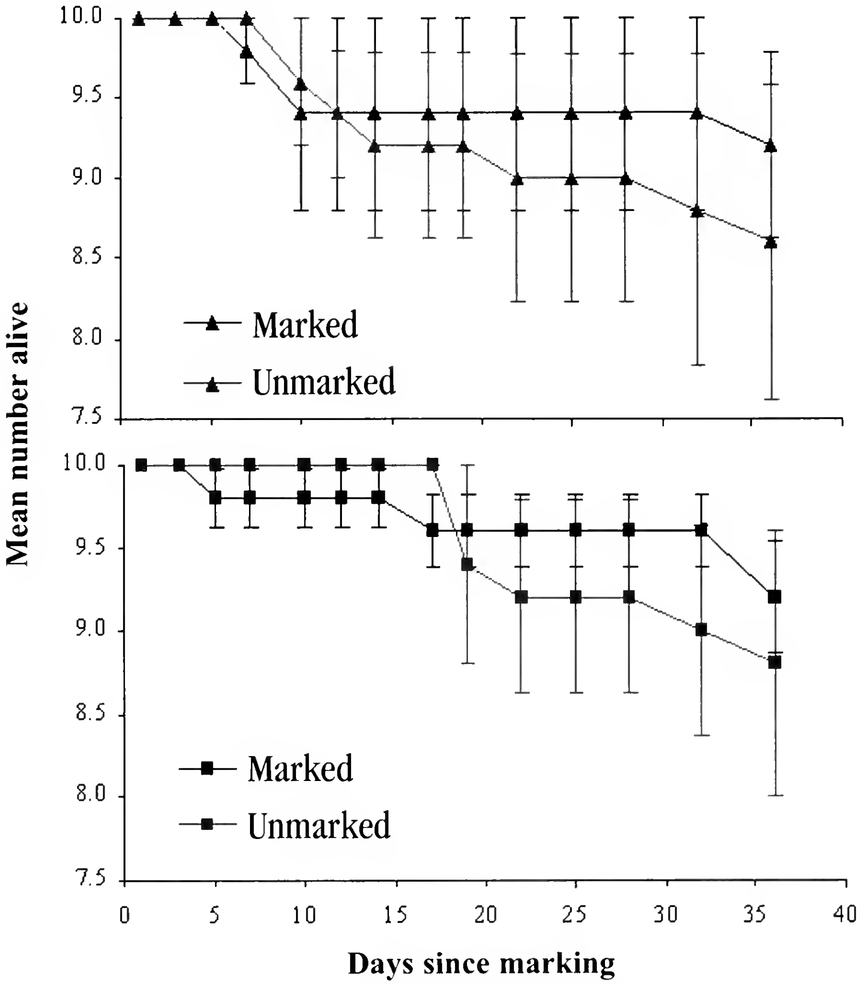

Figure 1. A comparison of the mean number of marked and unmarked *Bembidion decorum* (top, triangles) and *Bembidion atrocaeruleum* (bottom, squares) surviving in replicate (n = 5) gravel microcosms (error bars show ± 1 1SE).

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SCIENTIFIC NOTE

ATTENDANCE OF *AETALION RETICULATUM* (HEMIPTERA: AETALIONIDAE) BY *POLISTES ERYTHROCEPHALUS* (HYMENOPTERA: VESPIDAE) IN PERU[1]

M. A. MacCarroll[2] and W. K. Reeves[3]

Homopteran honeydew is a carbohydrate food source for Hymenoptera and Diptera in the Neotropics (Letourneau and Choe 1987, Cameron et al 1995). Honeydew contains a mixture of oligosacharides including melezitose and stachylose (Russell and Hunter, 2002) and might be a higher energy food source than floral nectar. The quality of food is important in determining caste in social Hymenoptera (O'Donnell 1998). In certain Diptera, such as sand flies (Psychodidae: Phlebotominae), the composition of the sugar might affect the development of medically important trypanosomatids *(Leishmania)* in the gut (Cameron et al. 1995).

Polistes erythrocephalus Latreille (Hymenoptera: Vespidae) was not known to tend or collect honeydew from aetalionids. On March 23, 2004, at 1243h, we observed four aggregations of *Aetalion reticulatum* (L.) (Hemiptera: Aetalionidae) feeding on a tree, most likely Solanaceae, in Agua Caliente, Department of Cusco, Peru. Each aggregation consisted of approximately 30-40 individuals, including nymphs, and adult males and females. A single female *P. erythrocephalus* was standing among or below each of the aggregations of *A. reticulatum. Polistes erythrocephalus* touched individuals of *A. reticulatum* with their antennae but the homopterans did not directly feed the wasps honeydew. Honeydew accumulated below the aggregations of *A. reticulatum,* and *P. erythrocephalus* gleaned the honeydew from the branch directly below the homopteran aggregation (Figure 1). We collected and tasted the honeydew from the branch to verify that it was honeydew and not rain water. When *P. erythrocephalus* was collected, it regurgitated a drop of honeydew from its mouth. This is the first account of *P. erythrocephalus* tending *A. reticulatum* and is further evidence that this homopteran is tended by wasps throughout its range. *Aetalion reticulatum* ranges from Mexico to Brazil and is tended by vespids in Costa Rica (Letourneau and Choe 1987). Voucher specimens of *P. erythrocephalus* and *A. reticulatum* are deposited in the American Museum of Natural History (Division of Invertebrate Zoology) and in the Clemson University Arthropod Collection.

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Figure 1. *Polistes erythrocephalus* feeding on honeydew below an aggregation of *Aetalion reticulatum* in Agua Caliente, Department of Cusco, Peru, March 23, 2004.

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We thank C.R. Bartlett, J.M. Carpenter, and P.D. McMillan for identifying specimens, and P.H. Adler and M.W. Turnbull for reviewing this manuscript. This research was partially supported by the College of Agriculture, Forestry, and Life Sciences Travel Grant from Clemson University. This is technical contribution 4991 of the Clemson University Experiment Station.

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SCIENTIFIC NOTE

FIRST RECORD OF *STICTHIPPUS CALIFORNICUS* (ORTHOPTERA: ACRIDIDAE) OUTSIDE CALIFORNIA, U.S.A.[1]

Thomas A. Stidham[2]

Sticthippus californicus (Scudder), originally described in the genus *Hippiscus* from Gilroy, Santa Clara County, California (Scudder, 1892), is widespread in California and economically important (Strohecker et al., 1968; Otte, 1984). At present, *S. californicus* has been reported solely from California (Strohecker et al., 1968; Otte, 1984; Helfer, 1987). On May 31, 2002, in western Nevada, I collected two adult males of *S. californicus* and observed other individuals approximately 3 miles south of state highway 722, southwest of Eastgate in Churchill County (lat. 39° 16' 15" N, long. 117° 53' 27" W). The two males (now deposited in the Essig Museum at the University of California at Berkeley) were collected with *Cratypedes lateritius* (Saussure) in an area with abundant sagebrush (*Artemisia spinescens* Eaton). The two male specimens have red hind tibia, hind wings with a yellow basal area, a bilobed rather than trilobed epiphallus, and other morphological characters consistent with specimens from California (Otte, 1984). The Nevada specimens are darker overall than that illustrated by Otte (1984), but are within the range of variation exhibited by *Sticthippus californicus* specimens in the Essig Museum.

ACKNOWLEDGMENTS

I wish to thank C. Barr (Essig Museum) for access to specimens, and D. E. Erwin and H. E. Schorn (U.C. Museum of Paleontology) for their assistance in the field.

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SCIENTIFIC NOTE

INSECT MEALS FROM A LEPTODACTYLID FROG (AMPHIBIA: LEPTODACTYIDAE) IN DOMINICAN AMBER (MIOCENE, 23 MA)[1]

Scott R. Anderson[2]

Dominican amber is renowned for both its clarity and taxonomic breadth of biological inclusions. Nearly every insect order and a variety of small vertebrates have been found in Dominican amber. Though insects are sometimes observed with vertebrate inclusions, most are not directly associated with the vertebrate, simply being victims of the same entombment. A few vertebrates have been observed with dipteran larvae surrounding them (Grimaldi, 1996; Poinar and Cannatella, 1987), showing that the decay was in progress when entombment occurred. The stomach contents consisting of several distinct insect meals of a leptodactylid frog in 23 million-year-old Dominican Amber is herein described, and is the first direct evidence of insects associated with a vertebrate during its lifetime.

The partial insects comprising the frog's stomach contents were primarily examined under a binocular/stereo dissecting scope, utilizing a variable zoom range of 15 to 90 times magnification. Lighting was supplied from above (direct) and below (backlighting) in varying intensities. Photography was performed by using a dissecting microscope (Nikon SMZ-10) with a digital camera connected to a personal computer equipped with the software program Auto-Montage. Auto-Montage integrates images taken at slightly different focal planes and endows the newly formed images with extended depth of field. Measurements were taken with a standard ruler calibrated in millimeters.

The stomach contents consisting of several distinct insect meals are located adjacent to the upper surface of the leptodactylid frog's tongue. The tongue is approximately 7 mm long from base to apex. The stomach contents occur on the anterior portion of the tongue, being approximately 3 mm long by 2 mm height. The stomach contents are partially obscured by the well-preserved upper portions of the hind leg (femur and tibiofibula present, as well as muscles, tendons, and skin). Figure 1 shows the location of the leptodactylid frog's tongue and stomach contents: the three lowermost arrows point to the tongue while a fourth arrow indicates the insect meals. Rotation and realignment of the specimen allows for the careful examination of the partial insect within the stomach contents.

The stomach contents can be divided into two main areas: a distinct partial hind leg and a rounded mass of indistinct, partially digested insects, approxi-

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mately 2 mm long by 2 mm wide. The distinct partial hind leg occurs close to the anterior portion of the tongue and is obscured from most views by the femur and skin of the frog. The tarsus, tibia, and a portion of the femur are visible and are all well preserved. The preserved portion of the femur is approximately 1 mm, while the tibia and tarsus each measure approximately 2 mm. A portion of the tarsus is obscured by the rounded mass of insect partials. Though incomplete, the femur is thickened compared to the tibia. The tibia has at least five spines. The spines are relatively long (longer than tibia diameter) and appear movable. Based on the observed characteristics, this insect meal was likely a common ground cricket (Orthoptera: Gryllidae: Nemobinnae). Due to the awkward rotation required to view this portion of the stomach contents and the resultant irregular surface created, photography of this feature has not yet proved successful.

Fig. 1 Location of the tongue and stomach contents of the leptodactylid frog entombed in 23 million-year-old Dominican Amber.

The second area of stomach contents that are observed consists of a rounded mass of insect partials approximately 2 mm long by 2 mm height. Though partially obscured by the femur and tibiofibula of the frog, most details of this area are readily observable when the specimen is rotated. Overall, this portion of the stomach contents appears to be a clumping of insect partials in a definite rounded mass. Most of the partial insects are indistinguishable, sclerotized portions of unidentifiable insects, exhibiting little recognizable structure besides the general sclerotized appearance. This is evidence of their partial digestion. One, very well-preserved slightly clubbed, 11-segmented, antenna is observed. A second antenna is also observed (appears to be the counterpart to the well-preserved antenna), but is deteriorated and total number of segments cannot be determined. Figure 2 shows this second area of stomach contents. The very well-preserved, slightly clubbed antenna is designated by an arrow, while a second arrow shows the clumped, deteriorated insect partials.

Though two hymenopterans (families undetermined) are observed within the amber specimen, the partial insects that comprise the stomach contents of the

Fig. 2
Close-up of second area of stomach contents (clumped partial insects shown in Figure 1).

frog are the only ones located in close proximity to the frog. Their deteriorated appearance shows that they were partially digested. At least two meals are identifiable within the stomach contents, although more are possible based on the general deteriorated state of the insect mass. Regardless of the total number of insect meals, finding both the soft tissue tongue and stomach contents of a fossil frog is phenomenal.

ACKNOWLEDGMENTS

Special thanks are given to my wife Heidi for allowing me to purchase the frog from Roy Larimer in 2000 and for her understanding and patience while I research this unique and interesting specimen. I am also grateful to Jorge A. Santiago-Blay (Department of Paleobiology, National Museum of Natural History, Washington, DC, USA) and Patrick R. Craig (Monte Rio, California, USA) for their invaluable input and critique.

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BOOK REVIEW

EARLY AMERICAN NATURALISTS. EXPLORING THE AMERICAN WEST 1804-1900. J. Moring. 2002. Cooper Square Press. 200 Park Avenue South, Suite 1109. New York, NY 10003-1503 U.S.A. 241 pp. Hardcover. ISBN 0-8154-1236-3.

Early American Naturalists Exploring the American West 1804-1900, delineates some of the trajectories of natural history in the United States during the post Lewis and Clark portion of the 19th century from three different and interlacing perspectives: chronological, biographical, and thematic. Fortunately, this book is more than a chronology, a collection of biographies, or an abstract discourse. Throughout his book, Moring emphasizes three major themes: 1) the human face of scientific research, 2) the links between science and politics, and 3) the progressive specialization of biology as the 19th century came to a closure. I detail those topics in the following paragraphs.

Moring describes the lives of numerous early explorers, including the multiple difficulties 19th century naturalists working in the U.S.A. had to face to get research done (e.g. the tragic loss of life, such as that of David Douglas, and/or specimens, including Thomas Say's, the father of American entomology, inability to keep his specimens well preserved) and their often extraordinary personalities. The preservationist attitudes of John Muir (pronounced Miur) contrast starkly with the less than ideal research methods and personal ambitions of vertebrate paleontologists Cope and Marsh. After reading the book, well seasoned practitioners of natural history, and even those on the sidelines will wonder how little some of the human aspects of science have changed. The book is sprinkled with humor (e.g. Audubon's depictions of imaginary fish precipitously described by the prolific Rafinisque or Nuttall's use of his rifle as a botanical digging tool). Characters of some notoriety in United States history (e.g. Aaron Burr and P. T. Barnum), those known more within museum circles (e.g. Spencer Baird, third Secretary of the Smithsonian Institution and his extensive network of collectors that helped making the "nation's attic" a world class natural history collection) or, sadly, faculty members who allegedly exploited students for their own benefit, parade in front of us, with their virtues and faults.

Early American Naturalists is filled with examples of how naturalists from the incipient nation, especially from the city of Philadelphia (Pennsylvania), the major intellectual center of the United States during most of the 19th century, navigated the treacherous political waters to land favorable positions. Letters of recommendation from influential notables, then as now, came in handy for some hopefuls. By the middle third of the 19th century, passionate adventurers from all works of life and some who wanted to avoid becoming involved in the American Civil War had joined the ranks of the natural historians. Wave after wave headed west and, as if they had Copland's "Rodeo" as a background, national and international naturalists became part of the American expansion.

As the 19th century comes to an end, the emphasis gradually shifts from general collecting by people with little formal preparation to generally more careful study and selective collecting by those with more extensive academic preparation (e.g. the "Scientifics" of Wilkes' expedition or the geological or biological surveys). Also, the academic motivations also slowly moved from discovering biodiversity to finding overarching biological principles that help understand what has been collected. It is in this context that Darwin's evolutionary hypothesis appears in a timely fashion and on generally fertile grounds. Although American Natural History is dominated by men, the lives of several notable women, such as Martha Maxwell and Florence Merriam Bailey, are described in considerable detail.

While I truly enjoyed reading *Early American Naturalists,* this work would have benefited from a more extensive "Further Reading" section (including references to the abundant resources of the internet) to reach readers avid to learn about major events (e.g. Louisiana Purchase, financial crisis of 1857), people (e.g. Asa Gray, John Wesley Powell), places or institutions (e.g. Peale family and their museum - see back cover of this issue - U.S. Biological Survey), and routes of early explorers (e.g. Pike, Long, Custis) could have been directed to. In spite of these drawbacks, *Early American Naturalists Exploring the American West* is a good introduction to the subject and nicely brings to the forefront part of the zeitgeist of the American 19th century. Those little or not familiarized with the historical context of 19th century natural history in the United States will benefit from reading this book.

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BOOK REVIEW

NIGHT VISIONS. The Secret Designs of Moths. Joseph Scheer. 2003. Prestel Publishing. 175 Fifth Avenue, Suite 402, New York, NY 10010 USA. 199 pp. HARDCOVER US$30.60 (approximately).

To read *Night Visions* is to hold a work of art, the result of an obsession that originated by accident. This work is totally dedicated to moths, turning any previous fears of these "misconceived creatures of the night" into adoration and wonder. This work entices readers' eyes, beginning with a table of contents hidden under a two-page wide – each page is 11.5" by 13.5" – wing of a *Hyalophora cecropia* saturniid. Moth images are magnified many times, revealing magnificent details that are only possible to see with microscopes or very good hand lenses.

Night Visions is less of a scientific read and more of a visual appreciation experience. The author, Joseph Sheer, also an artist, printmaker, and professor, introduces *Night Visions* by describing how his obsession with moths of all shapes and sizes originated. He describes how he had tested a new scanner by snaring a live house fly inside. The elaborate structures, which were revealed by fourteen thousand pixels per inch, sparked Scheer's curiosity in other insects. This sole incident seeded years of artistic and entomological growth for the author. Sheer describes his personal experiences with moths in a storytelling fashion. He brings these night-dwelling creatures into a lively spotlight.

Night Visions' contents include three chapters entitled: "Attracted to Light" by Joseph Scheer; "Moths: Species Rich, but Little Known" by Marc Epstein; and "Nature's Art and Technological Imagination" by Johanna Drucker. These write-ups are preceded by a selection of 72 plates of moth imagery – the *crème de la crème* among the thousands of scans Scheer has made through the years - followed by a list of featured moths, their classification, and wingspan dimensions. Small plate numbers and the scientific are printed on each image so as not to distract the readers' focus from the moths' microscopic intricacies and immeasurable beauty. Some images are full body while others are close ups of the head, antennae, or textured wing patterns. The only shortcomings I noticed are small portions of some images that are slightly out of focus.

Scheer's "Attracted to Light" points out that there are one hundred and fifty thousand species of moths, eight times the number of their better known and more popular siblings, the butterflies. Epstein's "Moths: Species Rich, but Little Known," touches on the classification, descriptions, and identifications of each featured species. This teaser is a vignette of questions and answers brought up by the study of moths, such as the possible explanations for moths' attraction to lights and the probable significance of their complex mimetic color patterns. Lastly, "Nature's Art and Technological Imagination" by Drucker is a well-written history of science and image translation. She presents an original and poetic explanation of the images in the book as "artwork, not scientific records." "Artistic expression with sophisticated tools" that helps you visually meditate on the extreme detail. She states how technology assists us to "see first and intellectualize afterwards." Despite this book's accidental origin, it is an inspiring visual documentary of the author's work. While Scheer's solo exhibitions are limited by the space provided, this book portrays over a hundred beautiful species of moths. *Night Visions* enriches the understanding of moth biodiversity for the non-expert reader and genuinely sensitizes us to the world of moths.

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BOOK REVIEW

BUGS BEFORE TIME: PREHISTORIC INSECTS AND THEIR RELATIVES. Cathy Camper. Illustrated by Steve Kirk. 2002. Simon & Schuster Books for Young Readers. 40 pp. ISBN 0-689-82092-5. US$16.95.

Cathy Camper tells readers right from the beginning to quit worrying about insects taking over Earth in the future — "...scientists who work with insects know that bugs have already taken over!" This picture book's brightly colored illustrations, many drawn from eye-popping perspective near ground level, make turning pages rewarding. Descriptions of fossil insects and their modern descendants reinforce for children the immensely long history of arthropods. Topics covered include insect evolution; relatives (e.g. eurypterids, trilobites, spiders, and centipedes); the formation of fossils; development of wings and flight; continental drift; and geologic time. Steve Kirk's intriguing artwork highlights the ordinary, such as cockroaches and dragonflies, as well as the amazing—*Titanopterous*, a gigantic grasshopper-like insect with a wingspan of 14 inches. Dinosaurs and appropriate flora complete the scenes. There are answers to the questions, why study insects? and, more importantly, why study fossil insects? With a well-tuned understanding of what interests children, Camper illustrates points with familiar references, often related to size: "Imagine trying to stomp on a cockroach almost as big as your shoe!" Prehistoric *Arthropleura* was "probably bigger than your mom." Descriptions include correct scientific terminology, such as: cerci, ovipositor, chelicerae, and others. Insect classes are referred to by name: Diploda (millipedes), Chilopoda (centipedes), Protodonata (ancient dragonfly look-alikes), etc. A bibliography and pronunciation glossary completes the lively text. *Bugs Before Time: Prehistoric Insects and Their Relatives* is an absorbing choice for young bug enthusiasts from ages 6 to 10.

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Mailed on November 12, 2004

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SOCIETY MEETING OF FEBRUARY 24, 2004

The Historic Titian Peale Butterfly and Moth Collection

Jason D. Weintraub
Department of Entomology, The Academy of Natural Sciences

Titian R. Peale (1799-1885)
Image courtesy of the Academy of Natural Sciences, Philadelphia

The Society's first meeting of 2004 highlighted one of the oldest entomological collections in the Western Hemisphere, the Titian Peale Butterfly and Moth Collection, housed at The Academy of Natural Sciences. Titian Peale was a prominent early naturalist, a contemporary and collaborator of Thomas Say, and the youngest son of the large family of artists and naturalists headed by Charles Willson Peale of Philadelphia. Peale went on some of the earliest exploring expeditions as a naturalist, including a trip to Florida in 1817 when it was still in Spanish hands, the Long Expedition in 1820, first exploring the land between the Mississippi and the southern Rocky Mountains, and the four-year Wilkes Expedition in the 1840s to South America and the Pacific Rim. During his long life until his death in 1885, Peale continued his pursuit of Lepidoptera, with his personal collection protected from light, dermestid beetles and moisture in specially designed boxes of Peale's own construction. These boxes, and specifically the book covers, allowed Peale to record a significant amount of data for these specimens, something lacking for most specimens prepared by his contemporaries.

Jason Weintraub examined the collection in a wonderfully illustrated talk, taking note of the highlights of the collection, including extinct species, species new to science, and assemblages of species from rare or threatened habitats. Weintraub also discussed the project funded by a *Save America's Treasures* grant that has allowed the boxes to be cleaned, restored and preserved, and the specimens to be repaired and individually photographed and catalogued. This digital catalogue is expected to be available later this year in a web-accessible form on-line.

Several Peale boxes were on display to accompany the evening's talk. In other notes, Mr. Marcos Lhano, of Montevideo, Uruguay, was introduced; he is spending approximately six months studying the grasshopper subfamily Leptysminae in the Orthoptera Collection at the Academy. Over 40 members and visitors were present at the meeting.

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FIRST RECORD OF *CAENOCHOLAX FENYESI* (STREPSIPTERA: MYRMECOLACIDAE) PARASITIZING *SOLENOPSIS INVICTA* (HYMENOPTERA: FORMICIDAE) IN ARGENTINA, WITH A DISCUSSION ON ITS DISTRIBUTION AND HOST RANGE[1]

Jerry L. Cook[2], Luis A. Calcaterra[3], and Lucas Nuñez[4]

ABSTRACT: The first record of *Caenocholax fenyesi* parasitizing the red imported fire ant, *Solenopsis invicta*, in South America is documented. *Caenocholax fenyesi* males were collected from colonies of *S. invicta* in northeastern Argentina. This record helps to clarify the occurrence and host utilization of *C. fenyesi* in the United States, where *S. invicta* is an invasive exotic species. This record, along with other recent reports, suggests that *C. fenyesi* males are generalist parasites, not utilizing a narrow host range, as do most known strepsipterans. However, the potential presence of cryptic species is an alternate explanation.

KEY WORDS: *Solenopsis invicta*, *Caenocholax fenyesi*, host association, distribution, host specificity, host switching

Host relationships in the strepsipteran family Myrmecolacidae are poorly known. However, in all species whose host has been documented, a form of heteronomy exists (Kathirithamby 1989). Males utilize ants (Hymenoptera, Formicidae) as hosts during their developmental stages, while females use orthopteroids for developmental stages and as the host of adult females (Kathirithamby and Hamilton 1992). Most species of Myrmecolacidae are known only from males, which are collected in their adult, free-living stage. These adult males are rarely collected with a host association, and hosts are currently known for males of eight of the 108 myrmecolacid species (Westwood 1861, Hofeneder 1949, Luna de Carvalho, 1972, 1973, Tesón & Remes Lenicov 1979, Kathirithamby 1991, and Kathirithamby and Johnston 1992, 2003). Additionally, several parasitized ant species have been collected but their associated strepsipteran species was not identified (Ogloblin 1939, Hughes et al. 2003).

The first host association between *Caenocholax fenyesi* Pierce and the red imported fire ant, *Solenopsis invicta* Buren, was discovered by Kathirithamby and Johnston (1992) in Texas, USA. This host association was considered as a crossover host since it appeared unlikely that parasitized *S. invicta* and the unknown orthopteroid female host were both simultaneously introduced and

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migrated throughout the southeastern United States in a span of less than 75 years (Cook 1996). Kathirithamby and Hughes (2002) discovered *Camponotus planatus* Roger parasitized by *C. fenyesi* in Veracruz, Mexico, and speculated that *C. planatus* was the original host of *C. fenyesi.* This discovery was from the vicinity of the type locality of *C. fenyesi* (Pierce 1909). *Dolichoderus bispinosus* Olivier was also recently found hosting *C. fenyesi* in the same Mexican locality (Hughes et al. 2003). Genetic studies by Kathirithamby and Johnston (2003) report that male *C. fenyesi* from Texas in *S. invicta* are 15 percent divergent from the morphologically identical male from Mexico, parasitic in *D. bispinosus.* This led them to name *C. fenyesi* from Texas *C. fenyesi texensis* and from Mexico *C. fenyesi waloffi.*

The first report of *Caenocholax* in South America was given by Ogloblin (1939) from collections in Argentina and Brazil. Ogloblin found male specimens in *Pheidole radoschkowski reflexans* Santschi that he reported as a new species of *Caenocholax,* but did not name the strepsipteran species. He found more of this strepsipteran species in *Pheidole fallax emiliae* Forel and an additional undetermined *Pheidole* species. Ogloblin also found three fire ant species; *Solenopsis saevissima pylades* Forel (now *S. xyloni*), *S. saevissima quinquecuspsis* Forel (now *S. quinquecuspis*), and *S. saevissima richteri* Forel (now *S. richteri*) in Missiones and Salta province, Argentina, that he reported as being parasitized by an undetermined species of *Myrmecolax.* This species was named *Myrmecolax ogloblini* by Luna de Carvalho (1973). Later, Tesón and Remes Lenicov (1979) observed specimens from the Ogloblin collection taken from the *Pheidole* species (labeled as *Caenocholax pheidolephagus,* but never published) and determined that they were *Caenocholax brasiliensis* Oliveira and Kogan. *Caenocholax brasiliensis* and *M. ogloblini* have since been synonymized with *C. fenyesi* (Kathirithamby and Hughes 2002).

The distribution of *C. fenyesi* confirms that its males must be hosted by more than one ant species, unless *C. fenyesi* constitutes a species complex. *Caenocholax fenyesi* has a currently known range from the southern United States to Chile and Argentina (Cook et al. 1997; Kathirithamby and Hughes 2002). While its known distribution now appears disjunct, it is probably widespread throughout this region. New collections continue to fill areas missing from the known distribution. The distribution of *S. invicta* is well known, and it is not found in Mexico, Central America, or Ecuador, where *C. fenyesi* occurs. *Camponotus planatus* is a widely distributed species, but its northern limit includes only the southernmost part of Texas and parts of Florida. Its southern distribution limit does not include Chile and Argentina (W. P. MacKay unpublished data). In this paper we make the first report of *C. fenyesi* parasitizing *S. invicta* in its homeland and discuss its host relationships.

NEW HOST ASSOCIATION RECORDS

Fifteen *Caenocholax fenyesi* males were isolated from four *Solenopsis invicta* colonies from northeastern Argentina. The *S. invicta* colonies were being maintained in laboratory rearing conditions at USDA-ARS-SABCL as part of a study of preference of *Pseudacteon* flies (Diptera: Phoridae) for different fire ant hosts. Two colonies were collected on September 11, and the others on November 20, 2003. Three colonies were from Herradura (S 26° 31', W 58° 17'), Formosa Province, on the coast of the Paraguay River. The other colony was collected near Centro Nacional de Desarrollo Acuícola (CENADAC), 20 km from Corrientes (S 27° 23', W 58° 41'), Corrientes Province, on the coast of the Paraná River. Both collecting sites are located in the eastern limit of the phytogeographical province of the Chaco. This province has a mean annual temperature of 20 to 23°C and an annual rainfall of 1,200 mm (Cabrera and Willink 1980) with a pronounced dry season. The area where the colonies were collected has a somewhat higher rainfall because it is located near a tropical rain forest habitat and the main rivers of the region (Paraná and Paraguay).

Colonies were collected, separated from the soil by flotation (Banks et al. 1981), and housed in ventilated plastic rearing trays (40 x 30 x 15 cm) with plastic cover and a 7-cm plaster nest to provide humidity. Trays containing 2g of worker ants (~3000 ants) and 2g of brood were maintained at 25°C and 60 percent RH, fed sugar water, and provided water *ad libitum*. The trays were being examined daily for the presence of *Pseudacteon* (Phoridae) pupae. *Caenocholax fenyesi* males were found between October 3 and 20, 2003, with additional specimens collected between December 19, 2003, and January 2, 2004.

We found only 15 *C. fenyesi* males from the approximately 12,000 *S. invicta* workers. Supposing the males emerged from different workers as is typical for this species (Cook 1996), the parasitism rate from these colonies was less than 0.2 percent. However, this may be an underestimation because stylopized ants lose their social instincts and abandon the nest (Ogloblin 1939, Cook 1996).

The strepsipterans were morphologically identified in the laboratory at Sam Houston State University. Three male *C. fenyesi* from this collection are deposited in the entomology collection at Sam Houston State University. The other individuals were kept at the SABCL collection.

In addition, a survey was conducted to search for *C. fenyesi* females in late November and early December 2003 in both areas where the *S. invicta* colonies were found parasitized. A total of 217 orthopterans were collected and examined, but none were parasitized by *C. fenyesi*. Collecting methods were light trapping (three hours each day and for three days), sweeping (during 30 minutes), and pitfall trapping (40 vials were put every 10 m for two days). In Herradura, 154 orthopterans (70 Grillidae, 77 Acrididae, and 7 Gryllotalpidae) were collected in the light traps and 8 Grillidae in the pitfall traps (2 of them were parasitized with dipteran parasites). In Corrientes, 35 orthopterans were collected from sweeping (1 of them parasitized by a nematode).

DISCUSSION

The lack of information on host associations in the Myrmecolacidae is common, and in the case of *C. fenyesi* has led to several speculations about its host relationships. Cook (1996) speculated that *C. fenyesi* most likely did not move with its host from *S. invicta's* introduction into Mobile, Alabama, around 1918 (Creighton 1930) to Texas by its discovery in 1988 (reported by Kathirithamby and Johnston 1992). This move would have required a simultaneous move of both sexes, which occur in different hosts, or by the first larval instar. The dispersal stage is the first instar larva, which must find and infect its host. It is unlikely that a 50µ larva, which moves by walking legs and sometimes jumping with its caudal appendage, will disperse very far in any given generation (Cook et al. 1998). Although dispersal may also be mediated by a host female, which may disperse into an area where suitable hosts for both strepsipteran hosts occurs.

Kathirithamby and Hughes' (2002) discovery of *C. fenyesi* using *C. planatus* as a host led them to speculate that it may be the original host. This supposition presents two problems, how *S. invicta* became its host in central Texas and why *C. planatus* would be the most likely original host. First, if *C. fenyesi* made a host switch from *C. planatus* to *S. invicta*, there is a logistical problem. *Camponotus planatus* only occurs in Texas in southern counties of the Rio Grande Valley, and the closest it has been reported to Brazos County (location of the material for the original host association) is the material that we (JLC) collected in San Patricio County and separate material collected by William P. Mackay from Victoria County (O'Keefe et al. 2000). *Solenopsis invicta* did not invade this region of Texas until the mid-1970s (Callcott and Collins 1996). The original host association that Kathirithamby and Johnston (1992) described was from specimens collected in 1988. While it is not impossible that *C. fenyesi* dispersed this far, it is unlikely given the dual host association of this strepsipteran and its low dispersal ability. It is even more unlikely that *C. planatus* is the source of *C. fenyesi* collected in Louisiana between 1964 and 1967 (Khalaf 1968), in Mississippi in 1966 (Khalaf 1969), and in 1960 from Arizona (Johnson and Morrison 1979). The presence of *C. fenyesi* in Arizona is most problematic to support the speculation of Kathirithamby and Hughes because neither *C. planatus* nor *S. invicta* are known to occur in Arizona. The second problem of what ant species is the original host of *C. fenyesi* is becoming more difficult to determine with the discovery of different host associations. The host record of *C. planatus* from the type locality of *C. fenyesi* does not necessarily suggest that it is the original host, but only documents that this could be the host of the type population. More recently, *D. bispinosus* has also been recorded from this region in Mexico, making even that assumption unclear.

The discovery of *C. fenyesi* utilizing *S. invicta* as a host in its native Argentina makes it an additional candidate as a primary host. The recent discovery of *S. invicta* in northwestern Argentina (Calcaterra et al. unpublished data), where males of *C. fenyesi* were also collected (Kathirithamby and Hughes 2002), could support this idea. All of these host ants are being parasitized in their natural habitats, as well as *S. invicta* being parasitized in its invaded territory of the United States. None of these ant species are found throughout the range of *C. fenyesi,* so there is a problem with designating any of them as an "original host," at least from the evidence that we now have. Other likely candidates could be other fire ants with wide distributions, such as *Solenopsis xyloni* McCook or *Solenopsis geminata* Fabricius, however, there is no concrete evidence that either is even a host. The only evidence for this assumption is that their distributions coincide in part with that of *C. fenyesi;* they are closely related to one known host, *S. invicta;* and Ogloblin's (1939) discovery of a specimen of what he identified as *S. s. pylades* Forel parasitized by a myrmecolacid that he did not identify. *Solenopsis saevissima pylades* is now a synonym of *S. xyloni* (Trager 1991). However, the identity of this *Solenopsis* species needs confirmation because *S. xyloni* is not thought to occur in South America (Trager 1991, Pitts 2002). The host found in Misiones by Ogloblin could be *S. invicta, S. richteri,* or *S. macdonaghi. Solenopsis invicta* is the most abundant of these species in this area.

One conclusion that can now be garnered from the data we have is that male *C. fenyesi* is a generalist parasite of ants. If all of these strepsipteran specimens belong to the same species, *C. fenyesi,* then it certainly is not host specific. Males of *C. fenyesi* are currently associated with three species of ants that are not even in the same subfamily (*S. invicta* is in the subfamily Myrmicinae, *D. bispinosus* in Dolichoderinae, and *C. planatus* in Formicinae). The female would also be a generalist with our current associations. One host of the female *C. fenyesi* has been identified by Kathirithamby and Johnston (2003) as the cricket *Macroanaxipha macilenta* (Saussure). Prior to this, Kathirithamby and Hughes (2002) synonymized *Myrmecolax ogloblini* Luna de Carvalho under *C. fenyesi,* which would be an additional host for the female. Myrmecolax ogloblini was described from material Ogloblin had collected and called *Mantidoxenos argentinum.* The hosts of this species are *Camponotus punctulatus cruentatus* Forel for the male and *Acanthiotespis maculaus* (Saussure) for the female (Luna de Carvalho 1973). *Acanthiotespis maculatus* is in the order Mantodea. If this synonymy is correct it would mean that the female is utilizing hosts in at least two separate orders, Mantodea and Orthoptera.

An alternate conclusion may be that there are cryptic species that are all morphologically similar to *C. fenyesi.* In this scenario, different host species may have different strepsipteran parasites. In the light of Kathirithamby and Johnston's (2002) genetic analysis, this may be more logical. Molecular approaches and host specificity tests are needed to clarify this subject.

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THREE NEW SPECIES OF *APOGONALIA* FROM THE DOMINICAN REPUBLIC (HOMOPTERA, CICADELLIDAE, CICADELLINAE)[1]

Paul H. Freytag[2]

ABSTRACT: Three new species of *Apogonalia* from the Dominican Republic are described, *A. angusta, A. noda,* and *A. loxa.*

KEY WORDS: *Apogonalia,* new species, Homoptera, Cicadellidae, Cicadellinae, Dominican Republic

The species of *Apogonalia* that occur on Hispaniola were reviewed by Young (1977). At that time four species were known, *A. histro* (Fabricius), *A. interrupta* (Signoret), *A. pinguis* Young and *A. robusta* (Walker). Three new species have now been found and are described here, two are related to *A. pinguis* and the other is not closely related to any of the four known species.

Apogonalia angusta NEW SPECIES
(Figures 1-5)

Description: Length of males 7.5 mm, females unknown. Similar to *A. pinguis* in general appearance, except slightly smaller, and more slender. General color pattern similar to *pinguis,* except with a dark brown spot, bordered by yellow, along middle of costa and a smaller greenish spot at base of costa. Male genitalia: Plates (Fig. 1) shorter then pygofer. Pygofer longer than wide, with slightly enlarged rounded apex. Paraphysis (Figs. 2 and 3) with two processes which are long, diverging, slightly enlarged near pointed apex. Aedeagus (Figs. 4 and 5) triangular in ventral view, with bifurcate, ventrally projecting, sharply pointed apex.

Type Data: Holotype male, Dominican Republic: Azua, East side of crest, Sierra Martín Carcía, 7 km WNW Barrero, 18° 21' N, 70° 58' W, 860 m, July 25-26, 1992, C. Young, R. Davidson, S. Thompson and J. Rawlins, cloud forest adjacent to disturbed forest. Paratype male, same data as holotype. Holotype and paratype have been deposited in the Carnegie Museum (Pittsburgh, Pennsylvania, U.S.A.).

Notes: This species is closely related to *pinguis* and can be separated from it by being smaller, less robust, and with a distinctly different aedeagus.

Apogonalia loxa NEW SPECIES
(Figures 6-10)

Description: Length of males 7.5-8.2 mm, females 7.5-8.5 mm. Similar to *A. pinguis* in size and coloration of head and thorax, differing on front wing coloration and male genitalia. General coloration similar to *pinguis* for head and pronotum. Front wings dark brown with three yellowish spots,

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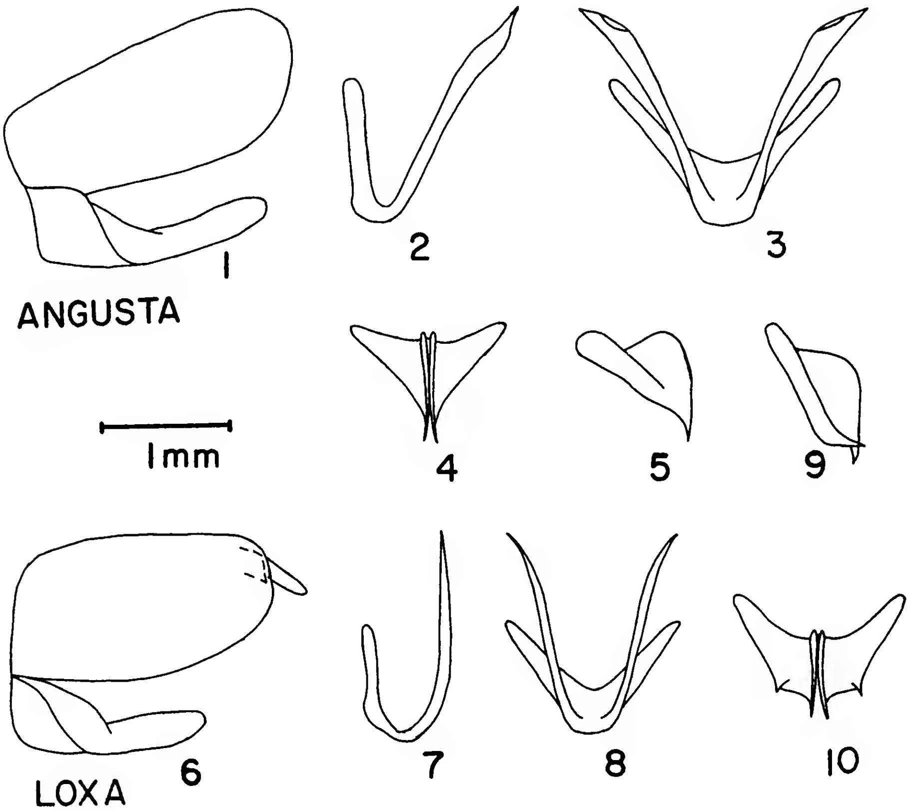
one spot in basal third of wing, one larger spot from end of clavus to the costal margin, and one across apical ends of subapical cells. Male genitalia: Plates (Fig. 6) slightly over half length of pygofer. Pygofer longer than wide, evenly rounded. Paraphysis (Figs. 7 and 8) with two thin, long, slightly diverging processes. Aedeagus similar to *pinguis* except lateral spines extending ventrally.

Type Data: Holotype male, Dominican Republic: Pedernales, 20 km. N Cabo Rojo, 18° 07' N, 71° 39' W, 1070 m, July 23-24, 1990, C. Young, J. E. Rawlins, S. Thompson. Paratypes: two males and three females, same data as holotype. Holotype and one female paratype have been deposited in the Carnegie Museum, one male and one female paratype in the University of Kentucky Collection (Lexington, Kentucky, U.S.A.), one male paratype in the Florida Collection of Arthropods (Gainesville, Florida, U.S.A.), and one female paratype in the National Collection, Santo Domingo, Dominican Republic.



Figures 1-5 *Apogonalia angusta* n. sp. Fig. 1, male genital capsule, lateral view. Fig. 2, paraphysis, lateral view. Fig. 3, paraphysis, ventral view. Fig. 4, aedeagus, ventral view. Fig. 5, aedeagus, lateral view. Figures 6-10, *Apogonalia loxa* n. sp. Fig. 6, male genital capsule, lateral view. Fig. 7, paraphysis, lateral view. Fig. 8, paraphysis, ventral view. Fig. 9, aedeagus, lateral view. Fig. 10, aedeagus, ventral view. All drawn to same scale.

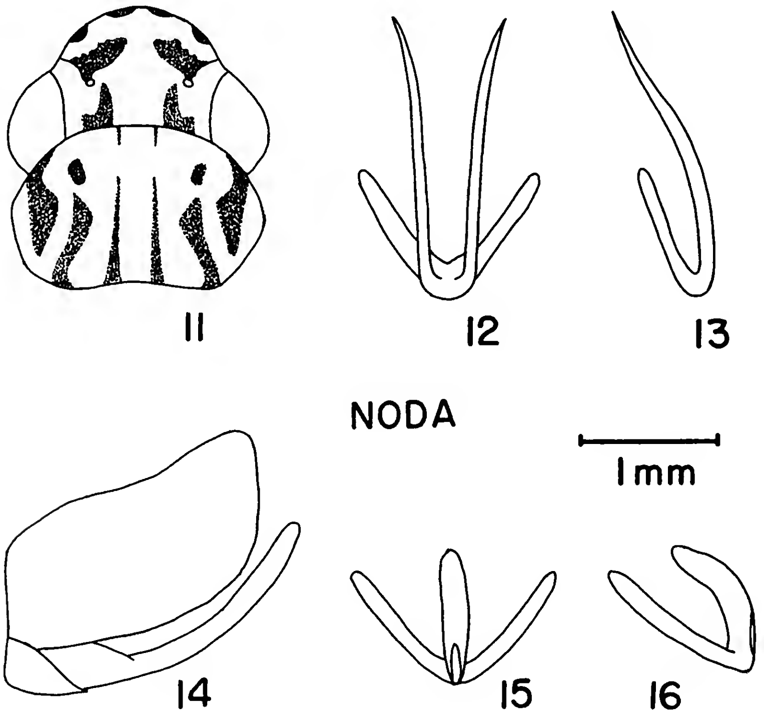
Notes: This species is quite similar to *pinguis*, but it differs by being darker in color, with the conspicuous yellow spots and the aedeagus having the lateral spines extending ventrally. Other specimens seen are one male and two females from the same area, collected July 20 or 31, at 730 m., by the same collectors, in the Carnegie Museum.

Apogonalia noda NEW SPECIES
(Figures 11-16)

Description: Length of males 7-7.5 mm., females 7-7.6 mm. A long, narrow, greenish species with reddish front wings. General coloration greenish yellow with dark brown pattern, and reddish under the front wings. Head and pronotum (Fig. 11) patterned with four evenly spaced dark spots across margin, two spots near ocelli, two near hind margin of head, and three irregular lines on each side of pronotum. Front wings with most longitudinal veins dark brown, patch of pink at base of wing, with underneath red. Dorsal surface of abdomen red, ventral surface reddish or dark brown. Male genitalia: Plates (Fig. 14) as long as pygofer. Pygofer long and truncate. Paraphysis (figs. 12 and 13) with two long thin parallel processes which diverge near apex. Aedeagus (Figs. 15 and 16) short with shaft simple, tubular, curving dorsad, gonopore near base.

Type Data: Holotype male, Dominican Republic: Hato Mayor, Parque Los Haitises, near Cueva de Arena, 19° 04' N 69° 28' W, 10 m., July 7-9, 1992, C. Young, R. Davidson, S. Thompson and J. Rawlins, costal vegetation on limestone. Paratypes: one male and two females, same data as holotype. Holotype and one female paratype in the Carnegie Museum, one male paratype in the University of Kentucky Collection and one female paratype in the Florida Collection of Arthropods.

Notes: This species can be distinguished from all other species of *Apogonalia* known from Hispaniola by its evenly spaced spots on the margin of the head, or the unusual male aedeagus. Other specimens seen are one male and two females from Pedernales, from 540 to 730 m., 23-26 km. N Cabo Rojo, July 20, 1990, and two males from Barahona, near Rio Nizao, July or August 1990, all collected by the same collectors, in the Carnegie Museum.



Figures 11-16 *Apogonalia noda* n. sp. Fig. 11, head, pronotum, and scutellum, dorsal view. Fig. 12, paraphysis, ventral view. Fig. 13, paraphysis, lateral view. Fig. 14, male genital capsule, lateral view. Fig. 15, aedeagus, ventral view. Fig. 16, aedeagus, lateral view. All drawn to same scale.

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INTRODUCTION OF THE MILLIPED, *CLEIDOGONA NANTAHALA* SHEAR, IN NEW ENGLAND, U.S.A. (DIPLOPODA, CHORDEUMATIDA, CLEIDOGONIDAE)[1]

William A. Shear[2] and Rowland M. Shelley[3]

ABSTRACT: The milliped *Cleidogona nantahala* Shear, 1972, is recorded from the New England states of Connecticut and Rhode Island, around 700 mi (1,120 km) northeast of its native area in western North Carolina. This is the third record of a species of *Cleidogona* from glaciated territory in eastern North America, and it is also the first documented case of a native diplopod's being transported by human agency to another part of the continent and becoming established there. The species is believed to have been transported to New England after 1950 in association with rhododendrons and other Appalachian plants, and with 50 mi (80 km) between the Rhode Island and Connecticut sites, two introductions may have occurred.

KEY WORDS: *Cleidogena nantahala*, New England, U.S.A., Diplopoda, Chordeumatida, Cleidogonidae

The milliped fauna of the northeastern United States and eastern Canada is depauperate compared to that farther south (Shelley 1988). As an arbirtrary southern limit, if one extends the Mason-Dixon line (the boundary between Pennsylvania and Maryland) and the Ohio river through central Indiana and Illinois, only 61 species of Diplopoda occur to the north (based on entries in Hoffman (1999*a*), 20 of which are known or suspected to be native European species that were introduced into North America through human agency. Forty-six of the 61 species, including all 20 aliens, inhabit formerly glaciated territory, so only 26 indigenous millipeds have invaded this area from refugia to the south (Shelley 2002*a*). Only one species, *Conotyla fischeri* Cook and Collins, 1895 (Chordeumatida: Conotylidae), appears to be endemic to glaciated regions, as it is known only from northern and western New York, where it ranges from Lake Ontario and the St. Lawrence River to the Adirondacks and the Finger Lakes area (Shear 1971, Shelley 1988, Hoffman 1999*a*).

Our knowledge of milliped distributions in North America, even in an area as well collected as this glaciated northeastern region, is still incomplete. However, no new taxa have been discovered there since the description of *Okeanobates americanus* Enghoff, 1979 (Julida: Okeanobatidae). Prior to this, the last ones were *Aniulus paludicolens* Causey, 1967, *Uroblaniulus stolidus* Causey, 1953, and *U. jerseyi* (Causey, 1950), all representatives of the Parajulidae (Julida). Shelley (2001) considered *A. paludicolens* to be a valid species, but the last two are of dubious validity and await a generic revision. Therefore, the discovery of an unreported, indigenous milliped from the northeast is of considerable interest.

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While examining the milliped collection from the Peabody Museum of Natural History, Yale University, New Haven, Connecticut (PMNH), one of us (RMS) discovered samples of a species of *Cleidogona* (Chordeumatida, Cleidogonidae) from Connecticut and Rhode Island. Initially, we thought the specimens represented an undescribed, endemic species because they did not conform to the two most northern representatives along the Atlantic Coast, *C. caesioannulata* (Wood, 1865) and *C. major* (Cook & Collins, 1895). Some of these specimens were mentioned by Hoffman (1999*a, b*), who suggested that they were *C. major*, but the northernmost locality of this species is Washington, DC (Shear 1972), some 300 mi (480 km) southeast of the Connecticut sites. *Cleidogona caesioannulata* has been collected as far north as Stroudsburg, Monroe County, Pennsylvania (see Shear (1972:225, map 12), and would thus be the most plausible candidate among the established species to occur in New England. However, when the specimens were dissected and the gonopods and cyphopods compared to those of described species, the millipeds turned out to be *C. nantahala* Shear, 1972, which occurs some 700 mi (1,120 km) to the southwest in western North Carolina and potentially also north Georgia (Shear 1972, Shelley 2000*a*). The identity was established through side-by-side comparisons with authentic North Carolina specimens. We present here the New England records, illustrations of the gonopods (figs. 1-3) and cyphopods (fig. 4) to facilitate future identifications of this species in the Northeast, remarks on northern representatives of *Cleidogona, a*nd a likely explanation of how *C. nantahala* reached this area.

Cleidogona nantahala Shear, 1972
(Figs. 1-4)

Cleidogona nantahala Shear 1972:227. Hoffman, 1999a:221. Shelley, 2000*a*:187.

Diagnosis: Gonopods apically divided, with narrow, curvilinear, apically subacuminate inner branch (ib) extending beyond distal extremity of laminate outer branch (ob); colpocoxite (c) apically divided (Figs. 1-3). Cyphopods with postgenital plate (pgp) distally expanded (Fig. 4).

New England Records (All specimens housed at the PMNH): CONNECTICUT: *New Haven Co.*, West Rock, ♂, ♀, March 22, 1964, B. Vogel. *Middlesex Co.*, Hurd State Park, beside Connecticut River, ♂, March 26, 1961, C. L. Remington. RHODE ISLAND: *Washington Co.*, Wood River crossing, Nooseneck Hill Road, under log, ♀, June 2, 2003, J. E. O'Donnell, R. J. Pupedis.

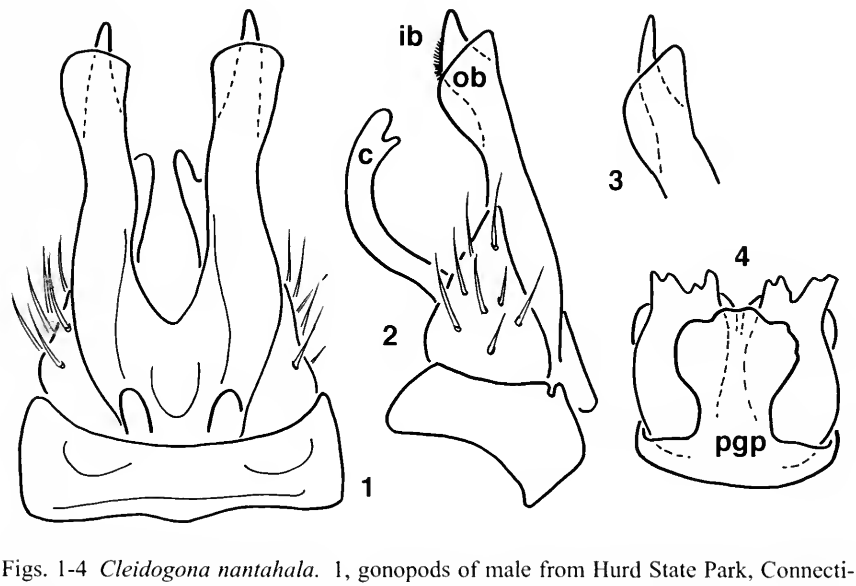
Remarks: *Cleidogona nantahala* belongs to the "*Major* species group" which ranges from Georgia to Washington, DC, but there is a considerable gap between the northernmost record, *C. major* at Washington, DC, and the New England localities. The northernmost generic record along the east coast is the aforementioned one of *C. caesioannulata* (a member of the "*Caesioannulata* species group") from Stroudsburg, Pennsylvania, some 110 mi (176 km) southwest of the New England localities. We believe this site represents the northern generic range limit along the east coast because no *Cleidogona* has been found to the north despite years of reasonably thorough diplopod sampling. *Cleidogona caesioannulata* has the widest distribution of any species, ranging from Stroudsburg westward and northward through Wayne County, Ohio, to Mason County, Michigan, on Lake Michigan about 2/3 of the distance northward on the Lower Peninsula at the level of the "thumb," and southward to North Carolina, where it occurs in all physiographic provinces and spans the state from the Coastal Plain (Beaufort County) to the Blue Ridge Mountains (Mt. Mitchell, Yancey County)[4] (Johnson 1954; Shear 1972; Shelley 1978, 2000*a*; Kevan 1983; Snider 1991). It is plausible that *C. caesioannulata* adapted to colder climatic conditions during glacial maxima and spread northward following glacial retreat; it may also have occurred farther north between glacial advances, such that the present distribution represents a truncation of a once wider and more northerly one. Whatever the explanation, species of *Cleidogona* are almost always associated with deciduous forest and probably could not have survived in periglacial tundra or taiga. It is germane to note here that unidentifiable females and juveniles of *Cleidogona* have been found in Middlesex and Essex counties, Ontario, the latter being the southernmost county in Canada and directly across the Detroit River from Detroit (Judd 1967; Kevan 1983; Shelley 1988, 2002*a*). Kevan (1983) and Shelley (1988, 2002*a*) believed that the individuals represent an undescribed species, as the postgenital plate of a female from Essex County, which is divided into two long, broad, apically truncated arms (see Shelley 1988, fig. 24), is unlike that of any species Shear (1972) reported, particularly *C. caesioannulata* or another "northern" species in the United States. Snider (1991) reported *C. caesioannulata* from 11 counties in Michigan, including St. Clair, so this species should be expected around Sarnia, Lambton County, Ontario, which is directly across the St. Clair River. Consequently, *Cleidogona* can be reasonably expected in Ontario from the latitudes of Sarnia and London southward (in Lambton, Middlesex, Elgin, Kent, and Essex counties), and two species can be anticipated, *C. caesioannulata* and the potential new one with the divided postgenital plate in females.

The New England specimens of *C. nantahala* are the third record of *Cleidogona* from formerly glaciated territory, the others being the aforemen-

[4] Hoffman (1999*b*) suggested that *Julus punctatus* Say 1821, under the replacement name and new combination *Cleidogona sayanum* (Bollman, 1893), is a senior synonym of either *C. caesioannulata* or *C. major*. The types of *J. punctatus* no longer exist, and Say did not provide any locality information in his description; however, circumstantial evidence adduced by Hoffman suggests that the specimen(s) were most likely collected around Philadelphia, in eastern Pennsylvania. Hoffman (1999*b*) had no specimens, but if *C. caesioannulata* is discovered near this city and a specimen is designated as the neotype of *J. punctatus*, *C. caesioannulata* will fall as a junior synonym of *C. sayanum* despite the fact that the latter name has not been used in the primary literature since its proposal in 1893. We are not prepared to accept this action and discourage others from doing so as it would replace the oldest current name in the genus (though not the type species) and, because of its wide distibution, the one most likely to be cited by researchers who are not systematists. For geographical reasons, it is unlikely that *C. major* is a synonym of *C. sayanum* because it is unknown north of Washington, DC, and such a synonymy would be equally disruptive because *C. major* is the type species of *Cleidogona*.

tioned ones of *C. caesioannulata* from Michigan and north central Ohio (Johnson 1954, Shear 1972, Kevan 1983, Snider 1991) and the potential new species from southern Ontario. They are so disjunct from *C. nantahala's* home range, in western North Carolina from Mitchell to Macon counties and, based on females, probably extending to Pickens County, Georgia (Shear 1972, Shelley 2000a), that the only plausible explanation for their New England occurrences is human introduction. For over 200 years, New England nurserymen have imported plants from the southern Appalachians, where a thriving cottage industry in the collection of native plants still exists; it thus seems likely that individuals of *C. nantahala* were transported to New England in soil of rhododendrons or other native plants. The time of the introduction is unknown, but southern New England is perhaps the best-known region of the continent as far as its total fauna is concerned because it has been a center for natural historians since colonial days. However, the earliest collection of *C. nantahala* was only 43 years ago, in 1961, by C. L. Remington, an assiduous arthropod collector who was actively sampling in southern New England for many prior years. Beatrice Vogel, who collected the species in 1964, was a Yale graduate student studying wolf spider systematics who also sampled frequently in the area. As no specimens are available earlier than this, it is reasonable to conclude that the introduction probably occurred after 1950. We do not know the circumstances of either find, but the 1961 collection was in a state park, suggesting that it was not disturbed habitat or a place where southern Appalachian plants had been cultivated. The Rhode Island collection also was not from a cultivated spot, and the distance from the Connecticut sites, ca. 50 mi (80 km), suggests that more than one introduction may be involved.

To our knowledge, *Cleidogona nantahala* is the first native North American milliped to be successfully introduced to another region of the continent, and we also believe it to be the first one introduced anywhere. Since the late 1980s, three North American scorpions – *Centruroides vittatus* (Say), *C. hentzi* (Banks), and *Vaejovis carolinianus* (Beauvois) – have been encountered with increasing frequencies in southeastern states well outside their normal ranges (Shelley 1994*a, b;* Shelley and Sissom 1995), and while there is no definite evidence that reproducing populations have become established, the increasing frequency with which individuals are being encountered in homes, office buildings, yards, and casually wandering along city sidewalks suggests that this is just a matter of time. However, as often as plants and soil have been transported from one region of the country to another, no native millipeds have ever been encountered outside their home areas until this discovery of *C. nantahala.* According to the list of species in Hoffman (1999*a*) and recent references (Shelley and Golovatch 2001; Shelley and Edwards 2001, 2002; Shelley 2004), 35 exogenous millipeds of European, Asian, Australian, and Neotropical origins have been introduced into North America and are now established here, primarily in urban environments; this figure does not include species intercepted during quarantines at ports. Asian and European millipeds have been widely introduced into islands throughout the world, but this has not happened with any North America species, not even in Hawaii, where the North American centipede, *Scolopendra polymorpha* Wood, occurring from the Central Plains westward (Shelley 2002*b*), was recorded from a pineapple field in Oahu by Shelley (2000*b*). The question therefore arises as to why this particular milliped species has been able to establish itself in New England and, once there, perhaps gradually spread and increase its range. Over a half-dozen species of *Cleidogona* also occur in western North Carolina; some of which are partly sympatric with *C. nantahala* and could potentially be introduced along with the latter, but this has not happened. Apparently there is an aspect of the ecophysiology of *C. nantahala* that makes it unique among cleidogonids as a colonizer.



Figs. 1-4 *Cleidogona nantahala*. 1, gonopods of male from Hurd State Park, Connecticut, anterior view. 2, left gonopod of the same, lateral view. 3, tip of left gonopod of male from West Rock, lateral view. 4, cyphopods of female from West Rock, posterior view. c, colpocoxite; ib, inner branch; ob, outer branch; pgp, postgenital plate.

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CORRIGENDUM

On a recently published paper [Brailovsky, *Entomological News* 115(1)], the name Heteroptera was misspelled as Heteroptyera on the cover.

OCCURRENCES OF THE CENTIPEDES, *SCOLOPENDRA MORSITANS* L. AND *S. SUBSPINIPES* LEACH, ON PACIFIC ISLANDS (CHILOPODA: SCOLOPENDROMORPHA: SCOLOPENDRIDAE)[1]

Rowland M. Shelley[2]

ABSTRACT: The scolopendrid centipedes, *Scolopendra morsitans* L. and *S. subspinipes* Leach, occur, respectively, in 14 and 16 nations and dependent island groups in Oceania, most of which probably represent human importations. Both species are known from the Cook Islands, the Federated States of Micronesia, Fiji, French Polynesia, Guam, New Caledonia, the Northern Marianna Islands, Papua New Guinea, the Republic of the Marshall Islands, the Solomon Islands, Tonga, and Western Samoa. Published records are summarized and new ones are reported; occurrences are depicted on a distribution map.

KEY WORDS: *Scolopendra morsitans, S. subpinipes,* Chilopoda, Scolopendromorpha, Scolopendridae, Pacific Islands

This contribution addresses islands in the broad expanse of the Pacific Ocean referred to in part as "Oceania" — east of Australia; north and east of New Guinea; east of the Philippines, Taiwan, the Ryukyu Islands, Japan, and the Kurile Islands; south of the Kamchatka Peninsula and the Aleutian Islands; and west of the continental islands of the Americas. A number of scolopendromorph centipedes (ones with 21 or 23 pairs of legs and pedal segments) have been introduced to islands in this vast area, and I address here the relatively large-bodied species of the genus *Scolopendra* L., which are often encountered in museums and university repositories. They belong to the family Scolopendridae, subfamily Scolopendrinae; have valvular, tripartite spiracles; and are thus readily distinguished from large-bodied representatives of the Otostigminae (*Ethmostigmus* Pocock, *Otostigmus* Porat, and *Rhysida* Wood), which have rounded, non-valvular spiracles. *Scolopendra* itself is characterized by the overlap of the first tergite by the cephalic plate and by a prominent, elongate, ventrodistal spine on the first (proximo-) tarsi of leg pairs 1-20. For the benefit of arthropod researchers in the Pacific who will likely encounter large chilopods, I detail the known occurrences of *S. morsitans* L. and *S. subspinipes* Leach in the defined area; both lack a procurved, transverse groove on the first tergite and longitudinal sutures on the cephalic plate, and are distinguished primarily by the number of ventral spurs on the ultimate prefemora. I provide diagnoses, literature citations, and new records from institutional holdings, all in the context of modern geopolitical boundaries; it is noteworthy that the two major publications on scolopendromorphs globally (Kraepelin 1903, Attems 1930) cite no records of these species from the Pacific

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region. In the locality listings, which are organized alphabetically, national names are capitalized and specific islands or island groups are italicized; missing data on labels (exact locality, date of collection, and/or names of collectors) are not reported, and the number of specimens in each sample is provided after the institutional acronym. To the best of my knowledge, all names for the islands and communities thereon are correct and accurately spelled as of 2002. It was not possible to survey every institution that potentially houses specimens, but I have investigated most major repositories in the United States and three in Europe. Acronyms of sources of preserved samples are as follows:

AMNH – American Museum of Natural History, New York, New York
BM – Bishop Museum, Honolulu, Hawaii
BMNH – The Natural History Museum, London, United Kingdom
CAS – California Academy of Sciences, San Francisco
FMNH – Field Museum of Natural History, Chicago, Illinois
MCZ – Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts
MNHP – Museum National d'Histoire Naturelle, Paris, France
NCSM – North Carolina State Museum of Natural Sciences, Raleigh
NMNH – National Museum of Natural History, Smithsonian Institution, Washington, District of Columbia
ZMH – Zoological Institute and Museum, University of Hamburg, Germany

Scolopendra morsitans L., 1758

Diagnosis: Ultimate prefemora with numerous ventral spurs, usually arranged in three rows of around three spurs apiece. Illustrations are available in Attems (1930, fig. 38) and Shelley (2002, figs. 57-64).

Published Records: PACIFIC ISLANDS IN GENERAL (Attems 1938). COOK ISLANDS: *Aitutaki* (Chamberlin 1944). *Rarotonga* (Chamberlin 1920). FEDERATED STATES OF MICRONESIA: *Pohnpei* (Kohlrausch 1881, Chamberlin 1920). FIJI: Islands in general (Kraepelin 1904, Brölemann 1904). *Viti Levu, Nacula, Hofvea, Yanuca, Vatoa,* and *Sava Kasa* (exact location unknown) (Würmli 1975). *Rotuma* (Pocock 1898, Chamberlin 1920). FRENCH POLYNESIA: *Austral Is.: Tubuai* (Kohlrausch 1881). *Marquesas Is.: Fatu Huku, Hiva Ova, Mohotani,* and *Ua Huka* (Adamson 1932, Silvestri 1939). *Society Is.: Tahiti* (Kohlrausch 1881, Würmli 1975). *Tuamotu Is.: Gambier and Mangareva* (Brölemann 1904). *Makatea* (Chamberlin 1944). NEW CALEDONIA: Nouméa (Brölemann 1904). NORTHERN MARIANNA ISLANDS: Islands in general (Kraepelin 1904, Brölemann 1904). REPUBLIC OF THE MARSHALL ISLANDS: Islands in general (Chamberlin 1920). TONGA: Islands in general (Kohlrausch 1881). *Eua* (Chamberlin 1920). TUVALU: *Funafuti* (Pocock 1898, Chamberlin 1920). WESTERN SAMOA: *Upolu* (Kohlrausch 1881, Chamberlin 1920).

New Records: FEDERATED STATES OF MICRONESIA: *Kosrae,* Matante, 580 m, under bark of dead tree, February 20, 1958, J. F. G. Clarke (BM 1). *Ulithi Atoll, Asor I.,* October 6, 1952, N. L. H. Krauss (BM 1). FIJI: *Ovalau,* Levuka (BMNH 3). *Vanua Levu* (BMNH 1). Island Unknown, Wai Salima, N. L. H. Krauss (NMNH 1). FRENCH POLYNESIA: *Tuamotu Is.: Raroia,* May 14, 1923 (AMNH 1). GUAM: Patipoint, in petiole of dead *Cycas* frond, June 4, 1945, H. S. Dybas (FMNH 1). KIRIBATI: *Tarawa,* Bairiki, December 1957, N. L. H. Krauss (BM 1); Banraeaba, December 1957,

N. L. H. Krauss (BM 1); Marenamuka, under coconut log, December 1957, N. L. H. Krauss (BM many); and Naanika, November 1957, N. L. H. Krauss (BM 1). NORTHERN MARIANNA ISLANDS: *Pagan*, N. end of Lake Laguna, in depression on young coconut tree standing in water, September 10, 1954, S. Castro (NMNH 2). PAPUA NEW GUINEA: *Bougainville*, Kohura, Prince Ra, June 9, 1952 (BM 2). REPUBLIC OF THE MARSHALL ISLANDS: *Majuro Atoll*, Majuro, on coconut palm, July 1, 1947, A. Spoehr (FMNH 2). *Arno Atoll*, Ine, June 8, 1950, I. LaRivers (BM 1). SOLOMON ISLANDS: *Guadalcanal*, 1944-1945, W. I. Beecher, F. Cilley (FMNH, AMNH 44). New Georgia, Munda, October 1, 1943 - November 21, 1943, W. J. Beecher (FMNH 2) and Seghe, April 1944, C. O. Berg (NMNH 1). *Russel Is., Bonika I.*, July 24, 1964, R. Straatman (BM 1); and *Paruru I.*, May 1943, W. J. Beecher (FMNH 2). TONGA: *Tongatapu*, November 15, 1893, R. B. Leefe (BMNH 4).

Remarks: Adamson (1932) believed that his were the first specific records of myriapods from the Marquesas (an island group in French Polynesia) except for a report that he cited of *S. morsitans* (L. Rollin, 1929, Les iles Marquises, p. 53, Paris), which is not available to me. The Marquesans apparently then regarded *S. morsitans* as a native species and so named it in their native tongue. He suggested that the species had reached the islands as a "natural immigrant" or had been brought in by the Polynesians themselves; the latter seems more likely as an extreme rafting event would be necessary for the species to have arrived there naturally.

Scolopendra subspinipes Leach, 1815

Diagnosis: Ultimate prefemora with 0-3 ventral spurs. Illustrations are available in Attems (1930, fig. 43) and Shelley (2002, figs. 50-56).

Published Records: PACIFIC ISLANDS IN GENERAL (Attems 1938). COOK ISLANDS: *Rarotonga* (Kohlrausch 1881). FIJI: Islands in general (Silvestri 1935). *Ono-i-Lau* (Kraepelin 1904, Brölemann 1904, Chamberlin 1920). *Levuka, Munia, Ovalau, Viti Levu* (Chamberlin 1920). FRENCH POLYNESIA: Marquesas, Society, and Tuamotu Islands in general (Silvestri 1935). *Marquesas Is.: Eiao, Fatu Hiva, Mohotani, Nuku-Hiva, Tahuata, Ua-huka, and Ua-Pou* (Adamson 1932, Silvestri 1939). *Hiva Oa* (Adamson 1932, Silvestri 1939, Chamberlin 1944). *Society Is.: Moorea* (Silvestri 1935). *Raiatea* (Kraepelin 1904, Brölemann 1904). *Tahiti* (Kraepelin 1904, Brölemann 1904, Chamberlin 1920, Silvestri 1935). *Tuamotu Is.: Gambier* and *Mangareva* (Brölemann 1904). HAWAIIAN ISLANDS: *Hawaii, Kahoolawe, Kauai, Lanai, Maui, Midway*, and *Oahu* (Shelley 2000; previous Hawaiian records summarized herein except those of Kraepelin [1904] from the islands in general and Oahu). NEW CALEDONIA: *Île des Pins* (Brölemann 1904). NORTHERN MARIANNA ISLANDS: Islands in general (Kraepelin 1904, Brölemann 1904). REPUBLIC OF THE MARSHALL ISLANDS. Islands in general (Takakuwa 1938). SOLOMON ISLANDS: Islands in general (Brölemann 1904). SAMOA ISLANDS IN GENERAL (Kraepelin 1904, Brölemann 1904, Attems 1914). TONGA: Islands in general (Kraepelin 1904, Brölemann 1904). WESTERN SAMOA: *Upolu* (Chamberlin 1920; Attems 1913, 1929).

New Records: AMERICAN SAMOA: *Tutuila*, November 8, 1923, R. H. Beck (AMNH 1) and Pago Pago, October 25, 1949, L. Zachowski, H. H. Marrer (NMNH 1). BONIN ISLANDS: *Chichi Jima* (Kondo), July 3, 1949, J. Savory (BM 2). COOK ISLANDS: *Rarotonga*, Avarua, W. M. Wheeler (MCZ 4) and under log, February 1964, N. L. H. Krauss (BM 1). FEDERATED STATES OF MICRONESIA: *Truk Atoll*, intercepted at Hawaii, January 27, 1949 (NMNH 1); Tol, base of Mt. Unibot, February 4, 1953, J. L. Gressitt (BM 1); and *Moen I.*, December 3, 1945, R. L. Ingram (NMNH 1). *Yap I.*, September 10, 1979, M. Lundgren (CAS 1); Dugoi Village, on trunk of orange tree, August 25, 1950, R. J. Goss (BM 1); Ruuf, from creeping vine, August 29, 1950, R. J. Goss (BM 2); and Dinay, November 16, 1977, M. Lundgren (CAS 1). FIJI: *Ovalau*, 1978, W. M. Mann (MCZ 2) and Levuka, 1969, W. M. Mann (MCZ 1). *Viti Levu*, Suva, 1915, J. P. Jefferson (MCZ 1). FRENCH POLYNESIA: *Marquesas Is.: Fatu Hiva*, January 6, 1925, P. H. Johnson (BMNH 1). *Hiva*

Oa, November 30, 1922, R. H. Beck, E.H. Quayle (AMNH 2); and Taio Hae Bay, Nuku, under rocks, October 6-8, 1934 (AMNH 3). *Mohotani*, 500 ft., February 2, 1931, Le Bronnec, H. Tauroa (BM 12). *Nuku Hiva*, nr. Taiohae, November 7, 1929, Mumford, A. M. Adamson (BM 8) and under log, 16 January 1968, J. F. G. & T. M. Clarke (NMNH 1). *Tahuata*, January 1925, P. H. Johnson (BMNH 2). *Society Is.: Bora Bora*, 1925, L. E. Cheesman (BMNH 2). *Moorea*, J. A. McTavish (AMNH 4); S end of Opunhoha Bay, beneath piles of coconuts, September 28 - October 6, 1958, D. E. Puleston (NMNH 8); and Opunoliu, December 1958, D. E. Puleston (NMNH 1). *Raiatea*, July 1909 (AMNH 1) and under box in shed, July 29, 1909 (AMNH 2). *Tahiti*, Mt. Aori, 2200', human feces, April 6, 1978, T. Mix (FMNH 1); Papeete, November 10, 1899 (MCZ 1), 3/4 mi (1.2 km) from lagoon, under rotten logs, April 23, 1925, J. M. Clements (NMNH 5), and nr. foot of mts. ca. 1 mi (1.6 km) from lagoon, April 23, 1925, J. M. Clements (NMNH 1); Papenoo, March 1925, P. H Johnson (BMNH 1); Pare Dist., September 2, 1961, J. F. G. Clarke (NMNH 1); and Tautira, January 1960, N. L. H. Krauss (BM 1). *Tuamotu Is.: Ahunui*, Lautiva, September 8, 1925, L. L. Bheerman (BMNH 1). *Makatea*, Uaite Paua, January 15-22, 1959, D. E. Puleston (NMNH 18). *Mangareva*, December 1914 (AMNH 1). *Raroia*, Tua Motu, May 23, 1929, D. E. Puleston (NMNH 1). *Rangiroa*, September 7, 1982 (ZMH 1). GUAM: July 1949, J. Kurfess (FMNH 1). Agarra, December 25, 1947, K. L. Maehler (NMNH 1). NORTHERN MARIANNA ISLANDS: *Agrihan*, May 29, 1952, J. L. Gressitt (BM 1). *Fefen*, May 27, 1946 (NMNH 1). *Pagan*, N. End of Lake Laguna, in depression on young coconut tree standing in water, September 10, 1954, S. Castro (NMNH 1). *Rota*, October 1945, W. L. Necker (FMNH 9); Sinapalo Village, June 1994, M. Lusk (NCSM 8). *Saipan*, November 16 - December 31, 1944, August 1945, H. S. Dybas (FMNH 6) and October 25, 1944, E. A. Chapin (NMNH 1). *Tinian*, May 18, 1946 (NMNH 3). PALMYRA ISLAND: C. M. Cooke (BM 1). PAPUA NEW GUINEA: *Bougainville*, Whitney South Pacific Expedition (AMNH 1). REPUBLIC OF THE MARSHALL ISLANDS: *Jaluit Is., Jabor I.*, April 25 - May 1, 1958, J. L. Gressitt (BM 1). SOLOMON ISLANDS: *Guadalcanal*, July 1945, F. Cilley (AMNH 1). *New Georgia*, Segi Pt., April 1944, C. O. Berg (NMNH 1). *Wana Wana I.*, July 9, 1944, Chapman (CAS 1). *Treasury Is., Stirling I.*, 1945, R. E. Best (MCZ 1). TONGA: *Nukualofa*, February 22, 1925, P. A. Buxton (BMNH 1); in house, January 1980, N. L. H. Krauss (BM 1); and 'Atenisi Univ.', April 11, 1981, M Walterding (CAS 1). *Tongatapu and Velitoa*, 1962, B. Nixon (CAS 2). *Vava'u*, along Leimatu'a-Tefisi Rd., January 10, 1982, M. Walterding (CAS 1). *Island(s) Unknown*, 1888, Dr. Philippe (MNHP 1). WAKE ISLAND: February 8, 1963, C. F. Clegg (BM 1). WESTERN SAMOA: *Upolu*, Apia, May 19 - September 1, 1924, P. A. Buxton (BMNH 4).

Remarks: According to Attems (1929), bites by *S. subspinipes* on the hand are common in Samoa. While *S. subspinipes* had not then, and apparently still has not, been taken on Hatutu and Fatu Huku islands, Adamson (1932) noted that *S. subspinipes* is abundant everywhere in the Marquesas from sea level to 2,000' except in dry regions; it also was not taken in cloud forest. He cited native Marquesan sources who believed the species had been introduced into the archipelago through commerce in the previous 50 years.

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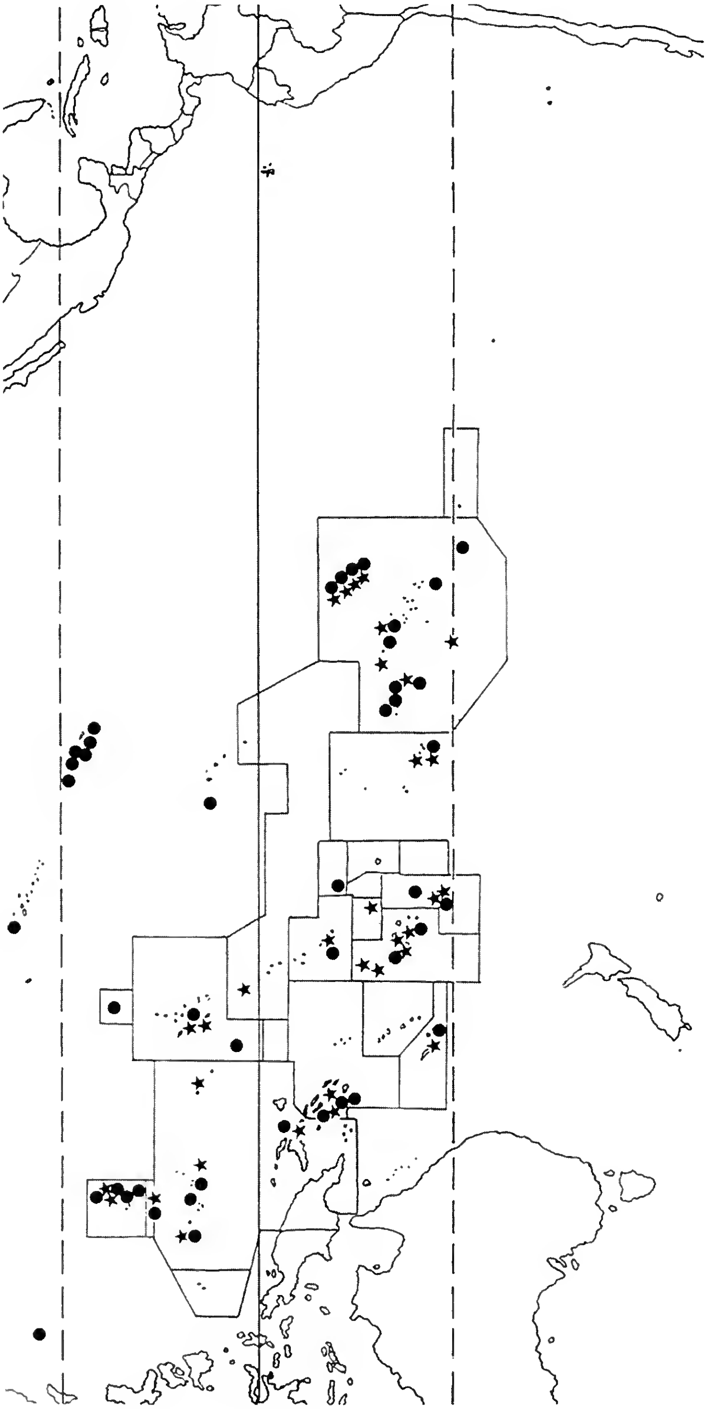

Fig. 1 Occurrences of *S. morsitans* (stars) and *S. subspinipes* (dots) on Pacific islands.

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HIGHER CLASSIFICATION OF THE BURROWING MAYFLIES (EPHEMEROPTERA: SCAPPHODONTA)[1]

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ABSTRACT: A revised cladogram of the monophyletic groups of genera constituting the tusked burrowing mayflies (infraorder Scapphodonta) is presented, based in part on new analyses of relationships that have recently appeared in the literature. A new strict phylogenetic higher classification of Scapphodonta that incorporates both extant and extinct taxa and that reflects the revised cladogram is presented. Aspects include the new superfamilies Potamanthoidea (Potamanthidae and Australiphemeridae) and Euthyplocioidea (Euthyplociidae and Pristiplociidae), and a newly restricted Ephemeroidea (Ichthybotidae, Ephemeridae s.s., Palingeniidae and Polymitarcyidae s.s.). Sequencing conventions allow recognition of multiple scapphodont superfamilies, ephemeroid families and polymitarcyid subfamilies. *Pentagenia* is placed in Palingeniidae, and *Cretomitarcys* is removed from the Scapphodonta.

KEY WORDS: Higher classification, burrowing mayflies, Ephemeroptera, Scapphodonta

The Ephemeroptera infraorder Scapphodonta is equivalent to what was recently considered the superfamily Ephemeroidea by McCafferty (1991) and others. It is a grouping hypothesized to be the sister clade of the infraorder Pannota, or the pannote mayflies, within the suborder Furcatergalia (McCafferty and Wang 2000). The Scapphodonta are technically the "tusked burrowing mayflies" and as a monophyletic group demonstrate a defining apomorphy of having larval tusks derived from the outer body of the mandible (e.g., see Bae and McCafferty 1995). Scapphodonta does not include other furcatergalian mayflies constituting the Behningiidae (the infraorder Palpotarsa, or tuskless "primitive burrowing mayflies") or the few specialized Leptophlebiidae (infraorder Lanceolata) that are also known to burrow and may possess tusks that are not homologous with scapphodont tusks (e.g., see Bae and McCafferty 1995, Edmunds and McCafferty 1996).

McCafferty (1991) presented hypothetical relationships of burrowing mayfly groups that served as a basis for exemplifying the application of strict phylogenetic schemes of higher classification to Ephemeroptera. This resulted in a conservative familial classification of the Ephemeroidea, or Scapphodonta, that has to a large degree been followed throughout the world in recent years. That classification consisted of only four families: Australiphemeridae, Potamanthidae, Ephemeridae, and Polymitarcyidae. Ephemeridae was divided into subfamilies Ichthybotinae, Ephemerinae, Hexageniinae, Pentageniinae and Palingeniinae. All of these subfamilies except Hexageniinae had been recognized as families at some point prior to 1991. Ichthybotinae, which had originally been considered a family by Demoulin (1957a) but historically not such by others, was reestablished by McCafferty (1999). Polymitarcyidae was divided into the subfamilies Pristiplociinae, Euthyplociinae, Exeuthyplociinae, Asthenopodinae, Campsurinae and Polymitarcyinae.

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Previous to this, however, the latter three had been considered in a more restricted family Polymitarcyidae, and Euthyplociinae and Exeuthyplociinae had been considered in the family Euthyplociidae. Pristiplociidae was given familial status by McCafferty (1997).

Since the McCafferty (1991) study, certain characters from internal anatomy that had been documented by Landa and Soldán (1985) and used by McCafferty (1991) have proven to be unreliable mainly because they had been based on too few exemplars within taxa. In addition, important new phylogenetic analyses of burrowing mayflies were made by Bae and McCafferty (1995) and Kluge (2003). These findings along with ancillary studies by McCafferty (1999) and McCafferty and Wang (2000) have prompted a reevaluation and reclassification of the Scapphodonta as presented below.

PHYLOGENY

Compared to the analysis of McCafferty (1991), the phylogenetic analysis based on tusk morphology given by Bae and McCafferty (1995) offered a more convincing hypothesis of branching sequences of certain clades, one example being that the *Campsurus* group (Campsurinae) and *Asthenopus* group (Asthenopodinae) were sister clades rather than the *Campsurus* group and the *Ephoron* group (Polymitarcyinae). The *Campsurus* group and *Asthenopus* group tusks were shown to share an apomorphic large mediobasal spine, medioapical crenulation and ventral setation. The Bae and McCafferty (1995) study also showed that within the extant Scapphodonta excluding the basally derived *Potamanthus* group (Potamanthidae), the *Euthyplocia* + *Exeuthyplocia* groups (Euthyplociinae and Exeuthyplociinae) do not share additional apomorphies with other clades, but have tusks with unique medial and lateral rows of setae. Among remaining clades, the *Pentagenia* group (Pentageniinae) + the *Palingenia* group (Palingeniinae) were hypothesized to be derived from an ancestor common with the *Ephemera* group (Ephemerinae) + *Hexagenia* group (Hexageniinae) rather than from within the *Hexagenia* group. This is supported by the apomorphic strong basal arch of the tusks in *Ephemera* + *Hexagenia* groups but not *Pentagenia* + *Palingenia* groups, and by the apomorphic U-shaped or arched arrangement of setae basally on the tusks found in *Pentagenia* + *Palingenia* groups but not the *Ephemera* + *Hexagenia* groups.

Kluge (2003) also presented data that suggested the *Euthyplocia* + *Exeuthyplocia* groups to have a basal branching position among non-potamanthid Scapphodonta, and gave another synapomorphy for these groups, i.e., the unique anteriorly developed clypeus. In addition, he hypothesized a sister relationship between a clade consisting of the *Ephoron* + *Campsurus* + *Asthenopus* groups and a clade consisting of the *Pentagenia* + *Palingenia* groups. For example, these clades were shown to share apomorphies including forecoxae that are nearly contiguous, and an inner basal convexity of the larval forefemora with a curved arrangement of setae [Kluge also included use of the arrangement of setae at the base of the tusk that had been introduced by Bae and McCafferty (1995) for the *Pentagenia* + *Palingenia* groups, see above]. Although Kluge (2003) stated that two-segmented maxillary and labial palps represented another synapomorphy for the *Pentagenia* + *Palingenia* + *Ephoron* + *Campsurus* + *Asthenopus* groups, the assigned character states of two- or three-segmented palps are not consistently distributed within this latter grouping or its hypothesized sister clade, or nearest outgroup (*Ephemera* + *Hexagenia* groups). For example, larvae of *Pentagenia vittigera* (Walsh) frequently have a second segmentation line in the maxillary palps, and the labial palps of genera of the *Hexagenia* group (e.g., *Litobrancha* McCafferty and some *Hexagenia* Walsh) are commonly two-segmented, as are species within the *Ephemera* group (e.g., at least some *Afromera* Demoulin). Kluge's statement of synapomorphy might better have been limited to the thicker, clublike, rounded palps (versus narrow, falcate or truncate palps).

The hypothesis of the sister relationship of *Pentagenia* + *Palingenia* groups and the *Ephoron* + *Campsurus* + *Asthenopus* groups is considerably different from the proposed relationships of Palingeniidae and Ephemeridae first given by McCafferty (1972) and McCafferty and Edmunds (1976) and expressed in the McCafferty (1991) scheme. However, behavioral evolutionary trends among the Scapphodonta that were theorized by Bae and McCafferty (1995) remain for the most part compatible with Kluge's phylogenetic hypothesis. In addition, functional and behavioral differences associated with burrowing in *Hexagenia* and *Pentagenia* Walsh (Keltner and McCafferty 1986) as well as similarities between *Pentagenia* and *Tortopus* Needham and Murphy (*Campsurus* group) (McCafferty unpublished) are also compatible with Kluge's hypothesis. Essentially, *Pentagenia* + *Palingenia* + *Ephoron* + *Campsurus* + *Asthenopus* groups demonstrate what appears to be well-armored and heavily sclerotized heads and tusks associated with an advanced type of burrowing that can involve chiseling into hard substrates or compacted substrates such as clay (e.g., Edmunds et al. 1956, Scott et al. 1959, Keltner and McCafferty 1986, Bae and McCafferty 1995, Edmunds and McCafferty 1996). Although the capacity for this type of burrowing may not be strictly realized in the individual microhabitats of every species within the clade, it does not exist in other Scapphodonta. The significant change from the Bae and McCafferty (1995) interpretation is that this behavioral trend evolved only once rather than twice independently within the Scapphodonta.

Kluge's (2003) additional hypothesis of a derivation of Behningiidae within the Scapphodonta is not convincing because it was based on suppositions that numerous characters only possibly derived in common with the Scapphodonta were lost subsequently in Behningiidae. Behningiidae forewings are unlike Scapphodonta in general and the most plesiotypic adults of Pannota (Neoephemeridae) in that they demonstrate only an inconsistent, slight tendency for basal vein curvature (possibly but not necessarily suggesting a phylogenetic branch basad of the common ancestor of the Scapphodonta and Pannota); larvae do not possess tusks or other apomorphic structures that are associated with burrowing in Scapphodonta (and there is no evidence that precursors to Behningiidae possessed tusks or such structures); and larvae are known to be an unusual type of interstitial sand-dwellers with predatory habits (Keffermüller 1959, Tshernova and Bajkova 1960, McCafferty 1975, Tsui and Hubbard 1979), a biology fundamentally dissimilar to that found among the Scapphodonta. In addition, the considerable unique morphology associated with both the larvae (e.g., legs) and adults (e.g., genitalia) of Behningiidae (see McCafferty 1979, Peters and Gillies 1991) does not appear to be derived in common with, or derived from, any Scapphodonta.

Considering all of the above, certain phylogenetic modifications can now be made to the cladogram of Scapphodonta originally offered by McCafferty (1991). Such a revised cladogram of the monophyletic groups of genera of the Scapphodonta is shown in Figure 1.

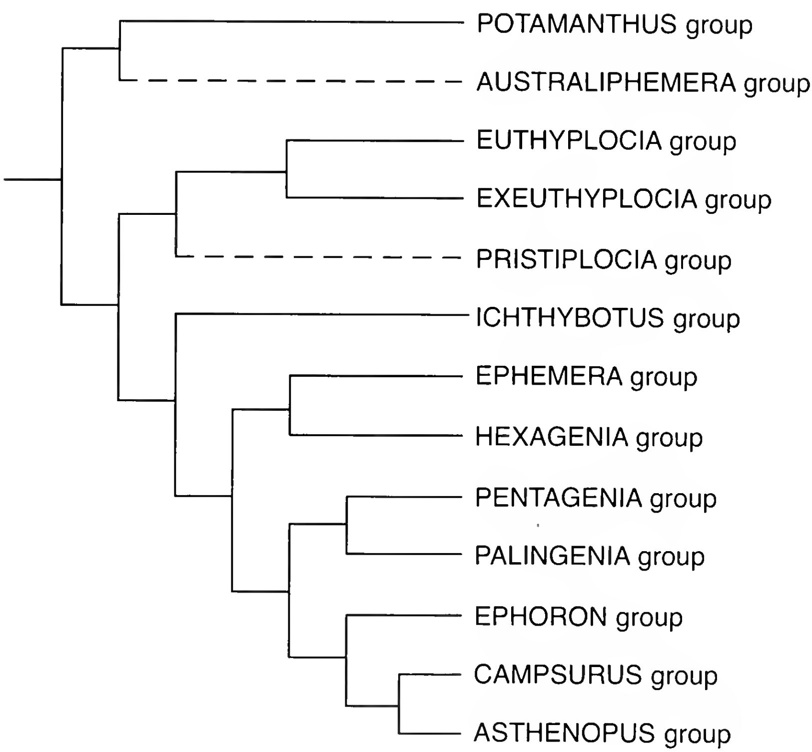

Fig. 1. Hypothesized cladogram of monophyletic groups of genera of Scapphodonta. See text for defining apomorphies.

CLASSIFICATION

The new phylogeny in turn requires a new, strict phylogenetic higher classification designed within the constructs of Linnaean hierarchy. Such a classification (Table 1) can reflect the branching sequences of major clades (Fig. 1) without the use of any numerical coding system.

Table 1. Higher classification of the Scapphodonta. Within superfamilies, single asterisked taxa are known from fossils only, and double asterisked taxa include both extant and extinct species. Bracketed genera are those whose relationships within the monophyletic group of genera remain unresolved. General distributions are given parenthetically.

Superfamily Potamanthoidea, n. superfam.
    Family Potamanthidae Albarda (Holarctic, Oriental)
        Genus *Rhoenanthus* Eaton
            Subgenus *Rhoenanthus* s.s.
            Subgenus *Potamanthindus* Lestage
        Genus *Anthopotamus* McCafferty & Bae
        Genus *Potamanthus* Pictet
            Subgenus *Potamanthus* s.s.
            Subgenus *Stygifloris* Bae, McCafferty & Edmunds
    Family Australiphemeridae* McCafferty (Pangaean)
        [Genera *Australiphemera* McCafferty, *Borephemera* Sinitshenkova, *Microphemera* McCafferty, *Paleoanthus* Kluge]

Superfamily Euthyplocioidea, n. superfam.
    Family Euthyplociidae Lestage (Pantropical)
        Subfamily Euthyplociinae s.s. (Pantropical)
            [Genera *Campylocia* Needham & Murphy, *Euthyplocia* Eaton, *Mesoplocia* Demoulin, *Polyplocia* Lestage, *Proboscidoplocia* Demoulin]
        Subfamily Exeuthyplociinae Gillies (Afrotropical)
            Genus *Afroplocia* Lestage
            Genus *Exeuthyplocia* Lestage
    Family Pristiplociidae* McCafferty (Gondwanan)
            Genus *Pristiplocia* McCafferty

Superfamily Ephemeroidea
    Family Ichthybotidae Demoulin (New Zealand)
            Genus *Ichthybotus* Eaton
    Family Ephemeridae** Latreille (nec Australian)
        Subfamily Ephemerinae** s.s. (nec Neotropical, nec Australian)
            Genus *Ephemera*** Linnaeus
                Subgenus *Ephemera* s.s.
                Subgenus *Aethephemera* McCafferty & Edmunds
            Genus *Afromera* Demoulin
        Subfamily Hexageniinae** McCafferty (nec Australian)
            Genus *Denina** McCafferty
            Genus *Hexagenia*** Walsh
                Subgenus *Hexagenia*** s.s.
                Subgenus *Pseudeatonica* Spieth

Genus *Litobrancha*** McCafferty
Genus *Eatonigenia* Ulmer
Genus *Eatonica* Navás
Family Palingeniidae Albarda (nec Australian, nec Neotropical)
Subfamily Pentageniinae McCafferty (Nearctic)
Genus *Pentagenia* Walsh
Subfamily Palingeniinae s.s. (E. Hemisphere, nec Australian)
[Genera *Anagenesia* Eaton, *Chankagenesia* Buldovsky, *Cheirogenesia* Demoulin, *Mortogenesia* Lestage, *Palingenia* Burmeister, *Plethogenesia* Ulmer]
Family Polymitarcyidae** Banks (nec Australian)
Subfamily Polymitarcyinae s.s. (nec Australian, nec Neotropical)
Genus *Ephoron* Williamson
Subfamily Campsurinae** Traver (Neotropical, Nearctic)
Genus *Campsurus* Eaton
Genus *Tortopus* Needham & Murphy
[Genus *Mesopalingea** Whalley & Jarzembowski (Laurasian)]
Subfamily Asthenopodinae Edmunds and Traver (Pantropical)
Genus *Asthenopus* Eaton
Genus *Povilla* Eaton
[Genus *Asthenopodichnium** Thenius]

Sequencing conventions (see Wiley 1981) are utilized for recognizing three superfamilies within Scapphodonta, four families within the Ephemeroidea, and three subfamilies within the Polymitarcyidae. The hypothesized cladogram of superfamilies, families and subfamilies can be reproduced precisely from their linear hierarchical classification. Within certain families or subfamilies, the phylogeny of genera has been hypothesized previously. For the basis of the linear sequence of taxa within Potamanthidae, see Bae and McCafferty (1991); and for the basis of the linear sequence of taxa within the Ephemeridae, see McCafferty (1973, 1987), McCafferty and Gillies (1979) and McCafferty and Sinitshenkova (1983). Those genera that are listed alphabetically within brackets in Table 1 require cladistic analysis before their interrelationships can be hypothesized.

The placement of the extinct families Australiphemeridae and Pristiplociidae (shown by dashed lines in Fig. 1) is presently hypothesized from morphological data limited to alate fossils. Some recent genera in other families of Scapphodonta are represented in the Cenozoic, but no recent genera are represented in the fossil record previous to the Cenozoic. The present and historical placement of Mesozoic genera among recent families is either unfounded or provisionally based on limited morphological data. *Mesogenesia* Tshernova was originally described in the Palingeniidae (Tshernova 1977), and Demoulin (1957b) considered *Parabaetis* Haupt in Ephemeridae, but both genera were shown not to belong to the Scapphodonta by McCafferty (1990). The genus *Mesopalingea* Whalley and Jarzembowski (1985) was originally placed in the family Palingeniidae. However, based on the morphology of the well-fossilized larval tusks, the genus should provisionally be placed in the subfamily Campsurinae of the family Polymitarcyidae. This would represent a rare instance of a Mesozoic family of Scapphodonta surviving the K-T boundary and the mass extinctions associated with that critical juncture. *Cretomitarcys* Sinitshenkova (subfamily Cretomitarcyinae Sinitshenkova) was based on an alate specimen found in upper Cretaceous New Jersey amber. Sinitshenkova's (2000) placement of this mayfly in the family Polymitarcyidae is not supportable because wing venation characteristics, including lack of fundamental basal vein curvature and the orientation of cubital and anal veins in the forewings are not those of Scapphodonta. Instead, forewing venation, such as the uninterrupted extension of veins CuP and A1 from the base of the forewing to the outer margin, suggests an extinct family (Cretomitarcyidae, n. stat.) of the suborder Carapacea, and extensive longitudinal venation of the hindwing may further suggest a relationship with the family Baetiscidae [compare Figs. 3 and 4 of Sinitshenkova (2000) with Figs. 226a and b of Edmunds et al. (1976)].

An important aspect of the new classification of Scapphodonta taxa is the recognition of two additional superfamilies and the restriction of the concept of the superfamily Ephemeroidea. The placement of the North American genus *Pentagenia* is also of some significance because it adds another family of mayflies (Palingeniidae) to the North American fauna. The placement of *Pentagenia* as such had been proposed by McCafferty and Edmunds (1976), but at that time it was supposed that the Palingeniidae had arisen from within Ephemeridae, and thus recognition of the two families was later deemed incompatible with a phylogenetic classification because of assumed paraphyly (McCafferty 1991). The family Ichthybotidae is somewhat an anomaly because of its geographic restriction to New Zealand in the absence of any other known Amphinotic Scapphodonta. McCafferty (1999) explained it as being relictual, suggesting that Scapphodonta was probably more widely distributed in the Southern Hemisphere prior to the K-T extinctions.

The familial classification presented here, including the linear sequence of families, is for the most part similar to that given a half century ago by Edmunds and Traver (1954). This may seem remarkable if one considers that the former classification was phenetic based. Some families have been slightly redefined or restricted in the new classification, Behningiidae has been removed; and the familial classification, including extinct families, would not be allowable under strict rules of phylogenetic classification within a single superfamily. Nevertheless, the comparison illustrates that family recognition in mayflies based on phenetic analyses may to a large degree be congruent with family recognition within a strict phylogenetic system. This should not detract from the importance of continuing to test and refine classifications based on cladistics, but instead illustrates that relative stability can sometimes be maintained by choosing among strict phylogenetic classification options.

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NEW STATE AND PROVINCIAL RECORDS FOR NORTH AMERICAN SMALL MINNOW MAYFLIES (EPHEMEROPTERA: BAETIDAE)[1]

W. P. McCafferty, M. D. Meyer, J. M. Webb, and Luke M. Jacobus[2]

ABSTRACT: New record data are contributed for 49 species of baetid mayflies from North America north of Mexico. A total of 209 newly documented locales constitute 115 new state or provincial records involving 30 USA states and five Canadian provinces.

KEY WORDS: New state, new provincial records, North America, small minnow mayflies, Ephemeroptera, Baetidae

As part of the mayflies of North America project, we are attempting to document complete ranges of the nearly 700 species in the region. Most species of the family Baetidae, or small minnow mayflies, have been especially poorly documented during the approximately 200 years of taxonomic and faunistic work on the mayflies in North America (see McCafferty 2001), and yet they are one of the most common and important groups of mayflies in both lotic and lentic aquatic habitats (e.g., Edmunds et al. 1976, McCafferty 1981). This is due mainly to the fact that these particular mayflies have been historically difficult if not impossible to identify. For example, it was not until 1979 that a number of species began to be identifiable in the more commonly collected aquatic, larval stage (Morihara and McCafferty 1979). The purpose of the present study has been to begin to shore up this shortcoming in distributional data, and thereby make these species more accessible for biogeographic studies as well as studies of biodiversity and conservation biology. As such, we are able to contribute 209 new locale records involving 49 of the 122 baetid species currently known to occur in North America north of Mexico. In all, 115 new state and provincial records are provided.

Species for which new data are documented are listed alphabetically. States and provinces are given in upper case. Most collection materials associated with the distributional data reside in the Purdue Entomological Research Collection; any other collection sources are indicated within brackets at the end of a data citation. Other collection sources include Arkansas State University [ASU], Louisiana State University [LSU], Illinois Natural History Survey [INHS], University of Iowa Hygienic Laboratory [UIHL], Massachusetts Audubon Society [MAS], and the J. M. Webb personal collection [WC]. Life stages associated with the data are given as (L) for larvae and (A) for adults.

RECORD DATA

Acentrella ampla Traver

New data. MASSACHUSETTS, Franklin Co, Colrain Township, Green R, XI-17-1994, B Colburn (L) [MAS]. SOUTH CAROLINA, McCormick Co, Cedar Springs Cr at Rt 138, II-17-1984, BC Kondratieff (A). TENNESSEE, Blount Co, Red Cr, ca 2 mi E Walland, IV-11-1977, AR Brigham,

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J Unzicker (L); Cocke Co, Cosby Cr at Cosby entrance to GSNP, V-17-2001, CD & RP Randolph, LM Jacobus (L). WEST VIRGINIA, Pocahontas Co, West Fork Greenbrier R at Olive Jct nr Durbin, IX-03-1979, SM Shields (L).

Acentrella insignificans (McDunnough)

New data. MONTANA, Blaine Co, Milk R 16 mi W Havre at US Hwy 2, 48/35/45 N, 109/21/48 W, and Chouteau Co, Eagle Cr 16 mi SE Big Sandy, 48/03/26 N, 109/48/25 W, and Big Sandy Cr, 2 mi SE Big Sandy, 48/09/04 N, 110/04/56 W, VI-14-2000, and Judith Basin Co, Arrow Cr, 4 mi N Geyser, 47/18/52 N, 110/29/11 W, VI-12-2000, and Judith R, 3 mi W Hobson at C M Russel Mem Hwy, 46/59/51 N, 109/55/34 W, VI-11-2000, and Liberty Co, Breed Cr W Whitlash at Bold Butte Rd, 48/54/28 N, 111/15/28 W, and creek crossing at Black Jack Rd, 2 mi N Mount Lebanon, 48/53/24 N, 111/02/01 W, VI-13-2000, WP McCafferty et al. (L); McCone Co, Missouri R at Lewis & Clark Rec Area, 8 mi SE Wolf Point at St Rd 13, 48/04/02 N, 105/32/18 W, VII-27-2002, WP McCafferty, LM Jacobus (L); Yellowstone Co, Pryor Cr at 1990, 45/47/56 N, 108/17/36 W, VI-09-2000, WP McCafferty et al. (L).

Acentrella parvula (McDunnough)

New data. MAINE, Hancock Co, Ellsworth, VI-18-1976, WP McCafferty, AV Provonsha, M Minno (A). MONTANA, Blaine Co, Milk R 16 mi W Havre at US Hwy 2, 48/35/45 N, 109/21/48 W, and Chouteau Co, Marias R, at US Hwy 87, S Loma, 47/55/48 N 110/30/35 W, VII-27-2002, WP McCafferty, LM Jacobus (L). NORTH CAROLINA, Swain Co, Confluence of the Oconoluftee R and Raven's Fork, VIII-28-2001, at light (A). OKLAHOMA, Pushmataha Co, Panther Cr at Hwy 2, 3.1 mi N Hwy 2-3 jct, IV-17-1993, DE Baumgardner (L). SOUTH CAROLINA, Barnwell Co, Steel Cr, nr confl Meyers Br, III-14-1984, BC Kondratieff (L). VIRGINIA, Carroll Co, New R at Rt 721 Bridge, in drift, VIII-02-1976, JH Kennedy (L).

Remarks. North Carolina data for this species are given here because the only other published record of that species in North Carolina (Pescador et al. 1999) lacked locale data.

Acentrella turbida (McDunnough)

New data. ILLINOIS, McHenry Co, Spring Grove, VI-04-1938, Mohr, Burks (A) [INHS]. LOUISIANA, Livingston Par, Little Nutalbany R, Albany, VI-27-1973, B Stark (A). MONTANA, Judith Basin Co, Arrow Cr 4 mi N Geyser, 47/18/52 N, 110/29/11 W, WP McCafferty et al. (L); Liberty Co, creek crossing at Black Jack Rd, 2 mi N Mount Lebanon, 48/53/24 N, 111/02/01 W, WP McCafferty et al. (L,A). VERMONT, Windhams Co, North Br, at W edge of Wilmington, VI-20-1976, WP McCafferty, AV Provonsha, M Minno (A). YUKON, Moose Cr, VII-31-2001, DW Parker (L) [WC].

Acerpenna macdunnoughi (Ide)

New data. ARKANSAS, Franklin Co, Prairie Cr at St Hwy 217, 2.2 mi N Charleston, VIII-15-1981, J. Huggins (L). MASSACHUSETTS, Berkshire Co, Savoy Township, Black Br, III-25-1995, B Colburn (A) [MAS]. MISSISSIPPI, Itawamba Co, Briar Cr, at Hartsell Rd, 34/19/44 N, 88/12/34 W, and unnamed stream at New Temple Rd, 34/20/47 N, 88/15/14 W, and Tishomingo Co, Little Cripple Deer Cr, at Co Rd 957, 34/44/01 N, 88/11/47 W, and Perrywinkle Cr at Co Rd 995, 34/44/29 N, 88/09/18 W, and Indian Cr at Co Rd 241 N Iuka, 34/51/25 N, 88/11/26 W, III-18, 19-2004, JM Webb (L). PENNSYLVANIA, Carbon Co, Hayes Cr, VIII-30-1993, J Munro (L).

Acerpenna pygmaea (Hagen)

New data. MASSACHUSETTS, Hampshire Co, South Hadley Township, Bachelor Cr, IX-30-1993, B Colburn (A) [MAS].

Baetis brunneicolor McDunnough

New data. MASSACHUSETTS, Franklin Co, Whately Township, Jimmy Nolan Br, X-07-1992, B Colburn (L) [MAS]. MONTANA, Big Horn Co, Indian Cr, at BIA Rd 88, NW Rosebud Battlefield St Prk, 45/16/08/ N, 107/ 02/43 W, VI-08-2000, and Liberty Co, Breed Cr W Whitlash at Gold Butte Rd, 48/54/28 N, 111/15/28 W, VI-13-2000, WP McCafferty et al. (L). NEW HAMPSHIRE, Crafton Co, Hale Br at For Serv Rd nr Sugarloaf Campsite, VI-16-1976, WP McCafferty, AV Provonsha, M Minno (L). OHIO, Hamilton Co, Miami R at New Baltimore, IX-18-1952 (L).

Baetis flavistriga McDunnough

New data. GEORGIA, Cherokee Co, Town Cr, Canton, VI-18-1973, B Stark, G Vaught (L); Rabun Co, Betty's Cr, 5 mi W Dillard, VI-20-1973, B Stark (L). MONTANA, Chouteau Co, Boxelder Cr on BIA Rd 8, 7 mi W Boxelder, 48/18/06 N, 109/53/10 W, VI-14-2000, and Liberty Co, Breed Cr, W Whitlash at Gold Butte Rd, 48/54/28 N, 111/15/28 W, VI-13-2000, WP McCafferty et al. (L,A). NEW HAMPSHIRE, Crafton Co, Hale Br at For Serv Rd nr Sugarloaf Campsite, VI-16-1976, WP McCafferty, AV Provonsha, M Minno (L). VIRGINIA, Rappahannock Co, Thorton R, Hwy 2, VI-22-1975, Baumann, Stark, Pine (L). VERMONT, Windhams Co, Bill Br, nr Molly Stark St Prk on St Rd 9, VI-20-1976, WP McCafferty, AV Provonsha, M. Minno (L). YUKON, Moose Cr, VII-31-2001, DW Parker (L) [WC].

Baetis intercalaris McDunnough

New data. MASSACHUSETTS, Hampshire Co, North AmherstVI-05-1965, MC Miller (A), Amherst, V-30-1941, LM Bartlett (A). SOUTH CAROLINA, Barnwell Co, Meyers Br, XII-01-1984, and Steel Cr, nr confl of Meyers Br, II-17-1984, III-19-1984, and Pen Br, XII-01-1984, and Steel Cr at Cypress Bridge, X-11-1984, BC Kondratieff (L, A).

Baetis notos Allen and Murvosh

New data. OKLAHOMA, Cherokee Co, Spring Cr, Teresita, VII-14-15-1995, RK Heth (L).

Baetis pluto McDunnough

New data. MASSACHUSETTS, Essex Co, Pye Br, below Rt 97 bridge at Topsfield, VI-04-1979, D Berysten (L). NEW HAMPSHIRE, Sullivan Co, Croydon Br N Grantham, IX-13-1975, KCS (L). TENNESSEE, Blount Co, Forge Cr at Parsons Br Rd, V-18-2001, CD & RP Randolph, LM Jacobus (L).

Baetis rusticans McDunnough

New data. MASSACHUSETTS, Berkshire Co, Florida Township, Smith Br, XII-22-1994, and Franklin Co, Sunderland Township, Mohawk Br, V-20-1992, B Colburn (L) [MAS].

Baetis tricaudatus Dodds

New data. ARKANSAS, Fulton Co, Spring R, V-07-1977, GL Harp (L) [ASU]. GEORGIA, Union Co, Nottely R, 7 mi S Blairsville, VI-20-1973, B Stark (L).

Callibaetis californicus Banks

New data. OKLAHOMA: Garfield Co (L) (no other data).

Callibaetis ferrugineus (Walsh)

New data. MASSACHUSETTS, Hamden Co, Springfield, VI-09-1965, RW Koss (A); Hampshire Co, Cushman Pond, X-29-1938, JR Traver (L), and Amherst, VI-11-1956, IV-17-1957, VI-21-1957, VIII-01-1960, JR Traver (A). MONTANA, Powder River Co, on For Rd 92 (Ten Mile Rd), 45/25/53 N, 106/08/59 W, VI-08-2000, WP McCafferty et al. (A). VERMONT, Waterbury Stiles Pond, VI-20-1948, LM Bartlett (A).

Callibaetis floridanus Banks

New data. ARKANSAS, Crittenden Co, Wapanocca L nr observation platform, Wapanocca Natl Wildlife Ref, IX-09-1978, and Mississippi Co. Big L nr shore, Big Lake Nat. Wildlife Ref, IX-02-1978, J Rettig (L) [ASU]. KENTUCKY, Hopkins Co, Flat Cr, 5.2 km E Pennyrile Pkwy, 6.8 km S Anton, VIII-06-1980 (L). MARYLAND, Frederick Co, Potamac R, point of rocks, 1 mi above Rt 15, VIII-24-1965, and Montgomery Co, Potamac R, 4 mi below mouth of Monocacy R, and Potamac R at Whites Ferry, VIII-26-1965, JW Richardson (L).

Callibaetis fluctuans (Walsh)

New data. ARKANSAS, Craighead Co, rice field nr Cache R, 4 mi W Bono, VIII-13-1980 (A). OKLAHOMA, Garfield Co, X-10-1964, and II-18-1965, RC Harrel (L).

Callibaetis pallidus Banks

New data. MINNESOTA, Polk Co, Crookston, VIII-27-1956, GF Edmunds (A). MONTANA, Chouteau Co, cattle tank 1 mi NE Big Lake, 47/40 N, 110/24 W, VI-12-2000, WP McCafferty et al. (L). WISCONSIN, Dane Co, Madison, VII-08-1912, and VII-01-1916, and V-1941, and IV-30-1949, and VI-30-1952, and VI-1956 (A). YUKON, Alaska Hwy, Mile Post 660, VII-01-1952 (A).

Callibaetis pretiosus Banks

New data. ARKANSAS, Calhoun Co, Locust Bayou at St Hwy 4, 12 mi W Hampton, IV-25-1977, HW Robison, and Lafayette Co, small pond behind brick residence, 1 mi E Stamps at St Hwy 82, I-26-1991, J Nichols (L) [ASU]. INDIANA, Bartholemew Co, farm pond 1.5 mi E Waymansville, VII-02-1999, LM Jacobus (L). LOUISIANA, Calcasieu Par, Sam Houston St Prk, Lake Charles, VIII-14-1963 (A).

Callibaetis skokianus Needham

New data. WISCONSIN, Dane Co, Madison, VII-08-1916, JG Sanders, and VI-03-1929, MH Doner (A); Door Co, Sturgeon Bay, VII-29-1957, RL Giese (A).

Centroptilum alamance (Traver)

New data. ILLINOIS, Pope Co, Lusk Cr, 1.82 km NE Waltersburg, VI-26-1997, and Golconda, IV-03-1946, and Herod, III-14-1946 [INHS].

Centroptilum album McDunnough

New data. OKLAHOMA, Cherokee Co, Spring Cr, Timberlake Ranch, V-01-1997, RK Heth (L).

Centroptilum bifurcatum McDunnough

New data. INDIANA, Bartholemew Co, White Cr, S Rd 930S, V-19-2000, LM Jacobus (L). IOWA, Winnesheik Co, Canoe Cr, Decorah, IX-09-2003, T Hubbard (L) [UIHL]. KANSAS, Douglas Co, Kansas R, at Eudora bridge, VIII-24-1978, P Liechti (L) [KU]. MONTANA, Chouteau Co, Shonkin Cr, .5 mi W Shonkin, 47/37/35 N, 110/34/53 W, VI-12-2000, WP McCafferty et al. (L); Hill Co, Milk R at St. John's bridge, VII-31-1999, JM Webb (L) [WC]; Wheatland Co, Musselshell R, at US Hwy 191 Harlowton, 46/25/44 N, 109/50/30 W, VI-10-2000, WP McCafferty et al. (L) .

Centroptilum conturbatum McDunnough

New data. MONTANA, Blaine Co, Milk R, 16 mi W Havre at US Hwy 2, 48/35/45 N, 109/21/48 W, VI-14-2000, and Chouteau Co, Highwood Cr, 3 mi S Highwood, 47/33/04 N 110/46/38 W, VI-12-2000, WP McCafferty et al. (L); Richland Co, Missouri R at St Rd 16, SE Culbertson, 48/07/21 N, 104/28/32 W, VII-27-2002, WP McCafferty, LM Jacobus (L). WISCONSIN, Trempealeau Co, Black R, above Hwy 35, VII-16-1991, RA Lillie (L).

Centroptilum minor McDunnough

New data. MAINE, Franklin Co, Carr R, at Rt 16, W North Anson, VI-21-1986 (L).

Centroptilum rufrostrigatum (McDunnough)

New data. OHIO, Geauga Co, Kirtland, VIII-31-1942, and Lake Co, Willoughby, IX-04-1942, JR Traver (A).

Centroptilum triangulifer (McDunnough)

New data. INDIANA, Perry Co, Poison Cr, ca 5 mi NW Derby, V-19-1977, M Minno, S Yocum (L). KENTUCKY, Breathitt Co, Canoe Cr, 3.7 km S KY 30 at mouth, and Carter Co, Tygarts Cr at jct KY 1662 & US 60, IV-17-1978, and Elliot Co, Little Fork Little Sandy R at jct KY 486 & Wallow Hole Cr Rd, .6 km NE Culver, VI-26-1978, and Fleming Co, Fox Cr at Big Run Rd bridge, .2 km NW Big Run Rd-KY 1013 jct, VII-20-1983, and Knott Co, Laurel Fork, 0.9 mi SE on KY 1098 from jct with KY 160, VI-20-1978, and Lewis Co, Kinniconick Cr 67 m up stream from Indian Cr confluence, .4 km ESE KY 344-377 jct, VII-22-1983, and Morgan Co, Caney Cr, 2.9 km N KY 2498 from jct with US 460, VI-29-1978, and Rowan Co, North Fork Triplett Cr, 5.7 km NNE on KY 377 from jct with KY 32 (L). OHIO, Lake Co, KirtlandIX-02-1942, JR Traver (A). WISCONSIN, Burnett Co, St. Croix R, Norway Point Landing, VI-11-1991, RA Lillie (L); Monroe Co, Squaw Lake, Fort McCoy, VIII-06-1981, AV Provonsha (L).

Centroptilum victoriae McDunnough

New data. ALBERTA, Pembino R, 53/39 N, 115/00 W, IX-18-no year, J Ciborowski (L,A). MONTANA, Big Horn Co, Indian Cr, at BIA 88, NW Rosebud Battlefield St Prk, 45/16/08 N, 107/02/43 W, VI-08-2000, and Blaine Co, Milk R, 16 mi W Havre at US Hwy 2, 48/35/45 N, 109/21/48 W, VI-14-2000, and Chouteau Co, Shonkin Cr .5 mi W Shonkin, 47/37/35 N, 110/34/53 W, VI-12-2000, and Eagle Cr, 16 mi SE Big Sandy, 48/03/26 N, 109/48/25 W, VI-14-2000, and Judith Basin Co, Judith R, 3 mi W Hobson at C. M. Russel Mem Hwy, 46/59/51 N, 109/55/34 W, WP McCafferty et al. (L). WISCONSIN, Dunn Co, Chippewa R, Pature Island access, VI-03-1993, and Marathon Co, Eau Claire R, Dells Prk, VI-10-1992, and Rusk Co, Jump R, at Sheldon, VI-17-1992, RA Lillie (L).

Cloeon dipterum (Linnaeus)

New data. ALASKA, Valdez-Cordova Co, Lake Mentasta, Glen Hwy MP 282, VIII-12-1954, CP Alexander (A).MICHIGAN, Oakland Co, 7 km SW Milford, IV-03-1988 (L,A).

Diphetor hageni (Eaton)

New data. NEW HAMPSHIRE, Sullivan Co, Grantham at light, V-10-1980 (A).

Fallceon quilleri (Dodds)

New data. MONTANA, Richland Co, Missouri R at St Rd 16, SE Culbertson, 48/07/21 N, 104/28/32 W, VII-27-2002, WP McCafferty, LM Jacobus (L); Yellowstone Co, Perry Cr at 190, 45/47/56 N, 108/17/36 W, VI-09-2000, WP McCafferty et al. (L).

Heterocloeon anoka (Daggy)

New data. IOWA, Mitchell Co, Deer Cr, 43/25/32 N, 93/01/27 W, and Rock Cr at Rock Creek, VIII-21-2001, and Worth Co, Willow Cr nr Hanlontown, IX-04-2001 (L) [UHL]. MANITOBA, Valley R at Hwy 5, and Wilson R at Hwy 10, VI-08-2000, JM Webb (L) [WC]. OKLAHOMA, Pushmataha Co, Kiamichi R at Hwy 2, 16.3 mi N Hwy 2-3 jct, 16 mi N Antlers, VII-16-1993, DE Baumgardner (L). PENNSYLVANIA, Lacawanna Co, Scranton, Summer 1945, HK Townes (L). SASKATCHEWAN, Montreal R, at Hwy 2, VIII-08-2000, and Overflowing R at Hwy 9, VII-09-2000, and Red Deer R at Hudson Bay Reg Prk, VII-19-2000, and South Saskatchewan R at Clarkboro

Ferry, VII-16-2000, and at Lemsford Ferry, IX-16-2000, and at Queen Elizabeth Power Stat VI-02-2000, and Waskesiu R at Hwy 2, VII-06-2000, and Weyakwin R at Hwy 2, VII-07-2000, JM Webb (L) [WC]; Torch R at Hwy 35, and Whitefox R, at Hwy 35, VII-02-1986, V Keeler (L) [WC]; Battle R, bridge S Washburn, VIII-27-1972, DH Smith (L) [WC].

Remarks. The present recognition and generic disposition of this species is being elaborated elsewhere by R. D. Waltz and WPM; however, it first appeared as given here in Webb and McCafferty (2004).

Paracloeodes minutus (Daggy)

New data. LOUISIANA, Lasalle Par, Trout Cr at White Sulphur Springs, VIII-25-1973 (L) [LSU].

Plauditus bimaculatus (Berner)

New data. LOUISIANA, Washington Par, Silver Cr, 6 mi NE Franklinton, V-05-1974 (A) [LSU].

Plauditus cestus (Provonsha and McCafferty)

New data. GEORGIA, Rabun Co, Betty's Cr, 5 mi W Dillard, VI-20-1973, B Stark (L). MANITOBA, Valley R at Hwy 5, VI-08-2000, and Shell R, at Hwy 5, VI-09-2000, JM Webb (L) [WC].

Plauditus dubius (Walsh)

New data. MONTANA, Teton Co, Teton R, 300M E overpass on 115, 32 mi N Great Falls, 47/55/27 N 111/43/38 W, VI-13-2000, WP McCafferty et al. (L).

Plauditus gloveri McCafferty and Waltz

New data. MANITOBA, Shell R at Hwy 5, VI-09-2000, and Valley R at Hwy 5, VI-08-2000, JM Webb (L) [WC]. MONTANA, Blaine Co, Milk R, 16 mi W Havre at US Hwy 2, 48/35/45 N, 109/21/48 W, VI-14-2000, and Chouteau Co, Big Sandy Cr, 2 mi SE Big Sandy, 48/09/04 N, 110/04/56 W, VI-14-2000, and Liberty Co, Breed Cr, W Whitlash at Gold Butte Rd, 48/54/28 N, 111/15/28 W, VI-13-2000, WP McCafferty et al. (L).

Plauditus punctiventris (McDunnough)

New data. NEW JERSEY, Monmouth Co, Shark Cr, Shark Cr County Park, V-17-2001, MD Meyer (L).

Plauditus texanus Wiersema

New data. OKLAHOMA, Pushmataha Co, Panther Cr, at Hwy 2, 3.1 mi N Hwy 2-3 jct, IV-17-1993, DE Baumgardner (L), and Terrapin Cr, III-17-1994 (L).

Plauditus virilis (McDunnough)

New data. MANITOBA, Pine R at Hwy 10, and Valley R at Hwy 5, VI-08-2000, JM Webb (L) [WC]. MONTANA, Judith Basin Co, Judith R, 3 mi W Hobsonat C. M. Russel Mem Hwy, 46/59/51 N, 109/55/34 W, VI-11-2000. WP McCafferty (L). NORTH CAROLINA, Swain Co, Confluence Oconaluftee R and Raven's Fork, VI-18-, VII-16-, VIII-16,28-2001, and Oconaluftee R under Blue Ridge Parkway overpass, at light (A). OKLAHOMA, McCurtain Co, Silver Cr, III-18-1994 (L). PENNSYLVANIA, Mifflin Co, Mifflin Co, Reedsville, VI-18-1948 [INHS].

Procloeon fragile (McDunnough)

New data. CONNECTICUT, New Haven Co, Mt. Carmel, X-20-1947, RM & AH Sommerman (A) [INHS]. MAINE, Franklin Co, Oquossoc, VII-15,27-no year, N Banks (A).

Procloeon pennulatum (Eaton)

New data. MONTANA, Hill Co, Milk R at St. John's bridge, VII-31-1999, JM Webb (L) [WC]. NEVADA, Elko Co, Humbolt R, Elko, VIII-29-1965, SL Jensen (L). WISCONSIN, Oconto Co, Oconto R, Hwy 88, VII-15-1992, and Sauk Co, Otter Cr, turnaround, VII-21-1993, slow run, VI-22-1992, RA Lillie (L).

Procloeon quaesitum (McDunnough)

New data. NOVA SCOTIA: Annapolis R, VI-25-1950 (L).

Procloeon rubropictum (McDunnough)

New data. NEW HAMPSHIRE, Windhams Co, Whetstone Br, nr Battleboro, VI-19-1976, WP McCafferty, AV Provonsha, M. Minnow (L). PENNSYLVANIA, Carbon Co, Hayes Cr, VIII-30-1993, J Munro (L).

Procloeon rufrostrigatum (McDunnough)

New data. ILLINOIS, Kankakee Co, Kankakee, VII-10-1925 [INHS]; Vermilion Co, Oakwood, VII-30-1939 [INHS]. OHIO, Lake Co, Willoughby, VII-10-1939, and VII-22-1942, JR Traver (A). WISCONSIN, Burnett Co, St Croix R, VI-16-1992, and Marathon Co, Eau Claire R, VI-10-1992, and Oconto Co, Oconto R, Hwy BB, VII-15-1992, and Waupaca Co, Embarrass R, Behnke Rd, VII-14-1992, RA Lillie (L); Washburn Co, Totogatic R at Minong, IX-03-1939 [INHS].

Procloeon simplex (McDunnough)

New data. ARKANSAS, Independence Co, West Lafferty Cr, 4 mi W Cushman, X-21-1978 (L) [ASU]. WISCONSIN, Burnett Co, St. Croix R, Norway Point Landing, VI-11-1991, RA Lillie (L); Washburn Co, Kimball Lake at Minong, VIII-25-1945 [INHS].

Procloeon viridoculare (Berner)

New data. LOUISIANA, Catahoula Par, Grant Par, Fish Cr, Pollock, VI-28-1973, B Stark (L). MONTANA, Powder River Co, Little Powder R at US Hwy 212, 45/22/26 N, 105/18/07 W, VI-08-2000, WP McCafferty et al. (L). OKLAHOMA, Garfield Co, Otter Cr, VIII-04-1964, RC Harrel (L), and Latimer Co, Red Oak Cr, 5 mi SE Red Oak, VI-08-1973, B Stark (L).

Remarks. The Oklahoma records for *P. viridoculare* are given here because no detailed locale data appeared with the only other published record of this species from Oklahoma (Wiersema and McCafferty 2004).

Pseudocentroptiloides usa Waltz and McCafferty

New data. WISCONSIN, Burnett Co, St. Croix R, Hwy 70, VI-16-1992, Seven Island area, VII-17-1991, and Columbia Co, Wisconsin R, below Portage, VII-12-1991, and Grant Co, Wisconsin R, Millerville, VII-11-1991, and Green Co, Sugar R, Hwy 11-81, VI-06-1992, and Rock Co, Sugar R, Nelson Rd, VI-06-1992, and Sauk Co, Honey Cr, above Hsy 60, VII-20-1991, and Shawano Co, Wolf R, Hwy CCC, VII-15-1992, and Waupaca Co, Embarrass R, Behnke Rd, VII-14-1992, and Wolf R, above Rey Rd, VI-09-1992, RA Lillie (L).

Pseudocloeon dardanum (McDunnough)

New data. MINNESOTA, Grant Co, Mustinka R at St Rd 9, 1 mi NW Norcross, 45/53/13 N, 96/12/49 W, VII-25-2002, WP McCafferty, LM Jacobus (L,A). MONTANA, Blaine Co, Milk R, 16 mi W Havre at US Hwy 2, 48/35/48 N, 109/21/48 W, VI-14-2000, WP McCafferty et al. (L,A); Milk R at Fort Belknap at US 2, 48/29/18 N, 108/45/40 W, and McCone Co, Missouri R at Lewis & Clark Rec Area, 8 mi SE Wolf Point at ST Rd 13, 48/04/02 N, 105/32/18 W, and Richland Co, Missouri R at St Rd 16, SE Culbertson, 48/07/21 N, 104/28/32 W, VII-27-2002, WP McCafferty, LM Jacobus

(L); Hill Co, Milk R at St. John's bridge, VII-31-1999, JM Webb (L) [WC]. SOUTH CAROLINA, Kershaw Co, Wateree R, 100 ft S U.S #1 at bridge, IX-04-1966, JW Richardson (L).

Remarks. The South Carolina record is significant in that it extends the known range of this species into the southeastern region of North America. Larvae of this species were described by Soluk (1981), at which time the species was thought to be primarily western. Thus, the much-used larval key to species of North American baetine mayflies (Morihara and McCafferty 1979) did not include the species, and any larvae of *P. dardanum* would have been keyed to *P. ephippiatum* (Traver) prior to the appearance of the McCafferty and Waltz (1995) key, which incorporated *P. dardanum* larvae for the first time. Since 1995, several records of *P. dardanum* have been confirmed from the Midwest (Randolph and McCafferty 1998), and larval records of *P. ephippiatum* from the East must now be reevaluated using the McCafferty and Waltz (1995) key.

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TITSONA TIDA CHAMBERLIN, 1962, A SYNONYM OF *CHONEIULUS PALMATUS* (NĚMEC, 1895) (DIPLOPODA: JULIDA: BLANIULIDAE), WITH NEW NORTH AMERICAN LOCALITY RECORDS[1]

Rowland M. Shelley[2] and Henrik Enghoff[3]

ABSTRACT: The unlabeled syntypes of the milliped, *Titsona tida* Chamberlin, 1962, collected at Mercury, Nye County, Nevada, exist in the microscope slide collection at the National Museum of Natural History, Smithsonian Institution, Washington, DC. They comprise a fragmented female of *Choneiulus palmatus* (Němec, 1895) (Julida: Blaniulidae) and the severely distorted anterior segments of, apparently, a female callipodidan, which, on a geographical basis, is probably *Colactis utorum* (Chamberlin, 1925) (Schizopetalidae). As an antenna of the former species has been dissected and mounted, a drawing of such being the only illustration accompanying the description, and other aspects of this account pertain to *C. palmatus,* we designate the blaniulid as the lectotype of *T. tida* and place the name in synonymy under *C. palmatus,* one of five European blaniulids that have been introduced into North America and occur here primarily in urban biotopes. Unpublished localities of *C. palmatus* from Canada and the United States are reported including the first from Québec, Connecticut, Illinois, Maryland, Minnesota, South Dakota, and Utah. A confirmatory illustration of two midbody segments of the lectotype shows the diagnostic setae of *C. palmatus* that occur along the caudal pleurotergal margins.

KEY WORDS: *Tisona tida, Choneiulus palmatus,* Diplopoda, Julida, Blaniulidae, new locality records, Canada, U.S.A., Holarctic, introduced millipede

In his final publication on millipeds, R. V. Chamberlin (1962) described three new species from Mercury, Nye County, Nevada, a small military community in the Nuclear Testing Area of the northern Mojave Desert, one of the most arid environments in the United States. The last account, and hence Chamberlin's final milliped description, was the proposal of *Titsona tida* n. sp. for two individuals of unspecified sexes collected in March 1960, a purported representative of the family Cambalidae (then called "Leioderidae"), order Spirostreptida, which is primarily known from relatively moist environments in California and Oregon west of the Sierra Nevada and Cascade Mountains, the Rocky Mountains and vicinity from Idaho to New Mexico, caves in Texas, and the forested biome that extends from eastern Texas to the Atlantic Coastal Plain (Loomis 1938; Chamberlin and Hoffman 1958; Shelley 1979, 1981; Hoffman 1980, 1999; Jeekel 2004). The type and only previously known species, *T. sima* Chamberlin, 1912, occurs in Yolo and Butte counties, California, in the first region above and some 370 mi (592 km) northwest of Mercury (Chamberlin 1912, Chamberlin and Hoffman 1958, Buckett 1964, Hoffman 1999, Shelley 2002a), so the species inhabit strikingly different environments. By itself, Chamberlin's description of *T. tida* provides nothing useful to ascertain its

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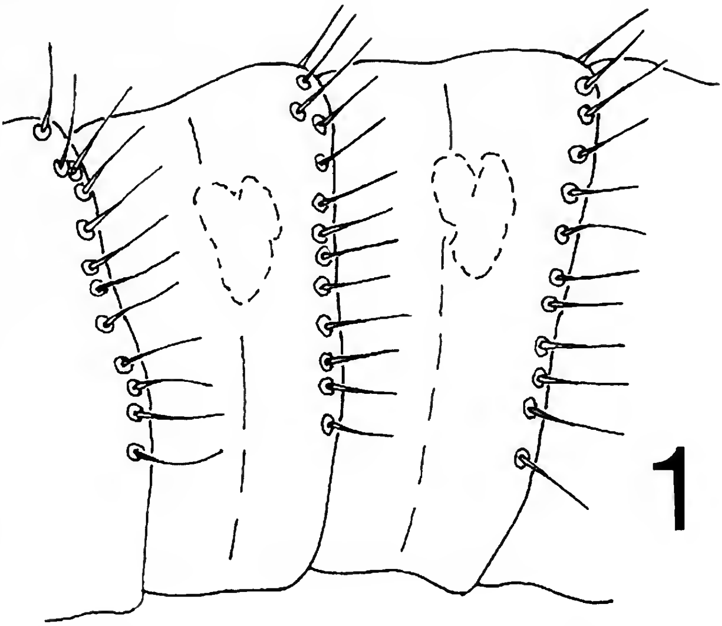
identity, and the only illustration is a meaningless drawing of an antenna without setae. As noted by Hoffman (1999), "There is no way to deduce from the description what this taxon represents," so the enigmatic name, *"T. tida,"* has been carried in the literature for 43 years, most recently being cited by Jeekel (2004).

According to Chamberlin (1962), the types of *T. tida* were deposited in his personal collection, which was transferred to the National Museum of Natural History, Smithsonian Institution, Washington, DC (NMNH), in 1972, after his death in November 1967, and Hoffman (1999) subsequently reported that the male holotype is at this institution even though Chamberlin did not mention sexes in the original description. However, *T. tida* is not included in the NMNH list of milliped types, and the specimens are not present in their type collection, as RMS searched for them in March 2004 without success. A topotype would thus seem necessary to clarify this name, but finding any millipeds in the desert at Mercury would be difficult, and with Chamberlin's meaningless description, there is the added problem of recognizing the species in the first place. Consequently, the destiny of *T. tida* would seem to be the *nomen dubium* or *nomen inquirendum* categories.

In addition to the NMNH's alcoholic or "wet" myriapod holdings (both types and non-types), there is also a collection of microscopic slides with specimens of millipeds and centipedes, and parts thereof, that were permanently mounted by researchers in the past. These slides have been generally ignored and their contents are unknown; RMS searched through them in 2004 for a missing centipede type and unexpectedly discovered two labeled *"Titsona tida."* The only other markings on the slide tags are "Ref. 93" on one and "Ref. 56" on the other, whose meanings are unknown; the locality is not mentioned nor are they labeled as "Types." However, we know of no other samples anywhere in the world identified as this species, and the slides contain two fragmented females with a separate antenna dissected from one, logically that drawn by Chamberlin (1962). We therefore consider these individuals as the syntypes of *T. tida* that were never marked as such. Both mounts are in poor condition with numerous bubbles in the medium beneath the coverslips. Milliped fragments extend through these bubbles and are difficult to discern, even under high power on a compound microscope, because of distortions by the surface films and meniscuses of the medium between the bubbles. The contents of these slides are as follows:

Slide marked "Ref. 93": The dissected antenna and a fragment containing the head and ca. 21 segments of a female of the family Blaniulidae (order Julida) possessing a row of long setae dorsally and dorsolaterally along the caudal margin of each pleurotergite (Fig. 1).

Slide marked "Ref. 56": One segment, oriented in caudal profile view, and two fragments of the same individual as evidenced by the long setae. One fragment contains ca. 16 midbody segments, and the other is the caudal end with around 13 segments. The segments are difficult to distinguish because of distortions from the bubbles and intervening strands of medium, so counts are only approximations, but the milliped has around 51 total segments. Also on this slide are the head and around 12 segments of the anterior end of another milliped that is severely distorted but clearly does not have segmental setae. It appears to be a callipodidan and is logically *Colactis utorum* (Chamberlin, 1925) (Schizopetalidae), which occurs to the east and west, in Lincoln County, Nevada, and Inyo County, California (Shelley 1996).



1

Fig. 1 Two midbody segments of the lectotype of *Titsona tida* showing the pleurotergal setae and defense glands, drawn at 200x.

As the dissected antenna corresponds to that drawn by Chamberlin (1962:55, fig. 6), we designate the blaniulid as the lectotype of *T. tida*. According to Chamberlin, the body in life was light brown with conspicuous defense glands laterally on each segment, which are visible on the slides as vaguely "heart-shaped" structures; there are also five ocelli arranged linearly on each side of the head with the medialmost significantly smaller. Coupled with the long pleurotergal setae (Fig. 1), these features are precisely those of *Choneiulus palmatus* (Němec, 1895), illustrated by Schubart (1934:188, fig. 298), Jeekel (1953, fig. 19), Enghoff and Shelley (1979:67, fig. 3), and Blower (1985:111, fig. 34A), and the roughly 51 segments of the lectotype correlate with the maximum of 58 segments on females reported by Enghoff (1984). *Choneiulus palmatus* is a native Palearctic milliped that occurs in Madeira, the Azores and Canary Islands, and widely in western Europe — Iceland, Ireland, Great Britain, Portugal, France, Luxembourg, Belgium, The Netherlands, Germany, Denmark, Poland, Czech Republic, Romania, Hungary, Switzerland, Italy, Norway, Sweden, Finland, Lithuania, and Russia

(European part) — and has probably been introduced to much of this area (Enghoff and Kime 2004). It is one of five European blaniulids that have been introduced into North America and now occur here primarily in urban habitats; with its synanthropic habits in the US and the absence of tree litter and moisture at Mercury, we surmise that the lectotype of *T. tida* was found in or beside one of the dwellings there. In North America, C. *palmatus* has been recorded from Nova Scotia, Newfoundland, and Ontario, Canada, and, in the United States, New York, Pennsylvania, Ohio, Colorado, Nevada, California, and Washington; it has also been introducted to Hawaii (Jawlowski 1939; Palmén 1952; Chamberlin and Hoffman 1958; Kevan 1983; Enghoff 1984; Shelley 1988, 2002*b*; Shelley and Swift 1998; Hoffman 1999). We therefore formally place *T. tida* in synonymy under *C. palmatus,* as summarized below, and provide unpublished North American records that the first author has discovered in 10 US repositories, which include one new Canadian province and six new US states. The contents of each sample (the total number of individuals and the number of each sex) were not always recorded, so this is only provided when known. Institutional acronyms are as follows:

AMNH – American Museum of Natural History, New York, NY.
CAS – California Academy of Sciences, San Francisco.
FSCA – Florida State Collection of Arthropods, Gainesville.
MCZ – Museum of Comparative Zoology, Harvard University, Cambridge, MA.
MPM – Milwaukee Public Museum, Milwaukee, WI.
NCSM – North Carolina State Museum of Natural Sciences, Raleigh.
NMNH – National Museum of Natural History, Smithsonian Institution, Washington, DC.
PMNH – Peabody Museum of Natural History, Yale University, New Haven, CT.
UCT – Department of Ecology and Evolutionary Biology, University of Connecticut, Storrs.
USU – Biology Department, Utah State University, Logan.

Choneiulus Brolemann, 1921

Choneiulus is characterized by the "fringed funnel" configuration of the male posterior gonopods and by the fully developed second legs of females. The gonopod morphology is shared with *Archichoneiulus* Brolemann, 1921, a north African genus that was synonymized under *Choneiulus* by Hoffman (1980) but retained as a separate genus by Enghoff (1984) because the second legs of females are reduced. *Choneiulus* includes five species, all confined to the western Mediterranean area of the Palaearctic region except for *C. palmatus* (Enghoff 1984, 2001).

Choneiulus palmatus (Nemec, 1895)

Titsona tida Chamberlin, 1962:54-55, fig. 6. Hoffman, 1999:112. Jeekel, 2004:74. **New Synonymy.**

Diagnosis: Distinguished from all other North American ocellate blaniulids (the indigenous species, *Virgoiulus minutus* (Brandt, 1841), and the introduced species, *Nopoiulus kochii* (Gervais, 1847) and *Proteroiulus fuscus* (Am Stein, 1857) by the presence of a row of very long setae dorsally and dorsolaterally along the caudal pleurotergal margins; the setae are considerably shorter in the other species (see Enghoff and Shelley 1979:67, figs. 1-4). From *P. fuscus,* which is most similar to *C. palmatus* in terms of pleurotergal setal lengths, *C. palmatus* differs by being more slender and by having the ocelli in a single row, whereas they form a narrow triangle in *P. fuscus* (see Blower, 1985:109, 111, figs. 33A-E, 34A). Males of *C. palmatus* are easily distinguished from other American species by the posterior gonopods, which resemble small, fringed funnels/trumpets and are usually visible in lateral view without dissection (pertinent illustrations in Enghoff and Shelley 1979 and Blower 1985). The female vulvae also exhibit a characteristic configuration but are difficult to dissect from these small, narrow millipeds (pertinent illustrations in Lohmander 1925, Enghoff and Shelley 1979, and Enghoff 1984).

New North American Records:

CANADA. NEWFOUNDLAND: southeast arm of Nameless Is., exact location unknown but possibly in Nameless Cove in northern Newfoundland near Anchor Point, ♀, July 8, 1938, BWB (NMNH). ONTARIO: *Middlesex Co.,* 9.4 mi (15 km) N London, June 23, 1983, R. G. Holmberg (FSCA). *Renfrew Co.,* Braeside, 4♀, April 11, 1987, L. LeSage, R. Skidmore (NCSM). QUÉBEC: Iberville Co., Iberville, Dietrich-Jooss Vineyard, May 14 - September 3, 1998, L. LeSage et al. (NCSM). *Missisquoi Co.,* Dunham, L'Orpailleur Vineyard, May 27, 1998, L. LeSage et al. (NCSM). **New Provincial Record.**

UNITED STATES. CALIFORNIA: *San Francisco Co.,* San Francisco, along Lawton St. nr. 30th Ave., soil in sidewalk crack, ♂, April 23, 1991, P. Rubtzoff (CAS). COLORADO: *Larimer Co.,* Fort Collins, ♀, May 24, 1961, T. A. Woolley (MCZ). CONNECTICUT: *New Haven Co.,* New Haven, Edgewood Park, ♀♀, November 1973, M. Rico (PMNH) and Yale University campus, ♂, October 3, 1986, J. M. Tuteur (PMNH); and Woodbridge, ♀, May 11, 1961, C. L. Remington (PMNH). *Tolland Co.,* Storrs, July 16, 1974, collector unknown (UCT). **New State Record.** ILLINOIS: *Lake Co.,* Lake Forest, Lake Forest Ravine, in oak tree hole, 3♀, November 7, 1959, W. Suter (FSCA). **New State Record.** MARYLAND: *Montgomery Co.,* Bethesda, ♂, 5♀, November 4, 1978, T. J. Spillman (NMNH). **New State Record.** MINNESOTA: *Ramsey Co.,* St. Paul, ♂, April 25, 1935, H. H. Sheperd (FSCA). **New State Record.** NEVADA: Nye Co., Mercury, ♀, March 1960, collector unknown (NMNH). NEW YORK: New York Co., New York City, Manhattan, Central Park, ♀, April 15, 1964, J. and W. Ivie (AMNH). *Tompkins Co.,* Ithaca, ♂, May 21, 1967, collector unknown (NMNH). *Westchester Co.,* Briarcliff Manor, ♂♂, ♀♀, April 16, 1979, A. M. Young (MPM, NCSM). OHIO: *Wayne Co.,* Wooster, April 14, 1958, A. A. Weaver (NCSM). SOUTH DAKOTA: *Pennington Co.,* Lead, along US Hwy. 85 at Homestake Mine, juv.♂, 24♀, May 15, 1986, R. M. Shelley (NCSM). **New State Record.** UTAH: *Cache Co.,* Logan, ♀, March 29, 1972, B. G. Orpin (USU). *Salt Lake Co.,* Alta, July 1948, collector unknown (AMNH); and Salt Lake City, May 20, 1949, S. Mulaik (AMNH). **New State Record.**

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SCIENTIFIC NOTE

DESCRIPTION OF SEVEN NEW SPECIES OF *JANBECHYNEA* (ORSODACNIDAE OR CHRYSOMELIDAE, *SENSU LATO*) FROM MEXICO: AVAILABILITY OF NEW NAMES AND CORRECTIONS[1]

Jorge A. Santiago-Blay[2]

Recently, I described seven new species of aulacosceline chrysomelids, *sensu lato* (Santiago-Blay 2004). Because of the voluminous nature of the book, *New developments in the biology of Chrysomelidae* (Jolivet et al. 2004), in which those descriptions were included, the chapter was part of the CD portion of the book. However, nowhere in the chapter or book did I indicate that "copies [of the work] (in the form in which it is published) have been deposited in at least 5 major publicly accessible libraries which are identified by name in the work itself" as required by Article 8.6 of the International Code of Zoological Nomenclature (1999). To make the binomina available, herein I am providing the Code-satisfying data: binomen, diagnosis, and the fixation of the holotype, including the repository (mandatory since January 1, 2000), for each new taxon. In addition, corrections to the paper are included.

Description of seven new species of *Janbechynea*

Bracketed phrases in type data have been added for clarity when they are not in the original label.

Janbechynea (Bothroscelis) georgepauljohnringo NEW SPECIES (Figures 80, 192-197 of Santiago-Blay 2004)

Type Data: Holotype, one adult female; deposited at Department of Entomology Collection, Texas A&M University (College Station, Texas). Mexico, Guerrero [3.4 km] 5.4 miles NE of Xochlipala; July 13, 1989; Jones and Schaeffer, collectors. Specimens Examined: one.

Abbreviated description and diagnosis: Approximately 8 mm long, setose throughout. Color: head and pronotum reddish orange dorsally, elytra yellowish brown with basal third of elytral humeral margin reddish orange; ventrally reddish orange except head which is yellowish orange and apex of femora, tibiae, and tarsi which are dark brown to black. Head and pronotum shinny, with regularly spaced puncta, each with one seta. Pronotum slightly longer than wide; disc convex; lateral aspects especially setose; lateral and posterior margins well defined, flanges only slightly turning upwards. Elytra dull, with numerous puncta, each bearing one seta, setae generally longer than interpunctal distance.

Distinguished from other species of *Janbechynea (Bothrosocelis)* as follows: 1) from *J. (B.) fulvipes* by the color and setation of the pronotum (pale yellowish orange and disc almost devoid of setae) and leg coloration (pale brown throughout); 2) from *J. (B.) virkkii* by its more robust appearance (L/W <

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2.5); 3) from *J. (B.) melyroides* by its more abundance and recumbent setation; and 4) from *J. (B.) suzanita* by its darker color and much smaller size.

Etymology: The specific epithet is an arbitrary combination of letters that is indeclinable and honors the first name of the members of the 1960's British musical band, "The Beatles": George Harrison, Paul McCartney, John Lennon, and Richard Starkey (a.k.a. "Ringo Starr") (Articles 11.3 and 26, International Commission of Zoological Nomenclature 1999).

Geographical distribution and host plants: Known only from type locality; no host plant data available.

Janbechynea (Bothroscelis) suzanita NEW SPECIES
(Figures 87, 234-239 in Santiago-Blay 2004)

Type Data: Holotype, adult female; deposited at the Department of Entomology Collection, Texas A&M University (College Station, Texas). Label reads "13 mi [≈ 8.1 km] NW Ocozocoautla, Chis. [= Chiapas?], Mex. [= Mexico]; VI-24-[19]65; H. R. Burke, J. R. Meyer, J. C. Shaffner. Specimens Examined: one adult female.

Abbreviated description and differential diagnosis: Approximately 12 mm long; very sparsely setose. Color: yellowish orange throughout, legs slightly more orange except for distal fourth of femur and distal segments which are black. Pronotum shinny, almost completely devoid of setae; disc broadly and uniformly rounded, lateral flanges turning upwards giving pronotum appearance of a wide "w" in cross section. Elytra dull, not shinny; with irregularly spaced, minute puncta and short setae; setae shorter than interpunctal distance.

Distinguished from other species of *Janbechynea* by its relative pronotum lacking setae, small elytral setae, and overall coloration. This species also resembles *Aulacoscelis grandis* and *A. tibialis,* from which it can be distinguished by the absence of the characteristic longitudinal flaps contiguous to the posterior pronotal pits which are present in all species of *Aulacoscelis. Janbechynea suzanita* is obviously different from all other *Janbechynea;* it may grant subgeneric status, just as Monrós (1954) commented for *A. grandis.*

Etymology: The specific epithet is an arbitrary combination of letters that is indeclinable and honors Ms. Suzanne Shaffer, dear friend of author JASB, and cybernophile. I have deleted the "ne" on "Suzanne" to make the specific epithet more euphonious. The suffix "ita," which has been added to "suzan," is, in this case, used to express affection; "a" indicates the person is a female, which is also the case of the holotype (Articles 11.3 and 26, International Commission of Zoological Nomenclature 1999).

Geographic distribution and host plants: Known only from type locality; no host plant data available.

Janbechynea (Bothroscelis) virkkii NEW SPECIES
(Figures 88, 240-245 in Santiago-Blay 2004)

Type Data: Holotype, one adult male; deposited at the University of California (Berkeley) Essig Museum of Entomology. Label reads "1 mi N. San José de Félix, Zac[atecas], Mex[ico]; VII-14-[19]54; J. W. McSwain, collector." Specimens Examined: 11; 7 males, 4 females, all but holotype designated as paratypes. Paratypes deposited at the Field Museum of Natural History (Chicago), Texas A&M Univesity, Shawn W. Clark Collection (Utah), California Academy of Sciences (San Francisco, CA).

Abbreviated description and differential diagnosis: Approximately 6-7 mm long, slender-looking species, setose throughout. Color: head, thorax, and pronotum chestnut brown; legs darkening towards apex, femora yellowish brown, tibiae brown, tarsi dark brown. Head and pronotum shiny, with regularly spaced shallow puncta, each with one seta. Pronotum wider than long; disk convex, lateral aspects of pronotum only moderately setose; lateral and posterior margins well defined, flanges only slightly turning upwards. Elytra not as shiny as head and pronotum, with numerous puncta, each bearing one seta, setae generally longer than interpunctal distance.

Distinguished from other species of *Janbechynea* by its small size and relatively slender look (L/W > 2.5).

Etymology: The specific epithet is an arbitrary combination of letters that is indeclinable and honors Dr. Niilo Virkki, dear friend, field companion in the hunt for "crisomélidos en copula," and colleague of author, cytogeneticist *par* excellence, from whom I learned the craft (Articles 11.3 and 26, International Commission of Zoological Nomenclature 1999).

Geographical Distribution and Host Plants: known from the central western Mexican States of México, Zacatecas, Durango, and Jalisco; no host plant data available.

Janbechynea (Janbechynea) julioi NEW SPECIES (Figures 82, 204-209 in Santiago-Blay 2004)

Type Data: Holotype one adult female, deposited at the Robert H. Turnbow Private Collection (Alabama). Mexixo, Chiapas, El Sumidero, Mirador La Coyota, La Mesa de Nayar; June 24, 1990; R. Turnbow; on Guazuma [Sterculiaceae]. Paratype female; same data as holotype. Specimens Examined: Two.

Abbreviated description (parenthetical phrases refer to female) and differential diagnosis: Approximately 10-11 mm long; head and pronotum shiny, abundantly setose; elytra dull, particularly setose. Color: with faded yellow and black longitudinal stripes dorsally, obvious in pronotum and elytra; yellowish brown throughout ventrally; legs yellowish brown, distal fourth of femora, tibiae, and tarsi brown to dark brown, darkening towards apex. Pronotum wider than long, strongly narrowing posteriorly; shiny, with numerous moderately deep punta, some bearing one seta, setation abundant throughout; disc convex, lateral flanges of pronotum only slightly turning upward. Elytra with numerous relatively deep puncta each bearing one seta (with two well-developed costae on basal third of elytra, elytral apices curved outwards), setae longer than interpunctal distance.

Distinguished from other species of the nominal subgenus of *Janbechynea*, as follows: 1) from *J. (J.) paradoxa* and *J. (J.) inverosimilis* by its smaller size and metacoxae lacking projections, 2) from *J. (J.) snyderae* by its pronotal shape and striped coloration; 3) from *J. (J.) woodburyi* by its striped coloration, and 4) from *J. (J.) maldonadoi* by its more setose head and pronotum.

Geographical distribution and host plants: Known only from type locality; "on *Guazuma sp.*" (Sterculiaceae).

Etymology: The specific epithet is an arbitrary combination of letters that is indeclinable and honors my former travel partner and beloved paternal grandfather, Julio Santiago-Ortega, whose memory of joy and delicious travel foods always remains (Articles 11.3 and 26, International Commission of Zoological Nomenclature. 1999).

Janbechynea (Janbechynea) maldonadoi NEW SPECIES (Figures 83, 210-215 in Santiago-Blay 2004)

Type Data: Holotype one adult male; deposited at University of California (Berkeley) Essig Museum of Entomology. Label reads "Mex[ixo], Nay[arit], La Mesa de Nayar; VII-19-1955; B. Malkin, colector." Paratype female; same data as holotype, except collected on VII-21-1955; also deposited at the University of California (Berkeley) Essig Museum of Entomology. Specimens Examined: Two.

Abbreviated description (parenthetical phrases refer to female) and differential diagnosis: Approximately 10-11 mm long; head and pronotum shiny, sparsely setose; elytra dull, particularly setose. Color: with yellow and black longitudinal stripes dorsally, obvious in pronotum and elytra; yellowish brown throughout ventrally; legs yellowish brown, distal fourth of femora, tibiae, and tarsi brown to dark brown, darkening towards apex. Pronotum wider than long, strongly narrowing posteriorly; shiny, with numerous moderately deep punta, some bearing one seta, setation sparse, not particularly abundant towards lateral sides; disc convex, lateral flanges of pronotum only slightly turning upwards. Elytra with numerous relatively deep puncta each bearing one seta (with two well-developed costae on basal third of elytra, elytral apices curved outwards), setae longer than interpunctal distance.

Distinguished from other species of the nominal subgenus of *Janbechynea*, as follows: 1) from *J. (J.) paradoxa* and *J. (J.) inverosimilis* by its smaller size and metacoxae lacking projections, 2) from *J. (J.) snyderae* by its pronotal shape and striped coloration; 3) from *J. (J.) woodburyi* by its striped coloration, and 4) from *J. (J.) julioi* by its less setose head and pronotum.

Etymology: The specific epithet is an arbitrary combination of letters that is indeclinable and honors my late friend and colleague in entomology, Dr. Jenaro Maldonado Capriles, with whom I spent so many joyful moments of learning. (Articles 11.3 and 26, International Commission of Zoological Nomenclature. 1999).

Geographical distribution and host plants: Known only from type locality; no host plant data available.

Janbechynea (Janbechynea) snyderae NEW SPECIES
(Figures 86, 228-233 in Santiago-Blay 2004)

Type Data: Holotype female; deposited at the Robert H. Turnbow Private Collection (Alabama). Label reads "Mexico: Chiapas, El Sumidero, Mirador La Coyota; June 24, 1990; R. Turnbow," collector. Paratype: one female, same data as male.

Abbreviated description (parenthetical phrases refer to female) and differential diagnosis: Approximately 10-13 mm long; head and pronotum shiny, barely setose; elytra dull, extensively setose. Color: head and pronotum dark yellowish brown, darkening mesally; elytra brownish black with brown margins. Head, prothorax, and mesothorax yellowish brown ventrally, metathorax dark brown, abdomen mesally yellowish brown, rest dark brown; legs yellowish brown throughout, with apex of tibiae and tarsi almost black, mesofemoral apex and metafemoral apical sixth almost black. Pronotum longer than wide, with lateral sides nearly parallel; shiny, with a very few shallow punta, with only a few bearing one seta, setation; disc convex and quite polished, lateral flanges of pronotum only slightly turning upward. Elytra with numerous, shallow minute puncta, each bearing one seta, setae longer than interpunctal distance, without two well-developed costae on basal third of elytra, elytral apices rounded (curved outwards on females).

Distinguished from other species of the nominal subgenus of *Janbechynea*, as follows: 1) from *J. (J.) paradoxa* and *J. (J.) inverosimilis* by its smaller size and metacoxae lacking projections, 2) from *J. (J.) maldonadoi* as well as *J. (J.) woodburyi* by its solid coloration; and from 3) *J. (J.) julioi* by its nearly parallel pronotum.

Etymology: The specific epithet is an arbitrary combination of letters that is indeclinable and honors my colleague, Rebecca Synder, an expert cybernophile who constantly helps me (Articles 11.3 and 26, International Commission of Zoological Nomenclature 1999).

Geographical distribution and host plants: Known only from type locality; "on *Guazuma* sp." (Sterculiaceae).

Janbechynea (Janbechynea) woodburyi NEW SPECIES
(Figures 89, 246-251 in Santiago-Blay 2004)

Type Data: Holotype female; deposited at the University of California (Berkeley) Essig Museum of Entomology. Label reads "Mex[ixo], Nay[arit], La Mesa de Nayar; VII-19-1955; B. Malkin, colector." Paratype female; same data as holotype, except collected on VII-21-1955; also deposited at the University of California (Berkeley) Essig Museum of Entomology. Specimens Examined: Two.

Abbreviated description and differential diagnosis: Approximately 10-11 mm long; head and pronotum shiny, sparsely setose; elytra dull, moderately setose. Color: yellowish brown throughout, with black head, scutellum, and elytral apices; head ventrally black except mesally yellowish brown, prothorax yellowish brown, rest of thorax and abdomen dark brown; legs dark brown throughout, femoral pro- and retrolateral sides with a yellowish longitudinal area. Pronotum wider than long, slightly narrowing posteriorly; shiny, with a few shallow punta, some bearing one seta, setation sparse, particularly abundant towards lateral sides; disc convex, with two quasicircular impressions sublaterally, lateral flanges of pronotum only slightly turning upward. Elytra with moderately numerous, shallow puncta relatively, each bearing one seta, setae longer than interpunctal distance, with two well-developed costae on basal third of elytra, elytral apices curved outwards.

Distinguished from other species of the nominal subgenus of *Janbechynea*, as follows: 1) from *J. (J.) paradoxa* and *J. (J.) inverosimilis* by its smaller size and metacoxae lacking projections and 2) from *J. (J.) snyderae, J. (J.) julioi*, and from *J. (J.) maldonadoi* by its bicolorism.

Etymology: The specific epithet is an arbitrary combination of letters that is indeclinable and honors my dear professor of botany in Puerto Rico, the late Roy Orlo Woodbury, phenomenal naturalist from whom I learned my love for plants, including cycads (Articles 11.3 and 26, International Commission of Zoological Nomenclature 1999).

Geographical distribution and host plants: Known only from type locality; no host plant data available.

Corrections

The species *Aulacoscelis pueblensis* Medvedev 1975 was not included in Table 1 of Santiago-Blay (2004). The data for that taxon are as follows: geographical distribution, Mexico; collecting days and months, not reported; plant associates, not reported.

The species *Janbechynea (J.) elongata* was not included on the key to the species of Aulacoscelinae. The second portion of couplet 23(22), should read "... elytra of females with three longitudinal, rather long, basal keels or with two transverse tubercles." Female *J. (J.) elongata* have the three longitudinal ridges but female *J. (J.) paradoxa* Monrós 1953 and *J. (J.) inverosimilis* Monrós 1954 do not. The later two species are separated on couplet 26(23).

ACKNOWLEDGEMENTS

Chris Reid (Division of Entomology, CSIRO, Canberra, Australia) pointed my nomenclatural mistake in Santiago-Blay (2004). In addition to all those acknowledged therein, I am grateful to Michael Schmitt (Zoologisches Forschungsinstitut und Museum Alexander Koenig, Sektion Coleoptera, Bonn, Germany) and F. Christian Thompson (Systematic Entomology Laboratory, National Museum of Natural History, Washington, DC) for confirming there was a mistake and suggesting Code-abiding solutions.

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SCIENTIFIC NOTE

A RECORD OF THE ARCTIC FORESTFLY, *NEMOURA ARCTICA* (PLECOPTERA: NEMOURIDAE), FROM THE CONTIGUOUS UNITED STATES[1]

B. C. Kondratieff[2] and R. W. Baumann[3]

The Nemourinae genus *Nemoura* Latreille currently includes a large number of recognized species primarily occurring in Europe and Asia (Baumann 1975, Harper 1975, Zwick and Sivec 1980, Shimizu 1997, Zhu and Yang 2003). Five species are known from North America, *N. arctica* Esben-Petersen, *N. normani* Ricker, *N. rickeri* Jewett, *N. spiniloba* Jewett, and *N. trispinosa* Claassen (Stark 2001). *Nemoura normani* is known from Alaska and the Northwest Territories; *N. rickeri* from Alaska, Manitoba, and Saskatchewan; *N. trispinosa* widespread over north central and northeastern North America; *N. spiniloba* is known from California; whereas, *N. arctica* is known from Eurasia and Western North America, having been recorded from the Canadian provinces of Alberta, British Columbia, Manitoba, Northwest Territories, Quebec, and in the U.S., Alaska (Stark 2001).

Nemoura arctica was originally described from Norway (Esben-Petersen 1910), and is considered a common species of streams and lakes in northern Europe (Lillehammer 1974b, Lillehammer 1988) and is recognized as a variable species in male and female terminalia structures (Lillehammer 1974*a*). Baumann et al. (1977) indicated that *N. arctica* had been collected only from two localities in the Rocky Mountains; Summit Lake, British Columbia, and Spearfish, South Dakota. However, the South Dakota records actually pertained to *N. trispinosa* (Sargent et al. 1999). Therefore, no record of this species has been published from the contiguous United States.

Almost eighteen years ago, the senior author collected a series of specimens of *N. arctica* from a lake in a high elevation alpine/subalpine wilderness in the Snowy Range of Wyoming. This area is located at 3,200 to 3,500 m elevation about 55 km west of Laramie, Wyoming. This area has developed from Quaternary and Holocene glaciation, with glacial cirque basins (Musselman 1992). An alpine lake dominates each watershed. Three other stoneflies are also known from the lakes; *Capnia confusa* (Claassen), *Malenka flexura* (Claassen), and *Podmosta delicatula* (Claassen).

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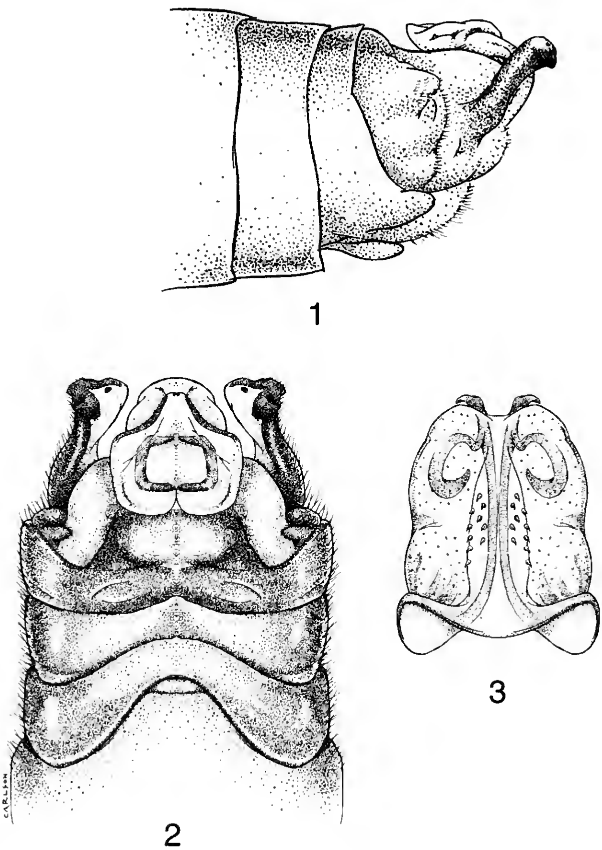
Mailed on December 21, 2004

We provide figures of the epiproct and cerci from the Wyoming population for comparison with previously published figures by Koponen (1949), Brinck (1952), Zhiltzova (1972), Lillehammer (1974a, 1988). The epiproct structures of the Wyoming specimens (Figs. 1-3) agree with the variation as accepted by Lillehammer (1974a, especially Fig. 25f).



Figures 1-3 *Nemoura arctica*. 1. Male terminalia, lateral. 2. Male terminalia, dorsal, 3. Sclerotized structures of the epiproct, ventral.

Material Examined: Wyoming, Albany Co., West Glacier Lake, Medicine Bow National Forest, June 29, 1987, B. Kondratieff and B. Painter; 1 male, 2 females, same but July 21, 1987, 3 males, 17 females. Material is deposited in the C. P. Gillette Museum of Arthropod Diversity, Colorado State University, and Monte L. Bean Life Science Museum, Brigham Young University.

ACKNOWLEDGMENTS

We thank Dave Carlson (Windsor, Colorado) for the illustrations.

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SCIENTIFIC NOTE

A FOURTH FLORIDIAN RECORD OF THE CENTIPEDE GENUS *RHYSIDA* WOOD, 1862; POTENTIAL ESTABLISHMENT OF *R. L. LONGIPES* (NEWPORT, 1845) IN MIAMI-DADE COUNTY (SCOLOPENDROMORPHA: SCOLOPENDRIDAE: OTOSTIGMINAE)[1]

Rowland M. Shelley[2] and G. B. Edwards[3]

The scolopendrid centipede subfamily Otostigminae is represented in the Western Hemisphere by two genera, *Otostigmus* Porat, 1876 (only the subgenus *Parotostigmus* Pocock, 1896, occurs here), and *Rhysida* Wood, 1862, neither of which is native to the continental United States (Shelley 2002). There is an old, uncorroborated record of *R. longipes* (Newport, 1845)[4] from Fort Jefferson, Dry Tortugas National Park, Florida (Wood 1862), and six authors have reported *R. celeris* (Humbert & Saussure, 1870) from "Carolina" and Georgia (Humbert & Saussure 1870, Kohlrausch 1881, Underwood 1887, Pocock 1896, Kraepelin 1903, Attems 1930). However, Crabill (1960) expressed doubt that the latter was established here, and Shelley (2002) agreed, deleting it from the North American fauna. Neither *Otostigmus* nor *Rhysida* has been revised, and they are on a list of seven scolopendromorph genera that particularly need "taxonomic attention" (Lewis 2003). Literature records are therefore confusing and probably unreliable, but the northernmost of the *Otostigminae* in the Americas are *R. nuda immarginata* (Porat, 1876), from Durango, Mexico; *R. l. longipes* from Sinaloa and St. Croix, US Virgin Islands; *O. (P.) denticulatus* (Pocock, 1896), from Guerrero, Mexico, and Guatemala; *R. n. nuda* (Newport, 1845), from Belize, Guatemala, El Salvador, Cuba, and Haiti; *O. (P.) occidentalis* Meinert, 1886, from Haiti; and *O. (P.) caraibicus* Kraepelin, 1903, from Puerto Rico, the US Virgin Islands (St. Thomas and St. John), and St. Kitts (Meinert 1886; Pocock 1896; Kraepelin 1903; Chamberlin 1918, 1921, 1950; Attems 1930; Bücherl 1974; Lewis 1989).

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[3] Florida State Collection of Arthropods, Division of Plant Industry, P. O. Box 147100, Gainesville, Florida 32614-7100 U.S.A. E-mail: edwardg@doacs.state.fl.us.

[4] Opinions differ as to whether to recognize subspecies in *R. longipes*. In the "modern era," Attems (1930) recognized three races and one variety, but Koch (1985) synonymized *R. l. kurandana* Chamberlin, 1920, under *R. nuda* (Newport, 1845). Takakuwa (1935), Verhoeff (1937), and Loksa (1971) proposed three new subspecies for forms from Asia, all summarized by Lewis (2002), but Bücherl (1974), Shelley and Edwards (1987), and Shelley (2002) did not recognize races at all. As Lewis' treatment (2002) is the most recent and comprehensive, we accept his assessment and assign the Florida specimens to the nominate race, the only one recognized in the Americas.

Mailed on December 21, 2004

No specimen of *Otostigmus* has ever been taken to the north, but representatives of *Rhysida* have been intercepted four times in quarantines at US ports since 1937 (Shelley 2002), and single individuals of *R. l. longipes* have been encountered three times in south Florida, in 1956-57 in Miami and South Miami, Miami-Dade County, and in 1962 in a home in Key West, Monroe County (Chamberlin 1958, Crabill 1960, Shelley 2002). Shelley and Edwards (1987) therefore included *R. l. longipes* in their key to Floridian scolopendromorphs, but as no specimens had been encountered for 40 years, Shelley (2002) concluded that it had not established reproducing populations.

While it is premature to rescind this conclusion, there is now reason to question it. On April 15, 2004, two inspectors from the US Department of Agriculture discovered 5-6 moderately large scolopendrid centipedes on grass beneath a piece of plywood outside a warehouse in the vicinity of Hialeah, Miami-Dade County; this site is some 15 mi (24 km) northwest of the Port of Miami, so the centipedes cannot be regarded as "interceptions." Two individuals were captured and sent to the second author, where they were accessioned as Florida State Collection of Arthropods sample #E-2004-2872 and sent to the first author for determination. The centipedes are ca. 57 mm long and 7 mm wide, and are a subuniform green dorsally that fades into light olive-brown on the last three tergites; the prefemora of the ultimate legs are light brownish, and the remaining podomeres are light green. They are clearly referrable to *Rhysida* because the first tergite overlaps the base of the cephalic plate; the spiracles are circular and non-valvular; and a pair of spiracles is present on segment 7. Key anatomical features are as follows: antennae (both broken, left with 4 antennomeres and right with 15) with three basalmost articles sparsely hirsute; teeth on coxosternal tooth plates 4+4, medial two on each plate indistinct and subequal in height; trochanteroprefemoral process long, apically subacuminate, without additional teeth; dorsal paramedian sutures present on tergites 4-20, lateral margination evident on 9-21; ultimate tergite smooth, without sutures, strongly marginate, edges elevated into low but distinct carinae; sterna smooth, with short paramedian sutures arising from anterior margins on sternites 3-18 and weak caudomedial depressions on 7-19; sternite 21 wider than long, sides converging caudally, caudal margin slightly concave; coxopleural processes with three end and one lateral spines each; prefemora of ultimate legs with ventral, ventromedial, and dorsomedial rows of three equidistantly spaced spines apiece, distalmost of latter at distomedial corner; legs 1-4 with one short distal spine each on anterior surfaces of tibiae; 1st tarsi with two ventrodistal spines on legs 1-11 and one on legs 12-19; two accessory claws present on legs 1-19. These features are compatible with the variation in *R. l. longipes* as characterized by Attems (1930) and Lewis (2002); based on proximity, the specimens are probably neotropical in origin, but theoretically, they could have come from anywhere within the species' range, which encompasses parts of the East Indies, Asia, Indian Ocean islands, and Africa as well as the Americas (Lewis 2002). From the circumstances of this discovery, it seems that the inspectors may have accidentally found representatives of a larger population of this species that lives, reproduces, and is now established in this region of Miami-Dade County. Somewhat simultaneously, EMV (see Acknowledgments below) spotted a centipede with similar coloration outside a warehouse in West Palm Beach. It eluded capture and may also have been *R. l. longipes,* but two native south Floridian scolopendrids (both in the Scolopendrinae), *Scolopendra viridis* Say, 1821, and *Hemiscolopendra marginata* (Say, 1821) (Shelley and Edwards 1987, Hoffman and Shelley 1996, Shelley 2002), are similar enough in size and color that a non-specialist could confuse these species. We therefore cannot say that *R. l. longipes* occurs in Palm Beach County but note the possibility for future reference.

As south Florida harbors numerous non-native species, we place on record the fourth capture of these allochthonous centipedes, and the first with more than one individual, because *R. l. longipes* may now be an established component of regional ecosystems. Concerted sampling around the same time of year is needed in and around Hialeah, possibly using pitfall traps, to attempt to gather additional individuals and determine whether *R. l. longipes* truly occupies this region of Miami-Dade County. Sampling efforts to the north will document whether the centipede also occurs in Palm Beach County.

One individual has been deposited in each author's institution.

ACKNOWLEDGMENTS

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SOCIETY MEETING OF MARCH 24, 2004

EVOLUTION OF FLEA BEETLES (COLEOPTERA: CHRYSOMELIDAE)

Catherine N. Duckett
Department of Entomology, National Museum of Natural History
Smithsonian Institution, Washington, DC 20560

In the evening presentation, Dr. Catherine Duckett, on an NSF Advance Fellowship at the Smithsonian Institution, demonstrated the use of phylogenetic hypotheses to study the evolutionary questions posed by flea beetles. Flea beetles form part of the subfamily Galerucinae that is composed of more than 8000 species, and include major agricultural pests such as *Diobrotica* spp. causing millions of dollars of damage yearly. Duckett presented three competing hypotheses of relationships for the tribes Alticini and Galerucini, including one which hypothesizes that the Galerucini evolved from a jumping flea-beetle ancestor. Duckett's molecular analysis of ribosomal DNA supported this hypothesis—that the flea beetles are not a monophyletic group because the galerucini evolved from a species that could jump. Using this supported hypothesis, Duckett answered questions posed by flea beetle evolutionary biology, including the evolution of pharmacophagy (adults selecting toxic cucurbitacins as defensive compounds), prediction of identity for an unknown larval type, and systematic placement of a newly discovered, enigmatic species.

In other observations made by members at the meeting, Howard Boyd noted that the bee *Colletes thoracicus* (Colletidae) had been active for nearly two weeks near his home in Tabernacle, NJ. Notice was made that Brood X of the Periodical Cicadas was expected this year in a broad area in eastern North America, including the Philadelphia/Delaware region. Dr. Ron Romig received a Certificate of Appreciation from the U.S. Department of Agriculture on behalf of his efforts for the Beneficial Insect Rearing Laboratory in Newark, DE. The certificate was presented by member Bill Day, of BIRL. Nearly 22 members and visitors were present at the meeting.

Jon Gelhaus, President Secretary of the
American Entomological Society (1997-2003)
Corresponding Secretary of the
American Entomological Society (2003-present)
E-mail: gelhaus@acnatsci.org.

Mailed on December 21, 2004

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BOOK REVIEW

FOSSIL REVOLUTION. THE FINDS THAT CHANGED OUR VIEWS OF THE PAST. Douglas Palmer. 2003. Collins, an imprint of Harper Collins Publishers, Ltd. 77-85 Fulham Palace Road, London, England, United Kingdom. 144 pp. Hardcover. ISBN 0-00-7118287.

I could not stop reading Palmer's *Fossil Revolution.* This abundantly illustrated book goes to the heart of the issue: how old are the Earth and its inhabitants? This work is filled with fascinating nuggets of cultural/scientific historiography; the noble along with the less than virtuous. Some of these include Brogniarts's progressive views on fossil plants – some with possible insect damage – as global climate indicators, the story behind the "beast of Maastricht," the presence of mammoths in Wrangel Island (Siberian Arctic) during the construction of the Egyptian pyramids (4,000-5,000 years before the present), the trafficking on fossils, Mary Anning, Jr. along with numerous men and their roles in paleobiology, the origin of names currently used in the geological time table, Linne as the type of *H. sapiens,* the creatures in Linne's Anthropomorpha, the effect of the European Industrial Revolution in geology and paleobiology, the 18th and 19th century views of "amateurs" and "professionals," dinosaur tracks (http://www.isgs.uiuc.edu/dinos/dinotracks.html), and others.

Through examples, the book also provokes a thoughtful reflection on how, as a community of scientific practitioners, geologists and paleobiologists were strongly influenced by views of western religious organizations, particularly those of Christendom regarding temporal issues. As numerous scientific discoveries began shattering the belief in a relatively young Earth, scientists started to abandon a *modus operandi* in which faith would have had the last word while reason obeyed. Palmer provides instances of fossils (e.g. the skulls of extinct large proboscideans, deemed to be remnants of former giants, or a giant fossil salamander, described as *Homo deluvii testis* Scheuchzer, "a human who witnesses the deluge") that were incorrectly interpreted as hard evidence for the existence of the nephilims (Genesis 6:4) and other sinners who died in a universal Noachian deluge. The paleobiological literature of the nineteenth century is filled with cases of respected scientists who explained the presence of plants and their herbivorous insects in coal measures in terms of a global pluvial catastrophe. Similar contemporaneous beliefs include the claim of some modern creationists that layers of fossilized strata are produced in months, or that genuine amber and their biological inclusions are thousands of years old, or that there are just a few hundred biological "species" on Earth, or that huge vertebrates may still roam in a remote unexplored jungle or a body of water. Even "illuminated" Thomas Jefferson, third President of the United States, hoped for the existence of living dinosaur-sized vertebrates in North America when he sent Lewis and Clark westward.

Extending the discussion on radiometric techniques (http://www.gate.net/~rwms/AgeEarth.html) and greatly expanding the "Further Reading" section would have increased the value of this book. Although most illustrations in *Fossil Revolution* are well selected and helpful, adding to its broad perspective, the images depicting insects in amber (pp. 137-139) leave a lot to be desired. I noted very few errors and a rather memorable controversial statement, perhaps a lapsus, "...the fossil record does not preserve flowering plants until late Jurassic times" (p. 44). After reading *Fossil Revolution,* one wonders why the clash between systems of thinking still seems to be so vociferous in the west. How have these issues been "solved," if at all, in other civilizations?

Fossil Revolution is an excellent read for anyone interested in the history of ideas and would make an excellent selection for interdisciplinary college courses. This novel interpretation of the fossil record also revolutionized our world's view about the age of the Earth and its inhabitants. Given appropriate technology and previous knowledge, one can understand and, sometimes, predict natural phenomena. Nothing surpasses the constant pursuit of the "ground truth."

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NEW SPECIFIC SYNONYMS AND RECORDS OF NORTH AMERICAN *CENTROPTILUM* AND *PROCLOEON* (EPHEMEROPTERA: BAETIDAE)[1]

N. A. Wiersema[2] and W. P. McCafferty[3]

ABSTRACT: Eight species of North American Baetidae are placed as subjective junior synonyms as follows: among *Centroptilum*, *C. album* [= *C. convexum* and *C. walshi*, n. syns.], *C. bifurcatum* [= *C. selandreorum*, n. syn.], *C. asperatum* [= *C. elsa* and *C. oreophilum*, n. syns.], among *Procloeon*, *P. ingens* [= *P. implicatum*, n. syn.], *P. rufostrigatum* [= *P. hobbsi*, n. syn.], and *P. viridoculare* [= P. *irrubrum*, n. syn.]. Eighteen USA state records for eight species of *Centroptilum* and 21 state records and one Canadian province record for eight species of *Procloeon* are included among the 17 species reviewed and the 67 new North American collection records cited. Certain previously incorrect records are reassigned.

KEYWORDS: Ephemeroptera, Baetidae, *Centroptilum*, *Procloeon*, new synonyms

A study of the North American Baetidae genera *Centroptilum* Eaton and *Procloeon* Bengtsson (sometimes referred to as long-clawed baetids) revealed a number of new specific synonyms and considerable new distributional data. This information is detailed here along with reassignments of some previously published collection records. New species descriptions and diagnoses and keys to all North American species of *Centroptilum* and *Procloeon* will be taken up elsewhere.

New data are given here for 17 species presented alphabetically. Specific synonymies for each species are given, including eight new synonyms for six of the species. A majority of the 67 new collection citations, including 19 of the 39 new state and provincial records, are based on materials from the Purdue Entomological Research Collection (PERC). Three of these 39 records are based on corrected assignments of previously published locale data. Other collections that have been the source of new records or other materials examined are Colorado State University (CSU), Cornell University (CU), Florida A & M University (FAMU), personal collections of L. S. Long (LSL), Massachusetts Audubon Society (MAS), Missouri Department of Natural Resources (MDNR), Snow Museum of Entomology (SME), personal collection of R. S. Sarver (RS), and personal collection of N. A. Wiersema (NAW).

CENTROPTILUM

Centroptilum album McDunnough

Centroptilum album McDunnough, 1926:189
Centroptilum walshi McDunnough, 1929:173, **NEW SYNONYM**
Centroptilum convexum Ide, 1930:222, **NEW SYNONYM**

[1] Received on July 19, 2002. Accepted on July 17, 2004.

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Records. MASSACHUSETTS: Franklin Co, East Branch North R, VI-23-1995 (larvae, MAS). OREGON: Lane Co, Cummins Cr nr Neptune St Park, VIII-25-1954 GF Edmunds, and Benton Co, no other data (larvae, PERC). TENNESSEE: Williamson Co, Holt Cr at Edmundson Pike, III-18-1995 (larvae, PERC).

Remarks. Examination of numerous larvae and adults throughout much of North America has demonstrated that species concepts of *C. walshi* and *C. convexum* include intergrading color variants of *C. album*. Larvae and adults that have been attributed to the above names are structurally indistinguishable. *Centroptilum album* is one of the most geographically widespread and commonly collected species of long-clawed baetids in North America.

Centroptilum asperatum Traver

Centroptilum asperatum Traver, 1935:708
Centroptilum elsa Traver, 1935:713, **NEW SYNONYM**
Centroptilum oreophilum Edmunds, 1954:1, **NEW SYNONYM**

Material Examined. *Centroptilum elsa*, HOLOTYPE: reared male adult, Wyoming: Moose, VII-30-1929, EB Knots (No. 1360.1, CU); PARATYPES: two males, same data as holotype (No. 1360.3 and 4, CU). *Centroptilum asperatum*, HOLOTYPE: male adult with subimaginal exuviae, California: Big Bear L, San Bernardino Mts, VIII-29-1932, CD Michener (No. 1359.1, CU). *Baetis* No. 1 Seemann, reared female adults, California: Cobil's Canyon, nr Claremont, Seemann (CU); larva, Napa Co, Capelle Cr at Rt 128, 2.1 mi N jct Rt 121, I-27-1994, BC Kondratieff (CSU).

Remarks. Our study indicated that the type concept of *C. elsa* represents small, pale, late summer emergents of *C. asperatum*. In addition, no reliable characteristics have been found to distinguish *C. oreophilum* from *C. elsa*. This is a strictly western North American species. It also includes Seemann's *Baetis* No. 1 taken from Riverside County, California (Seemann 1927) and the California locales cited above.

Centroptilum bifurcatum McDunnough

Centroptilum bifurcatum McDunnough, 1924:96
Centroptilum selanderorum Edmunds, 1954:2, **NEW SYNONYM**

Records. KANSAS: Douglas Co, Kansas R at Eudora Bridge, VIII-24-1978, P. Liechti (larvae, SME). KENTUCKY: Montgomery Co, Slate Cr at Cooks Branch Rd, .9 km SSW jct Ky 460 and 713, VII-19-1983, and Taylor Co, Robinson Cr, .75 km SW jct Ky 70 and 337 at Mannsville, VII-27-1983 (larvae, PERC). WASHINGTON: Benton Co, Richland, IX-18-1998, R Newell (adult, NAW).

Remarks. Initial evidence of the equivalency of *C. selanderorum* (known as adults) and *C. bifurcatum* was presented by McCafferty et al. (1993). The examination of considerable additional materials since that time has confirmed that genitalic form and coloration associated with *C. selanderorum* (Edmunds 1954) represents variability found within or between populations of the relatively widespread, mainly midwestern and western *C. bifurcatum*. The new Kansas and Kentucky records of this species extend the known midwestern range (e.g., Randolph and McCafferty 1998) south and into the fringe of the Southeast.

Centroptilum conturbatum McDunnough

Centroptilum conturbatum McDunnough 1929:171

Records. ARIZONA: Yavapai Co., Spring Cr, 8 mi SW Cedona, 1 mi off US 89A, 3500', T16N, R4E, center, SW/4, V-06-1981, and Red Tank Draw, 1.5 mi E I-17 & AZ 279, on Rd # 618, E Montezuma Well Nat Mon, 3780', V-04-1981, WU Brigham, AR Brigham, MW Sanderson (larvae, PERC). COLORADO: Jackson Co, Roaring Fork R at Co Rd 5 bridge, VIII-22-1991, R Durfee, and Douglas Co, Cherry Cr, bank/bw Castlewood Canyon St Prk, VII-17-1997, A Polonsky, R Durfee (larvae, CSU).

Remarks. This species is known from central and western Canada south through the intermountain western USA.

Centroptilum minor McDunnough

Cloeon minor McDunnough, 1926:190

Records. ALABAMA: Elmore Co, Sofkahatchee Cr, IX-16-1987, S Harris, and Dekalb Co, W. frk Little R at Desota St Prk, VI-22-1988, KS Fraser, and Clay Co, Cheaha Cr at For Rd 637, 2.7 mi W L Chinnabee, VI-01-1988, S Harris (male adults, CSU). MISSOURI: Maries Co, Gasconade R nr Hwy 63 bridge, V-03-1989, S Humphrey (larvae, MDNR). NORTH CAROLINA: Randolph Co, Little Brushy Cr at St Rd 1005, V-18-1990 (larva, NAW). TEXAS: Montgomery Co, Peach Cr at US 59, N New Caney, 20° 12' 11 N, 095° 11' 07 W, IV-19-1999, and Walker Co, Sandy Cr, E Huntsville St Prk, 30° 37' 52 N, 095° 31' 15 W, II-24-1999, and Waller Co, Ponds Cr at Hwy 290, IX-17,27-1997, NA Wiersema (larvae and reared females, NAW).

Remarks. This is an eastern species that in the south extends westward to Missouri and Texas.

Centroptilum ozarkensum Wiersema & Burian

Centroptilum ozarkensum Wiersema and Burian, 2000:177

Records. TENNESSEE: Cannon Co, East Fork Stones R at headwaters, VI-07-1997, and Williamson Co, Holt Cr at Edmundson Prk, III-19-1995, LS Long (larvae and exuviae, NAW).

Remarks. This species is currently known only from Missouri and Tennessee.

Centroptilum triangulifer McDunnough

Cloeon triangulifer McDunnough, 1931:88

Records. ARKANSAS: Boone Co, Bear Cr at St Rd 14, V-28-1974, WP McCafferty, AV Provonsha, L Dersch (female adult, PERC). FLORIDA: Calhoun Co, Chipola R at Hwy 20, I-20-1974 PH Carlson (larva, FAMU). IOWA: Chickasaw Co, East Fork of the Wapsipinicon R 2.5 mi NE of North Washington & N of 150th St. Bridge, X-03-2002 (larvae, PERC).

Remarks. This species is found generally in the eastern half of the continent and extends westward into the Southwest as far as Oklahoma and Texas.

Centroptilum victoriae McDunnough

Centroptilum victoriae McDunnough 1938:27

Records. INDIANA: La Grange Co, Pigeon Cr at 1100 E, VI-10-1974, L Dersch, D Tyler (exuviae, PERC). MICHIGAN: Marquette Co, Lower Elm Cr .25 mi SW Ives L Stone House, VII-9-11-1985, WP McCafferty, AV Provonsha, and Pine River at bridge on Huron Mtn Club Compound Rd, VI-2-5-1986, WP McCafferty (larva, PERC). VERMONT: Windhams Co, North Brook at W Edge of Wilmington, VI-20-1976, WP McCafferty, AV Provonsha, and M Minno (larvae, PERC).

Remarks. This species was first reported in name from the USA by McCafferty et al. (2002) in their inventory of Iowa mayflies. Reexamination of Maine material upon which the report of *C. semirufum* McDunnough by Burian and Gibbs (1991) was based, revealed that it was referable to *C. victoriae.* As a result, *C. semirufum* is currently known in the USA only from the state of Pennsylvania (Jacobus and McCaffery 2001). Historically, *C. victoriae* has been known primarily from central and eastern Canada.

PROCLOEON

Procloeon ingens McDunnough

Cloeon ingens McDunnough, 1923:44
Cloeon implicatum McDunnough, 1924:113, **NEW SYNONYM**
Procloeon implicatum (McDunnough), **NEW SYNONYM**

Remarks. We have found *P. implicatum* indistinguishable from *P. ingens.* Also, reexamination of material reported as *P. mendax* (Walsh) from Marquette County, Michigan, by Randolph and McCafferty (1998) showed it to be referable to *C. ingens.* This species is known from Alberta and the Yukon, east across Canada and also from a few USA states, including Colorado, Maine, and now Michigan.

Procloeon mendax Walsh

Cloeon mendax Walsh, 1862:381

Remarks. Leonard and Leonard (1962) mentioned *Cloeon* sp. from a small tributary of the Au Sable River in Crawford County, Michigan. Examination of this material and the figure of the genitalia of this species presented by Leonard and Leonard (1962), demonstrated it as referable to *P. mendax,* which otherwise is represented in Michigan only in an old report from Detroit (Wayne County) by Eaton (1887). The species has been reported infrequently from northeastern and midwestern North America.

Procloeon nelsoni Wiersema

Procloeon nelsoni Wiersema, 1999:27

Records. TENNESSEE: Rutherford Co, West Fork Stones R at Barfield, IV-22-1997, and Panther Cr at Panther Cr Rd, VI-08-1997, and Panther Cr at Walnut Grove Rd/Panther Cr Rd, IV-27-1997, and Williamson Co, unnamed trib of Mill Cr at Rock Springs Rd and Clovercroft, IV-07-1997, LS Long (larvae, female adults, some reared, LSL).

Remarks. Reexamination of the larva informally referred to as *Procloeon* sp. 3 from Texas by McCafferty and Davis (1992) revealed that is was referable to *P. nelsoni.* This species is currently known only from Texas and Tennessee.

Procloeon pennulatum Eaton

Centroptilum pennulatum Eaton, 1870:2
Centroptilum infrequens McDunnough, 1924:98

Records. ARKANSAS: Scott Co, Johnson Cr at Johnson Cr Rd nr US Hwy 71, 8 mi N Mena, VI-1-1974, WP McCafferty, AV Provonsha, L Dersch (larvae, PERC). COLORADO: Moffat Co, Yampa R at Echo Prk, Dinosaur Nat Mon, IX-03-1994, BC Kondratieff, R Durfee (reared adults, NAW). NEVADA: Elko Co, Humbolt R at Elko, VIII-29-1965, SL and JW Jensen (larva, PERC). TENNESSEE: Cannon Co, Carson Frk at Burt Burgen Rd and Todd's Cemetery, VIII-27-1997 (exuviae, NAW).

Remarks. This widespread Holarctic species was first recognized in North America by Lowen and Flannagan (1990) by way of synonymizing *C. infrequens* with it. The species is now known from all North American regions excluding the extreme southwestern USA and Mexico (see also comments under *P. rivulare*, below).

Procloeon rivulare Traver

Centroptilum rivulare Traver, 1935:716

Records. CONNECTICUT: New Haven Co, Seymour, Bladden's Brk, at Rt 67 and Skokorat Rd, VII-22-1996, SK Burian (larvae, NAW). MASSACHUSETTS: Hampshire Co, Mill R, Arcadia Sanctuary, Easthampton, VIII-01-1991 (larvae, MAS). MISSISSIPPI: Perry Co, Leaf River, 31/13/03N 87/03/47W, VII-2000 (PERC). TENNESSEE: Polk Co, Lost Cr at Lost Cr Campgr nr Ocoee R, III-5-1994, and Rutherford Co, West Fork Stones R at Barfield, IV-22-1997, LS Long (larvae, LSL). VERMONT: Windhams Co, small spring at North Brk at W edge of Wilmington, VI-20-1976, WP McCafferty, AV Provonsha, M Minno (larva, PERC). VIRGINIA: Highland Co, Back Cr at Va Hwy 84, V-05-1968 (larva, PERC).

Remarks. Reexamination of materials reported as *P. pennulatum* from North Carolina by McCafferty (1993) and New Brunswick by McCafferty and Randolph (1998) are referable to *P. rivulare*. This species is known from far eastern Canada (New Brunswick and Nova Scotia), through the Appalachian chain in the USA, and westward in Kentucky, Indiana, Mississippi, and Ohio.

Procloeon rubropictum McDunnough

Cloeon rubropictum McDunnough, 1923:43

Records. MISSOURI: Bollinger Co, Little Whitewater R, IX-22-1999, and Hickory Co, Little Niangra R, IX-17-1996, and Reynolds Co, E Frk Black R, IX-21-1999, and Shannon Co, Pea Vine Hollow, V-16-2001, and St. Clair Co, Brushy Cr, IX-20-1995 (larvae, MDNR). TENNESSEE: Rutherford Co, West Fork Stones R at Barfield, IV-22-1997, and Panther Cr at Panther Cr Rd, VI-08-1997, LS Long (larvae and female adult, LSL).

Remarks. This species is relatively common throughout eastern Canada and the eastern half of North America to as far west as Oklahoma, although it has yet to be reported from any states north or south of Oklahoma.

Procloeon rufostrigatum McDunnough

Centroptilum rufostrigatum McDunnough, 1924:95
Centroptilum bistrigatum Daggy, 1945:389
Centroptilum hobbsi, Berner, 1946:77, **NEW SYNONYM**
Procloeon hobbsi (Berner), **NEW SYNONYM**

Material examined. *Centroptilum hobbsi*, PARATYPE: female adult, Florida, Alachua Co, Sante Fe R at Poe Springs (FAMU). *Procloeon* sp. 1, female adults, Texas: Blanco Co, Blanco R (PERC).

Records. MISSOURI: Adair Co., Chariton R at Hwy 6 bridge, IX-20-2001, RJ Sarver (larvae, RS); Osage Co, Maries R, VIII-21-1996, RJ Sarver (larvae, MDNR). VERMONT: Windhams Co, Whetstone Brk at Battleboro, VI-19,20-1976, WP McCafferty, AV Provonsha, M Minno (larvae, PERC).

Remarks. Berner (1946) based his description of *C. hobbsi* on a small number of adult females from northern Florida, and he included a description of presumably associated larvae. The latter are indistinguishable from the larvae of *P. rufostrigatum*. Adult paratype material of *P. hobbsi* also proved to be equivalent to *P. rufostrigatum*. The report of *P. rivulare* from central Texas by Baumgardner et al. (1997) is referable to *P. rufostrigatum*, and reexamination of material informally referred to as *Procloeon* sp. 1 from Texas by McCafferty and Davis (1992) showed that it also is referable to *P. rufrostrigatum*. This species is common in the central plains states and Manitoba, but is also known from more eastern Canada and the USA.

Procloeon simplex McDunnough

Cloeon simplex McDunnough, 1925:185

Records. MISSOURI: Maries Co., Gasconade R nr Hwy 63 bridge, V-03-1989, S Humphrey (larvae, PERC, MDNR).

Remarks. This species is known from scattered localities in the eastern half of North America.

Procloeon viridoculare Berner

Centroptilum viridocularis Berner, 1940:39
Procloeon irrubrum Lowen and Flannagan, 1992:104, **NEW SYNONYM**

Records. ARKANSAS: Scott Co, Mill Cr at Mill Cr picnic area, Ouachita Nat For, VI-1-1974, WP McCafferty, AV Provonsha, L Dersch (larva, PERC). KENTUCKY: Christian Co., Buck Fork Pond R, VIII-14-1980, and Knott Co, Carr Fork, VI-27-1978, WP McCafferty, AV Provonsha (larvae, PERC). INDIANA: Benton Co., Big Pine Creek, V-25-1976, and trib of Big Pine Cr, ca 5 mi NE Templeton, VIII-04-1976, AV Provonsha, M Minno, and Elkhart Co, Elkhart R, IX-5-1978, WP McCafferty, AV Provonsha, and Hendricks Co, W frk White Lick Cr, VII-20-1978, M Minno, JH Hollis, and Jasper Co., Oliver Ditch (Iroquois R), VII-26-1973, K Black, and Jefferson Co, Indian-Kentuck Cr, VI-17-1977, AV Provonsha, M Minno, AA Alabi, and LaGrange Co., Pigeon Cr IX-7-1974, AV Provonsha, and Martin Co., West Fork White River at Hindostan Falls Publ Fish Site, VII-26-1982, and Bogg's Cr, IX-8-1978, AV Provonsha, M Doub, and Tippecanoe Co., Wabash R, VI-14-1977, M Minno, D Morihara, S Yocom, and Warren Co., Kickapoo Cr, V-21-1976, M Minno, D Morihara (larvae, PERC). OKLAHOMA: Noble Co, no other data (larva, PERC).

Remarks. We found that *P. irrubrum* was indistinguishable from *P. viridoculare.* This species is common in central states such as Iowa and Texas, and southeastern states such as Florida and Alabama. It is also known from a few additional midwestern and eastern states as well as Ontario.

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"SUPERMALE" CADDISFLIES (TRICHOPTERA: HYDROPSYCHIDAE, PHILOPOTAMIDAE) FROM THE NORTH CENTRAL UNITED STATES[1]

David C. Houghton[2]

ABSTRACT: Specimens of *Chimarra socia* and *Cheumatopsyche campyla* from Minnesota and Ohio, respectively, are reported with the unusual condition of possessing two sets of male genitalia. These specimens, the first report of "supermale" caddisflies from the United States are described and illustrated herein. The cause of the supermale condition remains unclear.

KEY WORDS: Trichoptera, Hydropsychidae, Philopotamidae, north central U.S.A., "supermale"

The term "übermännchen" or, in English, "supermale" or "metamale" describes sterile males with an extra male sex chromosome and often with exaggerated primary sexual characteristics (Klima and Mey 1987, Rédei 1998). Such specimens are quite rare in nature and it is not clear what causes the condition (Rédei 1998). The only known description of a possible supermale caddisfly was by Klima and Mey (1987), who discovered a specimen of the German caddisfly *Chaeopterygopsis machlachlani* Stein (Limnephilidae) with two phalli lying parallel to each other in the genital capsule and separated by a single intermediate appendage. The remainder of the genitalic structures of this specimen appeared to be normal. They hypothesized that this specimen was a supermale, although they did not provide any genetic information on it.

Other genitalic anomalies, such as intersexual and gynandromorphic individuals, have been reported in 14 caddisfly species within five families, mostly in the European literature (Nielsen 1948, Schmid 1956, Schmid 1958, McLachlan 1968, Swegman 1978, Dia and Botosaneanu 1982, Mey 1982, Klima and Mey 1987, Botosaneanu 1995). Klima and Mey (1987) provided a review of all such anomalous individuals prior to 1987.

This paper describes the apparent supermale condition in two caddisflies: a Minnesota specimen of *Chimarra socia* Hagen (Philopotamidae), and an Ohio specimen of *Cheumatopsyche campyla* Ross (Hydropsychidae). Both species are common throughout the eastern United States (Lago and Harris 1987, Nimmo 1987, Armitage 1991). In Minnesota, *C. socia* is common in the northeastern third of the state where it has been found in a variety of stream types (Houghton 2004). *Cheumatopsyche campyla* is abundant throughout Ohio and, likewise, found in a variety of habitats (B. J. Armitage, Ohio Biological Survey, personal communication). Examined material is deposited in either the University of Minnesota Insect Collection, Saint Paul, Minnesota (UMSP) or the University of Tennessee Trichoptera Collection (UT).

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Cheumatopsyche campyla, supermale

Description: Size, color, and general appearance typical of species; forewing length 9 mm; all 10 abdominal segments including genitalia present. *Genitalia* (Figure 1): Segment IX annular, broad ventrally with knob-like dorsal apex bearing long stout setae. Segment X slightly longer than deep in lateral view, extending shelf-like over inferior appendages; with median lobe bearing setae and with setaceous apical lobes knob-like in lateral view and tapering dorsally to rounded points in caudal view. With two sets of inferior appendages. One set appearing normal, each appendage with basal segment elongate in lateral view, bearing fine setae basally and stout setae apically; apical segment broader basally, tapering to sinuate apex. Second set of inferior appendages attached inward of normal set and asymmetrical in placement; right abnormal appendage rotated approximately 165° outwardly, left abnormal appendage rotated approximately 120° outwardly, both abnormal appendages offset approximately 10° clockwise, abnormal appendages otherwise similar to normal appendages. With two phalli, each rotated approximately 90° outwardly, parallel to each other and with their dorsal (now lateral) surfaces attached medially; phallic complex offset approximately 15° clockwise in genital capsule; both phalli typical in appearance with slightly enlarged ovate apices and complete phallobases; neither phallus appearing attached to ejaculatory duct.

Material Examined: OHIO: Montgomery Co., Wright-Patterson Air Force Base, 2.5 km wsw of Fairborn, 27.vii.1999, u.v. light, 1 supermale ♂ (UT); MINNESOTA: Koochiching Co., Rainy R., confl. Little Fork R., S.H. 11, 12.vii.1999, D.C. Houghton, u.v. light, 3 normal ♂♂; Anoka Co., Coon Cr., Coon Rapids Regional Park, 14.vii, 2000, D.C. Houghton, u.v. light, 7 normal ♂♂; Crow Wing Co., Pine R., S.R. 169, 20.vii.2000, D.C. Houghton, u.v. light, 23 normal ♂♂ (UMSP).

Chimarra socia, supermale

Description: Size, color, and general appearance typical of species; forewing length 6 mm; all 10 abdominal segments including genitalia present. *Genitalia* (Figure 2): Segment IX annular, with elongate spatulate mesal lobe on venter of sternum. Tergum X membranous, extended shelf-like caudally. Intermediate appendages sclerotized; curved and spatulate in dorsal view, each with two stout setae at apex. Preanal appendages lobe-like and setose, attached to intermediate appendages basally. With two sets of inferior appendages. One set appearing normal; each appendage with quadrate mesal lobe on inner surface near base bearing few setae; in lateral view base setose, projecting ventrad; remainder of appendage elongate with scattered setae; apical region broad, bearing setae. Second set of inferior appendages slightly thinner than and protruding caudad of normal set; attached inward of normal set and rotated approximately 45° inwardly; otherwise similar to normal set with similar setal arrangement. With two phalli, in dorsal view oriented parallel to each other in approximately the usual position within the genital capsule. Right phallus attached to ejaculatory duct and appearing normal, sclerotized laterally for majority of length with trilobed membranous apical portion; containing two pairs of internal sclerotized rods; outer pair slender, elongate, tips protruding apically from membranous region of phallus; inner pair sinuate, less heavily sclerotized. Left phallus without ejaculatory duct or complete phallobase; similar in appearance to right phallus with membranous apical lobes of phallus more distinct and with sinuate inner sclerotized rods protruding apically from phallic membrane.

Material Examined: MINNESOTA: Koochiching Co., Rainy R., confl. Little Fork R., S.H. 11, N 48° 31.174', W 93° 34.174', 244 m, 12.vii.1999, D.C. Houghton, u.v. light, 1 supermale ♂ (UMSP); same, 13 normal ♂♂; Lake Co., Baptism R., S.R. 1, Eckbeck Cpgrd, 30.vii.1991, R.J. Blahnik, u.v. light, 5 normal ♂♂ (UMSP).

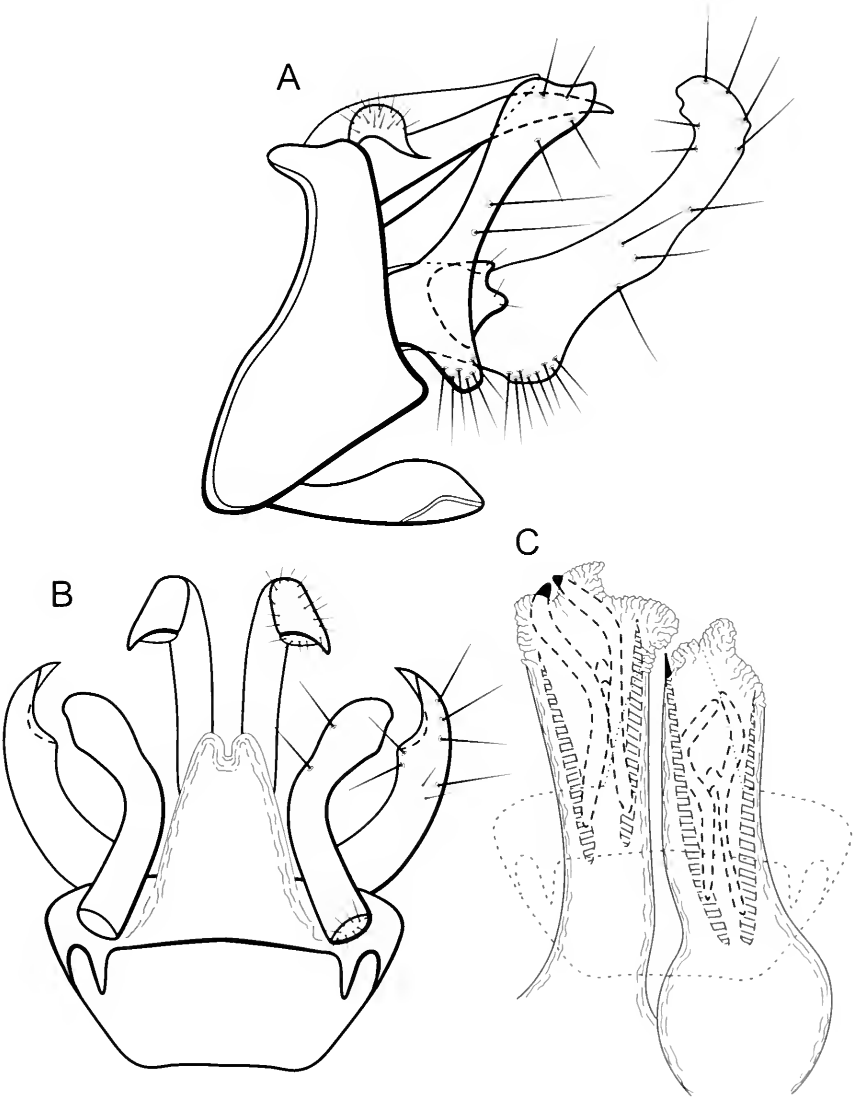

Figure 1. *Cheumatopsyche campyla,* supermale, male genitalia. A: Segments IX, X, inferior appendages, lateral. B: Segments IX, X, dorsal. C: Segments IX, X, Phalluses, dorsal. D: Tergum X, caudal.

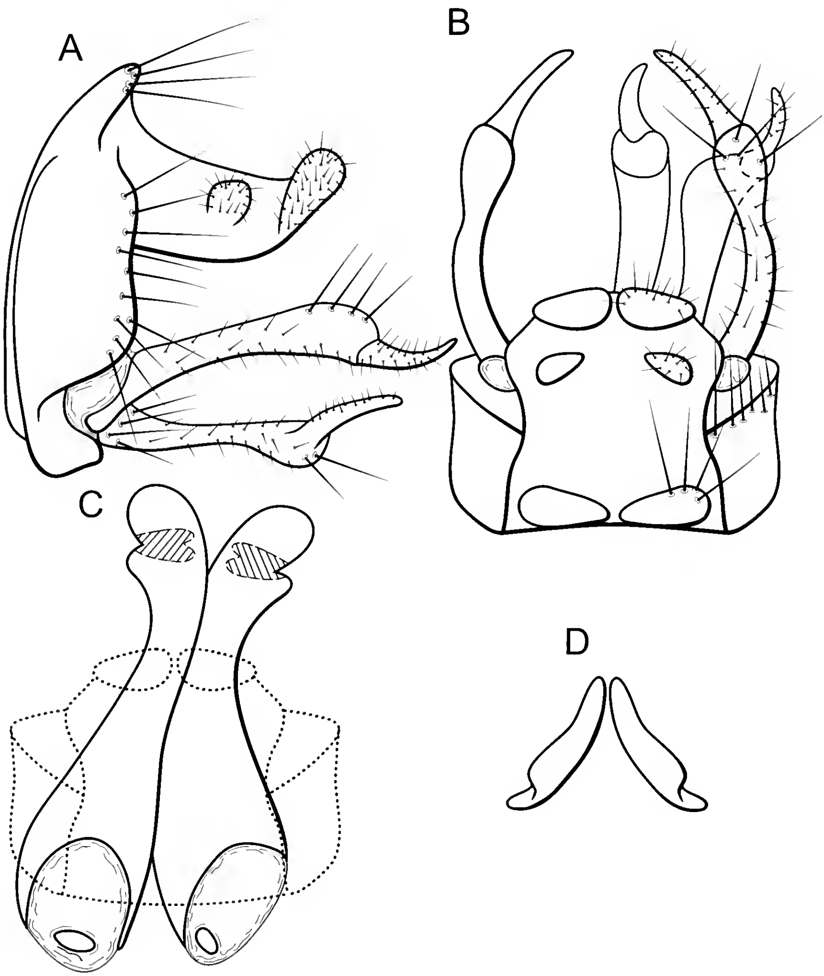

Figure 2. *Chimarra socia,* supermale, male genitalia. A: Segments VIII, IX, X, inferior appendages, lateral. B: Segments IX, X, dorsal. C: Segments IX, X, Phalluses, dorsal.

DISCUSSION

Except for the obvious anomalies, the general appearance and genitalia of these supermale specimens are similar to past descriptions of *C. socia* (e.g., Hagen 1861, Banks 1911, Ross 1944, Lago and Harris 1987) and *C. campyla* (e.g., Ross 1938, Nimmo 1987, Moulton and Stewart 1996), respectively. Likewise, they appear similar to other males examined from various locations in Minnesota. The chromosomal condition of both specimens is unknown.

The cause of genitalic anomaly remains a matter of conjecture. Under experimental conditions using x-rays, Patterson (1931) induced only a 0.03 percent occurrence of gynandromorphs in a colony of *Drosophila melanogaster.* Klima and Mey's (1987) supermale of *Chaeopterygopsis machlachlani* was collected along with an intersex specimen and 173 normal individuals. The authors speculated that this high prevalence of genitalic anomaly occurred due to chromosomal interaction caused by inbreeding in the species' isolated spring habitat rather than from mutation. Due to the widespread distribution of *C. campyla* and *C. socia* (Lago and Harris 1987, Nimmo 1987, Armitage 1991, Houghton 2004), it seems unlikely that inbreeding could be the cause of their supermale condition.

Although anthropogenic pollution has been shown to cause morphological aberrations in both vertebrates and invertebrates (Dickman et al. 1992, Maden et al. 1993, Fort et al. 1999, Gardiner and Hoppe 1999), more information about the collecting localities must be obtained before such a hypothesis could be made about the supermale specimens described here. The *C. socia* specimen was collected from the confluence of two large (>100 m wide) rivers, the Rainy and the Little Fork, shortly after dusk. This site is located on the Canadian border and approximately 20 km downstream of International Falls, a town of 6,700 (IFCC 2000). This same collection contained 47 species of caddisflies and 13 male specimens of *C. socia* without genitalic anomaly. The *C. campyla* specimen was collected from Wright-Patterson Air Force Base in southwestern Ohio. The same collection yielded 23 species of caddisflies and 123 male specimens of *C. campyla* without abnormality. It will be difficult to determine the cause of the supermale condition with such a small number of known specimens.

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TWO NEW SPECIES OF *ETHMIA* HÜBNER FROM CHINA (LEPIDOPTERA: ELACHISTIDAE: ETHMIINAE)[1]

Shu-Xia Wang[2] and Hou-Hun Li[2]

ABSTRACT: Two new species *Ethmia antennipilosa* and *E. cribravia* from Guangxi and Yunnan provinces of China are described. Photographs of the adults and genital structures are provided.

KEY WORDS: Lepidoptera, Elachistidae, Ethmiinae, *Ethmia*, new species, China

Ethmia is the largest genus in Ethmiinae, with more than 90 species described in the Palaearctic Region. The genus is represented in China by 46 species reported previously (Sattler, 1967; Amsel, 1969; Liu, 1980; Liu and Xu, 1982; Wang and Zheng, 1997; Kun and Szaboky, 2000; Kun, 2001; Kun, 2002a; Kun, 2002b). The purpose of this paper is to describe two new species of *Ethmia* from China.

Ethmia antennipilosa Wang and Li, sp. nov.
(Figs. 1, 3, 5)

Diagnosis: This new species is similar to *Ethmia epitrocha* (Meyrick) in pattern and male genitalia (Meyrick, 1914; Sattler, 1967), but can be separated from the latter by having an antenna with basal half of flagellum widely expanded; a bifurcate uncus from about middle; anterior part of gnathos with anterior margin rounded; a ventral margin of sacculus gently arched.

Type Data: Holotype ♂: China, Hengxian (22.6° N, 109.2° E), Guangxi Province, July 18, 2002, coll. Yanli Du, genitalia slide No. W03065. Deposited in the Department of Biology, Nankai University, Tianjnn, China.

Description (Figs. 1, 3). Head: frontoclypeus shinning black, medially tinged with white scales; vertex white. Antenna (Fig. 3) with scape white, with black scales along anterior and posterior margins; flagellum black, basal half greatly expanded, compressed dorsoventrally, with long yellowish-white scales, forming a hairbrush on posterior margin, compact rough scales; distal half gradually thinned toward apex, ending in point. Labial palpus black, with appressed scales; second segment thick and long, about 1.5 times as long as diameter of compound eye, dotted with white scales on dorsal surface; third segment thin, shorter than 1/2 of second, distal half white, pointed apically. Thorax grayish white, with four black spots: two spots near anterior margin, two near posterior margin. Tegula grayish white, with one black spot near anterolateral margin. Forewing: length 10.5 mm; ground colour light gray, somewhat pale brown; costal margin gentle; apex rounded; fourteen irregularly shaped black spots or blotches scattered on surface: three larger elongate blotches along basal half of costal margin; cell with four spots: one at base, one at 2/3 length and two other larger elongate spots near distal end; fold with three spots: one at base, 2/5 length and 3/5 length respectively, the basal spot is smallest; tornus with one spot above; one small spot at basal 1/4 near posterior margin; two irregular large spots near apex; nine small, black marginal spots from distal portion of costal margin to termen; fringe whitish gray. Hindwing and fringe pale gray. Fore and mid legs white above, black with white markings below; hind leg grayish white, tarsus brown basally, white apically.

Male genitalia (Fig. 5). Uncus widely bilobed apically, each lobe short, with rounded apex. Gnathos spinose, with posterior part subtriangularly shaped, the posterior margin dentate, slightly

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concave at middle; anterior part wider, the anterior margin rounded. Labis spinose and weakly sclerotized, with a rounded apical margin. Valva gradually narrowed from base, distal 1/3 elongate, with fine and large setae; apex blunt. Sacculus weakly sclerotized, slightly arched ventrally, with a large distal spine. Costa forming a sclerotized plate from base to 2/5 length. Aedeagus strongly curved basally, with a small sclerotized plate near apex.

Female. Unknown.

Etymology. The specific epithet is derived from the Latin, *antenna,* meaning long projection, as in those sticking up on sails, and *pilosa,* meaning hairy or pilose, referring to the specialized scales forming a hairbrush on the dorsal edge of antenna.

Ethmia cribravia Wang and Li, sp. nov.
(Figs. 2, 4, 6)

Diagnosis. This species is similar to *Ethmia dehiscens* Meyrick (Meyrick, 1924; Sattler, 1967), but differs from the latter by having a hindwing with long ochreous brown scales along the anal margin, dorsally projected valva at end and vesica of aedeagus with several cornuti.

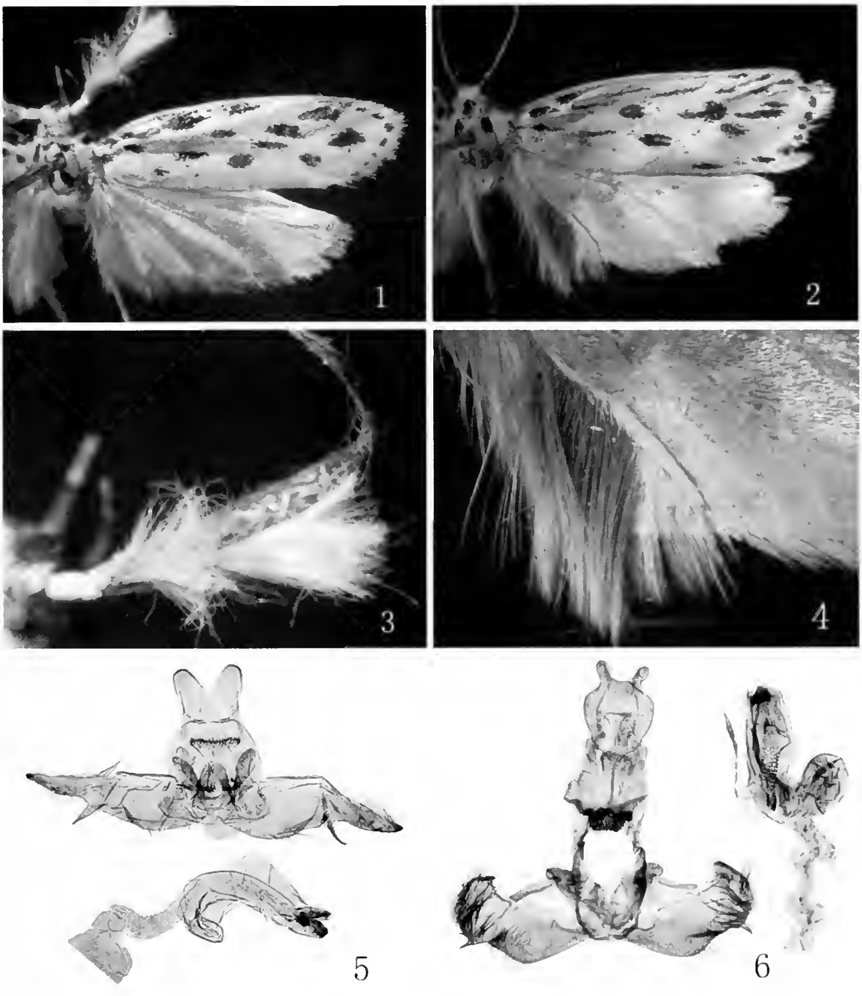
Type Data. Holotype ♂: **China,** Lijiang (26.8° N, 100.2° E), Yunnan Province, Apr 11, 1974, coll. Yao Zhou and Feng Yuan, genitalia slide No. W03071. Paratypes: 2 ♂♂, other same data as holotype. Deposited in the Department of Biology, Nankai University, Tianjnn, China.

Description (Figs. 2, 4). Head: frontoclypeus and vertex whitish gray, posterior area of vertex with a black spot at middle. Antenna filiform; scape blackish gray on dorsal surface, grayish white on ventral surface, flagellum gray. Labial palpus with first segment whitish gray; second segment with basal 2/5 black except for inner side; third segment with basal 1/3 black. Thorax brownish gray, with three black spots triangularly arranged. Tegula brownish gray except for base whitish, with a pair of black spots at base. Forewing: length 12.5 mm; costal margin gently arched; ground color brownish gray, overlaid with 16 black streaks and spots: costal margin with one spot at base, two larger spots beside this one near costal margin; cell with two rounded spots respectively set at middle near upper margin and at end, the latter larger, longitudinally extending inward; fold with three spots respectively set at base, middle and end; eight streaks extending from basal 1/5 near costal margin to around end of cell; posterior margin with one elongate spot at distal 1/3; 10-11 irregularly rounded small dots extending from distal 2/5 of costal margin and along termen to beyond tornus; fringe gray. Hindwing pale gray, with piliform ocherous brown scales on anal margin (Fig. 4). Fore and mid legs black, tarsomeres black basally, white apically. Hind leg whitish gray, except tarsus brown. Abdomen brown.

Male genitalia (Fig. 6). Uncus produced into two large lobes near half length, and irregularly rounded, caudal margin with a pair of short apex-rounded processes. Posterior part of gnathos heart-like in shape, spined, with dense short spines along posterior margin, which is bluntly rounded; anterior part somewhat trapezoidal in shape, wider than posterior part, densely with short strong spines, straight anteriorly. Labis relatively short, with short spines, concave inward at ventral 2/3, apex rounded. Valva with basal 2/3 broad; distal 1/3 slightly narrowed, apex rounded and margined with strong setae, dorsally forming a projection at end pointing upward, ventrally with a short spine near apex. Costa straight, sclerotized. Sacculus weakly sclerotized, with ventral margin straight in basal half, forming an obtuse angle at about middle. Aedeagus relatively thick, bent at basal 1/3; cornuti consisting of several spines.

Female. Unknown.

Etymology. This specific epithet is derived from the Latin, *cribravius,* meaning tufty, and it refers to the long setae along the anal margin of the hindwing.



Figs. 1-6. *Ethmia* spp. 1. Adult *Ethmia antennipilosa* sp. nov. (male). 2. Adult *Ethmia cribravia* sp. nov. (male). 3. Antenna of *Ethmia antennipilosa* sp. nov. showing specialized scales. 4. Part of hindwing of *Ethmia cribravia* sp. nov. showing specialized setae of anal area. 5. Male genitalia of *Ethmia antennipilosa* sp. nov. 6. Male genitalia of *Ethmia cribravia* sp. nov.

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A NEW SMALL MINNOW MAYFLY (EPHEMEROPTERA: BAETIDAE) FROM UTAH, U.S.A.[1]

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ABSTRACT: *Baetis moqui*, n. sp., is described from larvae collected from the Escalante Canyon Region of Garfield County in south-central Utah. The new species is unique among North American *Baetis* in having gill number one highly reduced or absent. Labial morphology and overall setation characteristics indicate a close relationship between *B. moqui* and the northern California species *Baetis alius* and the eastern North American species *Baetis pluto*. An updated key to the North American *Baetis* larvae is provided.

KEYWORDS: Ephemeroptera, Baetidae, *Baetis*, new species, Utah

Morihara and McCafferty (1979) provided the most recent revision of those North American small minnow mayfly species considered in the Arctogean (Holarctic + Oriental + Afrotropical) genus *Baetis* Leach. Since then, considerable phylogenetic research within the family Baetidae has led to an explosion of new genera and a further restriction of *Baetis* to selected species within the *Baetis* complex of genera, defined by two larval apomorphies: possession of a femoral villopore and flat-tipped setae on the antennal flagella, abdominal segments, and caudal filaments (Waltz and McCafferty 1987; Gaino and Rebora 1999).

Presently 21 North American species are considered within the genus *Baetis*, eight of which are known only from adults. In North America, most *Baetis* species are considered members of three species groups (Morihara and McCafferty 1979): The *fuscatus* group, which includes the species *Baetis carinus* Edmunds and Allen, *Baetis flavistriga* McDunnough, *Baetis intercalaris* McDunnough, *Baetis notos* Allen and Murvosh, and *Baetis rusticans* McDunnough; The *rhodani* group, which includes the species *Baetis adonis* Traver, *Baetis bicaudatus* Dodds, *Baetis diablus* Day, *Baetis foemina* McDunnough, *Baetis magnus* McCafferty and Waltz, *Baetis palisadi* Mayo, *Baetis parallelus* Banks, Baetis *persecutor* McDunnough, *Baetis piscatoris* Traver, and *Baetis tricaudatus* Dodds; The *vernus* group, which includes *Baetis brunneicolor* McDunnough, *Baetis bundyae* Lehmkuhl, and *Baetis hudsonicus* Ide. The Northern California species *Baetis alius* Day, and the principally Appalachian species *Baetis pluto* McDunnough have never been assigned to any species group, although their adult male genitalia would seem to indicate a close relationship to those species considered within the *fuscatus* species group.

A new species is described from larvae collected from the Escalante Canyon Region of Garfield County in south-central Utah. This new species along with

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B. alius and *B. pluto* are hereby considered as members of the newly recognized *alius* species group based on similarities of the labium (elongate palpal segments, elongate glossae and paraglossae, submentum and mentum; palpal segment two with moderately developed distomedial projection and convex medial margin), and adult male genital forceps (forceps of generally *fuscatus* type, with segment one lacking a distinct distomedial protuberance).

Baetis moqui, NEW SPECIES
(Figs. 1-6)

Diagnosis. The highly reduced and often absent nature of gill 1 distinguishes *B. moqui* from all other North American *Baetis*. In North America, larvae of *Americabaetis* Kluge and *Diphetor* Waltz and McCafferty are the only other Baetidae that lack gill 1. The distinct structure of the labial palpi will also serve to distinguish *B. moqui* from all other North American *Baetis* with the exception of *B. alius*. The wide first denticles of the mandibular incisors (Figs. 2 and 3); apically narrower, distomedially projecting paraglossae (Fig. 4); abdominal tergal patterning; and reduced or absent gill 1 (Fig. 5) of *B. moqui* will serve to distinguish it from the larvae of *B. alius*. Additionally, the dorsal setae of labial palpi segment two (Fig. 13) in *B. alius* tend to be arranged in a vertically oriented straight line, where as those of *B. moqui* usually have a more or less clumped arrangement (Fig. 4). Mouthpart setation has proven to be considerably variable within most mayflies, thus the above feature may be of limited use.

Description of the larva. Body length: 5.8-7.0 mm, cerci 4.5-5.2 mm, medial caudal filament 2.8-3.2 mm. Head: Head capsule almost entirely brown, frontal and region around epicranial suture usually pale. Antennae extending to at least first abdominal segment; scape and pedicel brown, flagella pale with brown apices. Labrum as in Figure 1. Maxillae with 2-3 crest setae; palpi extending beyond galealacinial crest, segment 1 subequal to segment 2. Mandibular incisors as in Figures 2 and 3; first denticle broad, approximately as wide as denticle 2 and 3 combined. Labium as in Figure 4. Labial palpi segment 2 with 5-7 dorsal setae and well developed distomedial expansion with roughly convex inner margin. Thorax: Nota with extensive dark and pale markings. Hindwingpads well developed. Legs (Fig. 6) with dorsal margin of femora with long, stout setae; ventral margin with short stout setae; outer surface with numerous stout setae; inner surface with very sparse short, stout setae; dorsal margin of tibial and tarsi with very short stout setae; ventral margin with longer stout setae; femora with broad, medial, brown band and dark brown distally. Claws with 9-13 denticles. Abdomen: Gill 1 highly reduced or absent, when present similar to Figure 5. Gills 2-7 elongate; gill 4 with greatest length. Terga 1 with posterior three-fourths dark brown, anterior fourth pale; terga 2-4 entirely dark brown with large pale, paired, submedial round areas, pale anterolateral corners, and often with pale, vertically oriented, medial band; terga 5-6 mostly pale with darkened posterolateral corners and often some dark medial patterning; terga 7-8 entirely dark brown except pale anterolateral corners; terga 9-10 generally pale, occasionally with some minor medial brown patterning. Sterna pale brown with weak tracheation marks; sterna 7-8 dark brown giving segments 7 and 8 banded appearance. Caudal filaments pale with darkened apices and often darkened basally.

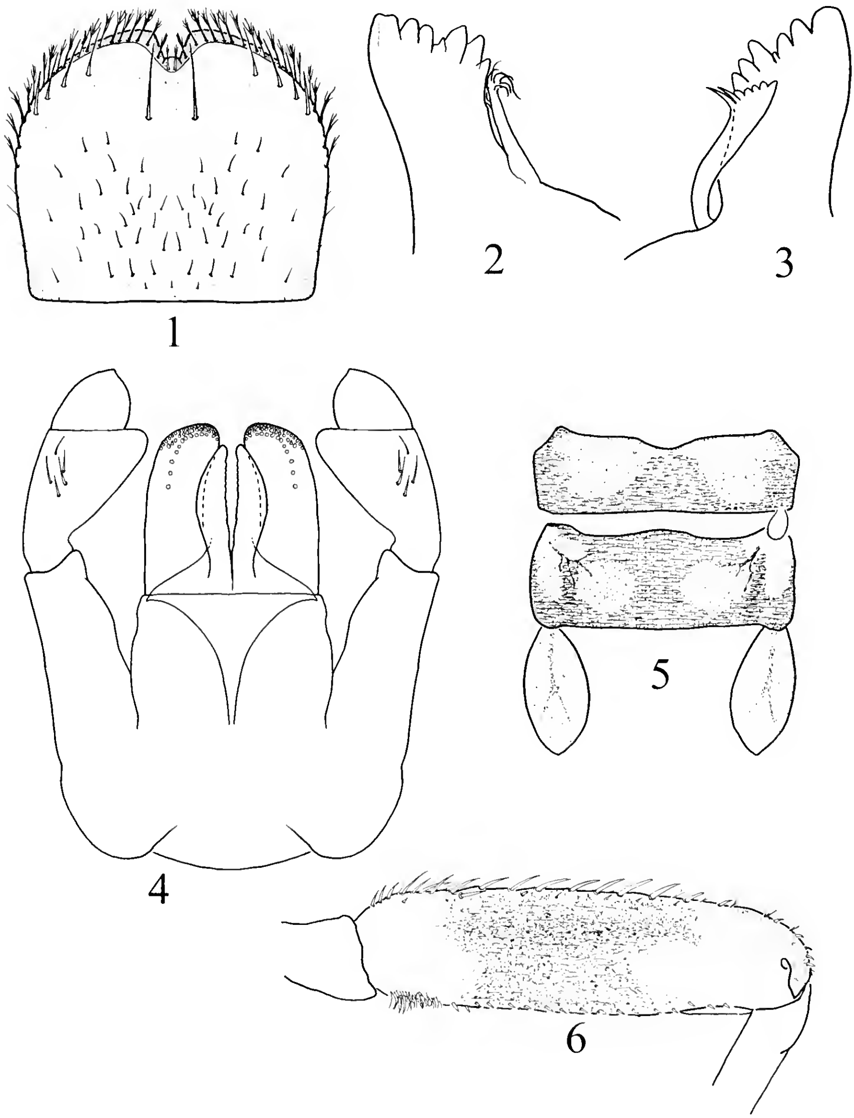
Type Material. HOLOTYPE: male larva, UTAH: Garfield Co., North Creek, above North Creek Reservoir, 8.2 mi from Hwy 12, North Creek Road, July 09, 2001, K. F. Kuehnl (deposited in the Purdue University Entomological Research Collection). Paratypes: 10 larvae same locality and deposition as holotype; 2 larvae, North Creek, above North Creek Reservior, 7 mi from Hwy 12, North Creek Road, July 06, 2001, K. F. Kuehnl (deposited in Monte L. Bean Life Science Museum, BYU).

Additional Material. UTAH: Garfield Co., Pine Creek, Box Death Hollow trailhead, Pine Creek Road, June 28, 2001, K. F. Kuehnl (20 larvae, personal collection of NAW and BYU).

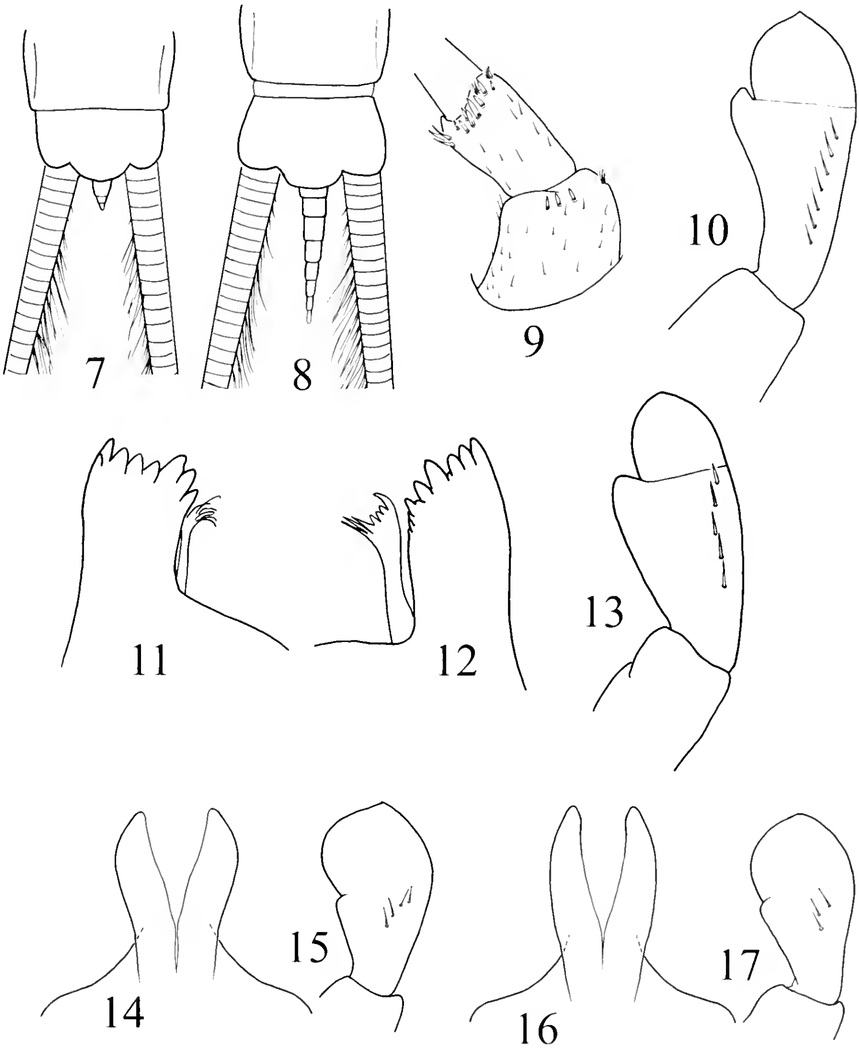
Specific Epithet. Moqui is an early name attributed to the Hopi (Hopati = peaceful ones) tribe of Pueblo Indians.

Remarks. *Baetis moqui* larvae have been collected from cold, clear water streams draining high elevation peaks (~3000 m) dominated by spring snowmelt and summer monsoonal rain events. Within these streams *B. moqui* larvae have been found on a variety of stream substrates including leaf packs and submerged vegetation along stream margins, but most commonly on fast flowing rocky substrates including leaf packs and submerged vegetation along stream margins, but most commonly on fast flowing rocky substrates within a coarse sand matrix. *Baetis moqui* were also commonly collected at a lower elevation (~2250 m to ~2100 m) from North and Pine Creeks and were not collected at the confluence of either stream with the Escalante River or at elevations above 2250 m. In addition, *B. moqui* was apparently absent from several similar adjacent streams including Sand, Boulder, Deer, Steep, and Calf Creeks, which were sampled and the presence of *B. moqui* was not detected at any elevation. Overall benthic macroinvertebrate community structure was similar between both North and Pine Creeks. Ecological associates found commonly with *B. moqui* include *B. tricaudatus, B. bicaudatus,* and *Ephemerella dorothea infrequens* McDunnough and several species of common western North American stoneflies including *Pteronarcella badia* (Hagen), *Isoperla* sp., *Sweltsa coloradensis* (Banks), and *Amphinemura* sp.

The geological formations where these streams flow are typical for southern Utah, with both streams flowing largely over various sandstones. North Creek originates on the Aquarius Plateau (~3000 m) and traverses through the Wahweap Formation (light gray to white, medium- to coarse-grained sandstone), Straight Cliffs Formation (light gray to white, medium- to coarse-grained sandstone) and finally through more recent alluvial terrace deposits as it enters the Escalante River (Doelling and Willis 1999). The headwaters of Pine Creek are located on Boulder Mountain (~3000 m) where it starts its ascent through Navajo sandstone (light-gray-orange, white, and pink medium-grained sandstone) then through the Carmel Formation and Entrada sandstones (white or pale orange fine to coarse-grained sandstone) before entering the Escalante River (Doelling and Willis 1999). Somewhat uncharacteristic of southern Utah, both North Creek and Pine Creek are clear water streams with low sediment loads. The Escalante River above and between these two creeks passes through substantial alluvium deposits and a thin layer of Tropic shale thus increasing the sediment load and overall turbidity within the river causing a white murky appearance.



Figures 1-6. *B. moqui*, n. sp.: 1. Labrum. 2. Right mandibular incisors. 3. Left mandibular incisors. 4. Labium. 5. Abdominal terga 1-2. 6. Femora.



Figures 7-17. Figs. 7-8, *B. bicaudatus*, posterior abdominal terga and partial caudal filaments. Figs. 9-10, *B. magnus*, 9. Antennal scape and pedicel. 10. Labial palpi. Figs. 11-13, *B. alius*, 11. Right mandibular incisors. 12. Left mandibular incisors. 13. Labial palpi. Figs. 14-15, *B. intercalaris*, 14. Glossae. 15. Labial palpi. Figs. 16-17, *B. flavistriga*, 16. Glossae. 17. Labial palpi.

KEY TO NORTH AMERICAN *BAETIS* LARVAE

The following key includes only those North American larvae presently considered within the genus *Baetis*. It is presented in order to complement the key found in Morihara and McCafferty (1979), not replace it. Identifications should still be confirmed by reference to the larval descriptions and diagnosis provided in Morihara and McCafferty (1979).

1a. Median caudal filament usually reduced to short stub (Fig. 6; Morihara and McCafferty 1979 Fig. 17f), occasionally up to approximately 0.2 length of cerci, distinctly tapering and without fringe of fine setae (Fig. 7) 2
1b. Median caudal filament at least 0.4 the length of cerci, lateral margins of median caudal filament more parallel in nature and with fringe of fine setae in at least apical half (Morihara and McCafferty 1979 Figs. 24e, 25e) 3

2a. Gills elongate, more than twice as long as wide (Morihara and McCafferty 1979 Fig. 18e); restricted to the Canadian tundra .... *Baetis foemina*
2b. Gills not elongate, less than twice as long as wide (Morihara and McCafferty 1979 Fig. 17g); widespread across western North America .... *Baetis bicaudatus*

3a. Antennal scape and pedicel with robust setae (Fig. 9; Morihara and McCafferty 1979 Fig. 18a); paraproct surface with robust setae (Morihara and McCafferty 1979 Fig. 11) 4
3b. Antennal scape and pedicle without robust setae (Morihara and McCafferty 1979 Figs. 25a, 26a); paraproct surface without robust setae (Morihara and McCafferty 1979 Fig. 10) 6

4a. Gill margins with large robust setae (Morihara and McCafferty 1979 Figs. 19g, 20g) and serrate or not serrate 5
4b. Gill margins without large robust setae and serrate (Morihara and McCafferty 1979 Fig. 12) .... *Baetis tricaudatus*

5a. Posterior margins of terga with robust setae (Morihara and McCafferty 1979 Fig. 20f); labial palpi elongate, segment 2 greater than two times as long and basal width of segment 3 (Fig. 10; Morihara and McCafferty 1979 Fig. 20b) .... *Baetis magnus*
5b. Posterior margins of terga without robust setae (Morihara and McCafferty 1979 Fig. 19e); labial palpi not elongate as above, segment 2 less than two times as long as basal width of segment .... 3 (Morihara and McCafferty 1979 Fig. 19a) .... *Baetis adonis*

6a. Gills elongate, more than twice as long as wide (Morihara and McCafferty 1979 Figs. 22e, 23f); principally restricted to Canadian tundra, rarely found in Northeastern Wisconsin and Northern Rocky Mountains of Wyoming 7
6b. Gills not elongate as above, equal to or less than twice as long as wide; widespread 8

7a. Median caudal filament almost equal in length to cerci .... *Baetis hudsonicus*
7b. Median caudal filament approximately 0.5-0.8 length of cerci .... *Baetis bundyae*

8a. Labial palpi slender, segment 2 at least twice as long and basal width of segment 3 (Figs. 4 and 13; (Morihara and McCafferty 1979 Figs. 33c and 36c); inner margin of labial palpi segment 2 convex (Figs. 4 and 13; Morihara and McCafferty 1979 Figs. 33c and 36c) 9
8b. Labial palpi more robust than above, segment 2 less than twice as long as basal width of segment 3 (Figs. 15 and 17; Morihara and McCafferty 1979 Figs. 21b, 24c, 25c, 26c); inner margin of labial palpi segment 2 concave (Figs. 15 and 17; Morihara and McCafferty 1979 Figs. 21b, 24c, 25c, 26c) 11

9a. Caudal filaments with near medial band of darkened segments similar to (Morihara and McCafferty 1979 Figs. 24e, 25e); eastern North American species, with principally Appalachian distribution .... *Baetis pluto*
9b. Caudal filaments generally uniform in color, without near medial band of darkened segments; western North American species, west of the Continental Divide 10

10a. Gill 1 highly reduced or absent (Fig. 5); mandibular incisors with broadened first denticle, approximately as wide as denticle 2 and 3 combined (Figs. 2 and 3) .... *Baetis moqui*

10b. Gill 1 not highly reduced or absent; mandibular incisor denticulation not as above, denticle 1 approximately equal in width to that of denticle 2 or 3 (Figs. 11 and 12; Morihara and McCafferty 1979 Fig. 33b)......*Baetis alius*

11a. Labial palpi with medial lobe of segment 2 moderately developed (Morihara and McCafferty 1979 Fig. 21b); pronotum almost uniformly shaded (Morihara and McCafferty 1979 Fig. 21e)......*Baetis brunneicolor*

11b. Labial palpi with medial lobe of segment 2 poorly developed (Figs. 15 and 17; Morihara and McCafferty 1979 Figs. 24c, 25c, 26c); pronotum with inverted U-shaped mark (Morihara and McCafferty 1979 Figs. 24e, 25e, 26d)...... 12

12a. Caudal filaments without medial band of darkened segments; abdominal terga with distinctive patterning similar to (Morihara and McCafferty 1979 Figs. 14e, 26e); southwestern species......*Baetis notos*

12b. Caudal filaments usually with medial band of darkened segments (Morihara and McCafferty 1979 Figs. 24e, 25e); abdominal terga not patterned as above, usually similar to (Morihara and McCafferty 1979 Figs. 24e or 25e); principally distributed across eastern North America, rarely found in the Southwest...... 13

13a. Labial palpi segment 3 expanded distomedially, giving an almost truncate appearance (Fig. 15; Morihara and McCafferty 1979 Fig. 24c); glossae with outer margin expanded and well rounded (Fig. 14); darker well marked abdominal terga with three, posterior round, pale areas (Morihara and McCafferty 1979 Figs. 24e); or entirely uniformly shaded with brown......*Baetis intercalaris*

13b. Labial palpi segment 3 not as above, distal margin evenly rounded (Fig.17; Morihara and McCafferty 1979 Fig. 25c); glossae without expanded outer margin (Fig. 16); darker well marked abdominal terga with two large, often kidney-shaped submedial pale areas (Morihara and McCafferty 1979 Fig. 25e)......*Baetis flavistriga*

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A WINTER PITFALL TECHNIQUE FOR WINTER-ACTIVE SUBNIVEAN FAUNA[1]

P. Paquin[2]

ABSTRACT: An adapted pitfall trap is described to sample the subnivean fauna active between the frozen ground and snow layers. A pitfall trap is placed in a frame adaptor before the first snow. An apparatus made of two wood boxes is placed over the pitfall; the frame box has no bottom and allows access to the pitfall from the top to gather samples. The open sides at the bottom allow organisms to enter the pitfall through the subnivean space. The bottom portion of the second box is closed and accumulates fallen snow. To service the traps, the removable snow column is lifted giving full access to the pitfall trap. The use of a fine mesh sifter improves the efficiency of the gathering of the samples; all sizes of organisms are transferred to alcohol in a single and simple procedure that avoids damaging specimens. Two factors related to the trap were studied: 1) the winter-trap did not cause any cold air induction to the subnivean level; the temperature averaged –5°C both under the snow and in the trap providing a stable environment despite ambient temperature variations above the snow. 2) Trampling of the surrounding snow caused by the regular servicing of the traps had no effect on the presence or absence of taxa collected, although a significant effect on the numbers of Acarina was observed.

KEY WORDS: Winter, sampling, snow, microhabitat

The subnivean space is the habitat between the frozen ground surface and the snow layer. It originates from bacterial activity in the ground layers (Coxson and Parkinson, 1987) that creates CO_2 and water vapor. The gas pressure erodes the snow layer in contact with the ground in an upward movement (Pruitt 1970). In combination with the frozen ground surface heterogeneity, this ongoing activity results in a space of variable dimensions, from a fine network of a few mm up to 8 cm (Coulianos and Johnels, 1962).

The ecological stability of the subnivean space strongly depends on the insulating properties of the snow (Mail, 1930; Näsmark, 1964; Aitchison, 1974). According to Pruitt (1970), snow accumulation of 20 cm is the threshold at which subnivean temperature becomes independent of ambient temperature, resulting in a stable environment. Well-adapted, winter-active fauna circulate in this habitat (Aitchison, 1979a, b, c, d, 1984; Merriam et al., 1983) but remain understudied due to the difficulty of sampling this fauna. Pitfall traps have been used extensively in ecological assessment, and several modifications were made to improve the efficiency or to better suit particular habitats. To study subnivean fauna, Aitchison (1974; 1979a) used a modified pitfall technique, elaborated from Näsmark (1964), consisting of a roof installed over the pitfall to prevent snow accumulation in the trap. However, this method was found inadequate for winter conditions where snow accumulated up to 1 meter.

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This paper describes a new type of winter pitfall trap and inherent methodologies that improve and facilitate collecting samples in winter conditions. Two factors regarding the technique were also investigated: cold air induction at the subnivean level due to the winter-trap and the effect of snow trampling due to the servicing of the traps on a regular basis.

METHODS

1) Study area

This study was conducted in the southern mixed-boreal forest of the Lake Duparquet area, Québec, Canada (48° 30' N, 79° 13' W). At this latitude, the snow covers the ground for approximately 6 months, — October to March — and traps were used over that period. The traps were tested in each of the major forest types of the mixed boreal succession: deciduous stands, dominated by aspen (*Populus tremuloides* Michx.), the mixed stands, which consisted of balsam fir (*Abies balsamea* [L.] Mill.), white spruce (*Picea glauca* [Moench] Voss), paper birch (*Betula papyrifera* Marsh.) and some P. tremuloides Michx., and the coniferous stands, dominated by white cedar (*Thuja occidentalis* L.) and balsam fir (*Abies balsamea* [L.] Mill.). See Leduc et al. (1995) and Bergeron (2000) for a detailed description of the ecological succession.

2) The winter pitfall trap

The described methods were used over three winter sampling seasons from 1993 to 1996. Dates and number of traps used are given in table 1. Typically, five winter pitfall traps were installed in a transect in a given forest site, and each trap was separated from the next by a distance of 7-10 meters.

Trap installation

The winter-pitfall trap should be deployed before the first snow falls, ideally shortly after the first ground frost. The installation of the pitfall trap itself (shown in Fig. 1a) can occur earlier in the season before the installation of the winter apparatus (shown in Fig. 1b).

The pitfall trap consisted of a 17 x 20 x 4 cm solid plastic pan inserted in a 28 x 30 cm wood frame adaptor. The adaptor and pitfall used are commercially available from Argiope® as items BAC-102 and BAC-205. The edges of the plastic pan expanded laterally and fitted perfectly into a groove in the wood frame. The ground was cut with a knife around the adaptor. The middle section of the hole was dug deep enough (about 15 cm) to clear the pan and minimize its uplift over the adaptor from soil and ice movements caused by frequent freeze and thaw cycles. The wooden frame was fitted flush with the ground. Brushing around the wood frame with a hand broom eliminated free particles and dirt that could be drawn into the pan by the movement of air when emptying the traps. After preservative liquid (30 percent ethylene glycol mixture) was added to the pan, it was placed in the wooden frame adaptor and the pitfall was ready to collect (Fig. 1a).

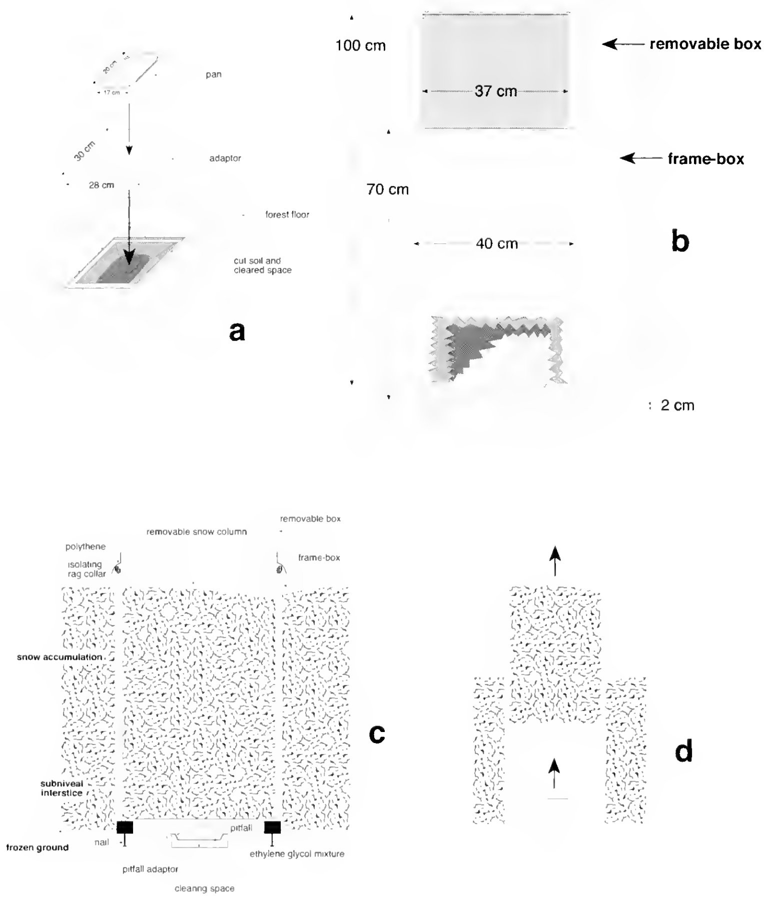

Figure 1. Winter-trap specifications and set-up. a) pitfall and wooden frame adaptor. b) winter apparatus design and size specifications. c) side view of winter-trap, specimens can reachi the pitfall through the 2 cm space on each side of the frame-box. d) removing the snow column gives access to the pitfall, which is lifted by hand through the frame-box.

The next step consisted of setting up the winter device (Fig. 1b). Two independent sections made of commercial plywood and wood blocks were assembled: the frame-box (the outer section in contact with the ground) and the removable column (the inner box with a closed bottom). Once assembled, the frame-box was placed on the ground to enclose the pitfall (Figs. 1b-c). Four blocks (5 x 10 x 10 cm, see Fig 1b.) at the bottom corners were the only contact with the soil, leaving a 2 cm space between all sides and the soil, giving free access to the pitfall (Figs. 1b-c). Three inch (7.6 cm) nails were inserted in the blocks, allowing the frame-box to be firmly anchored in the soil (Figs. 1c-d). The pitfall pan was then filled to a quarter full with preservative liquid and placed in the adaptor, which was reachable through the frame-box. The removable column was then fitted into the frame-box. A rag collar was placed between the two boxes to prevent cold air induction in the apparatus, and a polyethylene band was tacked over the insulating collar to prevent it from icing (Fig. 1c). The column was closed at the bottom and snow accumulated inside the column as well as on the ground, but the subnivean interstice allowed organisms to access the pitfall.

Servicing the traps

The removable column was lifted slowly to prevent any strong air current that could have caused movement of debris at ground level entering the pitfall (Fig. 1d). The column was then laid on its side, providing a straight, working surface for the subsequent steps. The pan was then removed through the open box (Fig. 1d) and the contents sifted over a small bucket (Fig. 2a) with a fine mesh nylon strainer (110 μm). The contents of the pan and the pan were carefully cleaned with a flask of ethyl alcohol over the strainer. Specimens were then concentrated with the ethyl alcohol flask to the center of the strainer (Fig. 2b). The strainer was then flipped over a funnel fitted to a cap and a jar (see Fig. 2c), and a final wash with alcohol allowed the transfer of all organisms into the jar in one simple procedure (Fig. 2d). This method was preferable to the use of forceps in the field, because efficient sorting of small organisms (such as mites) requires laboratory conditions and the use of a stereoscope.

Resetting the trap

The outside parts of the pan and the inner sections of the frame-box must be free from ice. It was also necessary to remove the ice from the 2 cm space at the bottom of the frame-box to ensure free access from the subnivean interstice. The pan was placed back in the adaptor, and the removable column was fitted back into the frame-box and re-isolated with the rag collar.

3) Factors that may influence trap catch

The use of the winter pitfall traps for two seasons (1993-1994 and 1994-1995), raised questions about possible biases associated with the methodology. The 1995-1996 season was devoted to testing two factors that may have influenced catches: 1) verification whether the use of the winter pitfall trap caused cold air induction in the subnivean space that may have influenced faunal activity; and 2) testing the effect of the trampling of snow due to the servicing of the traps on a regular basis.

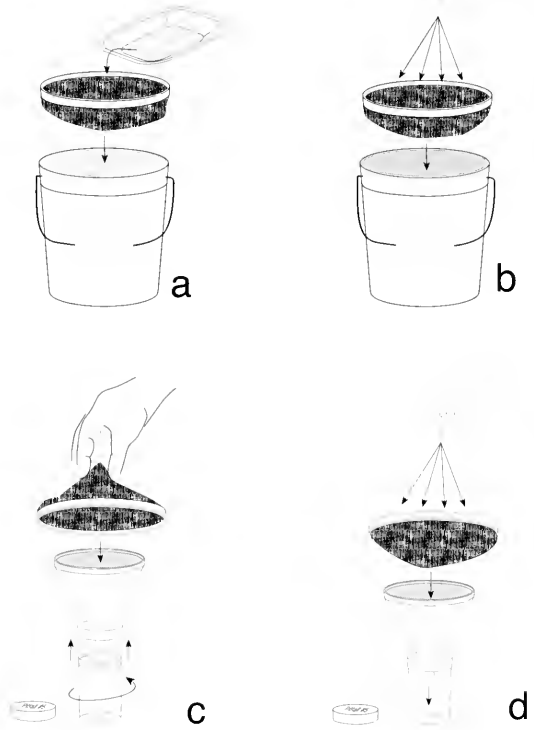

Figure 2. Collecting specimens and transfer in ethyl alcohol. a) the contents of the pan are sifted though a fine mesh strainer over a small bucket. b) specimens are concentrated in the center of the strainer with an alcohol flask. c) the strainer is flipped while grabbing the center by hand. d) specimens are washed in the funnel and put in a jar.

Cold air induction

Before winter, a pair of programmable thermometers with probes was installed a few millimeters above the ground surface. One was placed in a winter-trap and the other in the subnivean space, 10 meters away from the trap. The temperatures and snow depth were noted daily for the first two months of winter (November 3, 1995 – January 12, 1996).

Trampling effect

Ten winter traps were set up in a transect separated from each other by 7-10 meters in the cedar/balsam fir forest. Five traps were emptied every two weeks (5 visits in total) while the others were never visited before a final visit halfway through the winter season (February 12). In order to compare the trampling effect, data from the samples that were collected every two weeks were pooled for each trap. The five traps serviced on a regular basis could therefore be compared with the five traps that were never visited; each trap having been active for the same period of time. Similarity matrices measuring the association between objects (samples) were calculated with SIMIL 3.01 in the R package (Legendre and Vaudor, 1991). The Sørensen (2a/2a+b+c) – presence/absence sensitive – and Steinhaus coefficients (2W/A+B) – which accounts for presence/absence of taxa and abundance – were selected [see Legendre and Legendre (1998) for details]. Mantel tests (Mantel, 1967) were then performed with the MANTEL 3.01 program in the R package. This analysis tests by permutation the correlation between the similarity matrices (species x stations) and a binary matrix coding for treatment (trampling/non-trampling), as suggested by Legendre and Legendre (1998) for similar data.

RESULTS

The specimens collected, summarized in Table 1, are given to show the diversity of the subnivean fauna collected with this technique. All collections occurred in the presence of a snow layer that covered the ground for about six months at this latitude. A total of 22,419 specimens were collected representing 13 orders. An average of 19 specimens was collected per trap/week. Acarina were the most abundant in the collections followed by Collembola, Araneae, and Diptera.

Table 1. Overview of collected organisms: number of weeks of sampling, number of traps, and abundance of organisms

	1993-94 From 1 November to 23 April 25 weeks 15 traps (5 traps per forest type)	1994-95 From 30 October to 16 April 24 weeks 30 traps (10 traps per forest type)	1995-96 From 3 November to 12 February 10 weeks 10 traps (all set up in the cedar forest)
	Total abundance	Total abundance	Total abundance
Acarina	2274	4255	4891
Araneae	622	1745	106
Chilopoda	2	9	0
Coleoptera Staphynilidae (A)*	55	254	12
Coleoptera others (A)	10	118	2
Coleoptera immatures	42	51	65
Collembola	958	4227	1005
Diplopoda	3	0	0
Diptera (A)	101	1401	7
Diptera immatures	11	141	6
Homoptera Aphididae	1	3	0
Hymenoptera (A)	6	5	1
Lepidoptera (A)	1	5	0
Lepidoptera immatures	2	1	0
Opilio	3	3	0
Pseudoscorpionida	1	4	0
Symphyla	0	10	0
Total	4092	12232	6095
Grand total 22419 organisms			

* (A) = Adults

Cold air induction test

The subnivean temperature was similar to the temperature recorded in the winter-trap. The two temperature curves were barely distinguishable when a snow layer was present. They both averaged -5°C with a snow cover of 20 cm or more, and external temperature showed little influence, despite the fact that extreme temperatures (-40°C) were recorded (Fig. 3).

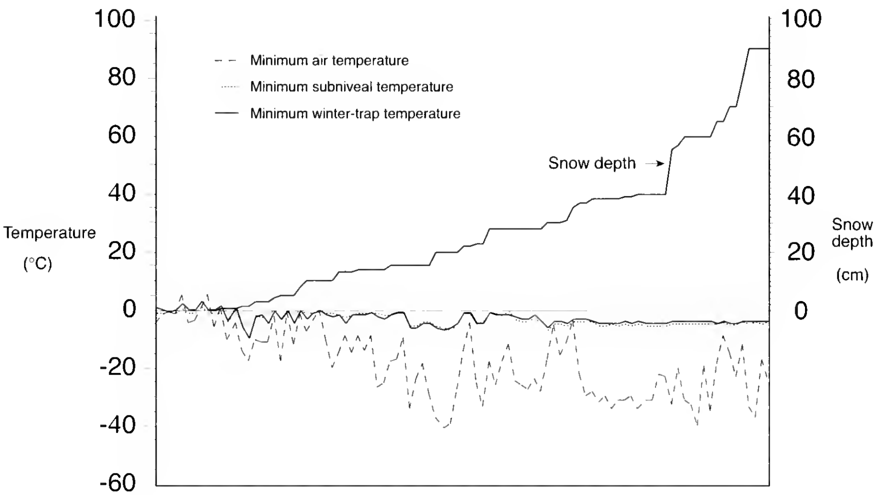

Figure 3. Relation between air, subniveal, and winter-trap minimum temperature and snow depth. The data were gathered from November 3, 1995 to February 12, 1996, with 2 programmable thermometers: one placed in a pitfall trap and a second one placed in the subnivean space a, 10 meters away from the trap.

Trampling effect

The Mantel correlation done with the Sorensen similarity matrix did not reveal any significant relationship between the traps visited every two weeks and those only emptied at the end of the experiment. However, in using the Steinhaus coefficient, which also accounts for abundance, a significant relation was found ($R = 0.357$; $P = 0.0176$). A third analysis using the Steinhaus coefficient excluding Acarina was not significant (Table 2).

DISCUSSION

The techniques described above allow sampling in winter conditions characterized by deep snow accumulation, which was not possible with previously known methods. The high number of specimens collected (22,419) and the general richness are evidence of the success of the method. Effectiveness was difficult to compare with other studies done on subnivean fauna because of differences in habitat, trapping effort, experimentation time, and differences in latitude and related winter conditions. However, Näsmark (1964) reported an average of 12 organisms per trap/week while this study found an average of 19 organisms per trap/week. The numbers of arthropod orders collected in this study (13 orders) is, however, similar to the results Merriam et al. (1983) (13 orders) and Näsmark (1964) (11 orders). Interestingly, numbers of Acarina found in the two later studies were low: a total of 127 mites found by Merriam et al. (1983) and 79 by Näsmark (1964) compared to the 11,420 mites collected in this study. This striking difference could be attributed to a deficiency in the other methodologies in collecting smaller organisms, but also to faunistic differences between forest habitats, which makes comparison of results hazardous. The results of this study, however, clearly show that this methodology is well-suited to smaller organisms. Several points can be made regarding the advantages of the winter pitfall trap technique described here. 1) The surface covered by the pitfall is bigger, 17 x 20 cm compared with 8 cm as used by Näsmark (1964), Aitchison (1984) and Itämies and Lindgren (1989). A better trapping effort minimizes variability among samples, which is a problem with pitfall trapping (Adis, 1979). 2) The use of a wood frame adaptor reduces the amount of dirt and particles in the samples, which saves a lot of sorting time in the laboratory. 3) A removable pitfall allows one to replace the pan when damaged, which occurs easily in cold weather. 4) The use of the technique shown in figures 2a-d is important for collecting very small arthropods, such as mites. The method of transfer of specimens into alcohol is appropriate for all sizes and allows one to do it in a single and simple procedure while avoiding damage to specimens. Delicate manipulations with forceps or brushes (Aitchison 1984) are hazardous in windy situations as well as unreliable for smaller specimens. 5) This method allows one to reuse ethylene glycol and verify its concentration in a routine procedure. 6) The use of a removable snow column ensures that identical insulating conditions are found under the trap and in the subniveal environment. 7) The total time required to service one winter-trap is brief, averaging 7 minutes. Such efficiency is important when a high number of traps have to be visited.

Cold air induction and subnivean temperature

The aim of this simple comparison was to ensure that the winter-trap did not create a cold air induction to the subniveal level and bias the specimens collected. Similar temperatures were found in the winter-trap and the subniveal environment. The use of the winter-trap did not cause any detectable cold air induction that could create biases. The minimum temperature reached in the subniveal space is similar to that observed by Aitchison (1984) and Näsmark (1964) (averaging -5°C) but is lower than the average reported by Mail (1930), Coulianos and Johnels (1962) and Hayward (1965) (being just under the freezing point). The latter authors may have obtained a slightly higher temperature because winter conditions were not as severe where they conducted their experiments.

Trampling effect

Trampling of snow did not cause any effect on the taxonomic composition of the collections at the order level with the Sørensen coefficient, which is only sensitive to presence/absence of taxa. However, the use of the Steinhaus coefficient, which is abundance sensitive, revealed a significant effect (R = 0.357, P = 0.018). The trampling effect was mainly due to the reduction in Acarina abundance, as shown by the non-significant result when mites were excluded from the analysis using the same coefficient (R = 0.211, P = 0.052). Although, the latter values were close to a significant level and suggested that trampling may have also affected the abundance of organisms other then mites, but not the taxonomic composition of collected orders.

As the sampling season progressed, the snow conditions changed. In the first part of the season, snow depth was thin, and trampling at that stage may cause snow compaction and destruction of the subnivean space. Although the compaction may only be temporary due to the continuous bacterial activity that restores the subnivean space, working only on one side of the trap will limit biases, leaving three undisturbed sides for full access to the pitfall through the subnivean space. As the season progresses, the surface snow layer develops a more robust and partially iced structure that can easily support more weight, and may cause fewer biases in collection.

Technical considerations and recommendations

During this experiment, methodological problems were encountered and are briefly mentioned here. Small rodents are also winter-active in the subniveal environment (Coulianos and Jonhels, 1962; Hayward, 1965). They can dig tunnels that intercept with the winter-trap. There was not enough ethylene glycol to cause drowning, but the samples were contaminated with dirt, feces and fleas. Although requiring more hand-sorting time, specimens were still as numerous and in good condition. Also, propylene glycol could be used as an alternative to ethylene glycol, as it is less toxic to mammals.

Another problem can occur late in the spring when the melting of the snow results in water accumulation under the residual snow and causes flooding of the forest floor (Jahn, 1970). This ecological perturbation in forested habitats is an important mortality factor for soil organisms (Joy, 1910; Uetz et al., 1979; Danks, 1991), and will also flood the winter traps and ruin samples. Frequent visits to the traps at this critical period during the sampling season will reduce this effect on the collections.

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CROSSOCERUS FLAVOMACULATUS, A NEW SPECIES OF THE SUBGENUS *ACANTHOCRABRO* FROM CHINA, WITH A KEY TO THE CHINESE SPECIES OF THE SUBGENUS (HYMENOPTERA: APOIDEA: CRABRONIDAE)[1]

Qiang Li[2] and Junhua He[3]

ABSTRACT: *Crossocerus (Acanthocrabro) flavomaculatus* new species is described from the Beijing, Shandong, and Gansu Provinces in China. The first Chinese records are given for *C. (A.) vagabundus vagabundus* (Panzer): Sichuan and Yunnan Province, Tibet Autonomous Region, and *C. (A.) vagabundus koreanus* Tsuneki: Beijing, Inner Mongolian Autonomous Region, Hubei Province. A key to Chinese species is provided.

KEY WORDS: *Crossocerus, Acanthocrabro,* Hymenoptera, Apoidea, Crabronidae, China

The subgenus *Acanthocrabro* Perkins occurs in the Northern Hemisphere where it is represented by just five species: *annandali* (Bingham), from northern India; *maculipennis* (Smith), from North America; *nitidiventris* (Fox), from eastern North America; *sauteri* Tsuneki, from Taiwan, the only record of the subgenus from China (Tsuneki, 1977); and *vagabundus* (Panzer), a widespread Palearctic species. During our study of Chinese material of *Acanthocrabro,* we discovered a new species and also discovered that *A. vagabundus* occurs in China. The new species is described here and a key provided for the identification of the Chinese species of *Acanthocrabro.*

For the identification of the species of *Acanthocrabro,* we use the following subgenus characters: head without large, median, posteroventral projection; occipital carina not a complete circle; mandible with a tooth on inner margin, with 3 teeth in female and 2 or 3 teeth in male at apex; flagellomere III not swollen beneath; propleuron and forecoxa without lateral, large projections; mesothorax with mesopleural tubercle in female and most male, without mesopleural tubercle in few male; male with forebasitarsus usually sinuate or twisted spirally, metacoxa edentate apically; gaster yellow maculate, sessile; metasomal tergum II without large, rounded, deep depression; female with pygidial plate usually narrowed and excavated apically; male with tergum VII usually large, near broad triangular or semicircular, not coarsely punctate than penultimate tergum (Bohart and Menke, 1976; Krombein, 1979; Leclercq, 1954, 1974, 2000; Marshakov, 1980; Nemkov et al, 1995; Oehlke, 1970; Pulavskii, 1978; Tsuneki, 1954, 1968, 1990; Yeo and Corbet, 1983).

For the terminology we mainly follow Bohart and Menke (1976). The abbreviations HW, HL, POD, OOD, LTI, and WTI are used for head width, head length, postocellar distance, ocellocular distance, maximum length of tergum I, and maximum width of tergum I, respectively.

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SYSTEMATICS

Key to the females of the subgenus *Acanthocrabro* from China

1. Clypeal margin with 5 teeth medially; vertex impunctate, scutum finely punctate; pygidial plate without median longitudinal carina; midfemur evidently swollen .... *C. (A.) sauteri* Tsuneki
- Clypeal margin with 2 or 3 teeth medially; vertex densely punctate, scutum coarsely, densely punctate; pygidial plate with or without median longitudinal carina; midfemur slightly swollen 2
2. Clypeus, scutum, prepectus, mesopleuron, propodeal enclosure and gastral tergum I with large yellow spots; large portion of leg and gaster yellow; pygidial plate with or without median longitudinal carina (Fig. 2) .... *C. (A.) flavomaculatus* sp. nov.
- Clypeus, scutum, prepectus, mesopleuron, propodeal enclosure and gastral tergum I without yellow spot; small portion of leg and gaster yellow; pygidial plate with median longitudinal carina ...3
3. Orbital foveae large, shallow; mesopleuron sparsely punctate; gastral tergum V with large yellow spot .... *C. (A.) vagabundus vagabundus* (Panzer)
- Orbital foveae small, deep; mesopleuron densely punctate; gastral tergum V without yellow spot. .... *C. (A.) vagabundus koreanus* Tsuneki

Key to the males of the subgenus *Acanthocrabro* from China

[Male of *C. (A.) sauteri* Tsuneki is unknown]

1. Clypeal margin with three teeth (Fig. 3); mandible apex tridentate (Fig. 4); forefemur without projection at its hind surface; mesopleuron with mesopleural tubercle; propodeal enclosure, gastral terga I and IV with large yellow spots, coxa at apex and tibia yellow ....*C. (A.) flavomaculatus* sp. nov.
- Clypeal margin with broad, large, high median projection and one or two lateral teeth; mandible apex bidentate; forefemur with projection at its hind surface; mesopleuron without mesopleural tubercle; propodeal enclosure, gastral terga I and IV without yellow spot, coxa and tibia black 2
2. Median clypeal projection broader than in next subspecies, clypeus with two lateral teeth; forefemur with a high, triangular projection at its hind surface ..*C. (A.) vagabundus vagabundus* (Panzer)
- Median clypeal projection narrower than in previous subspecies, clypeus with one lateral tooth; forefemur with a low, round projection at its hind surface.......*C. (A.) vagabundus koreanus* Tsuneki

Crossocerus (Acanthocrabro) flavomaculatus, NEW SPECIES

(Figures 1-4)

Diagnosis. This species can be distinguished from *Crossocerus (A.) vagabundus vagabundus* (Panzer) and *Crossocerus (A.) vagabundus koreanus* Tsuneki by the following combination of characters: mandible apex tridentate in male (Fig. 4), clypeal margin with a low, blunt median tooth (Fig. 1, 3), mesopleuron with mesopleural tubercle, forefemur without projection at its hind surface, and propodeal enclosure and gastral tergum I with yellow spots in male; clypeus, scutum, prepectus, mesopleuron, propodeal enclosure and gastral tergum I with yellow spots in female.

Description. Female. Body length 8.1-9.1 mm. Head black, thorax and gaster black or dark brown; the following are yellow: mandible largely, clypeus largely, antennal scape, pedicel at apex ventrally, pronotal collar above, pronotal lobe, lateral spot on anterior portion of scutum, basal half of scutellum, hind portion of prepectus, upper spot on mesopleuron, lateral spot on propodeal enclosure, tegula partly, tibia largely, basitarsus largely, femur at apex, large lateral spot or transverse band on gastral terga I – V, small lateral spots on sterna II and III; metanotum with or without yellow spot; tarsomeres II – V largely yellowish brown or reddish yellow. Head and thorax with weak steel blue lustre.

Anterior margin of clypeus slightly prominent medially (Fig. 1). Mandible with three teeth at apex and a tooth at midlength of its inner margin. Frons without supra-antennal projection, with median furrow; upper portion of frons and anterior portion of vertex densely, coarsely punctate, posterior portion of vertex densely, coarsely or finely punctate; vertex with large, oval orbital foveae. HW: HL: POD: OOD = 208: 141: 19: 31. Relative length of antennal scape: pedicel: flagellomere I: II: III: IV: V = 73: 16: 31: 17: 16: 16: 16.

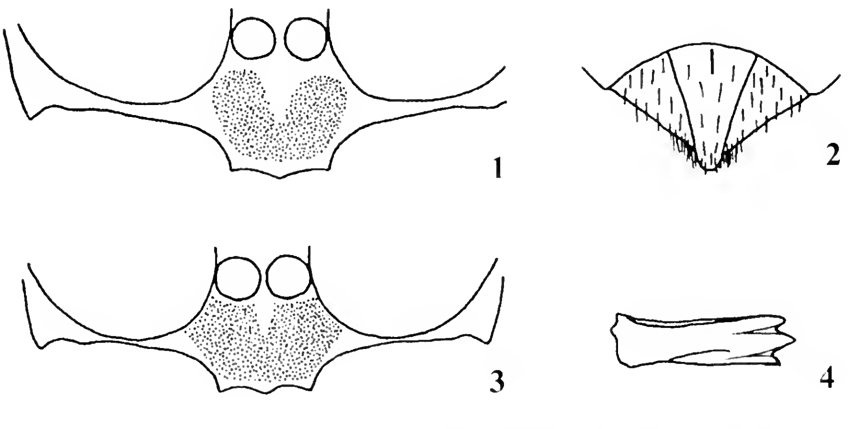
Lateral corner of pronotal collar round. Scutum densely, coarsely punctate, without longitudinal rugae adjacent to its posterior margin; scutellum sparsely or densely, coarsely punctate. Metanotum densely, finely or coarsely punctate. Mesopleuron densely, coarsely punctate, with mesopleural tubercle. Upper portion of upper metapleural area sparsely, finely punctate, lower portion of upper metapleural area and lower metapleural area without punctures. Propodeal enclosure delimited by furrow, with transverse furrow basally, with deep, V-shaped median furrow; posterior surface of propodeum with broad, deep median furrow on its upper portion, with sparse punctures, with short median carina, some transverse carinae and long or short lateral longitudinal carina on its lower portion; propodeal side with dense, fine, short, oblique rugae and punctures on its upper portion, with dense or sparse punctures on its median portion, without punctures on its lower portion. Hind tibia with spines on its outer surface.

Gaster not petiolate, tergum I sparsely punctate. LTI: WTL = 140: 141. Pygidial plate with or without short median longitudinal carina (Fig. 2).

Male. Body length 7.8 mm. The following are yellow: mandible largely, pronotal collar above, pronotal lobe, scutellum largely, anterior and posterior portions of prepectus, lateral spot on propodeal enclosure, coxa at apex, trochanter wholly or largely, fore and mid femora except lateral basal portion, tibia and basitarsus largely or partly, transverse bands on gastral terga I – IV, lateral spot on tergum VII, transverse bands on sterna II – IV.

Anterior margin of clypeus prominent medially, with low, blunt median tooth and lateral tooth on each side (Fig. 3); mandible with three teeth at apex (Fig. 4); orbital foveae smaller than in female evidently. HW: HL: POD: OOD = 175: 128: 17: 26. Flagellum ventrally fringed with white hair, apical segment normal. Relative length of antennal scape: pedicel: flagellomere I: II: III: IV: V = 54: 11: 26: 14: 12: 12: 12. Punctures on thorax and gaster smaller than in female evidently, mesopleuron densely or sparsely, finely punctate. LTI: WTI = 120: 127. Gastral tergum VII without pygidial plate.

Material examined. Holotype. ♀, China, Beijing, Malianwa, 8 June 1975, Chikun Yang; deposited in the Insect Collections of China Agricultural University, Beijing. **Paratypes:** 1♂, the same data as holotype; 1♀, China, Shandong Province, Taian, Mount Tai, 26 June 1992, Qiang Li, deposited in the Insect Collections of Yunnan Agricultural University, Kunming, Yunnan Province; 1♀, China, Gansu Province, Kou-ling, 13 September 1918, coll. Institute of Zoology, Academia Sinica, deposited in the Insect Collections of Institute of Zoology, Academia Sinica, Beijing.



Figs. 1-4. *Crossocerus (Acanthocrabro) flavomaculatus*, new species. 1-2. Female. 3-4. Male. 1, 3. Frontal view of clypeus. 2. Dorsal view of pygidial area. 4. Frontal view of mandible.

Distribution: China: Beijing, Shandong Province, Gansu Province.

Etymology. The name, *flavomaculatus,* derived from Latin *flavus* (= yellow) and Latin *maculatus* (= with spot), refers to the clypeus, scutum, prepectus, mesopleuron, propodeal enclosure and gastral tergum I in female and propodeal enclosure and gastral tergum I in male with yellow spots, which is one of the main recognition characters of the species.

Crossocerus (Acanthocrabro) vagabundus koreanus Tsuneki, 1957, NEW RECORD FOR CHINA

Material examined. 1♀, China, Beijing, Baihuashan, 1200 m, May 28, 1973, Yongshan Shi; 3♀♀, China, Inner Mongolia, Chahar, Yangklaping, July 26, 1937 (1♀), July 29, 1937 (1♀), August 2, 1937 (1♀), O. Pie; 1♂, China, Hubei Province, Shennongjia, Dajiuhu, 1800 m, August 1, 1981, Yinheng Han.

Distribution: China: Beijing, Inner Mongolian Autonomous Region, Hubei Province. Korea: Zokurisan, Taitimpyoo-Taihyoo, Keijio (Tsuneki, 1957:61).

Crossocerus (Acanthocrabro) vagabundus vagabundus (Panzer, 1798), NEW RECORD FOR CHINA

Material examined. 1♀, China, Sichuan Province, Emeishan, Qingyinge, 800-1000 m, May 10, 1957, Zuocai Yu; 1♀, China, Yunnan Province, Zhongdian, Chongjianghe, 2400 m, August 8, 1984, Ruiqi Wang; 1♂, China, Tibet, Bemi, 2300 m, August 16, 1983, Yinheng Han.

Distribution: China: Sichuan Province, Yunnan Province, Tibet Autonomous Region. Palaearctic Region.

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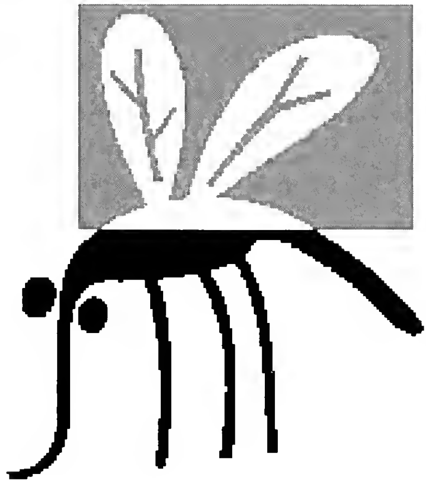

NOT KNOWING IS GNAWING AT ME

Frederick B. Getze[1]

It's important when speaking of animals, that

you know what's what and what's "knat"

for, the spelling of pests, the "G" use

Which, even for gnus, is not news.

So, lest spell-checkers make sounds like "blagnat"

Please, be sure of the first letter of "Gnat."

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Mailed on January 19, 2005

A NEW SPECIES OF *OXYCERA* MEIGEN (DIPTERA: STRATIOMYIDAE) FROM TURKEY[1]

Turgay Üstüner[2] and Abdullah Hasbenli[3]

ABSTRACT: A new species, *Oxycera turcica* sp.n., is described from Turkey and its diagnostic characters are illustrated. It is compared with two related species described by E. Lindner from Israel.

KEY WORDS: Diptera, Stratiomyidae, *Oxycera turcica*, new species, Turkey

Up to the present, only five species of *Oxycera* Meigen have been recorded from Turkey (Woodley 2001): *Oxycera insolata* Kühbander, 1984; *O. limbata* Loew, 1862; *O. meigenii* Staeger, 1844; *O. pygmaea* (Failen, 1917) and *O. trilineata* (Linnaeus, 1767). During our investigations of the Turkish stratiomyid fauna, we discovered a species which apparently represents an interesting contribution to the native *Oxycera* list. It appeared to be a new species distinctly differing from the related species described by Lindner from Israel, viz. *Oxycera galeata* Lindner, 1975 and *Oxycera orientalis* Lindner, 1974.

Oxycera turcica NEW SPECIES
(Figs. 1-18)

Type Data: Holotype, 1 male: Turkey: Sivas, Sarkısla, Karacaören Village, elev. 1710 m, June 23, 2003, coll. Üstüner, deposited in Selçuk University Department of Biology in Konya (coll. Üstüner) in Turkey. **Allotype:** 1 female: Turkey: Sivas, Sarkısla, Karacaören Village, elev. 1710 m, June 23, 2003, coll. Üstüner, deposited in Selçuk University Department of Biology in Konya (coll. Üstüner) in Turkey. 2 male: Turkey: Sivas, Sarkısla, Karacaören Village, elev. 1710 m, June 23, 2003, coll. Üstüner. 3 female: Turkey: Sivas, Sarkısla, Karacaören Village, elev. 1710 m, June 23, 2003, coll. Üstüner. 2 male: Turkey: Sivas, Gürün, from Gürün to Sivas 5. km., elev. 1550 m, July 26, 2003, coll. Üstüner. 4 female: Turkey: Sivas, Gürün, from Gürün to Sivas 5. km., elev. 1550 m, July 26, 2003, coll. Üstüner. 1 male: Turkey: Kayseri, Yahyaly, Burhaniye Village (35° 35' E ; 37° 49' N), elev. 1414 m, June 23, 2002, coll. Üstüner&Hasbenli. 1 female: Turkey: Kayseri, Sarız, Incemagara Village (36° 26' E ; 38° 22' N), elev. 1518 m, June 14, 2002, coll. Üstüner&Hasbenli. 2 male: Turkey: Kayseri, Yahyaly, Burhaniye Village (35° 35' E ; 37° 49' N), elev. 1414 m, July 13, 2002, coll. Üstüner& Hasbenli. 1 female: Turkey: Kayseri, Yahyaly, Burhaniye Village (35° 35' E ; 37° 49' N), elev. 1414 m, July 13, 2002, coll. Üstüner&Hasbenli. 1 female: Turkey: Kayseri, Yahyaly, Ulupynar Plateau (35° 33' E ; 37° 53' N), elev. 1500 m, July 13, 2002, coll. Üstüner&Hasbenli. 7 male: Turkey: Kayseri, Yahyali, Sogulca Plateau (35° 24' E ; 38° 0' N), elev. 1665 m, July 14, 2002, coll. Üstüner&Hasbenli . 5 female: Turkey: Kayseri, Yahyali, Sogulca Plateau (35° 24' E ; 38° 0' N), elev. 1665 m, July 14, 2002, coll. Üstüner&Hasbenli. 2 female: Turkey: Kayseri, Sarız, Bostanlık Village (36° 26' E ; 38° 29' N), elev. 1700 m, 15 July 2002, coll. Üstüner&Hasbenli. 1 male: Turkey: Kayseri, Sarız, Sarlak Village (36° 40' E ; 38° 39' N), elev. 1889 m, July 16, 2002, coll. Üstüner&Hasbenli . 1 female: Turkey: Kayseri, Sarız, Sarlak Village (36° 40' E ; 38° 39' N) elev. 1889 m, July 16, 2002, coll. Üstüner&Hasbenli. 1 male: Turkey: Kayseri, Sarız, Karapynar Village (36° 35' E ; 38° 35' N),

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Mailed on January 19, 2005

elev. 1723 m, July 16, 2002, coll. Üstüner&Hasbenli. 4 female: Turkey: Kayseri, Sarız, Karapynar Village (36° 35' E ; 38° 35' N), elev. 1723 m, July 16, 2002, coll. Üstüner&Hasbenli. 1 female: Turkey: Burdur, Aglasun, Yesilbas Village environment (30° 27' E ; 37° 39' N) elev. 140 m, July 15, 2000 coll.Üstüner & Hasbenli; 1 female Turkey: Konya, Bozkır, Yolören Village, elev. 1100m, July 5, 2001, coll. Üstüner. The paratype specimens are deposited in the collection of the Zoological Museum of the Gazi University (ZMGU), Ankara (coll. Hasbenli) and Selçuk University Department of Biology in Konya (coll. Üstüner) in Turkey. The type specimens were captured basking on *Salix* sp. and in a grassy area along a stream.

Male: Head (Figs. 1 and 2) hemispherical, slightly broader than thorax in dorsal view. Eyes contiguous, only very short and sparsely haired, facets on lower third of eyes considerably smaller, contrast border between larger and smaller facets very distinct. Triangular frons above antennae slightly covered with velvet-like, silvery-white pubescence, leaving only upper angle and narrow median groove bare and shining black. Face shining black with sparse pile. Fine powder-like, yellowish white stripe along inner margin of each eye. Postocular area swollen in lower half of head, shining black, with long, dense and white hairs. Scape and pedicel pale brown, flagellum black, last flagellomere slender but hardly longer than the rest of flagellum. Labella of proboscis light brown.

Thorax (Figs. 3 and 4) shining black with long, white hairs. Postpronotal calli, subnotopleural stripe and postalar calli yellow. Yellow and anteriorly pointed spot on postalar callus often reaching about half distance to transverse suture or slightly shorter. Scutellum including spines yellow, only base (or basal 2/3) of scutellum black. Thoracic pile white, dense and erect on lateral parts of scutum and rather longer on pleura. R4 absent. Legs mainly yellow but exterior surface of fore femur with a black stripe-like spot, middle and hind femora with a black ring-like spot in middle. Hind tibia black with a yellow ring in middle. All tarsi yellow but tarsomere 2 and 3 dark brown on dorsal surface.

Abdomen (Fig. 5) shining black, with a yellow lateral margin beginning at posterior corner of tergite 2, extending into lateral markings on tergites 3 and 4. Tergite 5 with a yellow apical spot. Venter entirely black.

Male terminalia (Figs. 6, 7 and 8): Epandrium relatively narrow, semicircular, about half as high as proctiger. Proctiger subtriangular, cerci elongate oval, narrowed proximally. Gonostylus suboval, pointed distally, innercurved. Aedeagal complex relatively short and massive, tripartite in distal half.

Length: body 5.0-6.0 mm., wing 4.5 mm.

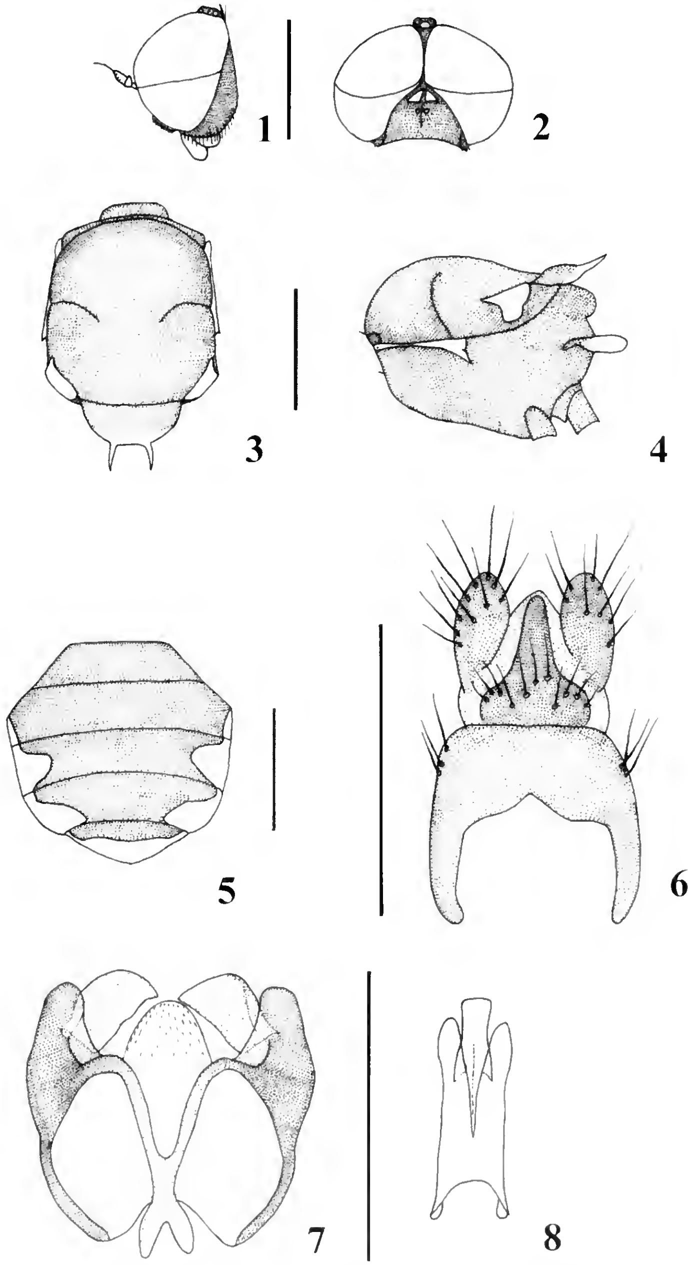
Female: Eyes at most with very inconspicuous and sparse short hairs. Frons (Fig. 10) shining black, about 1/3 as broad as head width, brownish above bases of antennae. Two small, white, almost round spots present at each side of frons at eye margin. Cerebrale (Fig. 11) (medial part of occiput) with a striking, semicircular yellow spot, rest of occiput black. Postocular band (Fig. 9) black, broad, approximately as wide as both basal antennal segments combined are long. Postocular area covered with sparse, short, white pile in upper half of head but with dense, long, white pile in lower half. Scape and pedicel yellowish brown, flagellum black, last flagellomere slender but hardly longer than rest of flagellum. Face black with sparse white hairs. Labella of proboscis pale brown with sparse, long, whitish hairs.

Thorax (Fig. 12) shining black. Postpronotal callus (Fig. 13) with a round yellow spot, yellow subnotopleural stripe extended at wing-base. Postalar callus with large yellow spot, this spot pointed anteriorly and almost reaching tranverse suture. Scutellum and scutellar spines yellow. Thoracic pile consisting of white, dense and erect hairs on margin of scutum, and relatively long hairs on pleura. Wings (Fig. 15) transparent, veins yellow, R_4 absent. Halteres yellow with darkened stalk. Legs mainly yellow, fore and mid tibia yellow, hind tibiae black with a yellow ring in middle. Tarsi chiefly yellow but tarsomeres 3 and 4 pale brown on outer surface.

Abdomen (Fig. 14) shining black, with a yellow lateral margin beginning at posterior corner of tergite 2, and with rather broad and yellow sidemarkings on tergites 3 and 4. Tergite 5 with a yellow apical spot or medianly broadened yellow margin. Venter entirely black.

Female terminalia (Figs. 16 and 17): Proctiger subtriangular, epiproct narrowed in distal half. Cerci bisegmented: basal segment about twice as long as broad, narrowed proximally, apical segment slightly shorter than twice as long as broad, both segments with long setae. Genital furca (= sternite 9) relatively narrow and elongate, markedly tapered towards distal part. Medial aperture subcircular but almost straight posteriorly. Posterolateral projections slender and long, 4-5 times longer than broad in middle.

Length: body 6.0 mm, wing 4.0-4.5 mm.



Figs. 1-8 *Oxycera turcica* n. sp. male. 1: Head in lateral view; 2: Head in frontal view; 3: Thorax in dorsal view; 4: Thorax in lateral view; 5: Abdomen in dorsal view. Scale bar = 1mm.; male genitalia. 6-7: dorsal and ventral parts of male genitalia; 8: aedeagal complex in dorsal view. Scale bar = 0.25 mm.

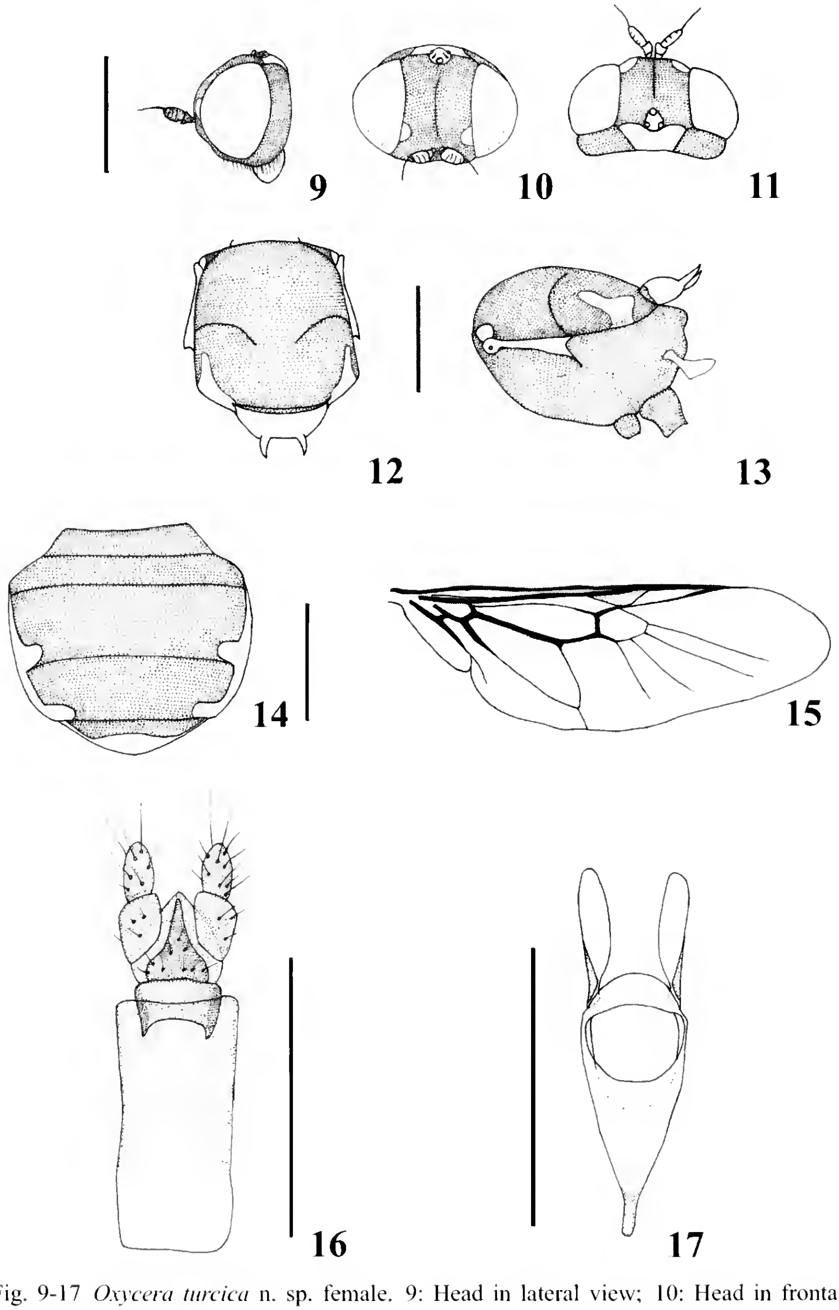


Fig. 9-17 *Oxycera turcica* n. sp. female. 9: Head in lateral view; 10: Head in frontal view; 11: Head in dorsal view; 12: Thorax in dorsal view; 13: Thorax in lateral view; 14: Abdomen in dorsal view; Scale bar = 1 mm; 15: Wing. Scale bar = 1mm; female genitalia; 16: Female terminalia in dorsal view; 17: genital furca. Scale bar = 0.25 mm.

DISCUSSION

The striking yellow semicircular spot beyond ocellar triangle in the female is very characteristic as well as anteriorly extended postalar spots. A similar cerebral yellow spot was figured by Lindner (1975) in his description of *Oxycera galeata* (as *Heraclina galeata*) based on the female holotype and a female paratype from Israel. However, this spot is apparently much higher and nearly triangular in *O. galeata*. Moreover, this species is well characterized by a large and conspicuous, subquadrate yellow midspot between the transverse suture and the scutellum.

Another species described also by Lindner (1974) from Israel is *Oxycera orientalis*. Also this species is based on the female holotype (and one male and one female paratype) from Israel. According to the original description, the female head of *O. orientalis* shows a very different yellow pattern compared with *O. turcica* sp.n. The cerebral spot is absent and the yellow frontal and postocular stripes are developed in addition to the paired frontal and upper postocular spots. The yellow frontal stripe begins on each side below the middle of the frons at the eye margin and continues slightly wider on the face, where it is covered with long white hairs.

Both Lindner's species under discussion were originally described in the genus *Heraclina* Lindner, 1938, separated on the largely variable character, presence or absence of vein R_4. Rozkošný (1983) and Rozkošný & Báez (1983) considered this genus to be a mere synonym of *Oxycera* Meigen, 1803, and this opinion was accepted by Woodley (2001).

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SCIENTIFIC NOTE

AN OVERLOOKED FAMILY-GROUP NAME FOR TERMITES (ISOPTERA)[1]

Michael S. Engel[2] and Kumar Krishna[3]

During ongoing work to complete a new, annotated world catalog of the termites (Isoptera), a family-group name was found that had been inadvertently overlooked during the preparation of an account of such names (Engel and Krishna, 2004). The name Odontotermitini was proposed as a tribe by Weidner (1956) for *Odontotermes, Ancistrotermes,* and *Microtermes.* Odontotermitini was not used by subsequent authors of termite classification. We provide here an entry for Odontotermitini, indicating the same information as provided for other termite family-group names (Engel and Krishna, 2004), and putting the name on record as an amendment to the earlier paper. Since the names provided in the earlier account are listed in order by taxonomic priority, Odontotermitini should be intercalated between the names Apicotermitinae and Cubitermitini. The entry would read as follows:

28a. Odontotermitini Weidner, 1956: 82. Type genus: *Odontotermes* Holmgren, 1910. Combining stem: Odontotermit–.

In the table summarizing the hierarchical outline of termite classification (Engel and Krishna, 2004), Odontotermitini would be listed as a synonym of Macrotermitinae, immediately under Acanthotermitinae, itself a synonym (*vide* Engel and Krishna, 2001; ICZN, 2003) as all three were proposed for groups of fungus-growing termites. Odontotermitini does not affect the priority or status of any other family-group names.

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We are grateful to V. Krishna and an anonymous reviewer for constructive comments on this note. This is contribution 3409 of the Division of Entomology, Natural History Museum, University of Kansas.

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Mailed on January 19, 2005

SCIENTIFIC NOTE

ON THE IDENTITY OF *HALICTUS CUBENSIS* SPINOLA, 1851 (HYMENOPTERA: HALICTIDAE)[1]

Michael S. Engel[2]

Some time ago Dr. Julio A. Genaro inquired if I might be able to determine the proper identity of the species known as *Halictus cubensis* Spinola, 1851 which was described from a male and female from Havana, Cuba. Unfortunately, Spinola (1851, p. 203) only mentioned the species in passing, proposing it rather cavalierly as a note under his treatment of *H. chloris* Spinola, 1851 (today *Corynura chloris*) and principally referring to the position of particular wing veins. Thus, although the name was made available, the real identity of the species has remained undetermined for over 150 years. Indeed, in the catalog of Western Hemisphere halictids, Moure and Hurd (1987, p. 206) rightly left *H. cubensis* as Halictini *incertae sedis.*

Through the kindness of Dr. Guido Pagliano I have recently had the opportunity to examine the male and female upon which Spinola based his brief description of *H. cubensis.* I have found that the female is a specimen of *Augochlora regina* Smith, 1853 (Augochlorini: Augochlorina), while the male is *Agaposmon viridulus* (Fabricius, 1793) (Caenohalictini: Agapostemonina). Both species are already relatively well characterized and I therefore do not believe it necessary to provide lengthy redescriptions of them herein. However, for the purpose of nomenclatorial stability I have provided the necessary taxonomic summaries for both species, designated a lectotype for *H. cubensis,* and indicated the necessary new synonymy that the lectotype designation precipitates *(infra).* Both of Spinola's specimens are now labeled with their appropriate identities and the male with a lectotype label as indicated.

SYSTEMATIC ENTOMOLOGY

Tribe Augochlorini Beebe
Genus *Augochlora* Smith
Augochlora (Augochlora) regina Smith

Augochlora regina Smith, 1853: 77.

Material. Female; [Havana, Cuba; coll. Poey] // [*Halictus cubensis* Spinola] // *Augochlora regina* Smith, det. M. S. Engel, 2004. Specimen conserved in the Spinola Collection of the Museo Regionale di Scienze Naturali, Turin.

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Mailed on January 19, 2005

Tribe Caenohalictini Michener
Genus *Agapostemon* Guérin-Méneville
Agapostemon (Agapostemon) viridulus (Fabricius)

Apis viridula Fabricius, 1793: 342.
Andrena (Agapostemon) femoralis Guérin-Méneville, 1844: 447.
Halictus cubensis Spinola, 1851: 203. **new synonym**
Agapostemon semiviridis Cresson, 1865: 172.

Lectotype (here designated). Male; [Havana, Cuba; coll. Poey] // [*Halictus cubensis* Spinola] // Lectotype, *Halictus cubensis* Spinola, 1851, desig. M. S. Engel [red label] // *Agapostemon viridulus* (Fabricius), det. M. S. Engel, 2004. Specimen conserved in the Spinola Collection of the Museo Regionale di Scienze Naturali, Turin. The lectotype is here designated for the express purpose of stabilizing the application of the epithet *cubensis* as proposed by Spinola (op. cit.). The specimen is in excellent condition.

Comments. Although I could have selected Spinola's female as the lectotype, *A. regina* has been more widely used in the literature, albeit still rather uncommonly, than *A. viridulus.* Furthermore, of these two names in current usage only *A. viridulus* is older than *H. cubensis.* Selection of the male as the name-bearing type for the latter renders the epithet a junior synonym of the former, preserving current usage and eliminating the long unused name. Since Spinola's description applies equally to his male and female specimens and he refers to both, either is eligible to serve as the name-bearing type of *H. cubensis.* I believe my selection does the most to promote nomenclatorial stability.

ACKNOWLEDGMENTS

I am indebted to Dr. Guido Pagliano (Turin, Italy) for kindly preparing the loan of Spinola's type material and for his patience during my study of the specimens. I am also grateful to Dr. Julio A. Genaro (presently of Toronto, Canada) for drawing my attention to the little mystery surrounding the identity of *H. cubensis* and to Dr. Charles D. Michener and an anonymous reviewer for constructive comments. This is contribution Nr. 3420 of the Division of Entomology, Natural History Museum and Biodiversity Research Center, University of Kansas.

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SCIENTIFIC NOTE

TWO NEW ORTHOPTERAN HOSTS OF NORTH AMERICAN POLIDEINI (DIPTERA: TACHINIDAE)[1]

James E. O'Hara[2] and David A. Gray[3]

The Polideini are a moderately sized tribe in the subfamily Tachininae with 36 genera and about 140 described species (O'Hara 2002). All but a few of the species are restricted to the New World. The tribe was redefined and the genera and species of America north of Mexico were revised by O'Hara (2002). In that work, all known hosts of the polideine species of America north of Mexico were listed and they include the greatest range of arthropod taxa of any tribe in the Tachinidae: various Lepidoptera, Hymenoptera (Diprionidae), Orthoptera (Gryllidae and Raphidophoridae), Blattaria (Blattellidae), Chilopoda (?*Geophilus* sp.), Scorpiones (Vaejovidae), and Araneae (Antrodiaetidae) (O'Hara 2002). Two new orthopteran hosts of North American Polideini were recently discovered by the junior author and are reported here. These new records are particularly noteworthy because orthopteran hosts of Tachinidae are not as well known as hosts in the major orders attacked, Lepidoptera, Coleoptera, Hymenoptera (Symphyta), and Hemiptera.

Dichocera lyrata Williston

Sixteen specimens of *Pristoceuthophilus marmoratus* Rehn (Orthoptera, Raphidophoridae) were collected by the junior author in mid to late October 2003 from Topanga Canyon, Santa Monica Mountains, Los Angeles County, California, in an area of mixed coast live oak (*Quercus agrifolia* Nee) and grassland bordering chaparral. The live crickets were returned to the laboratory for behavioral studies. A single tachinid maggot emerged from one of the crickets on January 7, 2004. It was reared to an adult and subsequently identified by the senior author as a male *D. lyrata*. There are no definite host records for *D. lyrata* in the literature, but a *Dichocera* "probably *lyrata*" specimen collected from Ithaca, New York, was reportedly reared from the raphidophorid *Ceuthophilus guttulosus guttulosus* Walker (Chinn and Arnaud 1993, O'Hara 2002).

Exoristoides johnsoni Coquillett

Six specimens of *Gryllus integer* Scudder (Orthoptera: Gryllidae) were collected by the junior author from high desert near Holbrook, Navajo County,

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Arizona, 1590 m (34.93°N, 110.13°W), on August 9, 2002. On the same day, a tachinid maggot emerged from a captured adult male cricket. The maggot was reared to an adult and subsequently identified by the senior author as a female *E. johnsoni*. This tachinid species has also been reared from the gryllids *Anurogryllus arboreus* Walker, *Gryllus pennsylvanicus* Burmeister and "*Gryllus* spp." (O'Hara 2002).

There is no published information on the reproductive habits of *D. lyrata* or *E. johnsoni*, but we can infer a little about their habits from an examination of their female reproductive systems and by comparison with related tachinids. A pinned female of each species was dissected and both contained a number of partially and fully developed first instar larvae; ca. 1050 larvae in *D. lyrata* and fewer than 100 in *E. johnsoni*. The reproductive capacity of the examined *E. johnsoni* appeared to be greater than the number of larvae observed, perhaps in the range of 200, but certainly far fewer than the observed number in the *D. lyrata* specimen, which seemed to be near capacity. This difference in apparent fecundity probably means that the likelihood of an individual *D. lyrata* larva successfully parasitizing a host is less than that of an *E. johnsoni* larva by nearly a factor of ten. Be that as it may, the larvae of both species are of a motile type common within the Tachininae suggesting that ready-to-hatch eggs are deposited on a substrate, most likely in response to host stimuli, and the first instars either actively search for a host or lie in wait for a passing host.

The tachinid specimens and their puparia have been deposited in the Canadian National Collection of Insects, Ottawa, Canada. The series of *P. marmoratus* from which the parasitized individual originated was identified by Ted Cohn (Adjunct Curator, Insect Division, University of Michigan, Museum of Zoology, Ann Arbor, Michigan). The parasitized *G. integer* was identified by the junior author. The remains of the hosts were not retained.

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SCIENTIFIC NOTE

DISTRIBUTIONAL RECORDS OF *CATARACTOCORIS* (HETEROPTERA: NAUCORIDAE) IN MESOAMERICA[1]

Robert W. Sites[2]

The genus *Cataractocoris* (Heteroptera: Naucoridae) is among the largest of the New World naucorids in body size. Ironically, this genus is seldom collected, in part because of its unusual habitat and restricted range. Whereas most species of Naucoridae are either lentic, riffle-dwelling, or occur among marginal stream vegetation, species of *Cataractocoris* occur in the film of water that sheets down over the vertical rock faces of waterfalls and in the splash zone below waterfalls (Usinger 1941). They also can be found in turbulent, rocky streams with fast current.

Only two species of *Cataractocoris* have been described: *C. macrocephalus* (Montandon) and *C. marginiventris* Usinger. Both species are known only from Mexico. Specifically, *C. macrocephalus* has been recorded from Temascaltepec District and *C. marginiventris* from both Temascaltepec and Guerrero districts (Usinger 1941, De Carlo 1950). Herein, I report records from two additional Mesoamerican countries for *C. macrocephalus* and from further northwest in Mexico for *C. marginiventris.* Both species likely are more widely distributed in Mexico and other Mesoamerican countries than currently known, but more collecting in appropriate habitats is needed to learn the extent of their distributions. Repository abbreviations are Texas A&M University (TAMU); Snow Museum, University of Kansas (UKSM); and Enns Entomology Museum, University of Missouri-Columbia (UMC).

Cataractocoris macrocephalus (Montandon)

EL SALVADOR: La Majadita, CL 1257, December 21, 1969, J. T. Polhemus, 2 males (UKSM). **GUATEMALA:** Yepocapa, Chimalt., July 1951, H. T. Dalmat, 2 males, 1 female (UKSM); Baja Verapaz, unnamed stream, 0.3 km S. La Cumbre, June 12, 2001, 4180 ft, W. D. Shepard, 1 female (UMC); Baja Verapaz, unnamed creek at Hwy 17, ca. 3 km S. La Cumbre and Jct Hwy, CA 14, 15° 00' 34" N, 90° 13' 51" W, 4180 ft, July 12, 2001, D. E. Baumgardner, 1 female (TAMU).

Cataractocoris marginiventris Usinger

MEXICO: Jalisco, Rio Las Juntas y los Verranos at los Verranos waterfall, February 18, 1999, L-238, R. W. Sites, 7 males, 13 females, 19 nymphs (UMC); Jalisco, Rio Mismaloya at Mismaloya, February 18, 1999, gravel/rocky stream, L-237, R W. Sites, 5 males, 2 females (UMC); Jalisco, Rio Tomatalan waterfall, Boca de la Tomatalan, February 18, 1999, L-236, R. W. Sites, 2 males, 2 females, 7 nymphs (UMC).

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Cataractocoris macrocephalus (Montandon)

Cataractocoris marginiventris Usinger

SCIENTIFIC NOTE

NEW HOST RECORD FOR *UROSIGALPHUS MIMOSESTES* GIBSON AND FIRST RECORD OF *U. NEOMEXICANUS* CRAWFORD (HYMENOPTERA: BRACONIDAE) IN MÉXICO[1]

Víctor López-Martínez,[2] J. I. Figueroa-De la Rosa,[3] J. Romero N.,[3] J. A. Sánchez G.,[4] and S. Anaya R.[3]

Hymenopterous wasps are the principal parasitoids of bruchids, principally species of Braconidae, Encyrtidae, Eulophidae, Eupelmidae, Eurytomidae and Pteromalidae. From the braconid wasps, the genus *Glyptocolastes* Ashmead, *Heterospilus* Haliday, *Stenocorse* Marsh and *Urosigalphus* Ashmead have a wide range of bruchids as a natural host (Center and Johnson, 1976; Hetz and Johnson, 1988; Marsh 1979, 1997; Steffan 1981). High number of hosts reported for the hymenopterous is given principally for its "host specificity to a particular environment, not a particular beetle" (Hetz and Johnson, 1988).

Systematic and biological hosts associations of *Urosigalphus* species has been published for Gibson (1972a, 1972b, 1982; Hetz and Johnson, 1988), they stated that 19 species are distributed in Mexico. *Urosigalphus* belongs to the tribe Brachistini of subfamily Helconinae, and can be characterized as egg-larval parasitoid (Sharkey, 1996), which is reported in a undetermined species of *Vrosigalphus* from Costa Rica (Traveset, 1991). According to Romero (2002), in his work about Mexican bruchids, 59 specimens of hymenopterous wasps that were reared from bruchids infesting Fabaceae pods and Convulvulaceae seeds, all belongs to the braconid genus *Urosigalphus.*

In the present work new distribution record and host associations data for *Urosigalphus (Bruchiurosigalphus) mimosestes* Gibson are given; besides new distribution records of *U. (Microurosigalphus) neomexicanus* Crawford for the country. The records presented here are based on material principally deposited in the Colección de Insectos del Centro de Entomología y Acarología, Montecillo (CEAM); and some material borrowed from Texas A&M University, College Station (TAMU) entomological collection.

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Subfamily Helconinae
Urosigalphus (Bruchiurosigalphus) mimosestes

The hypothesis of the host specificity to a particular enviroment of Hetz and Johnson (1988) can be partially corroborated with this work. *Urosigalphus mimosestes* has the capacity of attacking at least five species of bruchids associated to four host plants (Table 1), and probably have a wider host range.

This species has been reported from the Mexican states of Distrito Federal and Morelos (Gibson, 1972b; Figueroa and Romero, 2002), but now are reported from six Mexican states (Durango, Guanajuato, Hidalgo, Morelos, Nayarit, and Puebla) expanding the distribution of the species across the country.

Host plant	Bruchid host	Country	Reference
Not reported	*Mimosestes nubigens* (Motschulsky)	Honduras	Gibson (1972b)
Lonchocarpus rugosus	*Ctenocolum janzeni* Kingsolver	México	Figueroa and Romero (2002)
Acacia farnesiana, A. schaffneri	*M. nubigens*	México	New host plants records
Ipomoea simulans	*Megacerus callirhipis* (Sharp)	México	New host record
Prosopis juliflora	*Algarobius johnsoni* Kingsolver, *Mimosestes amicus* (Horn)	México	New host record

Table 1. Host records and distribution of *Urosigalphus (B.) mimosestes* in Mexico.

Material Examined: MÉXICO. DURANGO: 1 ♀, Vicente Guerrero, San Francisco Javier, 21-XII-1995, col. J. Romero N., reared seed *Prosopis juliflora*, parasitoide del brúquido *Algarobius johnsoni* Kingsolver. GUANAJUATO: 1 ♂, Irapuato, El Copal, 18-VIII-1994, Salas A. D., reared seed Prosopis sp., parasitoide del brúquido *Algarobius johnsoni* Kingsolver; 1 ♀ and 1 ♀, same data but 21-VII-1994, Salas A. D.; 3 ♀ and 3 ♂, same data but 22-VIII-1994; 2 ♀ and 2 ♂, same data but 17-IX-1994, Arévalo A; 4 ♀ and 1 ♂, km 3 carr. San José Iturbide-Victoria, 2-VIII-1996, col. J. Romero N., *Acacia schaffneri* (S. Watson) F. J. Herm, parasitoide del brúquido *Mimosestes nubigens* (Motschulsky); 1 ♀ and 1 ♂, San Luis de la Paz, 11-IV-1996, José A. Sánchez G; 1 ♀, Yiustis, 10-XII-1995, José A. Sánchez G. HIDALGO: 4 ♀ and 7 ♂, 3 mill. N Las Trancas, Parque Nacional Los Mármoles, 20-VII-1999, 6250 msnm, col. J. Romero N., reared seed JRN#240/99 Acacia farnesiana (L.), parasitoide del brúquido *Mimosestes nubigens* (Motschulsky); 3 ♀ and 4 ♂, Zindejeb, Tasquillo, 20-VII-1999, 1830 msnm, col. J. Romero N., reared seed JRN#239/799 *Prosopis juliflora*, parasitoide del brúquido *Mimosestes amicus* (Horn), 20° 33' 04" N 99°17' 44" W. MORELOS: 1 ♀, Tlalquitenango, La Mezquitera, 2-II-1997, 903 msnm, col. J. Romero N., reared seed JRN#201/97 *Prosopis juliflora*, parasitoide del brúquido *Algarobius johnsoni* Kingsolver. NAYARIT: 1 ♂, 15 mi. SE Tepic, 2-III-1973, ca. 4000, C. D. Johnson collector, reared seed CDJ#303/73 *Ipomoea simulans*, emerged by 25-IX-1973, parasitoide del brúquido *Megacerus callirhipis* (Sharp). PUEBLA: 1 ♀, 6 km SW Acatepec, 17-VII-1996, 1900 msnm, Jesús Romero N.

Urosigalphus (Microurosigalphus) neomexicanus Crawford

At this time, no biological data has been published of this species, but this reports an increasing number of *Urosigalphus* in México (19 to 20). This records are based upon 17 specimens examined, extending the distribution of the braconid to the Mexican states of Guerrero, Oaxaca and Puebla. Oaxaca represents its southernmost record.

This species was originally described from New Mexico, USA (Crawford, 1914). These have since been recorded from Arizona, Colorado, Illinois, Iowa, Kansas, Missouri, and Texas (Martin, 1956; Gibson, 1972a; Whitfield and Lewis, 2001). Future additional collections will help determine host and plant relations.

Material Examined: MÉXICO. GUERRERO: 1 ♂, 15 mi. W. Chichihualco, 15-VII-1984, Elev. Aprox. 1500', J. B. Woolley; 1 ♂, 5.4 mi. Southwest La Laguna, 14-VII-1985, Jones & Schaffner; 1 ♀ and 12 ♂ 6.2 mi SW Xochipala, 8-VII-1982, 5670 ft, R. Wharton. OAXACA: 1 ♂, 3 mi. se. Matatlan (Microondas road), 17-VII-1987, elev. 6650 ft., Kovarik & Schaffner. PUEBLA: 1 ♀, 6 km SW Acatepec, 17-VII-1996, 1900 m, Jesús Romero N.

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SCIENTIFIC NOTE

PERUSTIGMUS AND PERUSTIGMINAE VERHOEFF, 1941, INVALID GENUS- AND FAMILY-GROUP NAMES IN THE CENTIPEDE FAMILY SCOLOPENDRIDAE (SCOLOPENDROMORPHA)[1]

Rowland M. Shelley[2] and Amazonas Chagas, Jr.[3]

Verhoeff (1941) proposed the new scolopendromorph centipede genus *Perustigmus* for two new species in south Peru, *P. rapax* and *P. alticolus,* erecting the monotypic subfamily Perustigminae (family Scolopendridae) to accommodate them. He did not designate either as the type species, so according to Article 13.3 of the International Code of Zoological Nomenclature, *Perustigmus* is an unavailable genus-group name because it was published after 1930 without fixation of a type; Perustigminae is likewise unavailable because it was established for a genus that was invalidly proposed. The species, however, were validly proposed with anatomical characterizations and illustrations, and are available names even though the genus is not valid or available (Art. 11.9.3.1). Kraus (1957) placed both species in synonymy under *Cormocephalus andinus* (Kraepelin, 1903) without comment, and they were cited as synonyms of the nominate subspecies of the latter by Bücherl (1974), also without comment. To our knowledge the only other citations of any of these taxa were by Schileyko (1992) and Schileyko and Pavlinov (1997), who included *Perustigmus* in the subfamily Otostigminae (Scolopendridae) in their cladistic analyses of the Scolopendromorpha. The basis for this assignment is unknown as it also lacked comment, but it may have been based on the shape of the spiracles that Verhoeff (1941) characterized as "rund bis oval," rounded, non-valvular openings being characteristic of the Otostigminae. Their assignments of the genus conflict with Kraus' placements of the species because *Cormocephalus* belongs to the subfamily Scolopendrinae, which has narrow, "slit-like," valvular spiracles.

In this situation, the Code does not state whether unavailable names like *Perustigmus* and Perustigminae should be regarded as subjective synonyms of the valid names in which their components properly belong, and one could reasonably argue that the matter is moot since, as unavailable names, they technically do not exist in the first place. The type specimens of *P. rapax* and *P. alticolus* are cited by Weidner (1960) as (translated from German) "burned out in the

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Zoological Museum Hamburg in 1943." According to Dr. H. Dastych, the present chief curator (pers. comm. to RMS), the whole museum and most of Hamburg were destroyed during an air raid with incendiary bombs in 1943; the specimens that had been previously transferred to underground tunnels survived, but the types of the two species of *Perustigmus* were not among this material. Consequently, it is not possible to examine them to resolve the conflict of whether the species are properly referable to the Otostigminae or the Scolopendrinae/*Cormocephalus,* but Verhoeff (1941:61, figs. 80-81) provided figures of the caudal legs of *P. rapax* that enable a decision. In general, the caudal legs of Neotropical species of *Cormocephalus* are wide and robust; the prefemur is at most only slightly wider than long and possesses spines on the dorsolateral, medial, and ventral surfaces; and the claw is longer than the first tarsus. In contrast, the caudal legs of Neotropical representatives of the Otostigminae are slender; the prefemur is considerably longer than wide and may *(Rhysida)* or may not *[Otostigmus (Parotostigmus)]* possess spines; and the claw is shorter than the first tarsus. As Verhoeff's drawings conform to the former arrangement, we accept Kraus' placement of both species as synonyms of, now, the nominate subspecies of *C. andinus.* Consequently, in the interests of resolving and simplifying the nomenclature, we formally place *Perustigmus* and the Perustigminae in synonymy under *Cormocephalus* Newport, 1844, and the Scolopendrinae, respectively, with the rejoinder that they are **permanently** unavailable names.

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BOOK REVIEW

PEST AND VECTOR CONTROL. H. F. van Emden and M. W. Service. 2004. Cambridge University Press. 40 West 20th Street, New York, NY 10011-4211 U.S.A. ISBN: 0521010837. Paperback. US$50.00. Also available hardback.

Pest and Vector Control is a valuable addition to the pest management literature. The authors, world authorities and former classmates, have great enthusiasm for their subject matter. They write with clarity and vigor, and have produced a unique book: an introductory text covering the theory and practice of pest management for both agricultural pests and medical/veterinary pests. As the authors rightly point out, students and practioners in the two fields rarely interact despite evidence that management practices in one (usually for agricultural pests) have impacted the ecology, population dynamics, and control practices of the other (key medical and veterinary pests).

The book is composed of 13 chapters. The first two chapters outline the importance of insects to man and provide a theoretical background to pest and vector outbreaks. Terms that may be unfamiliar to readers are defined within the text, which is convenient and improves the readability of the book. The theory of pest outbreaks receives broad treatment, appropriate for an introductory text. The authors provide an excellent treatment of man's role in causing and exacerbating pest and vector outbreaks. There is also a short section on the impact of climate changes on insect populations. While necessarily speculative on the ultimate impact of these changes on pest and vector population dynamics, the authors recognize the need for students to be aware of this changing interaction.

Chapters 3 through 12 cover various control strategies. There is a fairly heavy emphasis on chemical control with the first three chapters devoted to pesticides: formulation, application, and problems associated with insecticides. Other control strategies including cultural, biological and genetic control, host plant resistance and the use of pheromones are covered in subsequent chapters. The use of pathogens in pest and vector control is considered separately from biological control. The authors separate pathogens from biological control because these agents are frequently used more like pesticides than biological control agents. These agents also lack some biological attributes of predators and parasitoids. Chapter 12 covers all other control methods. This chapter also provides readers with information on international organizations involved in pest and vector control. While not an extensive listing, this section gives students an introduction to these organizations and their missions. An appendix of web sites for these organizations would have been helpful. Chapter 12 also includes a brief discussion of the role and importance of community participation. Involving farmers and community members in agricultural, medical and veterinary pest management projects is complex, particularly in less developed countries, but increases the likelihood of success in these programs. Including this topic, and documenting it with specific examples, the authors have given students insight into the challenges and opportunities of participatory pest and vector management.

The final chapter begins with a discussion of failed pest and vector control projects from the 1950s. The authors trace the linkage from these failures, through the warnings sounded in Rachel Carson's Silent Spring, to the concept of integrated control. Some of the ideas and practices underpinning integrated control are then discussed: economic thresholds, monitoring, forecasting, modeling, control vs. eradication, and combining management practices. It's interesting that the book ends with the integrated control concept, a place many introductory texts begin. The book concludes by mentioning some of the economic and social pressures impacting pest and vector control. These include the increasing demand for "organic" produce, the growing influence of consumers, legislative action banning of specific pesticides, and the increasing interaction between management of agricultural pests and management of medical and veterinary pests/vectors.

Pest and Vector Control can be recommended to both introductory students and more experienced readers. Its strengths are clear, concise writing, a wealth of field examples from around the world, and the unique combination of covering both agricultural pests and medical/veterinary pests.

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SOCIETY MEETING OF APRIL 28, 2004

Pennsylvania Forest Insect Update

Sven-Erik Spichiger
Division of Forest Pest Management,
Pennsylvania Department of Conservation and Natural Resources
Harrisburg, Pennsylvania, U.S.A.

The Society's last meeting of spring 2004, before the summer hiatus, focused on forest pest insects with a talk given by Sven-Erik Spichiger. The Division of Forest Pest Management (FPM) is responsible for the health of 3.9 million state-owned acres of Pennsylvania's 17 million forested acres. Insects are a major component of forest health due to the roles they play in nutrient recycling, damage, regeneration, and other factors affecting the forest ecosystem. FPM has used integrated pest management to reduce damage to forested lands by many different insects including gypsy moth *(Lymantria dispar)* and hemlock woolly adelgid *(Adelges tsugae)*. FPM also monitors and provides Pennsylvania with information and recommendations about other forest insects like elongate hemlock scale *(Fiorinia externa)* and periodical cicada (*Magicicada* sp.).

In the current era of increased international trade, the role of FPM in the detection and management of new invasive forest pests has grown considerably. FPM cooperates with other state and federal agencies to combat the establishment of new invasive threats like emerald ash borer *(Agrilus planipennis),* Asian longhorned beetle *(Anoplophora glabripennis),* and Indian pinecone beetle *(Chlorophorus strobilicola).*

In anticipation of the forthcoming emergence of Brood X of the periodical cicadas (*Magicicada* spp.), specimens of these species were on display from collections of The Academy of Natural Sciences and Sven Spichiger. A taped loop of calls of the cicada species intermixed with a song about the cicadas (by Bob Dylan no less!) was provided by Greg Cowper and gave an appropriate atmosphere to the proceedings. Hal White gave a brief presentation surveying Dr. Philip Calvert's life, as a prelude to the Calvert Awards for students, which were given out this night. About 45 members and visitors were present at the meeting.

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NEW DISTRIBUTION RECORDS OF MOSQUITOES (DIPTERA: CULICIDAE) FOR YUCATÁN, MEXICO[1]

Rosario Nájera-Vázquez,[2] F. Dzul,[2] M. Sabido,[2] E. Tun-Ku,[2] and P. Manrique-Saide[3,4]

ABSTRACT: As part of the West Nile Virus Emergence Program in Yucatán, carried out by the Mexican Ministry of Health, an extensive mosquito larvae survey was made throughout urban, sub-urban and rural localities within 66 municipalities of this Mexican State. Larval collections (2623 samples) from domiciliary and peridomiciliary habitats were made from August to December 2003 (rainy season). New municipality distribution records were established for 16 mosquito species. *Psorophora howardii* was recorded for Yucatán State for the first time. *Ae. aegypti* was the most widely distributed species, and was recorded in almost all the municipalities sampled, followed by *Culex coronator, Cx. nigripalpus, Cx. quinquefasciatus, Cx. interrogator* and *Cx. thriambus*. A wide variety of habitats, natural or manmade, were found positive for mosquitoes, the most common being buckets, rock holes, water storage tanks, and laundry or kitchen items, all of which hosted a large number of different species.

KEY WORDS: Diptera, Culicidae, Mexico, Yucatán, new distribution records

Published contributions to the knowledge of mosquito fauna of the Mexican state of Yucatán (N 21°36', S 19°32' latitude; E 87°32', W 90°25' longitude) are scarce and geographically restricted. In the most recent document about mosquitoes of Mexico that specifically mentioned the species richness of Yucatán, Ibáñez-Bernal et al. (1996) reported forty-five species, but did not include detailed information about localities and species distribution. Other published literature about the mosquito fauna of Yucatán reports the presence of approximately 50 species (Vargas, 1956; Díaz-Nájera and Vargas, 1973; Ibáñez-Bernal and Martínez-Campos, 1994; Rivas et al., 2000). The majority of these reports only refer to "Yucatán" or the Municipality of Mérida, the location of the capital city of Yucatán State, yet there are 105 additional municipalities within the state.

Historically, mosquito studies in Yucatán have been primarily directed towards the control of *Aedes aegypti* and Dengue virus transmission or the reduction of nuisance biting. Recently the potential emergence of West Nile virus (WNV) in the area has resulted in a renewed interest in entomology in the state. Yucatán is considered a likely point of incursion of this virus into Latin America because it is a principal landfall for many species of birds that migrate from the

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Northeastern and Midwestern United States (Loroño-Pino et al., 2003). In response, the Mexican Ministry of Health established an entomological surveillance program in the state in order to get a more precise picture of the distribution of mosquito fauna in the different localities of Yucatán.

METHODS

As part of the WNV Emergence Program in Yucatán, carried out by the Mexican Ministry of Health, an extensive mosquito larvae survey was conducted in premises throughout urban, suburban, and rural localities within 66 municipalities between August and December 2003, during the rainy season. Due to time constraints all localities were visited at least once during the study period, and no attempt was made to count habitats without larvae. Upon entering the collection site, inspectors visually scanned the area for containers or other potential habitats for larval development, and then examined all of them for larvae. Larvae found in small containers were collected either by use of a zooplankton net or pipetted with a turkey baster. In larger breeding sites, larvae were collected by sweeping the surface of the water with a net for aquatic insects. Inspectors collected only a sample of larvae from each collection site.

From domiciliary and peridomiciliary containers and other habitats positive for mosquito larvae, 2,623 samples were collected and preserved in vials with ethanol 70 percent and subsequently transported to the Servicios de Salud of Yucatán headquarters or the Zoology Laboratory of the Universidad Autónoma de Yucatán. Specimens from each sample were examined in alcohol using a dissecting scope, separated, and identified using the keys by Clark-Gil and Darsie (1983) and Ibáñez-Bernal and Martínez-Campos (1994). Samples of the specimens, mounted on slides, are deposited in the Colección Entomológica Regional (CER) of the Universidad Autónoma de Yucatán.

RESULTS AND DISCUSSION

A list of mosquito larvae species is presented here, along with their spatial distribution (presence or absence) at the municipality/locality level of urban, suburban and rural areas of Yucatán, Mexico. The number of specimens examined is not available for all locations, and is therefore not included. However, at least one specimen of each species had to be present for a locality to be considered positive. Municipalities are given in uppercase, followed by the locality and the date of collection. When known, the neighborhood ("colonia," "barrio," or "fraccionamiento") is mentioned, and the longitude/latitude coordinates for each locality are given for all locations.

The larval collections in the Mexican state of Yucatán during the rainy season of 2003 established new municipality distribution records for 16 species. *Psorophora howardii* is first reported for Yucatán State. *Ae. aegypti*, the most widely distributed species, was recorded in 98.5 percent of the municipalities, followed by *Culex coronator*, *Cx. nigripalpus*, *Cx. quinquefasciatus*, *Cx. interrogator* and

Table 1. Mosquito species and their observed breeding sites in premises throughout urban, suburban, and rural localities of Yucatán, México (August to December 2003).

Breeding sites	*An. albimanus*	*Ae. aegypti*	*Hg. anastasionis*	*Hg. equinus*	*Hg. mesodentatus*	*Oc. sollicitans*	*Oc. scapularis*	*Oc. taeniorhynchus*	*Ps. conffinis*	*Ps. howardii*	*Wyeomyia sp.*	*Cx. bidens*	*Cx. cor-lac*	*Cx. coronator*	*Cx. interrogator*	*Cx. nigripalpus*	*Cx. quinquefasciatus*	*Cx. thriambus*	*Toxorhynchites sp*
Natural fruit shells		X	X	X			X				X				X				X
Temporal pools		X							X	X	X		X	X	X		X	X	
Conch shells		X	X	X							X								
Rock holes		X	X	X		X	X				X	X	X	X	X	X	X	X	X
Tree holes		X	X	X	X						X			X	X	X	X		
Ponds															X		X	X	
Marshes	X																		
Nonessential rubbish		X		X							X		X	X	X	X	X	X	X
Laundry and kitchen items		X	X	X			X				X		X	X	X	X	X	X	X
Tin cans and bottles		X	X	X							X		X	X	X	X	X	X	X
Discarded appliances		X											X	X	X			X	X
Used tires		X	X	X			X				X		X	X	X	X	X	X	X
Useful soakage pits		X													X	X	X	X	
Water storage tanks		X	X	X			X				X	X	X	X	X	X	X	X	X
Batea		X									X		X	X	X	X	X	X	
Animal water containers		X	X	X			X				X		X	X	X	X	X	X	X
Buckets	X	X	X	X		X	X				X	X	X	X	X	X	X	X	X
Flower vases and potted plants		X		X							X			X	X	X	X	X	
Wells		X															X	X	
Septic tanks		X						X						X	X		X	X	
Roof gutters		X		X										X		X	X	X	
Oxidation lagoon	X	X																	

Cx. thriambus. The remaining species were only registered for less than one third of the municipalities. It was not possible to identify some specimens, like *Toxorhynchites* and *Wyeomyia,* to species level, nor was it possible to clearly differentiate between *Cx, corniger-lactator* specimens with the identification keys used.

The breeding sites where samples of each species were collected are listed in Table 1. Breeding sites were classified in three groups: natural, nonessential, and useful (Pan American Health Organization, 1994). The second and third group includes manmade containers or artificial water bodies. Although a wide variety of types of containers were observed, they were grouped under representative names. Most of the names used to typify the containers are commonly used and known in the mosquito literature.

As evident from Table 1, most of the species reported were found breeding in a wide variety of containers, natural or manmade, useful or nonessential, but also in other habitats like temporary pools, ponds and marshes. *Ae. aegypti, Cx. quinquefasciatus, Cx. interrogator* and *Cx. thriambus* were the species most commonly observed in all the types of breeding sites.

All breeding sites, whether natural, nonessential, or useful, harbored significant species diversity. However, buckets, rock holes, water storage tanks, and laundry or kitchen utensils reported a larger diversity of species and were also the most common habitats positive for mosquito larvae. Although no data regarding productivity (population density or abundance) of the breeding sites is available, it appears that any control effort against mosquitoes should incorporate not only solid waste and environmental management (destruction, alteration, disposal or recycling of containers and natural habitats), but also the improvement of water supply and storage.

Subfamily Anophelinae

Anopheles (Nyssorrhynchus) albimanus Wiedemann

Material Examined: HOCTÚN: Hoctún (N 20°51'12.11", W 89°11'53.34"), 10 Nov 2003; MÉRIDA: Dzityá (N 21°2"38.29", W 89°40"28.03"), 24 Nov 2003; MÉRIDA (N 20°58'12.94", W 89°36'59.97"), 3 Dec 2003; PROGRESO: Chicxulub Puerto (N 22°16"23.35", W 89°35'40.93"), 23 Sep 2003.

Subfamily Culicinae

Tribe Aedini

Aedes (Stegomyia) aegypti (L.)

Material Examined: ACANCEH: Acanceh (N 20°48'12.33"; W 89°27'5.42"), 14 Nov 2003; AKIL: Akil (N 20°16'1.76"; 89°21'25.23"), 7 Oct 2003; BOKOBÁ: Bokobá (20°59'21.71", W 89°10'32.94"), 8 Sep 2003, 10-11 Oct 2003, 10-11 Nov 2003; BUCTZOTZ: Buctzotz (N 21°10'31.16", W 88°46'54.88"), 30 Sep 2003, 13-14 Oct 2003; CACALCHÉN: Cacalchén (N 20°58'1.45", W 89°13'14.22"), 11 Sep 2003; CANSAHCAB: Cansahcab (N 21°8'15.14", W 89°5'34.86"), 18 Dec 2003; CANTAMAYEC: Cantamayec (N 20°28'3.7", W 89°4'54.87"), 2, 4-5, 8 Sep 2003, Cholul (N 20°26'22.03", W 89°9'31.59"), 20 Oct 2003; CALOTMUL: Pocoboch (N 20°56'47.34" W 88°6'14.82"), 4 Nov 2003; CELESTÚN: Celestún (N 20°52'16.97", W 90°23'48.88"), 4, 6-7 Oct 2003; CHACSINKÍN: Chacsinkín (N 20°10'15.98", W 89°1'18.30"), 11-12, 15 Sep 2003; CHAPAB: Citincabchén (20°31'35.71", W 89°32'23.81"), 4 Sep 2003, 27 Oct 2003; CHEMAX: Chemax (N 20°37'52.63", W 87°55'41.93"), 2 Sep 2003, 24 Dec 2003, Sisbichén (N 20°48'0.28", W

87°54'46.75"), 10 Nov 2003, Xalau (N 20°39'31.65", W 88°0'5.46"), 3 Nov 2003, 8 Dec 2003; CHICHIMILÁ: Chichimilá (N 20°36'44.09", W 88°12'41.87"), 1-2 Oct 2003; CHIKINDZONOT: Chikindzonot (N 20°19'26.13", W 88°29'9.60"), 11 Sep 2003; CHOCHOLÁ: Chocholá (N 20°45'15.09", W 89°50'1.98"), 9 Sep 2003, 8 Dec 2003; CHUMAYEL: Chumayel (N 20°25'40.33", W 89°18'20.50"), 23-24, 29 Aug 2003, 2-4, 22, 29 Sep 2003, 10, 14-16 Oct 2003; CONKAL: Conkal (N 21°3'44.55", W 89°30'53.06"), 8, 10 Sep 2003; CUNCUNUL: Cuncunul (N 20°37'17.06", W 88°17'33.36"), 22 Oct 2003; DZAN: Dzan (N 20°23'30.65", W 89°28'30.18"), 29 Oct 2003; DZEMUL: Dzemul (N 21°11'29.77", W 89°18'10.28"), 10 Dec 2003; DZIDZANTÚN: Dzidzantún (N 21°13'27.27", W 89°1'55.32"), 10 Sep 2003, 15 Oct 2003; DZILAM GONZÁLEZ: Dzilam González (N 21°15'19.45", W 88°55'0.97"), 11 Dec 2003; DZILAM DE BRAVO: Dzilam de Bravo (N 21°21'0.76", W 88°52'51.67"), 11 Dec 2003; DZITÁS: Dzitás (N 20°49'7.58", W 88°31'21.76"), 17 Sep 2003, 23 Oct 2003, Xocempich (N 20°45'8.11", W 88°34'1.61"), 27 Nov 2003; ESPITA: Espita (N 20°58'56.07", W 88°17'51.38"), 5, 13 Nov 2003; HALACHÓ: Chuc-Holoch (N 20°28'5.18", W 90°6'45.75"), 17 Sep 2003, Halachó (N 20°29'35.62", W 90°5'26.89"), 17, 27 Sep 2003; HOCABÁ: Hocabá (20°48'11.64", W 89°14'39.12"), 19 Sep 2003; HOCTÚN: Hoctún, 10 Nov 2003; HUNUCMÁ: Hunucmá (N 21°00'56.56", W 89°52'25.88"), 29 Sep 2003; IZAMAL: Izamal (N 20°55'3.41", W 89°00'46.41"), 1 Sep 2003; KAUA: Kaua (N 20°36'16.89", W 88°24'35.40"), 18 Sep 2003; KANASÍN: Fraccionamiento Héctor Victoria, 30 Oct 2003, Kanasín (N 20°55'51.07", W 89°32'57.75"), 14 Aug 2003, 1 Oct 2003; KANTUNIL: Holcá (N 20°44'35.82", W 88°55'41.65"), 25 Sep 2003; KOPOMÁ: Kopomá (N 20°39'15.41", W 89°54'15.55"), 26 Sep 2003, 8 Dec 2003; MANÍ: Maní (N 20°23'18.00", W 89°23'48.57"), 18 Aug 2003, 25 Sep 2003, 27-28 Nov 2003, 1-3 Dec 2003, Tipikal, 10 Dec 2003; MÉRIDA: Colonia Amalia Solórzano, 30 Sep 2003, 1-2 Oct 2003, Colonia Amapola, 12, 18 Nov 2003, Colonia Benito Juárez, 23 Sep 2003, Colonia Buenavista, 19 Nov 2003, Camara Construcción, 2 Dec 2003, Caucel, 4 Sep 2003, Centro, 13 Oct 2003, 10-11, 13, 24, 26-27 Nov 2003, Fraccionamiento Chenkú, 24, 27-28 Nov 2003, Colonia Chichén Itzá, 25-26, 29 Sep 2003, 8 Dec 2003, Cholul, 4 Sep 2003, 11 Nov 2003, Colonia Azcorra, 12 Sep 2003, Mérida, 21 Nov 2003, Colonia Sarmiento, 8 Oct 2003, Dzityá, 8 Oct 2003, Fraccionamiento Francisco de Montejo, 19 Nov 2003, Colonia Itzimná, 12 Dec 2003, Fraccionamiento Juan Pablo, 15 Dec 2003, Fraccionamiento Juan Pablo Ote, 22 Sep 2003, Fraccionamiento Lindavista, 17, 24 Nov 2003, Fraccionamiento Magnolias, 21 Nov 2003, 1 Dec 2003, Colonia Nueva Chichén, 23 Sep 2003, Fraccionamiento Pedregales de Tanlum, 17 Nov 2003, Fraccionamiento Residencial Pensiones, 16-17 Oct 2003, Fraccionamiento Terranova, 21, 28 Nov 2003, Fraccionamiento Vergel, 30 Aug 2003, 11 Sep 2003, 4-5, 8-9 Dec 2003, Fraccionamiento Vergel I, 5 Dec 2003, Fraccionamiento Vergel II, 8 Sep 2003, 25 Oct 2003, 25 Nov 2003, 3-5, 7, 11 Dec 2003, Fraccionamiento Vergel III, 3-5, 8-9 Dec 2003, Fraccionamiento Vergel IV, 9, 11 Dec 2003, Fraccionamiento Vergel V, 9 Dec 2003, Fraccionamiento Vergel 65, 5, 9 Dec 2005, 11 Sep 2003, Colonia Vicente Guerrero, 2 Oct 2003, Colonia Vicente Solís, 15 Sep 2003; MUXUPIP: Muxupip (N 21°1'49.42", W 89°19'21.30"), 18 Sep 2003, 27 Nov 2003; OPICHEN: Calcehtok (N 20°34'41.52", W 89°55'12.78"), 20 Aug 2003; OXKUTZCAB: Cooperativa (N 20°13'57.38", W 89°28'35.95"), 9 Oct 2003, 12-14, 16, 18 Nov 2003, Xohuayán (N 20°11'22.81", W 89°23'9.99"), 13 Nov 2003, Yaxhachén (N 20°3'44.63", W 89°34'41.88"), 6-7, 11-12 Nov 2003; PETO: Peto (N 20°7'38.87", W 88°55'31.98"), 12, 16-17 Sep 2003; PROGRESO: Chicxulub Puerto, 9 Aug 2003, 9 Sep 2003, Chuburná Puerto (N 21°14'28.64", W 89°47'47.70"), 19 Sep 2003, Fraccionamiento Campestre Flamboyanes, 18 Sep 2003, Progreso (N 21°15'59.17", W 89°39'14.39"), 2 Oct 2003, Hacienda San Ignacio (N 21°8'36.94", W 89°39'2.61"), 29 Aug 2003; RÍO LAGARTOS: Río Lagartos (N 21°33'17.86", W 88°8'33.36"), 12 Nov 2003; SAMAHIL: San Antonio Tedzidz (N 20°53'5.85", W 89°53'16.60"), 27 Oct 2003; SANTA ELENA: Santa Elena (N 20°20'7.11", W 89°39'5.08"), 10, 23-26 Sep 2003; SOTUTA: Sotuta (N 20°35'20.19", W 89°0'25.21"), 20 Oct 2003, Tibolón (N 20°39'25.52", W 88°56'23.37"), 21 Oct 2003; SUMA: Suma (N 21°3'58.35", W 89°8'28.28'), 3 Sep 2003; TAHDZIÚ: Tahdziú (N 20°12'9.95", W 88°56'55.07"), 18-19, 24 Sep 2003; TAHMEK: Tahmek (N 20°51'53.29",W 89°15'15.65"), 5, 9, 13-14 Oct 2003, 3, 5-7, 9, 12 Nov 2003; TEABO: Teabo (N 20°23'56.09", W 89°17'13.64"), 21-22, 26, 18 Aug 2003, 10, 14-15, 24 Oct 2003; TEKANTÓ: Tekantó (N 20°59'36.62", W 89°6'0.70"), 9 Sep 2003; TEKAX: San Isidro Maquian (N 19°50'43.17", W 89°25'53.13"), 2 Sep 2003, Huntochac (N 19°49'19.66", W 89°30'52.65"), 3 Sep 2003, Tekax (N 20°12'26.24", W 89°17'51.99"), 19 Sep 2003, Kinil (N 20°19'21.92", W 89°8'16.49"), 1 Oct 2003, Pencuyut (N 20°17'41.47", 89°17'53.06"), 1-2, 7 Oct 2003, Xayá (N 20°17'42.62", W

89°11'29.91"), 1-3, 5-7, 9 Oct 2003, Kancab (N 20°11'40.63", W 89°20'56.25"), 6-7, 25 Nov 2003, San Pedro Xtoquil (N 19°46'6.85", W 89°26'40.76"), 27 Aug 2003; TEKIT: Tekit (N 20°31'56.92", W 89°20'5.22"), 18 Nov 2003; TEKOM: Tekom (N 20°35'9.65", W 88°15'35.95"), 22-24 Sep 2003; TELCHAC PUEBLO: San Crisanto (N 21°19'32.13", W 89°9'46.34"), 10 Oct 2003; TEMAX: Temax (N 21°7'39.50", W 88°55'45.03"), 13 Nov 2003; TICUL: Colonia Obrera, 13-14, 17 Nov 2003, Barrio Guadalupe, 10 Oct 2003, 17 Nov 2003, Kinder, 3 Nov 2003, Barrio Mejorada, 12 Nov 2003, Pustunich (N 20°22'26.22", W 89°31'0.31"), 29 Sep 2003, 6 Oct 2003, Barrio San Enrique, 3 Nov 2003, Barrio San Juan, 13, 15 Nov 2003, Colonia San Joaquín, 22 Sep 2003, 31 Oct 2003, Barrio San Román, 7-8, 10-11, 24 Nov 2003, Barrio Santiago, 4-7 Nov 2002, Ticul (N 20°24'9.21", W 89°32'32.43"), 5-6, 10, 29-30 Sep 2003, 27, 30 Oct 2003, 3-4, 7, 12 Nov 2003, Yotholín (N 20°19'45.02", W 89°27'37.78"), 29-30 Oct 2008, 13, 15 Oct 2003; TINUM: Piste (N 20°40'56.30", W 88°35'4.87"), 20 Oct 2003; TIXCACALCUPUL: Tixcacalcupul (N 20°31'19.78", W 88°15'50.83"), 24 Sep 2003; TIXKOKOB: Ekmul (N 20°57'8.97", W 89°20'43.95"), 22 Sep 2003, 1-3 Dec 2003, Tixkokob (N 20°59'17.24", W 89°23'24.73"), 20 Nov 2003; TIXMEHUAC: Chicam (N 20°20'15.34", W 89°9'41.45"), 24 Oct 2003, Kimbilá (N 20°17'40.13", W 89°5'25.71"), 24 Oct 2003; TIZIMÍN: Popolnah (N 20°57'46.94", W 87°33'4.35"), 3 Sep 2003, Tizimín (N 21°6'49.32", W 88°8'27.54"), 5-6, 11, 17-19, 24-25 Nov 2002, 1-2, 10 Dec 2003; TZUCACAB: Tzucacab (N 20°4'30.20", W 89°3'15.58"), 29 Aug 2003; UAYMA: Uayma (N 20°41'52.58", W 88°18'35.16"), 15 Aug 2003, 10, 15 Sep 2003; UMÁN: Umán (N 20°52'43.80", W 89°44'47.03"), 5, 8-9 Sep 2003; VALLADOLID: Valladolid (N 20°40'7.73", W 88°11'58.45"), 25 Sep 2003, 9 Oct 2003, 4, 26 Nov 2003; XOCCHEL: Xocchel (N 20°49'16.29", W 89°10'54.01"), 19 Sep 2003; YAXCABÁ: Libre Unión (N 20°41'39.78", W 88°48'24.86"), 9 Dec 2003, Yaxunáh (20°31'46.58", W 88°40'25.50"), 7 Oct 2003; YAXKUKUL: Yaxkukul (N 21°2'58.86", W 89°24'39.33"), 18 Oct 2003.

Haemagogus (Haemagogus) anastasionis Dyar

Material Examined: CHUMAYEL: Chumayel, 10, 17 Oct 2003; KANTUNIL: Holcá, 25 Sep 2003; KOPOMÁ: Kopomá, 8 Dec 2003; MANÍ: Maní, 28 Nov 2003; MÉRIDA: Dzityá, 8 Oct 2003; OXKUTZCAB: Cooperativa, 13-14 Nov 2003; SOTUTA: Sotuta, 20 Oct 2003; TAHDZIÚ: Tahdziú, 30 Sep 2003; TAHMEK: Tahmek, 6-7 Nov 2003; TEKAX: Xayá, 3 Oct 2003; TEMAX: Temax, 3 Nov 2003; TICUL: Colonia Obrera, 14 Nov 2003; TIXCACALCUPUL: Tixcacalcupul, 25 Sep 2003; TIXKOKOB: Ekmul, 2-3 Dec 2003; TIZIMÍN: Tizimín, 11 Nov 2003; YAXKUKUL: Yaxkukul, 18 Oct 2003.

Haemagogus (Haemagogus) equinus Theobald

Material Examined: CHACSINKÍN: Chacsinkín, 15 Sep 2003; CHAPAB: Citincabchén, 4 Sep 2003; CHEMAX: Kuxeb (N 20°49'47.33", W 87°51'49.32"), 24 Nov 2003; CHUMAYEL: Chumayel, 10, 15, 17 Oct 2003; CUNCUNUL: Cuncunul, 22 Oct 2003; HOCABÁ: Hocabá, 19 Sep 2003; MANÍ: Maní, 27 Nov 2003, 1 Dec 2003; MÉRIDA: Dzityá, 8 Oct 2003; OXKUTZCAB: Xohuayán, 13 Nov 2003, Yaxhachén, 12 Nov 2003; SANTA ELENA: Santa Elena, 26 Sep 2003; SOTUTA: Sotuta, 20 Oct 2003; TAHDZIÚ: Tahdziú, 30 Sep 2003; TAHMEK: Tahmek, 14 Oct 2003; TEABO: Teabo, 21 Aug 2003; TEKAX: Mesatunich (N 19°49'39.36", W 89°25'45.94"), 2 Sep 2003, Xayá, 3, 9 Oct 2003; TICUL: Colonia Obrera, 13 Nov 2003, Pustunich, 29 Oct 2003, Barrio San Juan, 7 Nov 2003, Ticul, 6 Nov 2003, Yotholín, 15 Oct 2003; TIXKOKOB: Ekmul, 2 Dec 2003; TIZIMÍN: Tizimín, 17 Nov 2003; UAYMA: Uayma, 15 Oct 2003; YAXKUKUL: Yaxkukul, 18 Oct 2003.

Haemagogus (Haemagogus) mesodentatus Komp and Kumm

Material Examined: TAHDZIÚ: Tahdziú, 30 Sep 2003.

Ochlerotatus (Ochlerotatus) scapularis (Rondan)

Material Examined: ACANCEH: Acanceh, 14 Nov 2003; CHACSINKÍN: Chacsinkín, 15 Sep 2003; CHAPAB: Citincabchén, 4 Sep 2003; HOCTÚN: Hoctún, 10 Nov 2003; OXKUTZCAB: Cooperativa, 13-14 Nov 2003, Yaxhachén, 10-12 Nov 2003; SOTUTA: Sotuta, 20 Nov 2003, Tibolón, 21 Oct 2003; TAHDZIÚ: Tahdziú, 30 Sep 2003; TAHMEK: Tahmek, 9, 12, 14 Nov 2003; TEKAX: Xayá, 3 Oct 2003; TEKOM: Tekom, 23 Sep 2003; TICUL: Colonia Obrera, 14 Nov 2003, Barrio San Juan, 23 Nov 2003.

Ochlerotatus (Ochlerotatus) sollicitans (Walker)

Material Examined: DZAN: Dzan, 28 Oct 2003; MÉRIDA: Fraccionamiento Magnolias, 21 Nov 2003; TIXKOKOB: Ekmul, 1 Dec 2003; CHEMAX: Sisbichén, 10 Nov 2003.

Ochlerotatus (Ochlerotatus) taeniorhynchus (Wiedemann)

Material Examined: CELESTÚN: Celestún, 7 Oct 2003.

Psorophora (Grabhamia) confinnis (Arribalzaga)

Material Examined: TEKAX: Huntochac, 3 Sep 2003.

Psorophora (Psorophora) howardii Coquillett

Material Examined: TEKAX: Xayá, 3 Oct 2003.

Tribe Culicini

Culex (Culex) bidens Dyar

Material Examined: CHEMAX: Chemax, 4 Oct 2003; DZITÁS: Dzitás, 17 Sep 2003; OXKUTZCAB: Yaxhachén, 6 Nov 2003; SANTA ELENA: Santa Elena, 26 Sep 2003; TIZIMÍN: Tizimín, 6 Nov 2003.

Culex (Culex) coronator Dyar and Knab

Material Examined: ACANCEH: Acanceh, 14 Nov 2003; BOKOBÁ: Bokobá, 8 Sep 2003, 11 Oct 2003; BUCTZOTZ: Buctzotz, 30 Sep 2003, 13-14 Oct 2003; CACALCHÉN: Cacalchén, 11 Sep 2003; CANSAHCAB: Cansahcab, 3 Sep 2003, 18 Dec 2003; CANTAMAYEC: Cantamayec, 2-5, 9-10 Sep 2003, 21-22 Oct 2003; CALOTMUL: Pocoboch, 4 Nov 2003; CHACSINKÍN: Chacsinkín, 11-12, 15 Sep 2003; CHAPAB: Citincabchén, 4 Sep 2003, 27 Oct 2003; CHEMAX: Chemax, 2 Sep 2003, Kuxeb, 24 Dec 2003, Sisbichén, 10 Nov 2003, Xalau, 3 Nov 2003, 8 Dec 2003; CHICHIMILÁ: Chichimilá, 1-2 Oct 2003; CHIKINDZONOT: Chikindzonot, 11 Sep 2003, 6 Oct 2003; CHUMAYEL: Chumayel, 29 Aug 2003, 2-5, 22 Sep 2003, 10, 14-17 Oct 2003; CHOCHOLÁ: Chocholá, 9 Sep 2003, 8 Dec 2003; CONKAL: Conkal, 8, 10 Sep 2003, Xcuyún (N 21°2'7.93", W 89°29'36.98"), 27 Aug 2003; CUNCUNUL: Cuncunul, 22 Oct 2003; DZAN: Dzan, 28-29 Oct 2003; DZEMUL: Dzemul, 10 Dec 2003; DZIDZANTÚN: Dzidzantún, 10 Sep 2003, 15 Oct 2003; DZILAM GONZÁLEZ: Dzilam González, 11 Dec 2003; DZITÁS: Dzitás, 17 Sep 2003; ESPITA: Espita, 13 Nov 2003; HALACHÓ: Cuch-Holoch, 17 Sep 2003, Halachó, 27 Sep 2003; HOCABÁ: Hocabá, 19 Sep 2003; HOCTÚN: Hoctún, 10 Nov 2003; HUNUCMÁ: Hunucmá, 26 Aug 2003, 29 Sep 2003, Texan Palomeque (N 20°55'50'37", W 89°49'42.34"), 28 Sep 2003 ; IZAMAL: Izamal, 1 Sep 2003; KAUA: Kaua, 18 Sep 2003; KANASÍN: Fraccionamiento Héctor Victoria, 30 Oct 2003, Kanasín, 14 Aug 2003, 1 Oct 2003; KANTUNIL: Holcá, 25 Sep 2003; KOPOMÁ: Kopomá, 26 Sep 2003, 8 Dec 2003; MANÍ: Maní, 18 Aug 2003, 1-2 Dec 2003, Tipikal, 10 Dec 2003; MÉRIDA: Colonia Amalia Solórzano, 2 Oct 2003, 30 Sep 2003, Colonia Amapola, 12 Nov 2003, Colonia Benito Juárez, 23 Sep 2003, Colonia Buenavista, 19 Nov 2003, Camara Construcción, 2 Dec 2003, Caucel, 4 Sep 2003, Centro, 24 Nov 2003, Fraccionamiento Chenkú, 26 Nov 2003, Cholul, 4 Sep 2003, 11 Nov 2003, Mérida, 21 Nov 2003, Colonia Sarmiento, 8 Oct 2003, Dzityá, 8 Oct 2003, Colonia Itzimná, 12 Dec 2003, Fraccionamiento Juan Pablo, 15 Dec 2003, Colonia Mulsay, 2 Dec 2003, Colonia Nueva Chichén, 23 Sep 2003, Fraccionamiento San Jose Vergel, 22, 25, 29 Aug 2003, Fraccionamiento Terranova, 21, 28 Nov 2003, Fraccionamiento Vergel, 8 Dec 2003, Fraccionamiento Vergel II, 8 Sep 2003, 25 Nov 2003, Fraccionamiento Vergel III, 8 Dec 2003, Fraccionamiento Vergel IV, 17 Sep

2003, 11 Dec 2003; MUXUPIP: Muxupip, 28 Aug 2003, 18 Sep 2003, 27 Nov 2003; OPICHEN: Calcehtok, 20 Aug 2003; OXKUTZCAB: Cooperativa, 12-14, 18 Nov 2003, Xohuayán, 13 Nov 2003, Yaxhachén, 6, 11-12 Nov 2003; PETO: Peto, 12, 16-17 Sep 2003, Xoy (N 20°7'31.99", W 88°58'48.31"), 2 Oct 2003; PROGRESO: Chicxulub Puerto, 9 Aug 2003, Chuburná Puerto, 19 Sep 2003, Fraccionamiento Campestre Flamboyanes, 18 Sep 2003, Hacienda San Ignacio, 28-29 Aug 2003; SAMAHIL: San Antonio Tedzidz, 27, 31 Oct 2003; SANTA ELENA: Santa Elena, 23-26 Sep 2003; SOTUTA: Sotuta, 20 Oct 2003, Tibolón, 21 Oct 2003; SUMA: Suma, 3 Sep 2003; TAHDZIÚ: Tahdziú, 18, 23, 25, 30 Sep 2003, 5, 9, 13-14 Oct 2003, 3, 6 Nov 2003; TEABO: Teabo, 21-22, 26-29 Aug 2003, 15, 24 Oct 2003; TEKANTÓ: Tekantó, 9 Sep 2003; TEKAX: Huntochac, 3 Sep 2003, Kancab, 6, 25 Nov 2003, Mesatunich (N 19°49'39.59", W 89°25'46.62"), 2 Sep 2003, Pencuyut, 1-2, 7 Oct 2003, San Isidro Maquian, 2 Sep 2003, San Isidro Yaxche (N 19°53'38.75", W 89°26'57.13"), 3 Sep 2003, San Juan Tekax (N 19°43'8.16", W 89°27'1.63"), 27 Aug 2003, Tekax, 19 Sep 2003, Xayá, 1-3, 6-9 Oct 2003, San Pedro Xtoquil (N 19°46'4.24", W 89°26'39.36"), 27 Aug 2003; TEKOM: Tekom, 22-24 Sep 2003; TEMAX: Temax, 13 Nov 2003; TICUL: Colonia Obrera, 17 Nov 2003, Pustunich, 29-30 Sep 2003, 6 Oct 2003, Barrio San Juan, 27 Oct 2003, 3 Nov 2003, Barrio San Román, 24 Nov 2003, Barrio Santiago, 6 Nov 2003, Ticul, 5, 10, 29 Sep 2003, 4 Nov 2003, Yotholín, 29 Sep 2003, 13, 15 Oct 2003; TINUM: Piste, 20-21 Oct 2003; TIXCACALCUPUL: Tixcacalcupul, 24 Sep 2003; TIXKOKOB: Ekmul, 22 Sep 2003, 1-3 Dec 2003, Ruinas de Aké (N 20°56'16.57", W 89°17'50.91"), 2 Dec 2003; TIZIMÍN: Popolnah, 3 Sep 2003, Tizimín, 5-6, 11, 17-19, 24 Nov 2003, 2, 10 Dec 2003; TZUCACAB: Tantankin, 29 Aug 2003, Tzucacab, 1 Oct 2003, 25 Sep 2003, 27, 29 Aug 2003; UAYMA: Uayma, 15 Aug 2003, 15 Oct 2003; UMÁN: Umán, 19 Aug 2003, 5, 8 Sep 2003; VALLADOLID: Valladolid, 17 Aug 2003, 25 Sep 2003, 9 Oct 2003, Xocempich, 27 Nov 2003; XOCCHEL: Xocchel, 19 Sep 2003; YAXCABÁ: Libre Unión, 9 Dec 2003, Yaxunáh, 7 Oct 2003.

Culex (Culex) interrogator Dyar and Knab

Material Examined: BOKOBÁ: Bokobá, 11 Oct 2003; BUCTZOTZ: Buctzotz, 30 Sep 2003, 13-14 Oct 2003; CANTAMAYEC: Cantamayec, 2 Sep 2003; CELESTÚN: Celestún, 7 Oct 2003; CHACSINKÍN: Chacsinkín, 11-12 Sep 2003; CHEMAX: Chemax, 4 Sep 2003, Xalau, 3 Nov 2003, 8 Dec 2003, Kuxeb, 24 Dec 2003; CHIKINDZONOT: Chikindzonot, 11 Sep 2003; CHUMAYEL: Chumayel, 2, 29 Sep 2003, 15-16 Oct 2003, CUNCUNUL: Cuncunul, 2 Oct 2003; DZIDZANTÚN: Dzidzantún, 10 Sep 2003; CHOCHOLÁ: Chocholá, 8 Dec 2003; HUNUCMÁ: Hunucmá, 26 Aug 2003; IZAMAL: Izamal, 1 Sep 2003; KAUA: Kaua, 18 Sep 2003; KANASÍN: Kanasín, 14 Aug 2003, 1 Oct 2003; KANTUNIL: Holcá, 25 Sep 2003; MANÍ: Maní, 28 Nov 2003; MÉRIDA: Colonia Amalia Solórzano, 30 Sep 2003, Colonia Benito Juárez, 23 Sep 2003, Camara Construcción, 2 Dec 2003, Fraccionamiento Chenkú, 27 Dec 2003, Colonia Chichén Itzá, 25 Sep 2003, Cholul, 4 Sep 2003, Mérida, 21 Nov 2003, 3 Dec 2003, Colonia Itzimná, 12 Dec 2003, Fraccionamiento Vergel, 8 Dec 2003, Fraccionamiento Vergel II, 25 Nov 2003, Fraccionamiento Vergel III, 12 Sep 2003; MUXUPIP: Muxupip, 18 Sep 2003, 27 Nov 2003; OPICHEN: Calcehtok, 20 Aug 2003; OXKUTZCAB: Cooperativa, 14 Nov 2003, Yaxhachén, 6, 12 Nov 2003; PETO: Xoy, 2 Oct 2003; PROGRESO: Chicxulub Puerto, 9 Aug 2003, 9 Sep 2003; SOTUTA: Tibolón, 21 Oct 2003; TAHDZIÚ: Tahdziú, 18 Sep 2003; 5, 9 Oct 2003, 9, 12 Nov 2003; TEABO: Teabo, 21-22 Aug 2003, 14-15 Oct 2003; TEKAX: Kancab, 25 Nov 2003, San Isidro Maquian, 2 Sep 2003, San Juan Tekax, 27 Aug 2003, Xayá, 1-3 Oct 2003; TEKOM: Tekom, 22 Sep 2003; TICUL: Pustunich, 29 Sep 2003, Barrio San Juan, 3 Nov 2003, Yotholín, 29 Sep 2003, 15 Oct 2003; TIXKOKOB: Ekmul, 1-2 Dec 2003; TIZIMÍN: Tizimín, 6, 19 Nov 2003, 10-11 Dec 2003; UAYMA: Uayma, 10 Sep 2003; UMÁN: Umán, 9 Sep 2003; VALLADOLID: Valladolid, 25 Sep 2003, 26 Nov 2003.

Culex (Culex) nigripalpus, Theobald

Material Examined: ACANCEH: Acanceh, 14 Dec 2003; BUCTZOTZ: Buctzotz, 30 Sep 2003, 13-14 Oct 2003; CANSAHCAB: Cansahcab, 18 Dec 2003; CANTAMAYEC: Cantamayec, 2, 8-9 Sep 2003, 22 Oct 2003; CELESTÚN: Celestún, 4 Oct 2003; CHACSINKÍN: Chacsinkín, 11-12, 15 Sep 2003; CHAPAB: Citincabchén, 4 Sep 2003; CHEMAX: Chemax, 2 Sep 2003, Xalau, 8 Dec 2003; CHICHIMILÁ: Chichimilá, 2 Oct 2003; CHUMAYEL: Chumayel, 2-3 Sep 2003; CUNCUNUL: Cuncunul, 22 Oct 2003; DZAN: Dzan, 28 Oct 2003; DZIDZANTÚN: Dzidzantún, 15 Oct 2003;

DZITÁS: Dzitás, 17 Sep 2003, 23 Oct 2003; HOCABÁ: Hocabá, 19 Sep 2003; HOCTÚN: Hoctún, 10 Nov 2003; KAUA: Kaua, 18 Sep 2003; KANASÍN: Fraccionamiento Héctor Victoria, 30 Oct 2003; KANTUNIL: Holcá, 25 Sep 2003; MÉRIDA: Colonia Amapola, 12 Nov 2003, Colonia Buenavista, 19 Nov 2003, Centro, 10 Oct 2003, Fraccionamiento Chenkú, 26 Nov 2003, Colonia Chichén Itzá, 25 Sep 2003, Mérida, 21 Nov 2003, Dzityá, 8 Oct 2003, Colonia Itzimná, 12 Dec 2003, Fraccionamiento Lindavista, 17 Nov 2003, Fraccionamiento Residencial Pensiones, 16 Oct 2003, Fraccionamiento Vergel, 3, 8 Dec 2003, Fraccionamiento Vergel II, 4 Dec 2003, Fraccionamiento Vergel III, 8-9 Dec 2003, Fraccionamiento Vergel 65, 5 Dec 2003; MUXUPIP: Muxupip, 27 Nov 2003; OPICHEN: Calcehtok, 20 Aug 2003; OXKUTZCAB: Yaxhachén, 12 Nov 2003; SAMAHIL: San Antonio Tedzidz, 27 Oct 2003; SANTA ELENA: Santa Elena, 25 Sep 2003; SOTUTA: Sotuta, 20 Oct 2003; TAHDZIÚ: Tahdziú, 21 Sep 2003; TAHMEK: Tahmek, 5, 9, 14 Oct 2003, 5-6 Nov 2003; TEABO: Teabo, 21 Aug 2003, 10 Oct 2003; TEKAX: San Isidro Maquian, 2 Sep 2003, Tekax, 19 Sep 2003, Xayá, 1-3 Oct 2003; TEKOM: Tekom, 22 Sep 2003; TEMAX: Temax, 13 Nov 2003; TICUL: Colonia Obrera, 14 Nov 2003, Barrio San Román, 10 Nov 2003, Barrio San Juan, 3 Nov 2003; TINUM: Piste, 20 Oct 2003; TIXCACALCUPUL: Tixcacalcupul, 24 Sep 2003; TIXKOKOB: Ekmul, 1-2 Dec 2003; TIZIMÍN: Tizimin, 5-6, 19 Nov 2003, 11 Dec 2003; VALLADOLID: Valladolid, 22, 25 Sep 2003, Xocempich, 27 Nov 2003; XOCCHEL: Xocchel, 19 Oct 2003; YAXCABÁ: Yaxunáh, 7 Oct 2003.

Culex (Culex) quinquefasciatus (Say)

Material Examined: BUCTZOTZ: Buctzotz, 13 Oct 2003; CANTAMAYEC: Cantamayec, 2, 5, 10 Sep 2003; CELESTÚN: Celestún, 26 Aug 2003, 3, 6-7 Oct 2003; CHACSINKÍN: Chacsinkín, 15 Sep 2003; CHAPAB: Citincabchén, 4 Sep 2003, 27 Oct 2003; CHEMAX: Chemax, 4 Sep 2003; CHICHIMILÁ: Chichimilá, 1, 15 Oct 2003; CHUMAYEL: Chumayel, 24 Aug 2003, 3 Sep 2003, 15 Oct 2003; CUNCUNUL: Cuncunul, 22 Oct 2003; DZIDZANTÚN: Dzidzantún, 15 Oct 2003; DZILAM GONZÁLEZ: Dzilam González, 11 Oct 2003; DZITÁS: Dzitás, 17 Sep 2003; ESPITA: Espita, 13 Nov 2003; CHOCHOLÁ: Chocholá, 8 Dec 2003; HOCABÁ: Hocabá, 19 Sep 2003; HUNUCMÁ: Hunucmá, 26 Aug 2003; KAUA: Kaua, 18 Sep 2003; KANASÍN: Kanasín, 14 Aug 2003, 1 Oct 2003; KOPOMÁ: Kopomá, 26 Sep 2003; MANÍ: Maní, 2 Dec 2003; MÉRIDA: Colonia Amalia Solórzano, 30 Sep 2003, Colonia Amapola, 12 Nov 2003, Colonia Benito Juárez, 23 Sep 2003, Caucel, 4 Sep 2003, Centro, 24 Nov 2003, Fraccionamiento Chenkú, 26 Nov 2003, Colonia Chichén Itzá, 25 Sep 2003, Cholul, 4 Sep 2003, Mérida, 21 Nov 2003, 3 Dec 2003, Colonia Itzimná, 12 Dec 2003, Fraccionamiento Lindavista, 7 Nov 2003, Fraccionamiento Vergel, 11 Sep 2003, Fraccionamiento Vergel I, 5 Dec 2003, Fraccionamiento Vergel II, 25 Nov 2003, 4 Dec 2003, Fraccionamiento Vergel III, 12 Sep 2003, 5, 9-8 Dec 2003, Fraccionamiento Vergel 65, 11 Sep 2003, 5 Dec 2003, Colonia Vicente Solís, 15 Sep 2003; MUXUPIP: Muxupip, 27 Nov 2003, 18 Sep 2003, 28 Aug 2003; OPICHEN: Calcehtok, 20 Aug 2003; OXKUTZCAB: Cooperativa, 13 Nov 2003, Yaxhachén, 6 Nov 2003; PETO: Peto, 12 Sep 2003; PROGRESO: Chuburná Puerto, 19 Sep 2003, Fraccionamiento Campestre Flamboyanes, 18 Sep 2003, Hacienda San Ignacio, 29 Aug 2003, Progreso, 2 Oct 2003; RÍO LAGARTOS: Río Lagartos, 12 Nov 2003; SAMAHIL: San Antonio Tedzidz, 27 Dec 2003; SANTA ELENA: Santa Elena, 23-26 Sep 2003; SOTUTA: Sotuta, 20-21 Oct 2003, Tibolón, 21 Oct 2003; TAHDZIÚ: Tahdziú, 19 Sep 2003; TAHMEK: Tahmek, 5, 9, 13-14 Oct 2003, 5-6, 9 Nov 2003; TEABO: Teabo, 21-22, 27 Aug 2003, 10, 14-15, 24 Oct 2003; TEKANTÓ: Tekantó, 9 Sep 2003; TEKAX: Huntochac, 3 Sep 2003, Xayá, 2-3 Oct 2003; TEKIT: Tekit, 8 Nov 2003; TEKOM: Tekom, 22 Sep 2003; TICUL: Pustunich, 29-30 Sep 2003, Barrio San Juan, 3, 8 Nov 2003, Barrio San Román, 8 Nov 2003, Fraccionamiento Santamaria, 3 Nov 2003, Barrio Santiago, 7 Nov 2003, Ticul, 5 Sep 2003, 30 Oct 2003, 12 Nov 2003, Yotholín, 29 Sep 2003; TIXKOKOB: Ekmul, 22 Sep 2003, 1-3 Dec 2003; TIZIMÍN: Popolnah, 3 Sep 2003, Tizimin, 6, 17, 19 Nov 2003, 1-2, 10-11 Dec 2003; UMÁN: Umán, 19 Aug 2003, 5, 9 Sep 2003; YAXCABÁ: Libre Unión, 9 Dec 2003.

Culex (Culex) thriambus Dyar

Material Examined: BOKOBÁ: Bokobá, 8 Sep 2003, 11, 14 Oct 2003; CACALCHÉN: Cacalchén, 11 Sep 2003; CANSAHCAB: Cansahcab, 3 Sep 2003; CANTAMAYEC: Cantamayec, 2, 5, 10 Sep 2003; CELESTÚN: Celestún, 26 Aug 2003; CHACSINKÍN: Chacsinkín, 12 Sep 2003; CHEMAX: Chemax, 4 Sep 2003; CHIKINDZONOT: Chikindzonot, 11 Sep 2003; CHUMAYEL: Chumayel, 2 Sep

2003; DZIDZANTÚN: Dzidzantún, 10 Sep 2003; DZITÁS: Dzitás, 17 Sep 2003; HALACHÓ: Cuch-Holoch, 17 Sep 2003, Halachó, 17, 27 Sep 2003; HUNUCMÁ: Hunucmá, 2, 26 Aug 2003, 9 Sep 2003, Texam Palomeque, 28 Sep 2003; IZAMAL: Izamal, 1 Sep 2003; KANASÍN: Kanasín, 14 Aug 2003, 1 Oct 2003; KANTUNIL: Holcá, 25 Sep 2003; KOPOMÁ: Kopomá, 26 Sep 2003; MÉRIDA: Colonia Amalia Solórzano, 30 Sep 2003, 1 Oct 2003, Colonia Benito Juárez, 23 Sep 2003, Caucel, 4 Sep 2003, Cholul, 4 Sep 2003, Colonia Miraflores, 18 Aug 2003, Mérida, 3 Dec 2003, Colonia Nueva Chichén, 23 Sep 2003, Fraccionamiento San Jose Vergel, 22, 25 Aug 2003, Fraccionamiento Vergel, 10-11 Sep 2003, Fraccionamiento Vergel II, 8, 21 Sep 2003, Fraccionamiento Vergel III, 12-11 Sep 2003, Fraccionamiento Vergel IV, 17 Sep 2003, Fraccionamiento Vergel 65, 11 Sep 2003; MOTUL: Motul (N 21°4'41.14', W 89°16'41.48"), 21 Aug 2003; MUXUPIP: Muxupip, 28 Aug 2003, 18 Sep 2003; OPICHEN: Calcehtok, 20 Aug 2003; OXKUTZCAB: Cooperativa, 14 Nov 2003, Yaxhachén, 6, 11 Nov 2003; PROGRESO: Chicxulub Puerto, 9 Aug 2003, Chuburná Puerto, 19 Sep 2003, Fraccionamiento Campestre Flamboyanes, 18 Sep 2003, Progreso, 2 Oct 2003, Hacienda San Ignacio, 28-29 Aug 2003; SAMAHIL: San Antonio Tedzidz, 27 Oct 2003; SANTA ELENA: Santa Elena, 23 Sep 2003; SUMA: Suma, 3 Sep 2003; TAHDZIÚ: Tahdziú, 18, 21, 23 Sep 2003; TEABO: Teabo, 22 Aug 2003; TEKANTÓ: Tekantó, 9 Sep 2003; TEKAX: Xayá, 3, 9 Oct 2003; TICUL: Carretera Estatal, 26 Sep 2003, Barrio San Juan, 3, 15 Nov 2003, Yotholín, 13 Oct 2003; TIXKOKOB: Ekmul, 22 Sep 2003, 3 Dec 2003; TIXMEHUAC: Chicam, 24 Oct 2003; UMÁN: Umán, 19 Aug 2003, 5, 9 Sep 2003.

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NEW RECORDS AND CLARIFICATIONS OF THE PENNSYLVANIA STONEFLY (PLECOPTERA) FAUNA, WITH AN ANNOTATED LIST OF THE STONEFLIES OF PENNSYLVANIA, U.S.A.[1]

Jane I. Earle[2]

ABSTRACT: Five species, *Nemoura trispinosa* Claassen, *Strophopteryx appalachia* Ricker and Ross, *Alloperla biserrata* Nelson and Kondratieff, *Neoperla robisoni* Poulton and Stewart, and *Neoperla choctaw* Stark and Baumann, are added to the Pennsylvania fauna. Five species, *Allocapnia wrayi* Ross, *Leuctra carolinensis* Claassen, *Tallaperla anna* (Needham and Smith), *Tallaperla elisa* Stark, and *Malirekus hastatus* (Banks) are deleted. An annotated list of the 133 described Pennsylvania stonefly species is presented.

KEY WORDS: Stoneflies, Plecoptera, Pennsylvania (U.S.A.), new records, clarifications, ecoregions

Surdick and Kim (1976) published the first definitive review of the Pennsylvania stonefly fauna, recording 90 species in nine families and 32 genera. Stark et al. (1986) reported 94 species in Pennsylvania. Earle (1994) added 14 species and deleted four species previously added in error. Masteller (1996a) added 17 species, deleted five species, and presented an annotated list of Pennsylvania species that included 131 described species plus three undescribed *Isoperla* species. Grubbs and Stark (2001) added two *Perlesta* species, *P. nelsoni* Stark and *P. teaysia* Kirchner and Kondratieff, bringing the Pennsylvania list to 133 described species.

Five species are added herein to the Pennsylvania list: *Nemoura trispinosa* Claassen, *Strophopteryx appalachia* Ricker and Ross, *Alloperla biserrata* Nelson and Kondratieff, *Neoperla robisoni* Poulton and Stewart, and *Neoperla choctaw* Stark and Baumann. Five species added in error are deleted: *Allocapnia wrayi* Ross, *Leuctra carolinensis* Claassen, *Tallaperla anna* (Needham and Smith), *Tallaperla elisa* Stark, and *Malirekus hastatus* (Banks). With these additions and deletions, the Pennsylvania stonefly fauna total remains at 134 described species; however, since several more soon to be described species will be added to the Pennsylvania list within the next few years, the Pennsylvania species list could approach 140.

Collections of new species records presented are by the author. New county records are capitalized. An annotated list of Pennsylvania species is presented in Table 1. Voucher specimens will be placed at the Academy of Natural Sciences of Philadelphia. Ecoregion information is from Woods et al. (1996).

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ADDITIONS

Nemouridae: ***Nemoura trispinosa:*** MONROE COUNTY: Red Run, Industrial Road (41°07' 42"N, 75°22'48"W), one female, May 15, 2003. This is a small, low gradient stream with a swampy riparian area. Red Run is in the Pocono High Plateau section of the North Central Appalachians Ecoregion, which is a low relief, forested highland with many lakes and low gradient streams with few riffles (Woods et al. 1996). *N. trispinosa* is distributed across the northern US and Canada, west to Manitoba and Wyoming and south to Ohio (Stark 2001).

Taeniopterygidae: ***Strophopteryx appalachia:*** HUNTINGDON COUNTY: Shade Creek near Orbisonia (40°12'19"N, 77°52'39"W), one male, April 25, 1994; FULTON COUNTY: Tonoloway Creek, SR 2005 (39°43'41"N, 78°09'08"W), 28 March 2003, 6 males; Sideling Hill Creek, PA Route 484 (39°44'35"N, 78°21' 33"W), 28 March 2003, one male and one female; BEDFORD COUNTY: Town Creek at Blues Gap Road (39°46'45"N, 78°30'12"W), one female. Shade Creek is a 3rd order limestone influenced stream in the Susquehanna River basin; the other streams are 4th order streams in the Potomac River basin. All are within the Ridge and Valley Ecoregion. The two northeastern species of *Strophopteryx* are apparently sympatric at least through part of their range, since one male *Strophopteryx fasciata* (Burmeister) was collected at the Tonoloway Creek site and from another nearby stream, Little Tonoloway Creek. Stewart (2000) reported that *S. appalachia* is found in the Appalachian Mountain region from West Virginia south to South Carolina. A northern range extension of *S. appalachia* into the Potomac River basin Maryland was recorded by Grubbs (1997). This record extends the northern limit of this species into southcentral Pennsylvania and the lower edge of the Susquehanna River basin. No other specimens of *S. appalachia* have so far been identified from farther north in Pennsylvania.

Chloroperlidae: ***Alloperla biserrata:*** BEDFORD COUNTY, Blackberry Lick Creek, PA, Route 26 (39°47'05"N, 78°24'23"W), one male, May 17, 2002. Blackberry Lick Creek is a 2nd order, largely forested stream in the Ridge and Valley Ecoregion, Potomac River basin. This is the ninth described species of *Alloperla* now recorded from Pennsylvania. *A. biserrata* was described from collections from several small streams in Virginia (Nelson and Kondratieff 1980). Since the initial description, *A. biserrata* has also been reported from Maryland and West Virginia (Grubbs 1997 and Stark 2001).

Perlidae: The Nearctic *Neoperla* were for many years believed to be one variable, widespread species, *Neoperla clymene* (Newman), until Stark and Baumann (1978) described several new species and removed several others from synonymy with *N. clymene,* resulting in eight North American species. Subsequent researchers described several more species, bringing the total number of North American species to 15 (Stark 1990 and DeWalt et al. 2002). Masteller (1996a) reported 4 species of Neoperla from Pennsylvania, *N. clymene, Neoperla catharae* Stark and Baumann, *Neoperla occipitalis* (Pictet), and *Neoperla stewarti* Stark and Baumann. The following two additional species will bring the Pennsylvania Neoperla species total to six.

Neoperla robisoni: BERKS COUNTY: Maiden Creek, PA, Route 143, ½ mile north of I-78 (40°34'55"N, 75°53'27"W) one male, June 27, 2000; PERRY COUNTY: Susquehanna River, Marysville (40°21'04"N, 76°55'51"W), one male, July 17, 1993 and one male July 25, 1998; Juniata River, Greenwood boat access (40°31'48"N, 77°08'33"W) one male, June 24, 1994. All locations are in the Ridge and Valley Ecoregion. *N. robisoni* was described by Poulton and Stewart from the Ozark Mountains (Ernst et al. 1986). These Pennsylvania records represent a range extension farther northeast from the previous northern limit, the Potomac River in Maryland (Grubbs 1997) and into the Susquehanna and Delaware River basins of Pennsylvania. The Pennsylvania and Maryland collections of *N. robisoni* are from medium to large, swift, rocky creeks and rivers. The other records are from large, lowland streams in the southeastern United States, from Mississippi to Tennessee (Grubbs 1997).

Neoperla choctaw: CUMBERLAND COUNTY: Conodoguinet Creek, Mountain Road (40°09'06"N, 77°30'00"W), 3 females, August 6, 1998. PERRY COUNTY: Susquehanna River, Marysville (40°21'04"N, 76°55'51"W) one female with eggs, July 13, 2002. The Pennsylvania habitats are large warm water creeks and rivers in the Ridge and Valley Ecoregion of the Susquehanna River basin. These records extend the distribution of *N. choctaw* north from its previously reported distribution of Arkansas, Missouri, Oklahoma, and West Virginia (Stark 2001). *N. choctaw* adults have distinctive coloring; the wings are dark brown to black and the body is checkered black and orange.

DeWalt et al (2002) reported that *Neoperla* are found in relatively clean streams and that 4 of the 7 species historically known from Illinois are now extirpated and 2 others have had significant reductions in range. The presence of the six *Neoperla* species currently in Pennsylvania is a testament to the good quality water of many of our larger creeks and rivers. *Neoperla,* however, have been under-collected as both nymphs and adults in Pennsylvania. Additional collecting in their preferred habitat should provide a better picture of their true distribution and abundance in Pennsylvania.

CORRECTIONS

Stark (2001) and Stewart and Stark (2002) presented compilations of state records for the North American stonefly species. Not all the additions and deletions presented in Earle (1994) and Masteller (1996a) were reflected in their lists. I present the following corrections to the Pennsylvania stonefly list based on review of publications that included PA species records and examination of questionable species believed to be misidentifications. Only misidentifications or species listed in error will be discussed below. An annotated species list is presented in Table 1.

Capniidae: Kondratieff and Kirchner (1982) described *Allocapnia wrayi* as a common winter stonefly east of the Appalachian Mountains ranging from Maryland to Georgia. Ross and Ricker (1971) described *A. wrayi* as a coastal plain species. *A. wrayi* was added to the Pennsylvania stonefly list by Masteller

(1996a and b) based on collections from 3 streams, two east and one west of the Appalachians. Specimens from these three locations have been examined and determined to be misidentifications of either *Allocapnia pygmaea* (Burmeister) or *Allocapnia recta* (Claassen). In addition, extensive sampling for winter stoneflies throughout Pennsylvania has not yielded any additional specimens of *A. wrayi*. *A. wrayi* should, therefore, be deleted from the Pennsylvania stonefly list.

Surdick and Kim (1976) listed several locations for *Paracapnia opis* (Newman) from collections made in 1937. For many years, the two *Paracapnia* species had been confused and described under several names until the description of *Paracapnia angulata* Hanson in 1961 (Hitchcock 1974). No additional *P. opis* adults have been identified from Pennsylvania; therefore, *P. opis* should not be considered part of the PA stonefly fauna.

Leuctridae: Surdick and Kim (1976) placed *Leuctra carolinensis* on the Pennsylvania species list based on five males and one female collected from one stream in Lackawanna County in northeastern Pennsylvania in 1945. I examined these specimens and identified them as *Leuctra tenella* Provancher. Masteller (1996a) added an additional *L. carolinensis* record based on collections from one stream in Tioga County in northcentral Pennsylvania by visiting scientists from the southeastern U.S. where *L. carolinensis* is a common species. *L. tenella* and *L. carolinensis* are similar species that have been confused and listed in error in other states (Kondratieff et al. 1995). Since *L. carolinensis* is considered a southern Appalachian species distributed from Maryland south to South Carolina (Stark 2001 and Kondratieff et al. 1995) and no additional specimens have been discovered in Pennsylvania after many years of sampling, *L. carolinensis* should be deleted from the PA list.

Peltoperlidae: *Tallaperla anna* was added to the Pennsylvania list in error and should be deleted. *T. anna* is restricted to the southern Appalachian Mountains of Virginia, North Carolina, South Carolina, and Georgia (Stark 2000). *T. anna* was included on the Pennsylvania species list in Surdick and Kim (1976) based on a collection from one stream in Luzerne County in northeastern Pennsylvania in 1949. Stark (personal communication) believes that he examined these specimens during his review of *Tallaperla* and identified them as *Tallaperla maria* (Needham and Smith). The National Museum of Natural History (Smithsonian Institution, Washington, DC), which is listed as the repository for the Pennsylvania specimen, has no current record of a *T. anna* from Pennsylvania (O.S. Flint, Smithsonian Institution, pers. comm.). No additional *Tallaperla* adults have been identified as *T. anna* since the 1949 collection. Considering the confirmed limited southern distribution, lack of additional records, and the difficulty of separating the very similar *Tallaperla* species, *T. anna* should be deleted from the Pennsylvania species list.

Tallaperla elisa was also added to the Pennsylvania list in error. Masteller (1996a) included *T. elisa* on his Pennsylvania stonefly list based on collections from one stream, Lyman Run, Tioga County in northcentral Pennsylvania by visiting scientists from the southern Appalachians. I collected several male *Talla-*

perla from Lyman Run and several nearby streams in May 1998, all of which were identified as *T. maria.* The Lyman Run *T. elisa* specimens were reexamined by the original collector who now believes that they are *T. maria* (C.H. Nelson, personal communication). *T. elisa* has been confirmed from only high elevation streams along the North Carolina and Tennessee border (Stark 2000 and personal communication). Additionally, Kondratieff et al (1995) considered *T. elisa* to so be rare through its range as to be considered for endangered species status. *T. elisa,* therefore, should be deleted from the Pennsylvania species list.

Grubbs (1997) included *T. elisa* as part of the stonefly fauna of Maryland; however, this record was based on nymphs and exuvia reported from one Maryland stream in Duffield and Nelson (1993). Since *Tallaperla* nymphs cannot be reliably identified to species and Grubbs did not collect any additional specimens in Maryland, *T. elisa* should not be considered part of the Maryland fauna.

Perlodidae: *Yugus bulbosus* (Frison) was the only Pennsylvania *Yugus* species included in Masteller (1996a). The revision of the genus by Nelson (2001) described two new species in the *Y. bulbosus* complex. Nelson described the distribution of *Y. bulbosus* as the southern Appalachians of Georgia, North Carolina, and Tennessee, the distribution of one of the new species, *Yugus kondratieffi* Nelson, as Virginia and North Carolina, and the distribution of the other new species, *Yugus kirchneri* Nelson, as Pennsylvania, West Virginia, and Virginia. *Yugus* adults are extremely elusive; the only confirmed Pennsylvania adult records are from Powdermill Run in Westmoreland County in southwestern Pennsylvania (Masteller 1996b), which Nelson examined and confirmed as *Y. kirchneri.* Nelson confirmed an additional Pennsylvania record for *Y. kirchneri,* a nymph collected in POTTER COUNTY, Bell Branch (41°29'00"N, 77°53' 39"W), 14 May 1976.

Pennsylvania was included in the distribution list for *Yugus arinus* (Frison) in Stewart and Stark (2002). This listing is believed to be based on an erroneous listing in Stark et al. (1986) and was deleted by Earle (1994). The only confirmed Pennsylvania species of *Yugus,* therefore, should be *Y. kirchneri.*

Surdick and Kim (1976) listed two species of *Isogenoides: Isogenoides doratus* (Frison) and *Isogenoides hansoni* (Ricker) in Pennsylvania. The *I. doratus* record in Surdick and Kim (1976) was based on collections by Jennings in 1942 and published in Frison (1942). Ricker (1952) described a new species, *I. hansoni,* using the Jennings Pennsylvania specimens and location as the holotype and type locality. Ricker (1952) stated that *I. doratus* was a Midwestern United States species. In addition to the above two *Isogenoides* species, Stark (2001) and Stewart and Stark (2002) also included *Isogenoides olivaceus* (Walker) as part of the Pennsylvania fauna. I have not found any records of this species in Pennsylvania in the literature or collections. Ricker (1952) listed the distribution of *I. olivaceus* as northern Wisconsin, Michigan, Ontario and Quebec. Minnesota is the only additional valid state record for this species in Stewart and Stark (2002). *I. hansoni* should be considered the only valid *Isogenoides* species in Pennsylvania.

Malirekus was considered a monotypic genus until the revision by Stark and Szczytko (1988) that established a new species, *Malirekus iroquois* Stark and Szczytko. They considered the two species to be allopatric, with *M. hastatus* occurring in the southeastern U.S. and *M. iroquois* in the northeastern U.S. and Canada, but cautioned that additional specimens from the mid-Atlantic region would need to be examined to determine the north-south limits of these two species. Grubbs (1997) did not find any *M. hastatus* in Maryland and suggested the North Branch Potomac River in West Virginia as the northern limit of *M. hastatus.*

The only published Pennsylvania record of *M. hastatus* is from the Stroud Research Center in Chester County Pennsylvania (Masteller 1996b), which was a reared specimen of questionable origin (D. Funk, Stroud Research Center, pers. comm.). *Malirekus* adults are rarely collected; however, nymphs are regularly collected from small streams throughout Pennsylvania. No adults collected so far in Pennsylvania have been positively identified as *M. hastatus. Malirekus* females are difficult to verify without examination of the eggs; however, the subgenital plates of the Pennsylvania females are consistent with *M. iroquois* (B.P. Stark pers. comm.). All nymphs collected so far in Pennsylvania have lacked the submental gills described by Stark and Szczytko (1998) as present on nymphs of southern populations of *M. hastatus. M. hastatus* should, therefore, be deleted from the PA stonefly list. New confirmed Pennsylvania records of *M. iroquois* are as follows: SULLIVAN COUNTY, Painter Run (41°19'22"N, 76°27'16"W), one male, May 29, 1977 (listed as *M. hastatus* in Kondratieff 2004); TIOGA COUNTY, unnamed tributary to Babb Creek at old village of Landrus (41°38' 20"N, 77°12'25"W), one late instar male nymph with visible genitalia, June 16, 1993; WESTMORELAND COUNTY, Roaring Run, near Camp Alliquippa (40° 04'09"N, 79°20'39"W, 21 May 1997, one female.

Pteronarcyidae: Nelson (2000) in Volume I of the series *Stoneflies (Plecoptera) of Eastern North America* listed the distribution of *Pteronarcys scotti* Ricker, one of the six Eastern North American *Pteronarcys* species, as Georgia, North Carolina, Pennsylvania, South Carolina, Tennessee, and Virginia. This inclusion of *P. scotti* as part of the Pennsylvania fauna was based on Surdick and Kim (1976) who listed a record of *P. scotti* nymphs from one Pennsylvania stream. Masteller (1996b) reported that *P. scotti* was added in error and he did not include it in his list of the Pennsylvania stonefly fauna. No adult *P. scotti* have been collected in Pennsylvania to confirm its presence, or from the adjacent states of Maryland and West Virginia (Grubbs 1997). *P. scotti* should, therefore, properly be considered a southern Appalachian species and not part of the Pennsylvania fauna.

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NOTE

The publication of Surdick (2004) after the completion of this paper resulted in a change: *Alloperla petasata* Surdick replaces *Alloperla caudata* Frison in Pennsylvania. The species list accompanying this paper has been adjusted accordingly.

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Table 1. Annotated list of the 134 Pennsylvania stonefly species.

Capniidae
Allocapnia aurora Ricker
Allocapnia curiosa Frison
Allocapnia frisoni Ross and Ricker
Allocapnia granulata (Claassen)
Allocapnia harperi Kirchner
Allocapnia maria Hanson
Allocapnia nivicola (Fitch)
Allocapnia pechumani Ross and Ricker
Allocapnia pygmaea (Burmeister)
Allocapnia recta (Claassen)
Allocapnia rickeri Frison
Allocapnia simmonsi Kondratieff and Voshell
Allocapnia vivipara (Claassen)
Allocapnia zola Ricker
Paracapnia angulata Hanson

Leuctridae
Leuctra alexanderi Hanson
Leuctra duplicata Claassen
Leuctra ferruginea (Walker)
Leuctra grandis Banks
Leuctra maria Hanson
Leuctra sibleyi Claassen
Leuctra tenella Provancher
Leuctra tenuis (Pictet)
Leuctra truncata Claassen
Leuctra variabilis Hanson
Paraleuctra sara (Claassen)
Megaleuctra flinti Baumann

Nemouridae
Amphinemura appalachia Baumann
Amphinemura delosa (Ricker)
Amphinemura linda (Ricker)
Amphinemura nigritta (Provancher)
Amphinemura wui (Claassen)
Nemoura trispinosa Claassen
Ostrocerca albidipennis (Walker)
Ostrocerca complexa (Claassen)
Ostrocerca prolongata (Claassen)
Ostrocerca truncata (Claassen)
Paranemoura perfecta (Walker)
Prostoia completa (Walker)
Prostoia similis (Hagen)
Soyedina carolinensis Claassen
Soyedina merritti Baumann and Grubbs
Soyedina vallicularia (Wu)
Soyedina washingtoni (Claassen)

Taeniopterygidae
Bolotoperla rossi (Frison)
Oemopteryx contorta (Needham and Claassen)
Strophopteryx appalachia Ricker and Ross
Strophopteryx fasciata (Burmeister)
Taenionema atlanticum Ricker and Ross
Taeniopteryx burksi Ricker and Ross
Taeniopteryx maura (Pictet)
Taeniopteryx metequi Ricker and Ross
Taeniopteryx nivalis (Fitch)
Taeniopteryx parvula Banks
Taeniopteryx ugola Ricker and Ross

Peltoperlidae
Peltoperla arcuata Needham
Tallaperla maria (Needham and Smith)

Chloroperlidae
Alloperla aracoma Harper and Kirchner
Alloperla atlantica Baumann
Alloperla biserrata Nelson and Kondratieff
Alloperla chloris Frison
Alloperla concolor Ricker
Alloperla imbecilla (Say)
Alloperla petasata Surdick
Alloperla usa Ricker
Alloperla vostoki Ricker
Haploperla brevis (Banks)
Rasvena terna (Frison)
Suwallia marginata (Banks)
Sweltsa lateralis (Banks)
Sweltsa naica (Provancher)
Sweltsa onkos (Ricker)
Utaperla gaspesiana Harper and Roy

Perlidae – Acroneuriinae
Acroneuria abnormis (Newman)
Acroneuria arenosa (Pictet)
Acroneuria arida (Hagen)
Acroneuria carolinensis (Banks)
Acroneuria evoluta Klapalek
Acroneuria filicis Frison
Acroneuria frisoni Stark and Brown
Acroneuria lycorias (Newman)
Attaneuria ruralis (Hagen)
Eccoptura xanthenes (Newman)
Hansonoperla appalachia Nelson
Perlesta decipiens (Walsh)
Perlesta nelsoni Stark

Perlesta nitida Banks
Perlesta placida (Hagen)
Perlesta teasyia Kirchner and Kondratieff
Perlinella drymo (Newman)
Perlinella ephyre (Newman)

Perlidae – Perlinae
Neoperla catharae Stark and Baumann
Neoperla choctaw Stark and Baumann
Neoperla clymene (Newman)
Neoperla occipitalis (Pictet)
Neoperla robisoni Poulton and Stewart
Neoperla stewarti Stark and Baumann
Agnetina annulipes (Hagen)
Agnetina capitata (Pictet)
Agnetina flavescens (Walsh)
Paragnetina immarginata (Say)
Paragnetina media (Walker)

Perlodidae – Isoperlinae
Clioperla clio (Newman)
Isoperla bilineata (Say)
Isoperla dicala Frison
Isoperla francesca Harper
Isoperla frisoni Illes
Isoperla holochlora (Klapalek)
Isoperla lata Frison
Isoperla marlynia (Needham and Claassen)
Isoperla montana (Banks)
Isoperla namata Frison
Isoperla nana (Walsh)
Isoperla orata Frison
Isoperla richardsoni Frison
Isoperla signata (Banks)
Isoperla similis (Hagen)
Isoperla slossonae (Banks)
Isoperla transmarina (Newman)

Perlodidae – Perlodinae
Cultus decisus decisus (Walker)
Cultus verticalis (Banks)
Diploperla duplicata (Banks)
Diploperla robusta Stark and Gaufin
Remenus bilobatus (Needham and Claassen)
Helopicus subvarians (Banks)
Isogenoides hansoni (Ricker)
Malirekus iroquois Stark and Szczytko
Yugus kirchneri Nelson

Pteronarcyidae
Pteronarcys biloba Newman
Pteronarcys comstocki Smith
Pteronarcys dorsata (Say)
Pteronarcys pictetii Hagen
Pteronarcys proteus Newman

FIFTY-THREE SPECIES OF TETRIGOIDEA (ORTHOPTERA) FROM CENWANG MOUNTAIN IN THE WESTERN GUANGXI ZHUANG AUTONOMOUS REGION, CHINA[1]

Guo-Fang Jiang[2] and Ge-Qiu Liang[3]

ABSTRACT: In this paper, we provide a checklist of 53 species of Tetrigoidea ground grasshoppers (Cladonotidae, Scelimenidae, Metrodoridae and Tetrigidae) from Cenwang Mountain, the natural reserve located near Tianlin County in the west Guangxi Zhuang Autonomous Region of southwestern China. In addition, the female *Macromotettix serrifemoralis* Zheng et Jiang and the male *Tetrix ruyuanensis* Liang are described for the first time.

KEY WORDS: Tetrigoidea, Cenwang Mountain, Western Guangxi Zhuang Autonomous Region, China, *Macromotettix serrifemoralis* female, *Tetrix ruyuanensis* male

Cenwang Mountain is a forested resort area (2,060 meters elevation) near Tianlin County, approximately 40 kilometers north of the city of Baise in the west Guangxi Zhuang Autonomous Region of southwestern China. The climate is subtropical, frosts are rare, and rainfall averages around 1,300 mm annually. Average temperatures range from 20.6°C in July to 4.7°C in January (Forestry Department of Guangxi, 1993). The vegetation zone is subtropical mountain broadleaf evergreens (Forestry Department of Guangxi, 1993). Vertical changes in the climate are clear because the mountain is large and steep. The overstory vegetation in the upper region (over 1,800 meters) of the mountain, where the collections were made, consists largely of secondary growth trees, *Quercus nubium, Fagus lucida* (both in the Fagaceae) and *Liquidambar acalycina* (Hamamelidaceae). The vegetation in the lower side of the mountain is very complex, being composed of subtropical middle mountain mixed broadleaf evergreen and deciduous forest (Forestry Department of Guangxi, 1993).

The 53 species of Tetrigoidea reported herein were collected from grassy vegetation near roadsides using a sweep net between 27 May – 5 June 2002 and 14-16 August 2002. The locations visited included the Linao Hill, Weihuo Hill, Cenwang Hill, Yaojiawan Hill, Dadong Hill, Langping, Jiudongping and Laoshan Tree Farm.

The specimens were deposited at the College of Life Sciences, Nanjing Normal University (Nanjing), and at the Institute of Entomology, Zhongshan University (Guangzhou).

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List of species of Tetrigoidea from the Cenwang Mountain, Western Guangxi Zhuang Autonomous Region, China

Taxa are listed alphabetically within each family. For each species listed, except *Tetrix ruyuanensis* Liang and *Macromotettix serrifemoralis* Zheng *et* Jiang, the data is organized as follows: scientific name, author and year, number of males and females, dates, as well as collection localities. The asterisk "*" represents records that have been reported elsewhere in China.

Cladonotidae

***Deltonotus guangxiensis* Liang et Jiang, 2004.** 1♂, 2♀ 14-16 August 2002, Linao Hill (1,400 meter elevation); 3♂, 1♀ Weihuo Hill (1,600m); 1♂, 2♀ Cenwang Hill (1,600-1800m)

***Pseudopitettix linaoshanensis* Liang et Jiang, 2004.** 3♂, 7♀ 14-16 August 2002, Linao Hill (1,400m); 1♀ Weihuo Hill (1,600m); 1♀ Yaojiawan Hill (1,200-1,400m)

Scelimenidae

***Criotettix bispinosus* (Dalman, 1818).** 5♂, 2♀ 27 May–5 June 2002, Dadong Hill (1,400m); 1♂, 3♀ Langping (1,200-1,300m)

***Criotettix curvispinus* Zheng, 1993.** 3♀ 27 May–5 June 2002, Yaojiawan Hill (1,200-1,400m)

***Eucriotettix oculatus* (Bolivar, 1898).** 4♂, 2♀ 27 May–5 June 2002, 14-16 August 2002, Linao Hill (1,400m); 3♂, 5♀Linao Hill (1,200-1,400m); 2♂, 6♀Dadong Hill (1,400m); 4♂, 1♀ Weihuo Hill (1,300m); 3♀ Langping (1,200-1,300m); 4♂ Jiudongping (1,200-1,300m)

***Scelimena melli* Günther, 1937.** 1♂, 3♀ 27 May–5 June 2002, Dadong Hill (1,400m)

***Thoradonta lativertex* Günther, 1938.** 3♂, 4♀ 14-16 August 2002, Linao Hill (1,400m); 2♂, 8♀ Weihuo Hill (1,300m); 4♂, 1♀ Dadong Hill (1,400m); 2♂, 5♀ Langping (1,200m); 2♂ Jiudongping (1,200-1,300m)

***Thoradonta transpicula* Zheng, 1996.** 2♂, 1♀ 27 May–5 June 2002, Dadong Hill (1,400m)

***Thoradonta yunnana* Zheng, 1981.** 2♂ 27 May–5 June 2002, 14-16 August 2002, Weihuo Hill (1,300m); 1♂, 2♀ Linao Hill (1,400m)

***Zhengitettix hainanensis* Liang, 1994.** 2♂, 4♀ 27 May–5 June 2002, 14-16 August 2002, Dadong Hill (1,400m); 1♂, 3♀ Linao Hill (1,400m); 5♂, 2♀ Weihuo Hill (1,300m); 2♂, 1♀ Jiudongping (1,200-1,300m)

* ***Zhengitettix obliquspicula* Zheng et Jiang.** 2♀ 27 May–5 June 2002, Linao Hill (1,200-1,400m); 1♂, 1♀ Dadong Hill (1,400m)

Metrodoridae

***Bolivaritettix circinihumerus* Zheng, 2003.** 7♂, 2♀ 27 May–5 June 2002, Langping (1,200-1,300m)

***Bolivaritettix circocephalus* Zheng, 1992.** 4♂ 14-16 August 2002, Jiudongping (1,200-1,300m); 2♂, 1♀Weihuo Hill (1,300m)

***Bolivaritettix fanjingshanensis* Zheng, 1992.** 3♂, 2♀ 14-16 August 2002, Jiudongping (1,200-1,300m)

***Bolivaritettix ghumtianus* (Hancock, 1915).** 4♂, 5♀ 14-16 August 2002, Linao Hill (1,400m); 2♂, 1♀ Dadong Hill (1,400m); 3♀ Langping (1,200m)

***Bolivaritettix guibeiensis* Zheng et Jiang, 1994.** 6♂, 1♀ 14-16 August 2002, 27 May –5 June 2002, Weihuo Hill (1,300m); 2♂, 3♀ Linao Hill, 1400m; 5♂, 2♀ Jiudongping (1,200-1,300m); 3♀, 7♀ Langping (1,200m)

***Bolivaritettix humerlis* Günther, 1939.** 3♂, 1♀ 27 May –5 June 2002, 14-16 August 2002, Cenwang Hill (1,500-1,800m); 2♂, 5♀Langping (1,200-1,300m); 4♂, 2♀ Linao Hill (1,400m); 1♀ Jiudongping (1,200-1,300m)

Bolivaritettix javanicus **(Bolivar, 1909).** 2♂ 14-16 August 2002, Weihuo Hill (1,600m)

Bolivaritettix lativertex **(Brunner von Wattenwyl, 1893).** 3♀ 14-16 August 2002, 27 May–5 June 2002, Jiudongping (1,300m); 2♂, 1♀ Weihuo Hill (1,600m); 3♂, 4♀ Dadong Hill (1,400m)

Bolivaritettix longzhouensis **Zheng et Jiang, 1995.** 2♂, 1♀ 14-16 August 2002, Weihuo Hill (1,600m); 1♂, 4♀ Cenwang Hill (1,400-1,800m)

Bolivaritettix nigritibialis **Zheng, 2002.** 2♂, 4♀27 May –5 June 2002, Langping (1,200-1,300m)

Bolivaritettix sikkinensis **(Bolivar, 1909).** 2♂, 6♀ 14-16 August 2002, Linao Hill (1,400m)

* ***Bolivaritettix tianlinensis*** **Zheng et Jiang, 2004.** 1♂, 2♀ 27 May–5 June 2002, Linao Hill (1,400m)

Bolivaritettix yuanbaoshanensis **Zheng et Jiang, 1995.** 4♂, 3♀ 14-16 August 2002, 27 May–5 June 2002, Linao Hill (1400m); 3♂, 1♀ Laoshan Tree Farm (1,200-1,600m); 2♂ Jiudongping (1,200-1,300m); 4♂, 1♀ Dadong Hill (1,400m); 2♂, 2♀ Cenwang Hill (1,400-1,800m); 1♂, 1♀ Weihuo Hill (1,300m)

Macromotettix serrifemoralis **Zheng et Jiang, 2002.** 3♂, 1♀ 14-16 August 2002, Linao Hill (1,400m) ; 5♀ Jiudongping (1,200-1,300m) ; 6♂, 2♀ Dadong Hill (1,400m) ; 2♂, 1♀Weihuo Hill (1,600m) ; 4♂, 2♀Cenwang Hill (1,400-1,800m) ; 3♂, 2V Yaojiawan Hill (1,200-1,400m) ; 4♂, 6♀ Laoshan Tree Farm (1,400-1,700m). Female described in next section.

Macromotettix tianlinensis **Liang et Jiang, 2004.** 10♀14-16 August 2002, Linao Hill (1,400m); 1♀ Jiudongping (1,200-1,300m); 1♀ Dadong Hill (1,400m)

Macromotettix torulosinota **Zheng et Jiang, 1998.** 2♂, 4♀ 27 May–5 June 2002, Linao Hill (1,400m); 3♂, 2♀ Dadong Hill (1,400m)

Mazarredia huanjiangensis **Zheng et Jiang, 1994.** 2♂, 2♀ 27 May–5 June 2002, Linao Hill (1,400m)

Mazarredia longipennis **Zheng et Jiang, 2004.** 3♂ 27 May–5 June 2002, Linao Hill (1,400m)

Systolederus fujiangsis **Zheng, 1993.** 2♂, 1♀ 27 May–5 June 2002, Linao Hill (1,400m)

Systolederus guangxiensis **Zheng, 1998.** 1♂, 1♀ 27 May–5 June 2002, 14-16 August 2002, Linao Hill (1,400m); 2♂, 4♀ Jiudongping (1,200-1,300m); 1♂, 3♀ Dadong Hill (1,400m)

* ***Systolederus longipennis*** **Zheng et Jiang, 2004**. 2♂ 27 May–5 June 2002, Dadong Hill (1,400m)

* ***Systolederus tianlinensis*** **Jiang et Liu, 2004.** 1♂, 1♀ 27 May–5 June 2002, Linao Hill (1,400m)

Xistra longidorsalis **Liang et Jiang, 2004.** 7♀ 14-16 August 2002, Linao Hill (1,400m); 1♂ Dadong Hill (1,400m)

Tetrigidae

* ***Bannatettix tianlinensis*** **Zheng et Jiang, 2004.** 2♀ 27 May–5 June 2002, Linao Hill (1,200-1,400m)

Ceperoi chinensis **Liang, 1998.** 1♂, 4♀14-16 August 2002, Linao Hill (1,400m); 5♂, 2♀ Cenwang Hill (1,600-1,800m); 2♀ Dadong Hill (1,400m); 1♂ Weihuo Hill (1,300m); 1♂, 3♀ Jiudongping (1,200-1,300m)

Coptotettix fossulatus **Bolivar, 1887.** 3♂, 1♀ 27 May–5 June 2002, Weihuo Hill (1,300m)

Coptotettix gongshanensis **Zheng, 1992.** 3♂, 2♀ 27 May–5 June 2002, Langping (1,200-1,300m)

Ergatettix brachypterus **Zheng, 1993.** 4♂, 1♀ 27 May–5 June 2002, Cenwang Hill (1,500-1,800m)

Euparatettix variabilis **(Bolivar, 1887).** 6♂, 7♀ 14-16 August 2002, Linao Hill (1,400m)

Formosatettix guangdongensis **Liang, 1991.** 6♂, 8♀ 27 May–5 June 2002, Linao Hill (1,400m)

Formosatettix yunnanensis **Zheng, 1992**. 3♂, 6♀ 27 May–5 June 2002, Cenwang Hill (1,800m)

Teredorus albimarginus **Zheng et Zhou, 1996.** 2♂, 5♀ 27 May–5 June 2002, Dadong Hill (1,400m)

Tetrix bolivari **Sauley, 1901.** 3♀ 27 May–5 June 2002, Weihuo Hill (1,300m); 4♂,1♀ Linao Hill (1,400m); 2♂,1♀ Linao Hill (1,200-1,400m); 2♂ Dadong Hill (1,400m); 3♂, 2♀ Yaojiawan Hill (1,200-1,400m)

* ***Tetrix cenwanglaoshana* Zheng et Jiang, 2004.** 2♀ 27 May–5 June 2002, Cenwang Hill (1,500-1,800m)

***Tetrix guangxiensis* Zheng et Jiang, 1996.** 3♂, 2♀ 27 May–5 June 2002, Weihuo Hill (1,300m); 3♂, 8♀ Linao Hill (1,400m) ; 7♂, 6♀ Linao Hill (1,200-1,400m) ; 5♂, 2♀ Dadong Hill (1,400m); 2♂, 6♀ Langping (1,200-1,300m)

***Tetrix japonica* (Bolivar, 1887).** 18♂, 23♀ 27 May–5 June 2002, 14-16 August 2002, Cenwang Hill (1,500-1,800m); 12♂,15♀ Weihuo Hill (1,300m); 6♂, 8♀ Linao Hill (1,400m); 9♂, 10♀ Linao Hill (1,200-1,400m); 14♂, 6♀ Dadong Hill (1,400m); 7♂, 8♀ Langping (1,200m); 16♂, 10♀ Jiudongping (1,200-1,300m)

***Tetrix ruyuanensis* Liang, 1998.** 6♂, 4♀14-16 August 2002, Cenwang Hill (1,500-1,800m); 2♂, 1♀ Weihuo Hill (1,300-1,600m); 3♂, 2♀ Langping (1,200-1,300m); 9♂, 5♀ Dadong Hill (1,400m); 10♂ Yaojiawan Hill (1,200-1,400m); 2♂, 1♀ Laoshan Tree Farm (1,400-1,700m)

***Tetrix subulata* (Linnaeus, 1761).** 3♂, 2♀ 27 May–5 June 2002, Linao Hill (1,200-1,400m); 1♂, 1♀ Dadong Hill (1,400m)

***Tetrix tenuicornis* (Sahlberg, 1893).** 2♂, 4♀ 27 May–5 June 2002, Cenwang Hill (1,500-1,700m)

***Tetrix tinkihami* Zheng et Liang, 1998.** 3♂, 1♀ 27 May–5 June 2002, Dadong Hill (1,400m)

***Tetrix tubercarina* Zheng et Jiang, 1994.** 3♂, 1♀ 27 May–5 June 2002, Langping (1,200-1,300m)

***Tetrix yunnanensis* Zheng, 1992.** 3♂, 5♀ 27 May–5 June 2002, Langping (1,200-1,300m)

Descriptions of female *Macromotettix serrifemoralis* Zheng et Jiang and male *Tetrix ruyuanensis* Liang

The female *Macromotettix serrifemoralis* Zheng et Jiang, 1998 and the male *Tetrix ruyuanensis* Liang 2002 were not reported in the original description and are described below for the first time.

Macromotettix serrifemoralis Zheng et Jiang, 2002 (Fig. 1)

Female: Body small and dark brown. Pronotum between humeral angles with two slanting white spots. Wings black. Outside of hind femur brown , lower side black. Hind tibiae dark brown, with two light transverse spots. Body length, 9 mm; pronotum length, 6.8 mm; hind femur length, 6 mm.

Head slightly projecting above pronotum. Width of vertex slightly narrower than the width of an eye; lateral margins slightly turn out forward; anterior margin round; median carina obvious; in profile, frontal costa protruding between the antennaes distinctly; the width of longitudinal sulcus slightly narrower than the width of coxa of antennae. Antennae filiform, lying between lower ridge of eyes. Eyes globose, projecting. Lateral ocelli placed on the middle part of anterior margins of eyes. Disc of pronotum with numerous tubercles, anterior margin straight; median carina distinct, in profile, upper margin of pronotum before and behind transverse sulci swelling upwards, the part behind the second swelling nearly straight; laterior carinae short, reduce postward on the prozona; humeral angle obtuse angle shaped, the part between them with two short longitudinal carinae; hind process of pronotum long cone-shaped, apex not reaching the tee of hind femur, apex sharp. Posterior angles of the lateral lobes of pronotum truncate; posterior margin of lateral lobes with two concaves. Elytra wide ovate, apex rounded. Wings developed, reaching the apex of hind process of pronotum. Lower margins of fore and middle femur straight; width of midfemur narrower than width of see parts of elytra. Length of hind femur about 3.2 times longer than the width, median keel of upper side with distinct fine teeth, preknee teeth before the knee acute angulate, knee teeth angulate. Outer side of hind tibia with 6 thorns, inner side with 5 thorns. Length of first segment of hind tarsus longer than the third. Ovipositor narrow and long, upper and lower ovipositors with slender teeth. Length of subgenital plate longer than wide, with a small triangle bulge in the middle of posterior margin.

Specimens Examined: 1♀, 27 May 2002, Guangxi: Tianlin (Jiudongping), 1200m, collected by Jiang Guo-Fang.

Fig. 1 *Macromotettix serrifemoralis* Zheng et Jiang, female whole body, lateral view. Body is 9 mm long.

Tetrix ruyuanensis Liang, 1998 (Fig. 2)

Male: Body small, dark brown, with tubercles. Body length, 7 mm; pronotum length, 7.5 mm; hind femur length, 5.5 mm.

Head not projecting above pronotum. Anterior margin of vertex arched, slightly protruding beyond eyes, its width about 1.6 times wider than the width of an eye; median carina obvious, two sides on the midian carina slightly concave, lateral ridge slightly raising on the apex. Front slanting, in profile, vertex forming ocute angles with frontal costa. Parts before lateral ocelli not concave, protruding archedly between antennae; longitudinal furrow deep, lateral ridge gradually expands from the part above lateral ocelli to the median ocellus, width of longitudinal furrow between antennae as wide as of the coxa of antennae. Lateral ocelli placed on the middle of anterior margins of eyes. Antennae filiform, lying between lower ridge of eyes, with 14 articles, length of an article about 5 times larger than the width of middle ones of antennae. Eyes globose. Anterior margin of pronotum slightly straight; disc of pronotum between transverse sulcus swelling by small hillock, upper margin of pronotum straight behind shoulders, hind process of pronotum cone-shaped, reaching the knee of hind femur; median carina swelling taking slightly thin in shape, laterior carinae parallel on the prozona, prozona similar to square shape, part between humeral angles without short longitudinal keel; humeral angle close to arc shape. Posterior margin of lateral lobes of pronotum with two concaves; posterior angles downward, apex of angles round. Elytra long ovate. Wings developed, reaching the apex of pronotum. Upper margins of fore femur and midfemur slightly bending, and lower margins slightly undulate; width of midfemur slightly wider than the width of visible part. Hind femur short and stranger, its length about 2.8 times larger than the width, median keels of upper and lower sides with slender teeth. Outer side of hind tibia with 9 spines, inner sides with 8 spines, tip wider than base slightly. Length of first article of hind tarsus longer than the third distinctly; the first and second pulvilli below the first tarsus small, triangle, tip sharp; the third large, similar to rectangle, tip blunt.

Specimens Examined: 1♂, 1 June 2002, Guangxi: Tianlin (Dadong Hill), 1400m, collected by Jiang Guo-Fang.

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The authors are grateful to Mr. Liu Jiangwen for collecting some of the amount specimens. This work was supported by a grant from the Comprehensive Investigation Foundation of Cenwanglaoshan Nature Reservation of Guangxi, China.

Fig. 2 *Tetrix ruyuanensis* Liang, male whole body, lateral view. Body is 7 mm long.

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DESCRIPTION OF THE MALE OF *VAEJOVIS CHISOS* SISSOM (SCORPIONES, VAEJOVIDAE) FROM TEXAS, U.S.A., WITH COMMENTS ON MORPHOMETRIC AND MERISTIC VARIATION IN THE SPECIES[1]

Lee R. Jarvis,[2] W. David Sissom,[2] and Richard N. Henson[3]

ABSTRACT: The scorpion *Vaejovis chisos* Sissom, 1990, is redescribed, based on the collection of three males and a number of new females. The hemispermatophore is described and illustrated, facilitating new comparisons with *Vaejovis sprousei* Sissom, 1990, its closest known relative. Differences in the hemispermatophore and male chela morphometrics clearly separate the two species. Variation in morphometric characters, metasomal setal counts, and pedipalp chela finger dentition is analyzed on the basis of this increased sample size.

KEY WORDS: Scorpiones, Vaejovidae, *Vaejovis chisos*, morphometrics and meristic variation, Texas, U.S.A.

The scorpion V*aejovis chisos* Sissom, 1990, was described on the basis of an adult female and two juvenile specimens from the Chisos Mountains in Big Bend National Park in Texas, U.S.A. The species is closely related to *V. dugesi* Pocock, 1902 and *V. sprousei* Sissom, 1990, neither of which were previously known from adult males. Recently, a significant number of new specimens of *V. chiso*s have been collected, including the first adult males, and it is the purpose here to describe the male and provide a better assessment of intraspecific variation in the species. The recent discovery of the male of *V. sprousei* (González Santillán and Sissom, 2004) enables the two species to be more adequately compared.

Measurements were taken using an Olympus Model VMZ dissecting microscope calibrated at 20X, and illustrations were made from the same microscope using an ocular grid. Landmarks for measurements are provided by Sissom et al. (1990). Hemispermatophores were dissected as described by Sissom et al. (1990); terminology for hemispermatophores follows Lamoral (1979) and Stockwell (1989); trichobothrial terminology follows Vachon (1974). GPS data for collecting sites were taken from TrailSmart Topo! GPS Software, Wildflower Productions 1999. Specimens are deposited at Appalachian State University, Boone, North Carolina, U.S.A.

Vaejovis chisos Sissom, 1990

(Figs. 1-4)

Vaejovis chisos Sissom 1990a: 48, 49-51, fig, 2A-G.

Vaejovis chisos: Kovařík, 1998: 146; Sissom and Jackman, 1998: 151; Sissom, 2000: 540; González Santillán et al., 2004: 9.

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Mailed on February 3, 2005

Type Data. Holotype female from Kibbee (or Kibbe) Spring, Chisos Basin, Chisos Mountains (1,828 m), Big Bend National Park, Brewster Co., Texas, 31 Aug 1983 (W. D. and J. C. Sissom). Deposited in the American Museum of Natural History, New York, U.S.A.

Distribution. Known only from the Chisos Mountains, Texas, U.S.A.

Description of male. Adult 27.35 mm in length. Base coloration light yellow brown, with moderate fuscosity on dorsum, metasoma, pedipalps, and legs.

Prosoma: Anterior carapacial margin emarginate; median notch weak, rounded; entire carapacial surface finely to coarsely granular.

Mesosoma: Post-tergites densely coarsely granular. Genital operculum completely divided, with genital papillae protruding posteromedially. Pectinal tooth count 17-18. Pectinal teeth large, each with elongate patch of peg sensilla. Sternite VII with one pair of moderate, granular lateral carinae. Stigmata suboval to elongate suboval.

Metasoma: Segments I-IV: Dorsolateral carinae strong, serrate on I-III, crenulate on IV. Lateral supramedian carinae moderate to strong, crenulate. Lateral inframedian carinae on I complete, granulose; on II incomplete, moderate, irregularly granular on posterior third; on III incomplete, weak on posterior third; on IV absent. Ventrolateral carinae moderate, crenulate. Ventral submedian carinae on I weak, smooth to finely granular; on II-IV, moderate, crenulate. Dorsal intercarinal spaces with scattered coarse granulation. Segment V: Dorsolateral carinae moderate, serrate proximally; weak, granular distally. Lateromedian carinae present on anterior three-fourths of segment, moderate, granular. Ventrolateral and ventromedian carinae strong, serrate. Intercarinal spaces finely granular. Metasoma I-IV setal counts: dorsolaterals, 0/0:1/1:1/1:1/1; lateral supramedians, 0/0:1/1:1/1:2/2; lateral inframedians, 1/1:0/0:0/0:0/0; ventrolaterals, 2/2:2/2:2/3:3/3; ventral submedians, 3/3:3/3:3/3:4/4. Ventral accessory setae lacking. Metasomal segment V: dorsolaterals, 3/3; lateromedians, 2/2; ventrolaterals, 4/4. Metasomal segment I length/width = 0.92; III length/width = 1.18; V length/width = 2.38.

Telson: Dorsal surface flattened, smooth; ventral surface with irregular fine granulation and weak punctations, about 16 pairs of large setae.

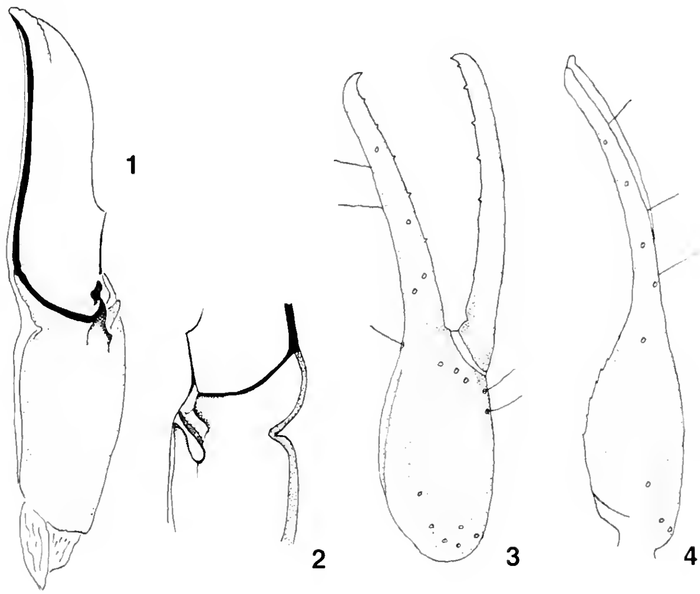
Hemispermatophore (Figs. 1-2): Moderately slender; distal lamina with a distal crest on dorsal surface and a single, blunt hook-like structure near the base. Capsular area with simple invaginated sperm duct floor (Stockwell 1989: 130) and without conspicuous lobes or processes. Sperm duct flanked along distal edge by a series of minute denticle-like structures.

Chelicerae: Dentition typical of family (Vachon 1963; Sissom 1990b, fig. 3.1H); ventral margin of movable finger smooth (i.e., lacking denticles). Ventral aspect of cheliceral movable finger with distinct serrula.

Pedipalps: Trichobothrial pattern Type C, orthobothriotaxic (completely illustrated for the holotype female in Sissom 1990a: Fig. 2, A-F). Femur: Dorsointernal, ventrointernal, and dorsoexternal carinae strong, granulose; ventroexternal carinae vestigial, with irregular coarse granules along distal part of segment. Internal face with about 18-20 large granules; dorsal face with scattered coarse granulation. Femur length/width ratio = 3.47. Patella: Dorsointernal and ventrointernal carinae strong, serrate. Dorsoexternal and ventroexternal carinae moderate, granular. Internal face with longitudinal row of about 16 granules; external face with scattered coarse granulation; dorsal and ventral faces lacking noticeable granulation. Patella length/width ratio = 3.30. Chela (Figs. 3-4) with dorsal marginal carinae weak, granular; dorsointernal carinae weak to moderate, with a few larger, rounded granules; other carinae essentially obsolete. Dentate margin of fixed finger with primary row divided into six subrows by five larger denticles; six inner accessory denticles; trichobothria *ib* and *it* at base of fixed finger. Dentate margin of movable finger with primary denticle row divided into six subrows by five larger denticles; apical subrow with only one denticle; seven inner accessory denticles. Terminal denticles of chela fingers somewhat enlarged and bladelike, overlapping considerably when chela closed; fingertips with small white distal caps. Chela length/width ratio = 4.73; movable finger length/chela width = 3.05; fixed finger length/carapace length = 0.89.

Legs. Midventral spinule row of telotarsus terminating between two pairs of enlarged spinules.

Measurements of male (mm): Total L, 27.35; carapace L, 3.20; mesosoma L, 8.65; metasoma L, 11.95; telson L, 3.55. Metasomal segments: I L/W, 1.65/1.80; II L/W, 1.85/1.70; III L/W, 1.95/1.65; IV L/W, 2.70/1.60; V L/W, 3.80/1.60. Telson: vesicle L/W/D, 2.25/1.30/1.00; aculeus L, 1.30. Pedipalps: femur L/W, 2.95/0.85; patella L/W, 3.30/1.00; chela L/W/D, 5.20/1.10/1.20; fixed finger L, 2.85; movable finger L, 3.35; palm (underhand) L, 2.05.



Figs. 1-4. Morphology of the male of *Vaejovis chisos:* 1, dorsal aspect of right hemispermatophore; 2, ventral aspect of right hemispermatophore; 3, external aspect of right pedipalp chela; 4, dorsal aspect of right pedipalp chela.

Variation. In addition to the three adult males examined, 30 new adult females were also available, providing the opportunity to better analyze variation in morphometric and meristic characters in the species.

Variation in pectinal tooth counts for 3 males and 20 females was as follows: in males, there were 3 combs with 18 teeth and 3 combs with 19 teeth; in females there were 1 comb with 14 teeth, 11 combs with 15 teeth, 22 combs with 16 teeth, and 5 combs with 17 teeth. In the three females from the original type series, there were three combs with 16 teeth and three with 17. In females, the genital opercula have a membranous anterior connection, but in males they are completely separated. Female pectinal teeth are shorter and peglike, in contrast to the larger "banana-shaped" teeth of the male. In addition, each pectinal tooth in the male bears an elongate patch of peg sensilla; these patches are smaller in the female.

Setal counts for the metasoma exhibited little variation. The modal counts, based on the left metasomal I-IV carinae of 20 specimens, were as follows: dorsolaterals, 0:1:1:1; lateral supramedians, 0:1:1:1; lateral inframedians, 1:0:0:0; ventrolaterals, 2:3:3:3; and ventral submedians, 3:3:3:4. In one of the specimens, an unpaired accessory seta was found in the ventral intercarinal space on segment III. For segment V, the modal counts for these specimens were: dorsolaterals, 3; lateromedians, 2; ventrolaterals, 4. Four of the specimens had small setal pores distally above the ventrolateral carinae (not the larger distal setae on the anal carina where it meets the ventrolateral carina), but these were interpreted as microsetae and not counted.

Variation was also noted in the number of inner accessory denticles flanking the chela finger denticle rows. These were counted on 20 specimens, and the counts are reported for both the left and right sides (L/R). For the chela fixed finger, three specimens exhibited counts of 5/5, five had 5/6 or 6/5, and 12 had 6/6. In most cases (12/16 fingers), those with five granules were missing the basal granule of the series, but on four fingers, the distal denticle was missing. For the movable finger, two specimens had counts of 5/6, one had 7/5, 13 had 6/6, three had 6/7 or 7/6, and one had 7/7. This type of variation in inner accessory denticles is also seen in *Vaejovis vorhiesi* Stahnke, 1940 and related species from Arizona (Sissom, unpub. data).

Variation in selected morphometric ratios of the three adult males is as follows (presented as mean ± sd [range]): chela length/width, 4.78 ± 0.11 (4.71-4.90); pedipalp femur length/width, 3.57 ± 0.14 (3.47-3.73); pedipalp patella length/width, 3.19 ± 0.12 (3.07-3.30); fixed finger length/carapace length, 0.86 ± 0.06 (0.79-0.91); metasomal segment III length/width, 1.23 ± 0.05 (1.18-1.28); metasomal segment V length/width, 2.33 ± 0.05 (2.27-2.38); and carapace length/metasomal segment V length, 0.88 ± 0.62 (0.84-0.91). For 20 females, the ratios were as follows: chela length/width, 4.80 ± 0.25 (4.39-5.25); pedipalp femur length/width, 3.44 ± 0.12 (3.17-3.57); pedipalp patella length/width, 3.08 ± 0.07 (2.96-3.20); fixed finger length/carapace length, 0.86 ± 0.02 (0.81-0.90); metasomal segment III length/width, 1.09 ± 0.03 (1.05-1.13); metasomal segment V length/width, 2.21 ± 0.05 (2.14-2.32); and carapace length/metasomal segment V length, 0.97 ± 0.02 (0.93-1.10).

Comments. The morphometric ratios used earlier to separate females of *V. chisos* from *V. sprousei* (Sissom 1990a) are still largely valid, except that there is very slight overlap between the lower end of the ranges in *V. chisos* and the upper end of the ranges in *V. sprousei.* The differences in the male hemispermatophore (see below) and chela morphometrics (slender in *V. chisos* and slightly inflated in *V. sprousei*) provide additional characters to separate the two species.

Within the *mexicanus* group, the hemispermatophores of *V. chisos* and *V. sprousei* are quite similar in structure. Both have a crest on the distal lamina, a single blunt hook at the base of the blade on the dorsal aspect, and a series of denticles along the invaginated floor of the sperm duct. However, the hemispermatophore of *V. chisos* is much more slender than that of *V. sprousei* (see González Santillán and Sissom, 2004). Further, the denticles along the sperm duct are very distinct in *V. sprousei* but minute and scarcely discernible in *V. chisos.*

Specimens were collected in thickly wooded areas with substantial ground cover (i.e. decayed leaves, plant cover), mainly from the banks and slopes associated with trail cuts. These areas were moister than adjoining slopes where the species was not found.

Specimens Examined. USA: Texas: Brewster Co.: Big Bend National Park, near upper end of Pine Canyon, 27 May 1992 (R. Henson, J. Davidowski, T. Weseman), 3 females, 1 male (ASU); Big Bend National Park, from waterfall in Pine Canyon to edge of wooded area (29°15'44" N: 103°15'15"W to 29°16'01"N: 103°14'44"W), 27 May 1992 (R. Henson, T. Weseman, J. Davidowski), 1 male (ASU); Big Bend National Park, Upper Pine Canyon Trail, 23 May 2003 (R. Henson, P. Carmichael, N. Lopez, A. Anderson), 16 females, 1 male (ASU); 29 May 2003, 1 female, 6 juvs. (ASU); Big Bend National Park, Kibbee Spring Trail (29°16'24"N: 103°17'06"W to 29°16'25"N: 103°17'13"W), 22 May 1992 (R. N. Henson, T. Weseman, J. Davidowski), 1 female (ASU); Big Bend National Park, wooded area of Pine Canyon Trail, 27 May 2002 (R. N. Henson, T. Weseman, J. Davidowski), 9 females, 1 juvenile male (ASU).

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ADDITIONS AND EMENDATIONS TO THE MAYFLY (EPHEMEROPTERA) FAUNA OF SASKATCHEWAN, CANADA[1]

J. M. Webb,[2] D. W. Parker,[3] D. M. Lehmkuhl,[4] and McCafferty[5]

ABSTRACT: Twenty-four species of Ephemeroptera are added to the known Ephemeroptera fauna of Saskatchewan based on the report of new data. Five species previously recorded from Saskatchewan were based on misidentifications or unsubstantiated data. With the new additions and emendations, 106 species of mayflies are known from Saskatchewan. Significant range extensions are reported for *Plauditus gloveri, Procloeon viridoculare,* and *Serratella serrata.*

KEY WORDS: Ephemeroptera, Saskatchewan (Canada), new records, emendations

McCafferty and Randolph (1998) accounted for 83 mayfly species from Saskatchewan in their faunistic review of Canadian Ephemeroptera. Since then another three nominal species were reported by Sun et al. (2002), Randolph et al. (2002), and McCafferty et al. (2004), and two previously reported species have been removed from the list of species known from Saskatchewan as a result of synonymies (McCafferty 2001, Wang and McCafferty 2004). It should also be noted that *Arthroplea bipunctata* (McDunnough), *Ecdyonurus simplicioides* (McDunnough), and *Asioplax edmundsi* (Allen) [reported as *Tricorythodes corpulentus* Kilgore and Allen] had been correctly reported from Saskatchewan (Mason and Lehmkuhl 1983, Whiting and Sheard 1990) but were not listed by McCafferty and Randolph (1998). A further study of the Saskatchewan fauna, as reported here and based primarily on the study of old and new collections, has generated numerous new provincial records and allowed corrections to certain previous records. The Saskatchewan record of *Procloeon rivulare* (Traver) by Mason and Lehmkuhl (1983) cannot be confirmed and is highly unlikely, the records of *Heptagenia solitaria* McDunnough and *Ephemerella aurivillii* (Bengtsson) by Lehmkuhl (1976) are referable to *H. pulla* (Clemens) and *E. needhami* McDunnough respectively, and a record of *Tortopus primus* (McDunnough) by Lehmkuhl (1976) was only a probable record and has not yet been substantiated. Additionally, the material reported as *Baetisca obesa* (Say) by Lehmkuhl (1972) is referable to *B. laurentina* McDunnough. Therefore, *H. solitaria, P. rivulare, E. aurivillii, T. primus,* and *B. obesa* should be deleted from the Saskatchewan list of mayflies. The following species should be added to the Saskatchewan list of mayflies based on new data: *Ameletus subnotatus, Baetis bicaudatus, B.*

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bundyae, B. intercalaris, Centroptilum album, C. conturbatum, Plauditus cestus, P. gloveri, Procloeon ingens, P. mendax, P. rufostrigatum, P. simplex, P. viridoculare, Baetisca columbiana, Brachycercus edmundsi, Caenis hilaris, Eurylophella bicolor, Serratella serrata, S. tibialis, Leucrocuta maculipennis, Siphloplecton basale, and *Parameletus chelifer.* Based on the additions, corrections, and deletions of Saskatchewan mayflies given or revised herein, there are currently 106 species accounted for in Saskatchewan. Some further modification will be apparent in the treatment of new data given below.

Data presented herein are given alphabetically under applicable families. Unless indicated otherwise, all material examined are larvae and all collections were made by JMW. Vouchers of material examined are located in the collection of JMW, unless otherwise indicated.

Ameletidae

Ameletus subnotatus Eaton

Material Examined: Pasquia R. at Hwy 9, 53.253°N 102.114°W, 25-IV-1980 ER Whiting; Weyakwin R. at Hwy 2, 54.434°N 105.820°W, 27-IX-1997; McVey Cr. at Hwy 55, 53.426°N 102.682°W, 24-IV-1980 ER Whiting.

Baetidae

Baetis bicaudatus Dodds

Larvae were found in collections from north of Lake Athabasca, in extreme northwestern Saskatchewan.

Material Examined: Shaft Cr., 59.570°N 108.680°W, 26-VI-1986 J Ciberowski & ER Whiting; Berth Cr., 59.567°N 108.533°W, 26-VI-1986 J Ciberowski & ER Whiting; Crackingstone R. at Laredo Rd. Brg., 59.500°N 109.983°W, 29-VI-1986 J Ciberowski & ER Whiting.

Baetis bundyae Lehmkuhl

In Saskatchewan, this species was found in slow-flowing streams in the northwestern portion of the province.

Material Examined: Shaft Cr., 59.570°N 108.680°W, 26-VI-1986 J Ciberowski & ER Whiting; Berth Cr., 59.567°N 108.533°W, 26-VI-1986 J Ciberowski & ER Whiting; Stream at Km 75 of Hwy 955, 56.989°N 109.034°W, 30-VI-2000 (+ reared adult), 9-VI-2001 JMW & M Pollock; Stream on Hwy 955, 57.075°N 109.071°W, 30-VI-2000.

Baetis intercalaris McDunnough

This species was collected only in medium and large streams along the Manitoba Escarpment and the Cypress Hills.

Material Examined: Fir R. at Hudson Bay Regional Park, 52.821°N 102.388°W, 23-VII-2001; Red Deer R. at Hudson Bay Regional Park, 52.814°N 102.373°W, 19-VII-2000; Frenchman R. at Ravenscrag, 49.490°N 109.087°W, 23-VI-2000; Carrot R. at Hwy 55, 53.365°N 103.263°W, 23-VII-2001.

Centroptilum album McDunnough

In Saskatchewan, this species is widespread throughout the boreal forest.

Material Examined: Broad Cr. at Hwy 904, 54.840°N 108.408°W, 10-VI-2001 JMW & M Pollock, 1-VII-2000; Green Bush Cr. at Hwy 3, 52.835°N 102.701°W, 19-VII-2000; Low Cr. at Hwy 904, 54.824°N 108.478°W, 1-VII-2000; Otosquen Cr. at Hwy 9, 53.301°N 102.158°W, 9-VII-2001; Overflowing R. at Hwy 9, 53.026°N 102.322°W, 19-VII-2000; Stream at Km 170 of Hwy 903, 55.432°N 108.769°W, 10-VI-2001 JMW & M Pollock; Umpherville R. at Hwy 905, 58.093°N 103.792°W, 8-VIII-2000; Weyakwin R. at Hwy 2, 54.434°N 105.820°W, 7-VII-2000.

Centroptilum conterbatum McDunnough

Material Examined: Battle Cr. at Ranger Station, West Block of Cypress Hills Provincial Park, 49.600°N 109.923°W, 25-VI-2000, 30-VII-2000; Low Cr. at Hwy 904, 54.825°N 108.78°W, 1-VII-2000; Pasquia R. at Hwy 9, 53.250°N 102.110°W, 20-VII-2000; Stream on Hwy 955, 57.075°N 109.07°W, 30-VI-2000.

Plauditus cestus (Provonsha and McCafferty)

Larvae of this species were collected from pea-sized gravel in medium-gradient streams draining the Manitoba Escarpment.

Material Examined: Green Bush Cr. at Hwy 3, 52.835°N 102.701 W,17-VII-1999, 19-VII-2000; Red Deer R. at Rendek Elm Forest, 52.910°N 102.030°W, 24-V-2001; Torch R. at Hwy 35, 53.535°N 104.057°W, 22-VII-1986 ER Whiting, 2-VII-1986 V Keeler.

Plauditus gloveri McCafferty and Waltz

Several larvae were collected from streams along the Manitoba Escarpment. This report represents a considerable northwestern range extension.

Material Examined: Green Bush Cr. at Hwy 3, 52.835°N 102.701°W, 19-VII-2000; McVey Cr. at Hwy 55, 53.426°N 102.682°W, 20-VII-2000; Stream on Hwy 9, S of Hudson Bay, 52.668°N 102.372°W, 24-V-2001; Whitefox R. at Hwy 35, 53.517°N 104.057°W, 2-VII-1986 ER Whiting.

Procloeon ingens (McDunnough)

A single larva was found in a pool of a stream along the Manitoba Escarpment.

Material Examined: Overflowing R. at Hwy 9, 53.026°N 102.322°W, 19-VII-2000.

Procloeon mendax (Walsh)

A single larva of this species was found in a small stream in northern Saskatchewan.

Material Examined: Stream at Km 105 of Hwy 905, 57.084°N 103.773°W, 8-VIII-2000.

Procloeon rufostrigatum (McDunnough)

Several larvae were collected from streams along the Manitoba Escarpment.

Material Examined: Carrot R. at Hwy 55, 53.365°N 103.263°W, 23-VII-2001; Fir R. at Hudson Bay Regional Park, 52.821°N 102.388°W, 23-VII-2001; Green Bush Cr. at Hwy 3, 52.835°N 102.701°W, 19-VII-2000; Red Deer R. at Hudson Bay Regional Park, 52.814°N 102.373°W, 19-VII-2000; Red Deer R. at Rendek Elm Forest, 52.910°N 102.030°W, 9-VII-2001.

Procloeon simplex (McDunnough)

Larvae were collected from submerged vegetation in depositional areas of streams throughout western and central Saskatchewan.

Material Examined: Battle Cr. at Ranger Station, West Block of Cypress Hills Provincial Park, 49.600°N 109.923°W, 30-VII-2000; Beaver R. at Hwy 4, 54.295°N 108.601°W, 1-VII-2000; Frenchman R. at Ravenscrag, 49.490°N 109.087°W, 23-VI-2000, 29-VII-2000, 30-VII-1999; Overflowing R. at Hwy 9, 53.026°N 102.322°W, 19-VII-2000; Stream on Hwy 965, 55.115°N 107.914°W, 30-VI-2000; Waskesiu R. at Hwy 2, 54.076°N 105.989°W, 6-VII-2000.

Procloeon viridoculare Berner

Saskatchewan represents the northernmost record of this species. In Saskatchewan, larvae were found in large parkland rivers and in streams along the

Manitoba Escarpment. All larvae were collected in areas with silt-covered, medium sized cobbles.

Material Examined: Battle R. at Hwy 21, 1-VII-2000; Fir R. at Hudson Bay Regional Park, 52.821°N 102.388°W, 23-VII-2001 (+ reared adult); North Saskatchewan R. at Borden Bridge, 52.371°N 107.145°W, 14-VII-1999, 2-X-1999.

Baetiscidae

Baetisca columbiana Edmunds

Webb and McCafferty (2003) recently confirmed the validity of this species and reported it from Alberta.

Material Examined: Umpherville R. at Hwy 905, 58.093°N 103.792°W, 8-VIII-2000.

Baetisca laurentina McDunnough

Re-examination of material reported as *B. obesa* from Saskatchewan by Lehmkuhl (1972) showed they were referable to *B. laurentina*. This species is found throughout the boreal forest.

Material Examined: Fir R. at Hudson Bay Regional Park, 52.821°N 102.388°W, 23-VII-2001; Giekie R. 15km upstream of Hwy 905, 57.600°N 104.133°W, 12-VI-1980 ER Whiting; Hudson Bay (town), 1958, no collector indicated (deposited in museum of Agriculture and Agrifood Canada, Saskatoon SK); McFarlane R., 59.200°N 107.917°W, 20-VI-1980 J Ciberowski; Red Deer R. at Rendek Elm Forest, 52.910°N 102.030°W, 24-V-2001 (+ reared adults), 8-V-2001 JMW & DW Parker (+ reared adults); Stream on Hwy 9 S of Hudson Bay, 52.668°N 102.372°W, 24-V-2001; Torch R. at Hwy 35, 53.535°N 104.057°W, 27-V-1986 ER Whiting; Torch R. N of Hwy 35, 53.539°N 104.069°W, 9-VII-2001, 8-V-2001 JMW & DW Parker, 25-V-2000 JMW & DW Parker (+ reared adults).

Caenidae

Brachycercus edmundsi Soldàn

This species has been found in small boreal streams and the Saskatchewan R. System. In the South Saskatchewan R., *B. edmundsi* is only found downstream of Gardiner Dam, a hypolimnetic-release hydroelectric dam. Upstream of the dam and its associated impoundment, *B. edmundsi* is replaced by *B. prudens* (Mc Dunnough).

Material Examined: Arsenault R. at Hwy 903, 55.113°N 108.378°W, 10-VI-2001 JMW & M Pollock; Battle R. at Hwy 21, 52.841°N 109.343°W, 1-VII-2000 (adults); Cr. at Km 65 of Hwy 9, 53.370°N 102.088°W, 23-VII-2001; Green Bush Cr. at Hwy 3, 52.835°N 102.701°W, 17-VII-1999; MacLennan R. at Hwy 2, 54.200°N 105.933°W, 16-VI-1971 DH Smith; North Saskatchewan R. at Cecil Ferry, 53.229°N 105.5114°W, 11-VI-1971 DM Lehmkuhl (+ reared adults), 6-VI-2000; Otosquen Cr. at Hwy 9, 53.301°N 102.158°W, 24-VII-1999, 9-VII-2001; South Saskatchewan R. at Queen Elizabeth Power Station, 52.130°N 106.650°W, 10-VII-1999 (+ reared adults), 2-VI-2000.

Caenis hilaris (Say)

This species occurs in medium-sized rivers in eastern Saskatchewan. Saskatchewan extends its known range westward.

Material Examined: Fir R. at Hudson Bay Regional Park, 52.821°N 102.388°W, 23-VII-2001; Montreal R. at Hwy 2, 55.038°N 105.311°W, 8-VIII-2000; Red Deer R. at Rendek Elm Forest, 52.910°N 102.030°W, 8-VII-2001 (adults); Torch R. at Hwy 35, 53.535°N 104.057°W, 22-VII-1986 ER Whiting; Torch R. N of Hwy 35, 53.539°N 104.069°W, 22-VII-2001, 9-VII-2001; Whitefox R. at Hwy 35, 53.317°N 104.057°W, 2-VII-1986 V Keeler.

Ephemerellidae

Ephemerella needhami McDunnough

All previous reports of *E. aurivillii* (Lehmkuhl 1976) were found to be referable to *E. needhami.* This species is common in fast-flowing streams throughout the boreal forest.

Material Examined: Crackingstone R. at Laredo Rd. Brg., 8km SW of Uranium City, 59.500°N 108.700°W, 29-VI-1986 J Ciberowski & ER Whiting; Giekie R. 15km upstream of Hwy 905, 57.600°N 104.133°W, 12-VI-1980 ER Whiting; Green Bush Cr. at Hwy 3, 52.835°N 102.701°W, 19-VII-2000 (+ reared adult); Meeyomoot R. at Hwy 165, 54.768°N 105.158°W, 17-VI-1971 DH Smith, 13-VI-2000; Mistohay R. at Hwy 104, 9-VII-1974 L Dosdall (adult); Overflowing R. at Hwy 9, 53.026°N 102.322°W, 20-V-1980 ER Whiting; Red Deer R. at Rendek Elm Forest, 52.910°N 102.030°W, 24-V-2001; River 10km W of Uranium City, 59.567°N 108.783°W, 21-VI-1986 L Dosdall & DW Parker; Stream at Km 165 of Hwy 903, 55.415°N 108.718°W, 10-VI-2001 JMW & M Pollock; Torch R. at Hwy 35, 53.535°N 104.057°W, 27-V-1986 ER Whiting, 2-VII-1986 V Keeler, 8-VII-1986 V Keeler; Torch R. N of Hwy 35, 53.539°N 104.069°W, 8-V-2001 JMW & DW Parker, 25-V-2000 JMW & DW Parker.

Eurylophella bicolor (Clemens)

Material Examined: Giekie R. 15km upstream of Hwy 905, 57.600°N 104.133°W, 12-VI-1980 ER Whiting; Red Deer R. at Rendek Elm Forest, 52.910°N 102.030°W, 8-V-2001 JMW & DW Parker, 24-V-2001; Stream on Hwy 905, 57.252°N 103.998°W, 8-VIII-2000; Torch R. at Hwy 35, 53.535°N 104.057°W, 2-VII-1986 V Keeler, 27-V-1986 ER Whiting; Torch R. N of Hwy 35, 53.539°N 104.069°W, 25-V-2001 JMW & DW Parker.

Serratella serrata (Morgan)

In Saskatchewan, this was collected from a small creek with large boulders in the northeastern portion of the province.

Material Examined: Montreal R. at Station 2, 25-VII-1960 Cushing; Umpherville R. at Hwy 905, 58.093°N 103.792°W, 8-VIII-2000.

Serratella tibialis (McDunnough)

Material Examined: Broad Cr. at Hwy 904, 54.840°N 108.408°W, 9-VII-1974 L Dosdall (+ adults); Low Cr. at Hwy 904, 54.824°N 108.478°W, 1-VII-2000.

Heptageniidae

Leucrocuta maculipennis (Walsh)

In Saskatchewan, this species is exclusively found in portions of the South Saskatchewan River that have not been altered by hydroelectric dams. Interestingly, Whiting and Sheard (1990) did not record its presence in the South Saskatchewan R., although it is now one of the most abundant heptageniids there.

Material Examined: South Saskatchewan R. at Lemsford Ferry, 51.030°N 109.120°W, 30-VII-2000, 16-IX-2000 (+ reared adults), 6-VI-2001, 3-VII-2001 (+ reared adults), 20-VIII-2001.

Metretopodidae

Siphloplecton basale (Walker)

This species is found in northern lakes, the Saskatchewan R. and its larger tributaries (except the South Saskatchewan R.), and medium-sized boreal rivers.

Material Examined: Courtney Lake at Hwy 905, 57.386°N 103.979°W, 13-VI-2000; Giekie R. 15 Km upstream of Hwy 905, 57.600°N 104.133°W 13-VI-1982 ER Whiting (adult); Giekie R. at Hwy 905, 57.703°N 103.951°W, 12-VI-2000; McDougal Cr. at Hwy 120, 54.103° N 104.537°W, 16-VI-1980 ER Whiting (adult); North Saskatchewan R. at Cecil Ferry, 53.229°N 105.5114°W, 26-IV-1980 ER Whiting; Saskatchewan R. at Squaw Rapids Powerhouse Boat Ramp, 53.683°N 103.333°W, 14-V-1980 PG Mason (adults); Torch R. N of Hwy 35, 53.539°N 104.069°W, 25-V-2000 JMW & DW Parker (adults); Wathaman R. at Hwy 905, 57.078°N 103.742°W, 17-VI-1982 ER Whiting (adult).

Siphlonuridae

Parameletus chelifer Bengtsson

Material Examined: McFarlane R., 59.150°N 107.900°W, 18-VI-1980 J Ciberowski (adult).

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NEW SPECIES OF *HERCOSTOMUS* FROM TAIWAN (DIPTERA: DOLICHOPODIDAE)[1]

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ABSTRACT: Three species of *Hercostomus* from Taiwan are described as new to science: *Hercostomus chiaiensis* sp. nov., *H. hualienensis* sp. nov., and *H. taitungensis* sp. nov.

KEY WORDS: Diptera, Dolichopodidae, *Hercostomus*, Taiwan, new species

The genus *Hercostomus* is one of the most diverse genera in the Dolichopodidae with about 500 known species worldwide. Seventeen species of *Hercostomus* from Taiwan were recorded in the catalogue of Dyte (1975). With the work of Wei (1997), Yang (1996, 1997a-b), Yang and Grootaert (1999), Yang and Saigusa (1999, 2000, 2001a-d, 2002), Yang and Yang (1995), Yang, Yang and Li (1998), Zhang and Yang (2003a-c), the number of species of *Hercostomus* known from continental China soared from 11 species (Dyte 1975, Negrobov 1991) to 235 species. The species of *Hercostomus* from Taiwan remains poorly known. Taiwan belongs to the Oriental Realm with a subtropical and tropical climate. The fauna of Dolichopodidae of Taiwan is definitely rich and unique.

In this paper, three species of *Hercostomus,* which belong to the *H. hamatus*-group, from Taiwan are described as new to science, based on the specimens collected by Dr. Ignac Sivec and Dr. Bogdan Horvat. The *hamatus*-group is characterized by the black antenna, postocular bristles entirely black, hind femur with black tip, R_{4+5} and M distinctly convergent apically, male cercus rather small, subtriangular and usually with several finger-like marginal processes bearing bristles, and hypandrium irregularly furcated (Wei, 1997). The type specimens are deposited in the Slovenian Museum of Natural History, Ljubljana.

The following abbreviations are used: acr – acrostichal setae, ad – anterodorsal setae, av – anteroventral setae, dc – dorsocentral setae, LI – fore leg, LII – mid leg, LIII – hind leg, pd – posterodorsal setae, pv – posteroventral setae, v – ventral setae.

Hercostomus (Hercostomus) chiaiensis, NEW SPECIES
(Figs. 1-5)

Diagnosis: First flagellomere nearly as long as wide; arista subapical. LI with 3rd to 5th tarsomeres flattened and black except 5th tarsomere white with black

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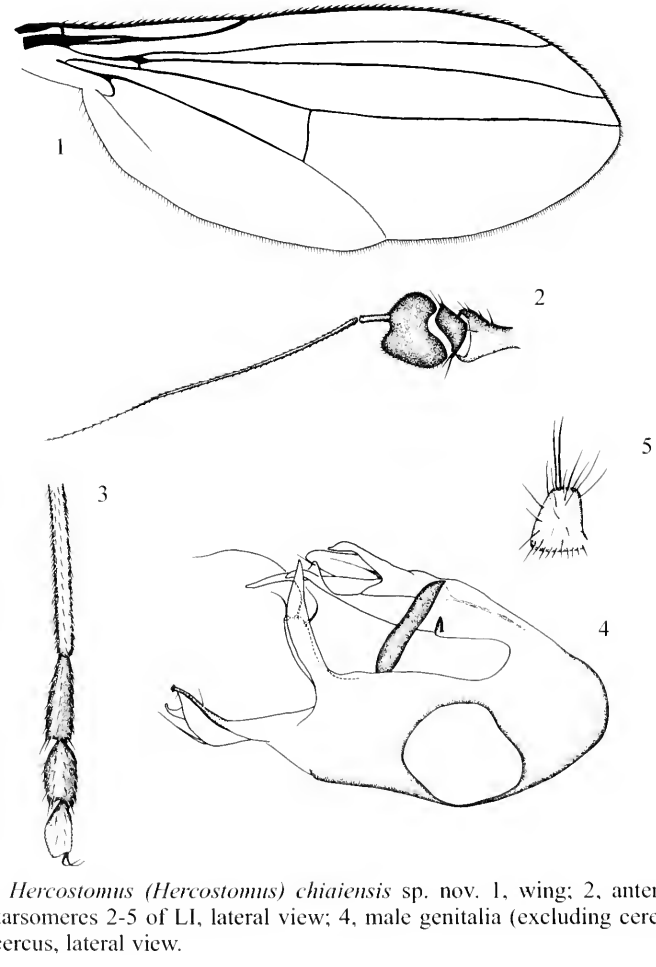
base and some white hairs. Male cercus nearly quadrate without finger-like marginal process.

Description: Male. Body length 3.4 mm, wing length 3.4 mm. Head metallic green with pale gray pollen. Face narrowing ventrally, narrower than 1st flagellomere. Hairs and bristles on head black; postocular bristles entirely black. Antenna (Fig. 2) black with wide ventral area of scape brownish yellow; 1st flagellomere short, nearly as long as wide, obtuse apically; arista black, subapical, minutely pubescent, with rather short basal segment. Proboscis yellow with black hairs; palpus yellow with black hairs and 1 black apical bristle.

Thorax metallic green with pale gray pollen. Hairs and bristles on thorax black; 6 strong dc, 7 irregularly paired acr; scutellum with one pair of strong bristles. Propleuron black haired with 1 black bristle on lower portion. Legs yellow; coxa I yellow, coxa II and III dark brown. Femur III with black tip. Tarsus I with tarsomeres 3-5 (Fig. 3) flattened, black except 5th tarsomere white with black base and white hairs; tarsus II from tip of 2nd tarsomere onward black; tarsus III from tip of 1st tarsomere onward black. Hairs and bristles on legs black, coxa II and III each with 1 outer bristle, femur II and III each with 1 preapical bristle. Tibia I with 1 ad and 2 thin pd, apically with 4 short bristles; tibia II with 3 ad and 2 pd, apically with 4 bristles; tibia III with 3 ad, 4 pd and 3 thin v, apically with 3 bris-



Figs 1-5. *Hercostomus (Hercostomus) chiaiensis* sp. nov. 1, wing; 2, antenna, lateral view; 3, tarsomeres 2-5 of LI, lateral view; 4, male genitalia (excluding cercus), lateral view; 5, cercus, lateral view.

tles. Relative lengths of tibia and 5 tarsomeres LI 1.5 : 0.8 : 0.65 : 0.3 : 0.2 : 0.2; LII 2.0: 1.0 : 0.55 : 0.4 : 0.25: 0.25; LIII 2.5: 0.5 : 0.9: 0.5: 0.3 : 0.25. Wing (Fig. 1) hyaline, tinged with grayish; veins brown. R_{4+5} and M distinctly convergent apically; CuAx ratio (length of m-cu/length of CuA distal section) 0.5. Squama yellow with brown hairs. Halter yellow.

Abdomen metallic green with pale gray pollen. Male genitalia (Fig. 4-5): Epandrium distinctly longer than wide, with two lateral lobes spine-like and strongly curved; cercus subquadrate without marginal processes (Fig. 5); hypandrium thick and irregularly furcated.

Female. Unknown.

Holotype: Male, Taiwan: Chiai county, 1160m, 23°29'22"N, 120°41'38"E, 1996.X.21, Ignac Sivec.

Distribution: Taiwan (Chiai).

Etymology: The specific name refers to the type locality Taiwan, Chiai County.

Remarks: The new species is somewhat similar to *H. dissimilis* Yang and Saigusa in having leg I with 3rd to 4th tarsomeres flattened, but may be separated from the latter by the arista being nearly apical and leg I with the 5th tarsomere flattened and white with a black base. In *H. dissimilis,* the arista is dorsal, and the 5th tarsomere of leg I is entirely white and not flattened as are the 3rd to 4th tarsomeres (Yang and Saigusa, 1999).

Hercostomus (Hercostomus) hualienensis, NEW SPECIES
(Figs. 6-9)

Diagnosis: First flagellomere 1.4 times longer than wide; arista apical. Abdominal sternite 4 with a ventral process. Hypandrium irregularly furcated with several small inner denticles near base.

Description: Male. Body length 3.6-3.7 mm, wing length 3.6-3.7 mm. Head metallic green with pale gray pollen. Face narrowing ventrally, narrower than 1st flagellomere. Hairs and bristles on head black; postocular bristles entirely black. Antenna (Fig. 7) black with wide ventral area of scape brownish yellow; 1st flagellomere short, 1.4 times longer than wide, obtuse apically; arista black, apical, minutely pubescent, with very short basal segment. Proboscis dark yellow with black hairs; palpus dark yellow with black hairs and 1 black apical bristle.

Thorax metallic green with pale gray pollen. Hairs and bristles on thorax black; 6 strong dc, 6-7 irregularly paired acr; scutellum with 2 pairs of bristles (basal pair short and hair-like) and several short pale hairs on disc and marginal hairs. Propleuron black haired with 1 black bristle on lower portion. Legs yellow; coxa I yellow, coxa II and III blackish brown. Femur III with black tip. Tibia III with brownish tip. Tarsus I and II from tip of 1st tarsomere onward dark brown to black; tarsus III black. Hairs and bristles on legs black, coxa II and III each with 1 outer bristle, femur II and III each with 1 preapical bristle, femur II with 1 pv at tip. Tibia I with 1 thin ad and 2 pd; tibia II with 3 ad and 2 pd, apically with 4 bristles; tibia III with 4 ad and 4 pd, apically with 3 bristles. Relative lengths of tibia and 5 tarsomeres LI 2.0 : 1.05 : 0.9 : 0.5 : 0.25 : 0.25; LII 3.0: 1.5 : 1.0 : 0.55 : 0.35: 0.25; LIII 3.5: 0.85 : 1.0: 0.5: 0.6 : 0.55. Wing (Fig. 6) hyaline, tinged with grayish; veins brown. R_{4+5} and M distinctly convergent apically; CuAx ratio 0.6. Squama yellow with black hairs. Halter yellow.

Abdomen metallic green with pale gray pollen. Sternite 4 with a short, subtriangular ventral process. Male genitalia (Figs. 8-9): Epandrium longer than wide, lateral lobe long and thick, bearing 3 apical bristles; cercus (Fig. 9) with 2 finger-like processes; aedeagus curved apically; hypandrium irregularly furcated with several inner denticles near base.

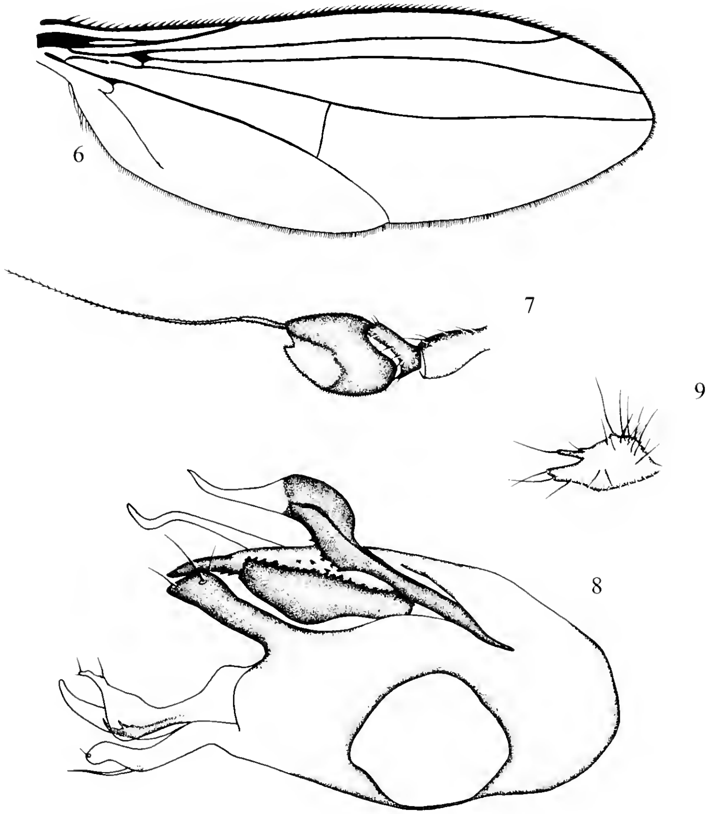
Female. Body length 4.2-4.4 mm. Wing length 4.1-4.2 mm. Similar to male, but sternite 4 without ventral process.

Holotype: Male, Taiwan: Hualien county, Nanan, 200 m, 23°18'47"N, 121°15'37"E, 1996. V. 4, Ignac Sivec and Bogdan Horvat. **Paratypes:** 2♂♂, Taiwan: Hualien county, Nanan, 200 m, 23°18'47"N, 121°15'37"E, 1996. V. 4, Ignac Sivec and Bogdan Horvat; 2♂♂, Taiwan: Chiai county, 1160 m, 23°29'22"N, 120°41'38"E, 1996. X. 21, Ignac Sivec; 9♂♂4♀♀, Taiwan: Taipei county, S Vulai, 330 m. 24°50'03"N, 121°31'56"E, 1996. III. 15, Ignac Sivec and Bogdan Horvat; 1♂1♀, Taiwan: Taichung county, Wushihkang, 720 m. 1996. X. 18, Ignac Sivec.

Distribution: Taiwan (Hualien, Taipei, Chiai, Taichung).

Etymology: The specific name refers to the type locality Taiwan, Hualien county.

Remarks: The new species differs from other species of the *hamatus*-group by the hypandrium bearing small inner denticles near base.

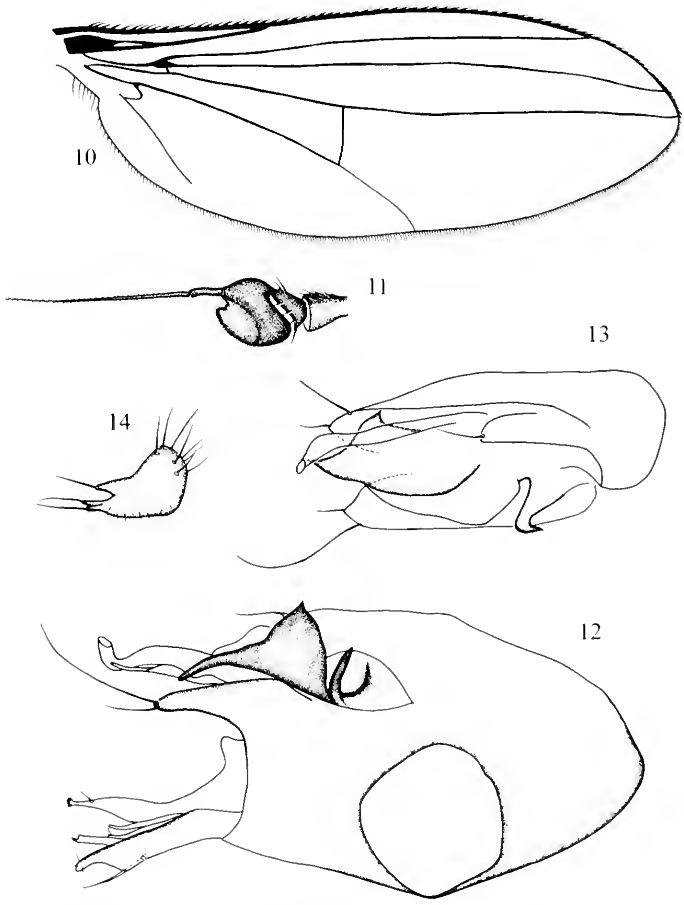


Figs 6-9. *Hercostomus (Hercostomus) hualienensis* sp. nov. 6, wing; 7, antenna, lateral view; 8, male genitalia (excluding cercus), lateral view; 9, cercus, lateral view.

Hercostomus (Hercostomus) taitungensis, NEW SPECIES
(Figs. 10-14)

Diagnosis: First flagellomere nearly as long as wide; arista nearly apical. LI with 5th tarsomere white. Abdominal sternite 4 with a ventral process.

Description: Male. Body length 2.9-3.0 mm, wing length 2.6-2.8 mm.



Figs 10-14. *Hercostomus (Hercostomus) taitungensis* sp. nov. 10, wing; 11, antenna, lateral view; 12, male genitalia (excluding cercus), lateral view; 13, male genitalia, ventral view; 14, cercus, lateral view.

Head metallic green with pale gray pollen. Face narrowing ventrally, narrower than 1st flagellomere. Hairs and bristles on head black; postocular bristles entirely black. Antenna (Fig. 11) black with wide ventral area of scape brownish yellow; 1st flagellomere short, nearly as long as wide, obtuse apically; arista black, subapical, minutely pubescent, with rather short basal segment. Proboscis dark yellow with black hairs; palpus brown with black hairs and 1 black apical bristle.

Thorax metallic green with pale gray pollen. Hairs and bristles on thorax black; 6 strong dc, 6-7 irregularly paired acr; scutellum with 2 pair of bristles (basal pair short and hair-like). Propleuron black haired with 1 black bristle on lower portion. Legs yellow; coxa I yellow, coxa II and III blackish brown. Femur III with black tip. Tibia III with brownish tip. Tarsus I from tip of 1st tarsomere onward brown except 5th tarsomere white; tarsus II from tip of 1st tarsomere onward black; tarsus III entirely black. Hairs and bristles on legs black, coxa II and III each with 1 outer bristle, femur II and III each with 1 preapical bristle, femur II with 1 apical pv. Tibia I with 1 thin ad and 2 thin pd, apically with 2 short bristles; tibia II with 3 ad and 2 pd, apically with 4 bristles; tibia III with 4 ad, 4 pd and 3 thin v, apically with 3 bristles. Relative lengths of tibia and 5 tarsomeres LI 1.5 : 0.9 : 0.5 : 0.3 : 0.2 : 0.2; LII 2.0: 1.0 : 0.65 : 0.5 : 0.3: 0.2; LIII 2.6: 0.7 : 0.85: 0.5: 0.3 : 0.3. Wing (Fig. 10) hyaline, tinged with grayish; veins brown. R_{4+5} and M distinctly convergent apically; CuAx ratio 0.6. Squama yellow with black hairs. Halter yellow.

Abdomen metallic green with pale gray pollen. Sternite 4 with a short, subtriangular ventral process. Male genitalia (Fig. 12-14): Epandrium longer than wide with lateral lobe bearing 2 apical bristles; cercus (Fig. 14) with 3 finger-like processes; aedeagus curved apically; hypandrium irregularly furcated, with a strong curved lateral spine near base.

Female. Body length 2.8-3.0 mm, wing length 2.6-2.8 mm. Similar to male, except tarsi of LI from tip of 1st tarsomere onward brown and sternite 4 without ventral process.

Holotype: Male, Taiwan: Taitung county, S Lital, 810 m. 23°10'52"N, 121°01'32"E, 1996. IV. 4, Ignac Sivec and Bogdan Horvat. Paratypes: 1♂2♀♀, Taiwan: Chiai county, 1160 m, 23°29'22"N, 120°41'38"E, 1996. X. 21, Ignac Sivec; 1♂, Taiwan: Taipei county, S Vulai, 330 m, 24°50'03"N, 121°31'56"E, 1996. III. 15, Ignac Sivec and Bogdan Horvat; 1♂2♀♀, Taiwan: Hualien county, 200 m, 1996. IV. 14, Ignac Sivec and Bogdan Horvat.

Distribution: Taiwan (Taitung, Chiai, Taipei, Hualien).

Etymology: The specific name refers to the type locality Taiwan, Taitung county.

Remarks: The new species is somewhat similar to *H. dissectus* Yang and Saigusa in having leg I with 3rd and 4th tarsomeres black and 5th tarsomere white, and the hypandrium bearing a strong curved lateral spine near the base, but may be separated from the latter by the arista being subapical. In *H. dissectus,* the arista is dorsal (Yang and Saigusa, 1999).

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A NEW SPECIES OF *AMPHINEMURA* (PLECOPTERA: NEMOURIDAE) FROM CHINA[1]

Ding Yang,[2,3] Weihai Li,[2] and Fang Zhu[2]

ABSTRACT: *Amphinemura guangdongensis* sp. n., a new species of the family Nemouridae is described from China, and its relationships are discussed on the Chinese species.

KEY WORDS: Plecoptera, Nemouridae, *Amphinemura*, new species, China

The genus *Amphinemura* is distributed in the Holarctic and Oriental regions (Baumann, 1975). It currently contains about 120 species worldwide, including 37 from China. The species of *Amphinemura* from China were studied mainly by Wu (1938, 1962, 1973) and Zhu and Yang (2002, 2003).

The present paper deals with one new species of the genus *Amphinemura* from China. The material studied is deposited in the Insect Collection of China Agricultural University, Beijing, and all of the specimens are preserved in 75 percent alcohol. The morphological terminology generally follows that of Baumann (1975).

Amphinemura guangdongensis Yang, Li and Zhu, NEW SPECIES (Figs. 1-5)

Diagnosis: Epiproct with a pair of large anterolateral spines that curved outward and a sharp apical process extended from its ventral sclerite. Median lobe of paraproct furcated into a slender projection and wide setous hump.

Description: Male: Body length 7.0-8.5 mm; forewing length 9.4-9.6 mm, hindwing length 7.8-8.1 mm.

Head dark brown; antennae dark brown; mouthparts dark brown. Thorax dark brown; pronotum uniformly dark brown. Wings hyaline, tinged with grayish. Legs brown, except femora brownish yellow to dark brownish yellow and tibiae with dark brown basal portion. Abdomen brownish; hypopygium including cerci dark brown; hairs on abdomen mostly pale.

Terminalia (Figs. 1-5): Tergite 9 weakly sclerotized, rather constricted medially, with large triangular mid-anterior incision and weak mid-posterior incision, and with two groups of several black tiny spines at mid-posterior margin. Sternite 9 with slender vesicle; subgenital plate rather wide basally, then distinctly tapering toward tip. Tergite 10 weakly sclerotized except basal margin distinctly sclerotized, with a rather large and shallow median concavity bearing several tiny black spines closely located along anterolateral margin and a large black spine with 3 tiny spines at mid-lateral margin. Cercus slightly sclerotized, long and nearly cylindrical. Epiproct with a pair of large anterolateral spines that curved outward and a sharp apical process extended from its ventral sclerite. Paraproct divided into three lobes: outer lobe distinctly sclerotized, much shorter than median lobe, distinctly curved and finger-like; median lobe weakly sclerotized, well developed, apically distinctly sclerotized, strongly curved upward and forward, with rather wide and furcated tip, and with one

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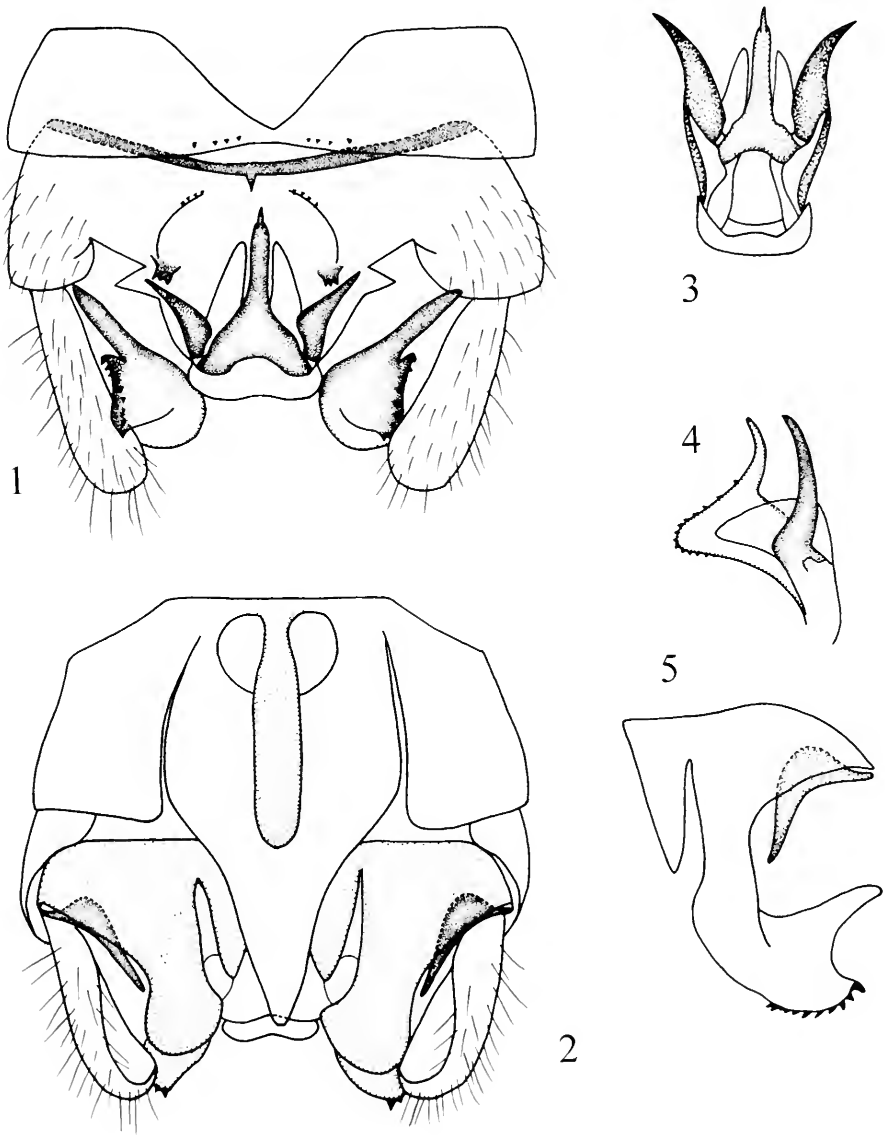

Figures 1-5. *Amphinemura guangdongensis* sp nov., male. 1, genitalia, dorsal view; 2 genitalia, ventral view; 3, epiproct, posterior view; 4, epiproct, lateral view; 5, paraproct.

row of black tiny spines along dorsal ridge; inner lobe weakly sclerotized, nearly as long as outer lobe, more or less straight, with acute tip.

Female: Unknown.

Type Data: Holotype, male, Guangdong, Ruyuan, Nanling National Natural Reserve, 2003. III. 25, Ding Yang. Paratypes: 1 male, Guangdong, Yingde, Shimentai National Forest Garden, 2003. III. 29, Ding Yang; 9 males, Zhejiang, Qingyuan, Baishanzu National Nature Reserve (1300 m), 1994. IV. 18, Hong Wu.

Etymology: The species is named after its type locality, Guangdong.

DISCUSSION

The new species have distinctively sclerotized processes on the epiproct. This feature can be found also in some Chinese species, e.g., *A. sinensis* (Wu, 1926), *A. chui* (Wu, 1935), *A. fleurdelia* (Wu, 1949), and *A. trifurcata* (Wu, 1949). They would be related to each other, but *A. fleurdelia* can be separated from the other four species in having the slender ventral sclerite on epiproct. The new species is closely related to *A. sinensis* in the ventral sclerite on epiproct projected forward apically in the lateral view while the ventral sclerite on epiproct is truncate apically in the lateral view in *A. trifurcata* and *A. chui,* but can be distinguished from *A. sinensis* by the ventral sclerite with long dorsal process curved forward. In *A. sinensis,* the dorsal process of the ventral sclerite is short and curved upward.

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A NEW GENUS AND SPECIES OF ENTOMOBRYIDAE (COLLEMBOLA, ENTOMOBRYOMORPHA) FROM THE IBERIAN PENINSULA

Enrique Baquero,[2] Maite Martínez,[2] Kenneth Christiansen,[3] and Rafael Jordana[2]

ABSTRACT: A new genus and species, *Hispanobrya barrancoi* Jordana and Baquero, gen. n., sp. n. is described. It was found in the Gador Mountain range (Almería, Spain). This genus is similar to *Capbrya* Barra, 1999, from South Africa. The distinguishing characteristics of the new genus are the presence of a post-antennal organ (PAO), no clear tenent hair, a characteristic unguis, the presence of a reduced trochanteral organ, and flattened body setae. The distribution of the bothriotricha is similar to that of the genus *Capbrya*.

KEY WORDS: Collembola, Entomobryomorpha, Entomobryidae, *Hispanobrya* gen. n., Spain, Iberian Peninsula

Specimens of an undescribed collembolan with characteristics of both the families Entomobryidae and Isotomidae were found during a study of the cave fauna of Almería (south of Iberian Peninsula). Their habitus, length of abdominal segments III and IV, presence of PAO led to an initial identification as *Isotomurus*. Detailed study, including SEM (Scanning Electron Microscopy) observation, allowed us to see characters not visible under the light microscope. These details included the eye fine structure, claw, unguiculus, and body sculpture. As a result of this study it became clear that these specimens were a new genus similar to the genus *Capbrya* Barra, 1999, from South Africa.

METHODS

The specimens were collected in the "Paraje Natural Karst en Yesos de Sorbas" in Almería, Spain. The plant community of the "Paraje Natural Karst en Yesos de Sorbas" is gypsophilous and is dominated by small bushes of *Thymus* spp. (thyme, Lamiaceae). There are few other plants near these. In the more open regions, where the thyme is less dense, there is a scattering of annual plants (Lázaro, 1986). The remaining soil is covered mainly by lichens, which cover about 90 percent of the gypsum surface. The predominant lichen community is *Heliantemo alypoidis-Gypsophiletum struthii* (Rivas-Goday and Esteve, 1965).

Samples were taken in the spring, summer and autumn, but *Hispanobrya* gen. n. was found only in the spring and summer. Specimens were preserved in 70 percent ethanol. Some specimens were mounted on slides using 'Hoyer medium,' whereas others were dehydrated using an ethanol series followed by critical-point drying in CO_2, mounted on aluminum SEM stubs, and coated in Argon

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atmosphere with 16 nm of gold in an Emitech K550 sputter-coater. SEM observations were made in a Zeiss DSM 940 A. Abbreviations: MZNA, Museum of Zoology, University of Navarra.

In addition to direct capture, specimens were captured with two types of pitfall traps. One, containing a solution of water and chloral hydrate (10g/l), was collected after 24 hours. A second type had a mesh and 200 g of sheep/goat manure without preservative. The specimens in these traps were collected directly after 48 hours, with an ethanol wetted paintbrush.

Hispanobrya Jordana and Baquero, NEW GENUS

Diagnosis: Body without scales. Abdominal tergite IV 1.72 times as long as abdominal tergite III (1.6-1.9; n=6). First antennal segment undivided, fourth antennal segment with apical vesicle but without a laminar projection. 7+7 ommatidia with reticulated cornea, and a very poor developed 8th ommatidium. Its cornea are almost invisible with the SEM, but the ommatidium lens is barely visible under light microscopy. The PAO is in the form of a protruding vesicle with a perforated cavity on top (Fig. 1A). There are no clear tenent hairs on legs. A reduced trochanteral organ is present in leg III. The formula of trichobothria is 2, 3, 2 on abdominal tergites II, III and IV.

Type species. *Hispanobrya barrancoi* sp. n. Jordana and Baquero.

Etymology. The generic name refers to the geographical region (Hispania, Latin for the Iberian Peninsula).

Hispanobrya barrancoi Jordana and Baquero, NEW SPECIES
(Figs. 1-4)

Description. Total length without appendages 0.7-1.0 mm (n=20) (holotype, 0.95 mm) (Fig. 1B). Background color whitish, with some pigment on head and antennae, and bands covering most of the tergites of all segments. Under SEM the body presents a very uniform reticular pattern, consisting of large hexagonal cells with primary tubercles at the corners (Fig. 1A,C).

Antennae longer than head (holotype antenna/head ratio 2.2). Length of antennae segments (holotype): 0.07:0.11:0.12:0.14 (Fig. 3A,B). Antennal segments II and III similar in length. Antenna with abundant sensillae (about 50) of three types: 1) short, cylindrical, blunt and smooth; 2) long (two times the preceding) and smooth (Fig. 1C); 3) longer and serrated asymmetrically. Antennae segment IV with extrusible apical vesicle but without laminar projection. Antennae segment III with fewer sensory setae than segment IV, and an apical organ with two leaf-like perforate sensory organs (Fig. 3C). Antennal segment II with fewer sensillae than III. Antennal segment I with two basal sensillae on dorsal side, and five basal sensillae on ventral side.

Head. The PAO is a protruding vesicle (20 x 10 micra in a Paratype) with a perforated cavity on top (11.5 x 6.9 micra), situated in front of the eyes A and B. Under SEM the cavity of the PAO shows perforations (Fig. 1A), and 7+7 reticulated ommatidia can be observed. The G ommatidia cannot be seen under the SEM, but a small lens can be seen under the light microscope. A large number of macrosetae of different sizes present (Fig. 4B). The bothriotrichum beside the eyes is present. Labrum with 554 setae (Fig. 4C). Labral papillae smooth with an anterior row of short blunt setae. The remaining labral setae are smooth and acuminate, the five prelabrals setae ciliated. The labial setae drawn appear like a typical entomobryid labial triangle with the M1, M2, R, E, L1 and L2 setae, all similar and ciliate, and seta a2 smooth present (Fig. 4B). Labial palps with five basal setae (Fig. 4D); the external differentiated papilla has a blunt, thickened seta. Venter of head with mesosetae of varied sizes.

Body chaetotaxy. Microsensillae: 10/1000. Sensillae: 12/02223, thoracic ones lateral but those of

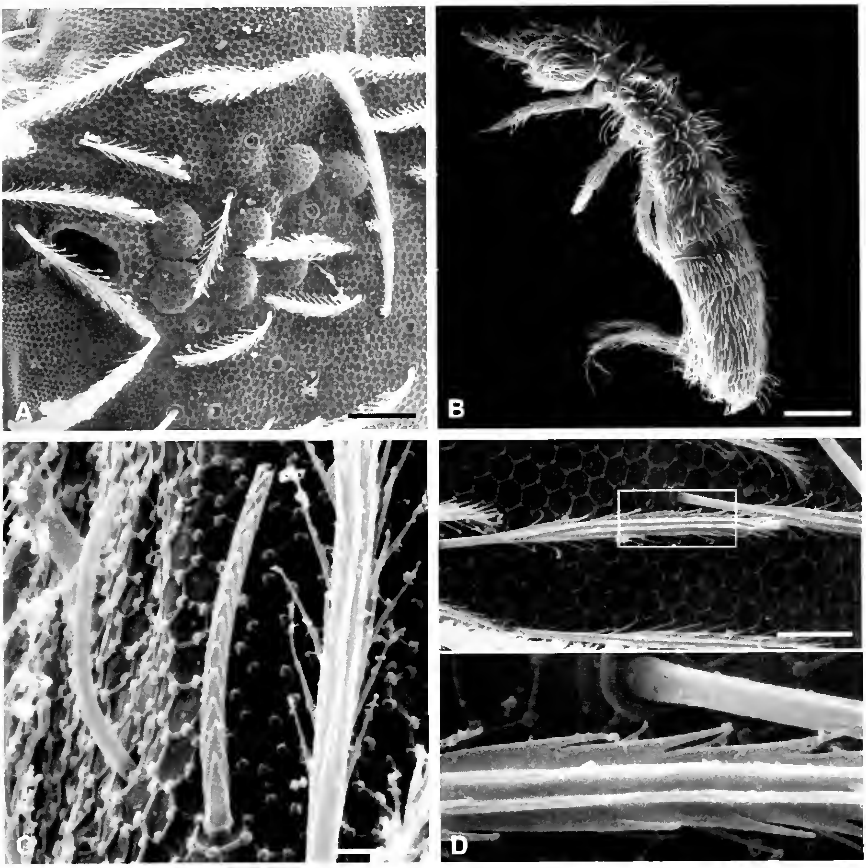

Fig. 1. *Hispanobrya barrancoi* (SEM microphotographs). A, Detail of the eyes and PAO (bar = 10 micra). B, Lateral habitus (bar = 100 micra). C, Two types of sensillae present on the antennal segment IV, one of them smooth and the other with peculiar spine-like projections, very difficult to see under light microscope (bar = 2 micra). D, Mesosetae and detail (x4) (bar = 5 micra).

abdominal segments III and IV posterior and in front of the last row of setae, and in abdominal segment V with the anterior sensillae three times as long as the posterior. Pseudopores on thoracic and abdominal segments I-IV. Bothriotricha on abdominal segments II-IV (2/3/2) (Fig. 2C,4A). There are 3+3 pubescent setae (type 2 from Christiansen, 1958) on abdominal segment IV similar to the bothriotricha but thicker. Macrosetae similar to the *Entomobrya* type 1 setae occur on the thorax and abdomen but are somewhat different in appearance from those seen in the genus *Entomobrya* (Fig. 1D,3L). The rest of setae are more flattened with 6-8 rows of barbed ridges; the basal barbs project out laterally more than the distance of the seta width. This type of setae are 19-46 micra long. Macrosetae present on head, thoracic segments and abdominal segment I (Fig. 2A,4A). Mesosetae on abdominal segments II-VI (Fig. 2B) and on legs up to 25 micra long. Trochanteral organ on leg III has four smooth setae (Fig. 3D,E). On the leg III there is a smooth and long inner seta. Pretarsus with a single anterior seta. The unguis (Fig. 3F-J) with three longitudinal ridges extended beyond the level of the basal teeth, with the central ridge longer than the others, inner lamellae joined basal to apex forming the apical tooth. Between the basal paired teeth and the anteapical teeth there is an unpaired

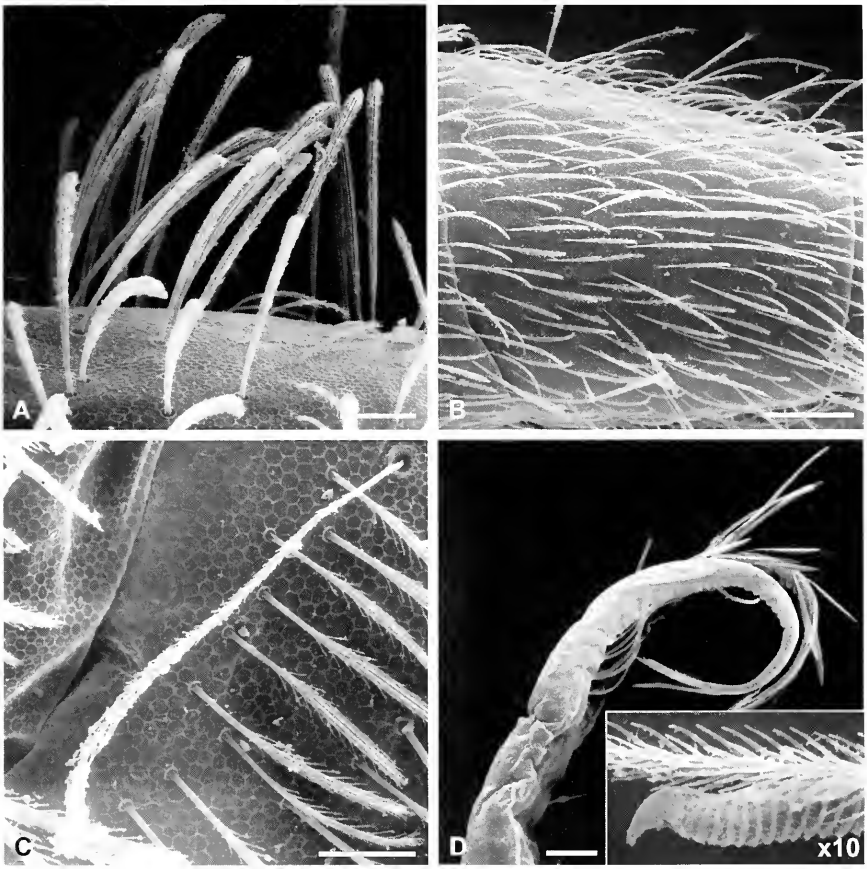

Fig. 2. *Hispanobrya barrancoi* (SEM microphotographs). A, Macrosetae on the thoracic segment II (bar = 10 micra). B, Lateral view of abdominal segment IV (bar = 30 micra). C, Bothriotrichum on abdominal segment II. (bar = 5 micra). D, Lateral view of the furcula and detail of the mucro (inset x10) (bar = 20 micra).

tooth. The unguiculus is half as long as the unguis, and has two short lateral wings but no terminal filament. The four lamellae have a strong ridge. The lateral flaps of the ventral tube each have eight apical setae, only one being smooth, anteriorly with 1+1 setae, and no posterior setae (Fig. 3K).

Tenaculum with four teeth on each ramus, and a single seta on the corpus (Fig. 3M).

Furca. Manubrium with setae similar to those on the legs, manubrial plaque with two pseudopores, two inner setae and one outer seta (Fig. 3N). *Dentes* ringed on its basal two thirds (Fig. 2D), with the final third narrowed and striated transversally, and with three subapical setae that reach the apex of the mucro, which is falciform and without basal spine.

Type Material. Holotype. Female, SPAIN, "Paraje Natural Karst en Yesos de Sorbas," Almería, 300 m (UTM co-ordinates 30SWG8308), Mediterranean maquia, 28 June 2002, Ruiz-Portero (pitfall trap) code: MZAL0164-02p (slide) (MZNA). **Paratypes.** Same data as for holotype, MZAL0164-02 (6 specimens in ethyl alcohol), MZAL0164-04p (slide) and MZAL0164-03, 05, 06 (3 specimens on 2 SEM stubs) (MZNA).

Other material studied. Same locality as for holotype, MZAL0150-03p (1 specimen on slide), 9 August 2002 (direct capture and pitfall trap); MZAL0151-02t (1 specimen in ethyl alcohol), 7 August

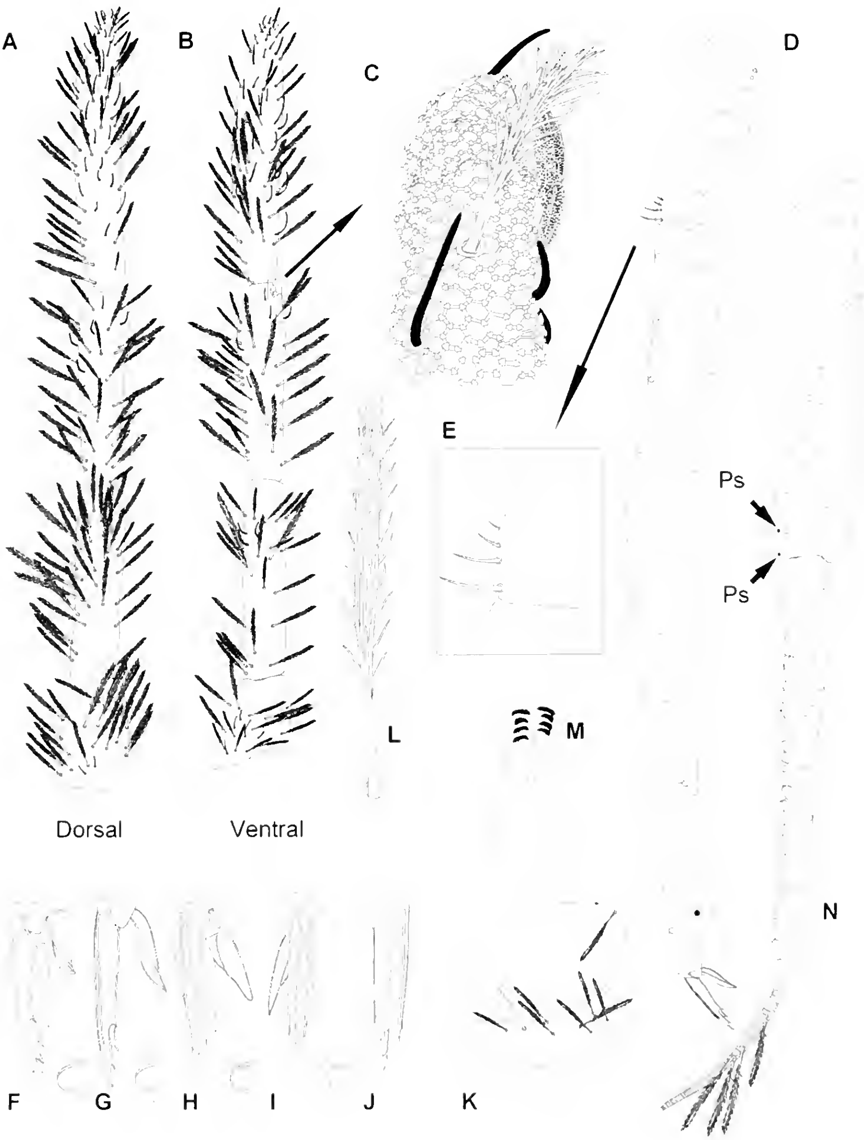

Fig. 3. *Hispanobrya barrancoi*. A, Antennae dorsal view. B, Antennae ventral view. C, Detail of the sensory organ of antennal segment III. D, Leg III. E, Trochanteral organ. F-J, Claw rotation to show its structure. K, Ventral tube (collophore). The arrow points to the head. L, Detail of a mesosetae (type IV, Christiansen, 1958) from the body. M, Tenaculum. N, Furcula.

2002, (direct capture and pitfall trap); MZAL0152-02t (1 specimen in ethyl alcohol), 14 June 2002 (direct capture and pitfall trap); MZAL0153-03t (1 specimen in ethyl alcohol), 26 June 2002 (direct capture and pitfall trap); MZAL0154-03t (1 specimen in ethyl alcohol), 17 May 2002 (direct capture and pitfall trap); MZAL0161-03t (2 specimens in ethyl alcohol), 31 May 2002 (direct capture and pitfall trap); MZAL0162-03t (4 specimens in ethyl alcohol), 27 August 2002 (direct capture); MZAL0163-03t (1 specimen in ethyl alcohol), 6 May 2002 (direct capture and pitfall trap) Ruiz-Portero (all MZNA).

Etymology. The name is dedicated to Dr. Pablo Barranco, who kindly provided the material.

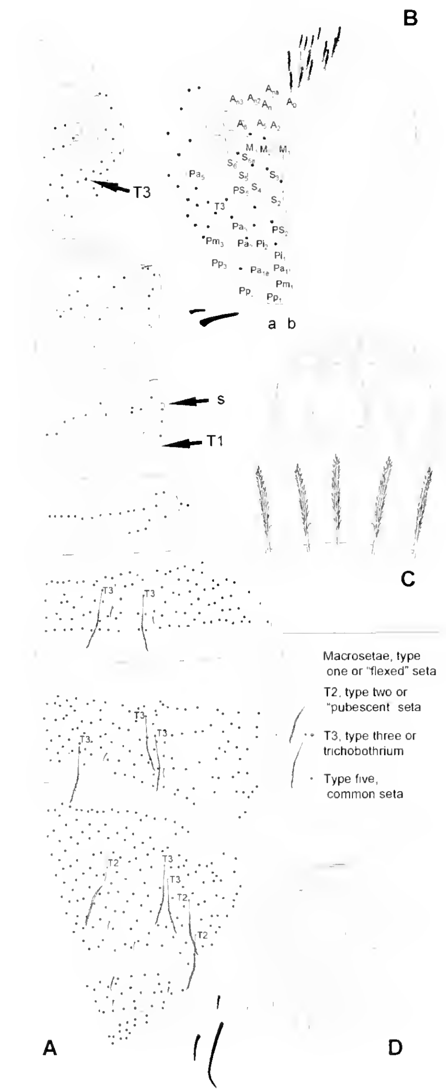

Fig. 4. *Hispanobrya barrancoi.* A, Body dorsal chaetotaxy. B, Dorsal (a) and ventral (b) head chaetotaxy. C, Labrum. D, Labial papillae.

DISCUSSION

Capbrya Barra from South Africa is the genus most similar to *Hispanobrya. Hispanobrya* is similar to *Capbrya* in habitus, the falciform mucro, the dentes without spines, crenulated with the final third striated transversally, the number and position of the bothriotricha and type 2 setae on abdominal segment IV, the ratio between abdominal tergites III and IV, the general chaetotaxy and absence of a clear tenent hair. It differs in claw morphology, the sensory organ on antennal segment III, the eye number, and the PAO. The lack of SEM figures for the antennae of *Capbrya* makes comparison of the sensory setae difficult.

Nothobrya Arlé, 1961 is similar in size and habitus, but has a vesicular PAO and six segmented antennae (Baquero et al., 2004). The setae morphology and distribution are also different.

The presence of PAO of *Hispanobrya* Jordana and Baquero, gen. n., *Capbrya* and *Nothobrya* is similar to *Indoscopus* Prabhoo, 1971, at least one species of *Alloscopus* Börner, 1906 and *Australotomurus* Stach, 1947; however, the other features of *Hispanobrya* are totally unlike those found in these genera. The PAO is also found in some genera of Tomocerinae. The presence of type 1 setae, the trochanteral organ on leg III and the 2- 3- 2 arrangement of bothriotricha on abdominal segments II-IV, as well as the habitus indicate that all three genera belong in the family Entomobryidae *sensu lato,* but the chaetotaxy, the detailed structure of the setae and the unusual features of the unguis in *Hispanobrya* does not fit into any subfamily as they are presently defined.

These discoveries raise two important questions: 1) what does the discovery of these two genera in two such disparate localities imply and 2) what is the impact of this upon the suprageneric classification of the Entomobryidae *sensu lato.*

ACKNOWLEDGEMENTS

We are grateful to Dr. Pablo Barranco (Department of Applied Biology, University of Almeria) for the material object of the study. Stephanie Peterson assisted in the preparation of the manuscript.

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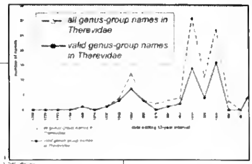

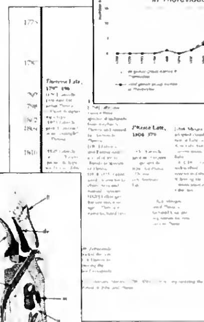

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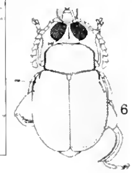

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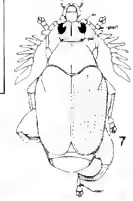

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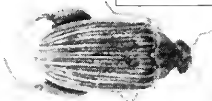

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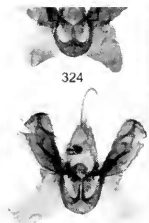

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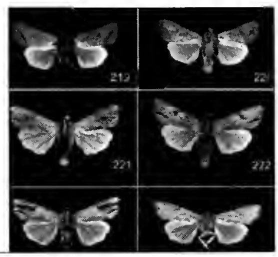

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SCIENTIFIC NOTE

FIRST RECORD OF *MICROCEROTERMES SERRULA* (DESNEUX) (ISOPTERA: TERMITIDAE) IN THAILAND[1]

Richard M. Houseman[2]

Our knowledge of termite biodiversity in Thailand historically has been limited. Holmgren (1913) first recorded five species and Snyder's (1949) catalogue of the termites of the world listed six. It was not until Ahmad's (1965) monograph that a significant survey of Thailand termite diversity was published. He recorded 74 species in 29 genera, of which 32 species were new to science. Later, 19 species were listed by Harris (1968) from collections made by H. Hillman and A. Manjikul. Morimoto (1973) reported 48 species from his collections in Thailand, including 13 new records and four species new to science. Based on all published records, 90 termite species in 29 genera have been reported from Thailand. Most published records are from north of the Isthmus of Kra, while a few collections have been reported from the southern peninsular region of Thailand.

Five species of *Microcerotermes* have been reported from Thailand: *Microcerotermes minutus* Ahmad, *Microcerotermes annandalei* Silvestri, *Microcerotermes crassus* Snyder, *Microcerotermes paracelebensis* Ahmad, and *Microcerotermes distans* (Haviland). Herein, I report one additional species, *Microcerotermes serrula* (Desneux) (Fig. 1), collected from the southernmost peninsular region of Thailand in Songkhla Province near the border with Malaysia. This species is widespread throughout peninsular Malaysia (Tho 1992) in lowland dipterocarp (Dipterocarpaceae) forests and rubber plantations, where they build characteristic aerial nests on trees. I collected specimens of *M. serrula* from an aerial nest (Fig. 2) in a rubber plantation, and similar nests were observed on rubber trees throughout Songkhla Province. The effect of *M. serrula* on rubber trees and rubber production is unknown.

Repository specimens are located in the National Science Museum, Pathum Thani, Thailand; Royal Forestry Department, Bangkok, Thailand; Department of Pest Management, Faculty of Natural Resources, Prince of Songkhla University, Hat Yai, Thailand; and the Enns Entomology Museum, University of Missouri-Columbia, Columbia, Missouri U.S.A.

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[1] Received on September 28, 2004. Accepted on October 14, 2004.

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Mailed on February 3, 2005

Microcerotermes serrula (Desneux)

THAILAND: Songkhla province, Sadao district, rubber plantation near Ban Phru Tieo, ~6 km north of Malaysian border (WGS 84), N 06°34.500 E 100°24.053, 03 June 2003, R.M. Houseman, complete aerial nest containing workers, nymphs, and soldiers.

Fig. 1. Soldier of *Microcerotermes serrula* (Desneux). View of head and pronotum from above.

Fig. 2. Carton nest of *Microcerotermes serrula* (Desneux) in the branches of a rubber tree *Hevea brasiliensis* (Willd.).

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SOCIETY MEETING OF OCTOBER 20-22, 2004

"Working Together to Promote Interaction and Cooperation in Entomology"

Joint Meeting of the American Entomological Society (AES) and the Entomological Society of Pennsylvania (ESP)

Susan King (AES) and David Rebuck (ESP), co-organizers

http://www.acnatsci.org/hosted/aes/ http://www.entsocpa.org/

The October meeting was a joint conference between the American Entomological Society and the Entomological Society of Pennsylvania, having last met together in 1994. This conference, stretching over three days, in three locations in southeastern Pennsylvania and northern Delaware, was organized by the presidents of the two societies, Susan King (AES) and David Rebuck (ESP). The varied meeting consisted of a mixture of invited and submitted talks and posters, tours of facilities, and a keynote speaker and awards banquet. There were 14 talks given over a wide range of entomological subjects, including the keynote presentation given by Dr. Bern Sweeney, Director of the Stroud Water Research Center, where the Thursday sessions were held. He spoke on "The Freshwater Crisis: The Global Problem with Backyard Solutions." Tours were given of the Stroud Water Research Center, and of the Department of Entomology and Wildlife Ecology and the USDA Beneficial Insects Laboratory, both at the University of Delaware, where the Wednesday meeting was held. Friday's meeting was held at French Creek State Park, where some of the participants from outside the region stayed. The meetings were well attended; at the Thursday meeting over 60 participants attended the morning talks.

The full list of speakers for this joint meeting can be viewed at http://www.acnatsci.org/hosted/aes/joint-meeting-flyer.pdf.

The speakers for upcoming meetings (November 2004 - April 2005) of AES can be found at http://www.acnatsci.org/hosted/aes/membership.html.

Jon Gelhaus, Corresponding Secretary of
The American Entomological Society (2004)
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Mailed on February 3, 2005

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In 1987, the American Entomological Society initiated the Calvert Award to be presented to a young person who has demonstrated outstanding accomplishments in insect-related study. The Award is named in honor of Dr. Philip P. Calvert who joined the Society as a teenager, later became its president, and was a member for 74 years. As Professor of Biology at the University of Pennsylvania and an Associate of the Academy of Natural Sciences of Philadelphia, Dr. Calvert played an important role in stimulating an interest in insects among young people.

On April 23, 2003, the seventeenth Calvert Award was presented to D. J. Haney, an eighth grade student at William Allen Middle School, Moorestown, New Jersey. His project was entitled, "To Bite or Not to Bite." Mr. Haney's project evolved from a concern about the transmission of West Nile Virus by mosquitoes. He studied the effectiveness of a variety of natural compounds on their ability to repel a local variety of mosquito.

Daniel Zinshteyn, an eighth grade student from Philadelphia who attends Baldi Middle School, was first runner-up in 2003 with another insect repellent project, "DEET: Are there hidden dangers?" For his project, Daniel compared the repellent effectiveness of DEET and Black Walnut extracts on fruit flies, and found the extract to be safer and more effective. The second runner-up was Courtney Cope, from Sellersville, PA, and Penn View Christian School, for her project, "Horned Passalus Beetles can pull their Own Weight, Can You?"

On April 28, 2004, the eighteenth Calvert Award was presented to Brady Rollins of Newark, Delaware, a student at the Towle Institute, Hockessin, Delaware. Her project was entitled, "Terminating Termites." Ms. Rollin's interest in termites arose from a visit to the Entomology and Applied Ecology, University of Delaware. Her project was selected from among about 20 insect-related science projects presented at the annual Delaware Valley Science Fairs held April 7 at the Expo Center in Fort Washington, Pennsylvania.

Sam Spoor, a seventh grade student at Woodlyn Christian School in Woodlyn, Pennsylvania, was first runner-up with another insect repellent project, "Battling Mosquitoes." Sam's project arose from his interest in reducing the number of mosquitoes breeding around his home. Second runner-up was Natalie Piger from Bethlehem, Pennsylvania, and St. Anne's School for her project on rearing Painted Lady butterflies, "Growing to set free?"

All students were honored at the Calvert Award ceremonies at American Entomological Society meetings held at the Academy of Natural Sciences in Philadelphia.

Harold B. White, Dept. of Chemistry and Biochemistry, University of Delaware
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Mailed on February 3, 2005

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E[NT]OMOLOGICAL NEWS

THE AMERICAN ENTOMOLOGICAL SOCIETY
MAILED ON MARCH 15, 2005

ENTOMOLOGICAL NEWS, THE AMERICAN ENTOMOLOGICAL SOCIETY, AND NEW GUIDELINES FOR AUTHORS OF *ENTOMOLOGICAL NEWS*

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THE GENUS *RAMOSULUS* YOUNG IN COLOMBIA (HOMOPTERA: CICADELLIDAE, CICADELLINAE)[1]

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ABSTRACT: The genus *Ramosulus* Young is reviewed for Colombia. Of the four species in the genus, two species, *R. corrugipennis* (Osborn) and *R. phaedrus* Young, were known for Colombia. Five species are described as new, *R. agostus*, *R. crassus*, *R. hamatus*, *R. lobatus*, and *R. nanus*, making the total number of species nine for the genus and seven for Colombia.

KEY WORDS: *Ramosulus*, Homoptera, Cicadellidae, Cicadellinae, Colombia

The genus *Ramosulus* was described by Young (1977) in his revision of the *Cicadellini of the New World.* He designated *Cicadella corrugipennis* Osborn as the type of the genus, and included four species. Two of the species were known from Colombia, *R. phaedrus* Young and *R. corrugipennis* (Osborn) [Young (1977), Freytag and Sharkey (2002)]. This paper is an update of our knowledge of the genus for Colombia, and includes the description of five new species.

All types of the new species are deposited in the Instituto von Humboldt, Villa de Leyva, Colombia. Most material came from National Parks and Reserves. All species of *Ramosulus* are small, usually 4 to 5.5 mm, and mostly black with orange and sometimes yellow markings. This genus is known from the northern part of Brazil and from Colombia to Bolivia.

Key to the species of *Ramosulus* in Colombia (males)

1\. Clypellus black; pronotum with an interrupted transverse band of orange ...... *phaedrus* Young

1'. Clypellus with lower portion pale yellowish white; pronotum with a complete transverse band of orange 2

2\. Pronotal transverse orange band nearly straight across, and either wide or narrow; scutellum variable (Figs. 1-4) 3

2'. Pronotal transverse orange band wide on lateral margins then narrow and bisinuous; scutellum entirely black (Figs. 5-6) 6

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3. Orange band across crown not reaching hind margin of head near eyes; pronotal transverse orange band narrow and close to posterior margin (Fig. 1) .... *lobatus* n. sp.

3'. Orange band across crown reaching hind margin of head near eyes; pronotal transverse orange band wide (Figs. 2-4) 4

4. Pygofer with a tuft of short setae at apex (Fig. 14); aedeagus with a long shaft (Fig. 11) ....*corrugipennis* (Osborn)

4'. Pygofer with a spine-like process at apex (Figs. 10, 18, and 22) 5

5. Scutellum with a pair of orange spots (Fig. 3); aedeagus with shaft straight, with apical processes long, and each nearly as long as the shaft (Fig. 16) ...... *crassus* n. sp.

5'. Scutellum entirely black (Fig. 4); aedeagus s-shaped, with apical processes long, and each nearly two-thirds length of shaft (Fig. 20) ....*agostus* n. sp.

6. Orange band on crown not reaching hind margin of head near eyes (Fig. 5); pygofer with a stout spine off ventral caudal margin (Fig. 23).....*nanus* n. sp.

6'. Orange band on crown reaching hind margin of head near eyes (Fig. 6); pygofer with a small hook-like process off caudal margin (Fig. 26)..*hamatus* n. sp.

Ramosulus phaedrus Young

Ramosulus phaedrus Young 1977, p. 441.

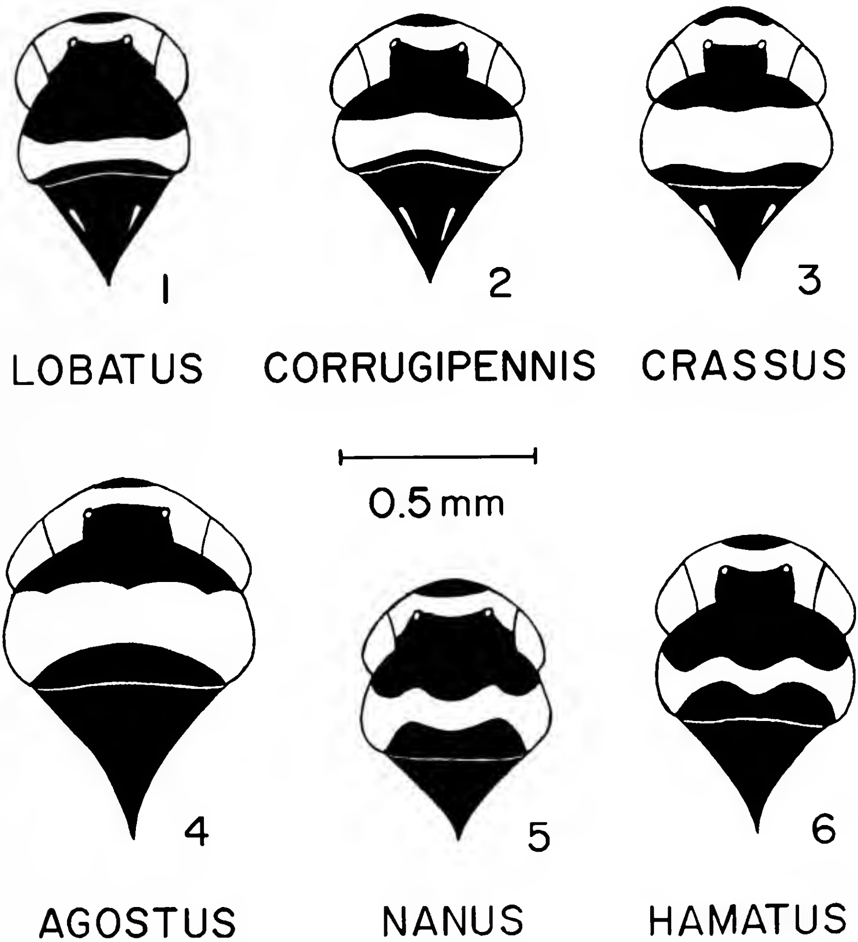
Length of males 5-5.1 mm, females 5.3-5.4 mm. Head mostly black with a median stripe from between ocelli extending onto face, and area from antennal ledges along eyes to posterior margin, orange. Pronotum black with a transverse band across median, interrupted medially, orange. Scutellum black with pair of small orange spots on posterior half. Wings much as in *corrugipennis*. Legs mostly brown.

Male genitalia: Young (1977) illustrated the male genitalia of this species. The types of this species were not seen, but this species was described from Cundinamarca, Colombia, on the basis of two males and three females. No other specimens have been seen of this species.

Ramosulus lobatus n. sp.

(Figs. 1 and 7-10)

Length of males 4.2-4.6 mm., females 4.3-4.6 mm. Overall color pattern similar to *corrugipennis*. However, head, pronotum, scutellum (Fig. 1) with orange band not reaching hind margin of crown; scutellum with triangular spots, yellow.

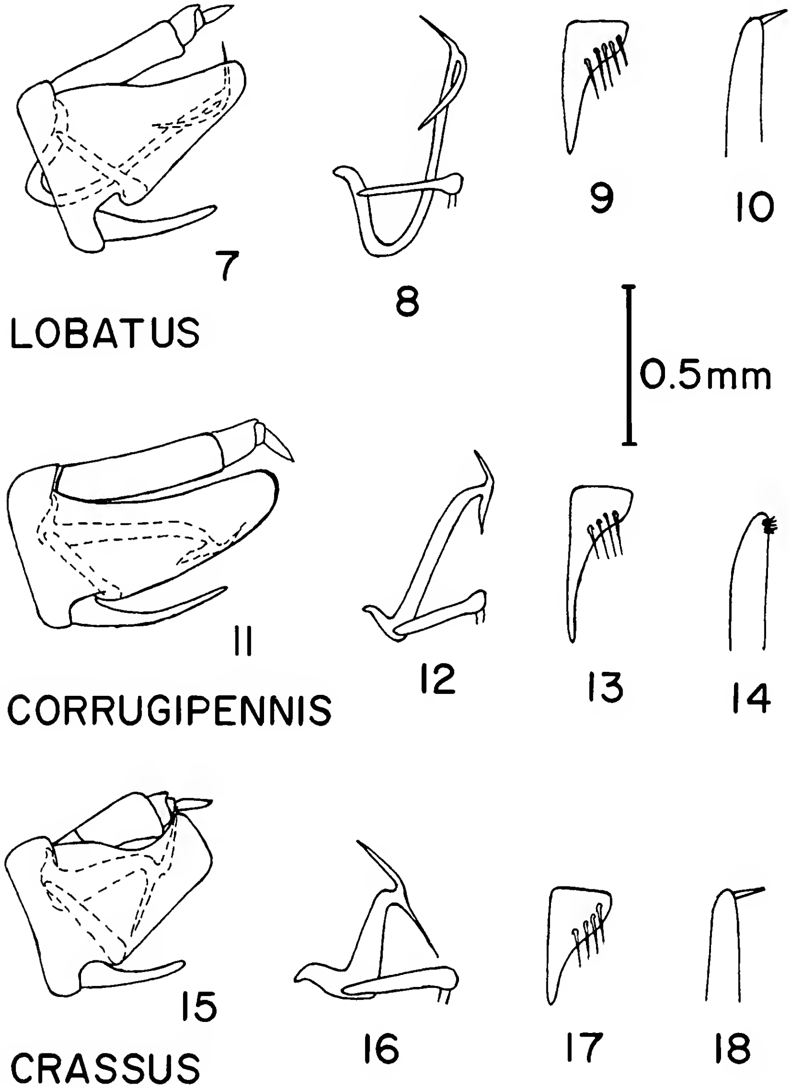


Figures 1-6. Dorsal view of head, pronotum and scutellum of the species of *Ramosulus* covered in this paper. All drawn to same scale. Fig. 1, *Ramosulus lobatus* n. sp. Fig. 2, *R. corrugipennis* (Osborn). Fig. 3, *R. crassus* n. sp. Fig. 4, *R. agostus* n. sp. Fig. 5, *R. nanus* n. sp. Fig. 6, *R. hamatus* n. sp.

Male genitalia: Pygofer (Fig. 7) triangular with lobe on ventral margin near base, with setal-like process (Fig. 10) at apex. Plate (Fig. 9) narrowing to pointed apex, about half length of pygofer. Aedeagus (Fig. 8) long, narrow, u-shaped near base in lateral view with two long processes at apex, one extending dorsad beyond apex, other extending basad close to shaft. Paraphysis (Fig.8) u-shaped, around base of aedeagus.

Female genitalia: Seventh sternum with posterior margin evenly convexly rounded, similar to *corrugipennis*.

Type Material: Holotype male: Colombia: Putumayo, PNN La Páya, Salao Grande, 0°01'S 74° 56'W, 330 m., 22-VIII-2001, Red, D Campos, M 2085. Paratypes: Four males, same data as holotype; one male, same data as holotype, except M 2087.



Figures 7-10. *Ramosulus lobatus* n. sp. Fig. 7, male genital capsule, lateral view. Fig. 8, aedeagus and paraphysis, lateral view. Fig. 9, plate, ventral view. Fig. 10, apex of pygofer, ventral view. Figures 11-14. *Ramosulus corrugipennis* (Osborn). Fig. 11, male genital capsule, lateral view. Fig. 12, aedeagus and paraphysis, lateral view. Fig. 13, plate, ventral view. Fig. 14, apex of pygofer, ventral view. Figures 15-18. Ramosulus crassus n. sp. Fig. 15, male genital capsule, lateral view. Fig. 16, aedeagus and paraphysis, lateral view. Fig. 17, plate, ventral view. Fig. 18, apex of pygofer, ventral view. All drawn to same scale.

Other specimens examined: one male, Colombia, Caquetá, PNN Chiribiquete, Rio Cuñare, 0°32'N 72°37'W, 300 m., Malaise, 15-19-XI-2000, E. González y M. Ospina; one male and one female, Colombia: Meta, PNN Tinigua, Vda. Bajo Raudal, 2°16'N, 73°48'W, 460 m., Malaise, 29-VI-20-VII-2002, C. Sánchez, M 2332; one female, Colombia, Meta, PNN Tinigua, Caño Nevera, 2°11'N 73°48'W, 390 m., Malaise, 23-I-7-II-2002, C. Sánchez, M 2330; one female, same data as last, except 20-23-XII-2001, M 2621; one female, Colombia: Meta, PNN Sierra de La Macarena, Cabaña Cerrillo, 3°21'N 73°56'W, 460 m., Malaise, 21XII-2002-4I-2003, A. Herrera y W. Villalba, M 2983. All specimens deposited in the Instituto von Humboldt.

Ramosulus corrugipennis (Osborn)
(Figs. 2 and 11-14)

Cicadella corrugipennis Osborn 1926, p. 204.
Ramosulus corrugipennis Young 1977, p. 439.

Length of males 4.2-4.6 mm, females 4.5-5 mm. Color mostly black with orange pattern. Head, pronotum, scutellum (Fig. 2). Head with crown black with wide transverse orange band anterior to ocelli, extending onto antennal shelf and back to posterior margin near eyes. Face with upper two-thirds black, lower third yellowish white. Pronotum black, with wide transverse orange band across posterior half, covering nearly half of dorsal surface. Scutellum black, with triangular orange spots on posterior half. Front wings black, with three wide longitudinal orange bands, one along commissural edge of clavus, one below claval suture from base to apical cells, one along entire costal margin; claval suture and commissure marked with thin line of yellow, apical cells smokey. Legs mostly yellow with orange tibiae.

Male genitalia: Pygofer (Fig. 11) elongate with rounded apex, apex with a cluster of short setae (Fig. 14). Plate (Fig. 13) narrowing to long pointed apex, about two-thirds length of pygofer. Aedeagus (Fig. 12) with long shaft, curving ventrally near apex, with two stout process at apex, one extending dorsally, one extending ventrally. Paraphysis (Fig. 12) u-shaped, around base of aedeagus.

Female genitalia: Seventh sternum with posterior margin evenly convexly rounded.

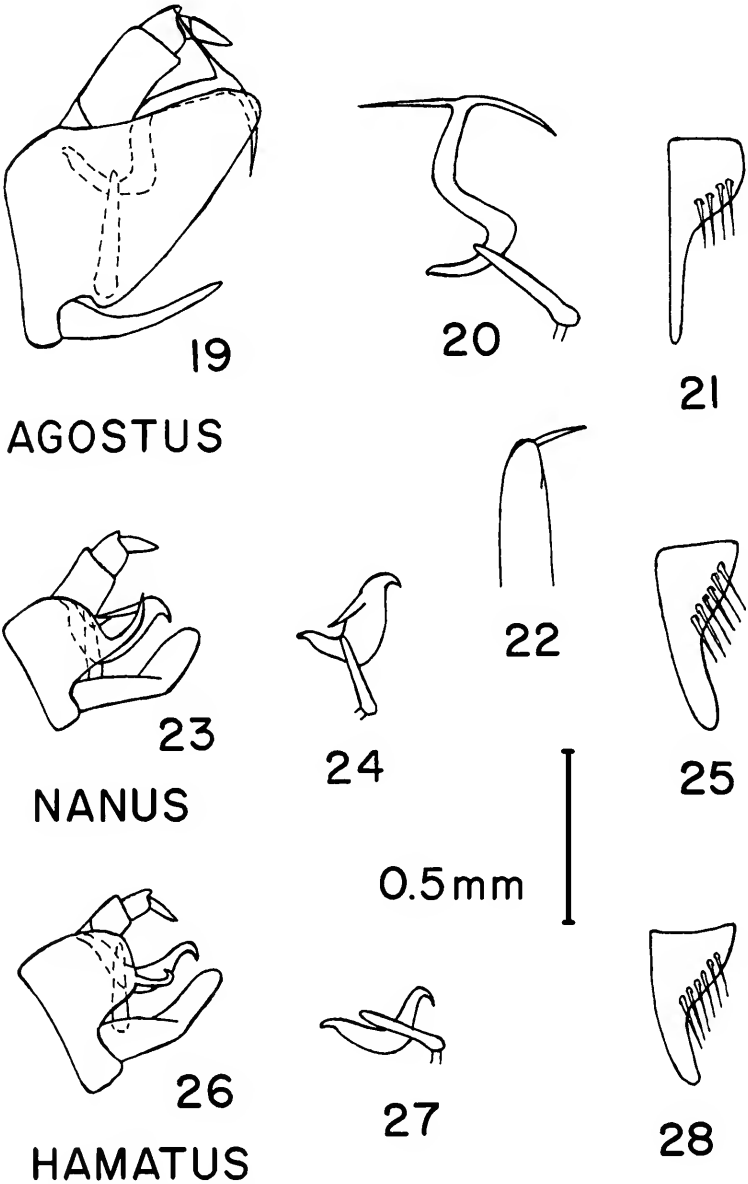
Young (1977) illustrated both the male and female characters of this species. This species has the widest range of any of the species of the genus and is known from Bolivia, Brazil, Colombia, Ecuador, and Peru. It is the most commonly collected species in Colombia and has been collected in Amazonas, Meta, Putumayo and Vaupés. Adults appear to be collected year round in these areas.

Ramosulus crassus n. sp.
(Figs. 3 and 15-18)

Length of male 4.1 mm, female unknown. Overall color pattern similar to *corrugipennis*, except legs mostly orange. Head, pronotum, scutellum (Fig. 3), as in *R. corrugipennis*, except transverse orange band across pronotum covering two-thirds of dorsal surface.

Male genitalia: Pygofer (Fig. 15) short, narrowing to truncate apex, with large spine-like process at apex (Fig. 18). Plate (Fig. 17) short, narrowing to a pointed apex, less than half length of pygofer. Aedeagus (Fig. 16) short, stout at base, narrowing to ventrally bent apex, with two long processes at apex, one extending dorsally, other ventrally. Paraphysis (Fig. 16) u-shaped, around base of aedeagus.

Type Material: Holotype male: Colombia: Meta, PNN Tinigua, Vda. Bajo Raudal, 2°16'N 73° 48'W, 460 m., Malaise, 29-VI-20 VII-2002, C. Sánchez,M 2332.



Figures 19-22. *Ramosulus agostus* n. sp. Fig. 19, male genital capsule, lateral view. Fig. 20, aedeagus and paraphysis, lateral view. Fig. 21, plate, ventral view. Fig. 22, apex of pygofer, ventral view. Figures 23-25. *Ramosulus nanus* n. sp. Fig. 23, male genital capsule, lateral view. Fig. 24, aedeagus and paraphysis, lateral view. Fig. 25, plate, ventral view. Figures 26-28. *Ramosulus hamatus* n. sp. Fig. 26, male genital capsule, lateral view. Fig. 27, aedeagus and paraphysis, lateral view. Fig. 28, plate, ventral view. All drawn to same scale.

Ramosulus agostus n. sp.
(Figs. 4 and 19-22)

Length of male 5.5 mm, female 5.5 mm. Head, pronotum, scutellum (Fig. 4). Head with black rectangular spot on anterior median margin extending onto face, longer than wide, remainder of face yellowish white. Pronotum with transverse orange band wide and located medially. Scutellum black. Front wings similar to *corrugipennis*.

Male genitalia: Pygofer (Fig.19) triangular with a long spine at apex (Fig. 22). Plate (Fig. 21) narrowing near middle to a long pointed apex, about half length of pygofer. Aedeagus (Fig. 20) with shaft s-shaped in lateral view, with two long processes at apex, one extending dorsad, other ventrad. Paraphysis (Fig. 20) u-shaped and near base of aedeagus.

Female genitalia: Seventh sternum with posterior margin evenly convexly rounded, embrowned on median third.

Type Material: Holotype male: Colombia: Chocó, PNN Utria, Boroboro, 6°01'N 77°20'W, 10 m., Malaise, 5-19-VII-2000, J. Pérez, M 335.Paratype female: Same data as holotype, except 20 m., 19-27-VII-2000, M 334.

This is the largest species in the genus at this time. Other specimens seen are two males from Colombia; Teresita, March 26, 1967, sweeping; and one male same data except April 20, 1967, in the University of Kentucky collection.

Ramosulus nanus n. sp.
(Figs. 5 and 23-25)

Length of males 4.1-4.2 mm., female unknown. Head, pronotum, scutellum (Fig. 5). Head black with transverse band of orange anterior to ocelli, extending onto antennal ledges and along eyes but not reaching posterion margin; face with median black spot on anterior margin, remainder yellowish white. Pronotum black with transverse orange band on posterior half bisinous, wider on lateral margins. Scutellum black Front wings similar to *corrugipennis*, except with additional narrow yellow band, or bands, between claval suture and larger band of orange on clavus.

Male genitalia: Pygofer (Fig. 23) small, rounded with prominent apical ventral spine. Plate (Fig. 25) short, robust, narrowing near middle to rounded apex, somewhat paddle shaped in lateral view (Fig. 23), extending slightly beyond pygofer. Aedeagus (Fig. 24) short, stout, with two processes at apex, one short and curving ventrally, other longer extending basally. Paraphysis (Fig. 24) u-shaped near base of aedeagus.

Type Material: Holotype male: Colombia: Vaupés, RN Mosiro-Itaiura (Caparú), Centro Ambiental, 1°04'S 69°31'W, 60 m., Red, 20-I-1-II-2003, M. Sharkey & D. Arias, M 3387. Paratypes: three males, same data as holotype, except Malaise, M 3386.

Ramosulus hamatus n. sp.
(Figs. 6 and 26-28)

Length of males 4-4.4 mm., females 4.3-4.6 mm. Overall color pattern similar to *R. nanus*, except the orange band on crown extends to posterior margin. Head, pronotum, scutellum (Fig. 6).

Male genitalia: Pygofer (Fig. 26) short, rounded with small hook-like process at caudal apex. Plate as in *nanus* (Fig. 28). Aedeagus (Fig. 27) short, somewhat stout, with a short process at apex curving ventrad. Paraphysis (Fig. 27) u-shaped, around basal part of aedeagus.

Female genitalia: Seventh sternum with posterior margin evenly, but slightly, concavely rounded either side of median, also embrowned either side of median giving median triangular appearance.

Type Material: Holotype male: Colombia: Amazonas, PNN Amacayacu, Mocagua, 3°23'S, 70°06'W, 150 m., Malaise, 19-31-VII-2000, A. Parente, M 676. Paratypes: Two males, same data as holotype.

Other specimens examined: 51 males and 46 females, mostly same data as holotype, but collected various times since the time the types were collected. Specimens deposited in the Instituto von Humboldt and the University of Kentucky collection.

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REDESCRIPTION OF *MICROTOMUS REUTERI* BERG (HETEROPTERA: REDUVIIDAE: HAMMACERINAE) FROM SOUTHERN SOUTH AMERICA[1]

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ABSTRACT: *Microtomus reuteri* (Berg) is redescribed. Photographs and drawings of the male and female genitalia are given.

KEY WORDS: *Microtomus reuteri*, Hammacerinae, Reduviidae, Heteroptera, redescription, Argentina, Bolivia, Brazil

The American subfamily Hammacerinae (Reduviidae) is characterized by having the second antennal segment annulated and the scutellum with two apical prongs. According to Costa Lima (1835) these antennal pseudosegments can vary in number from 8 to 40, Maldonado Capriles and Santiago-Blay (1991) considered from the variation to range from 23 to 28, and Schuh and Slater (1995) from 4 to 36. Meanwhile Coscarón et al. (2003) described the maximum number in *M. tibialis* (Stichel) with 35 pseudosegments.

This subfamily is comprised of two genera, *Homalocoris* Perty 1833 and *Microtomus* Illiger 1807 (Maldonado Capriles 1990). *Microtomus* includes 12 species, some of them were studied in previous contributions as *M. cinctipes* (Stål), *M. conspicillaris* (Drury), *M. gayi* (Spinola), *M. luctuosus* (Stål), *M. lunifer* (Berg), *M. pessoai* Lent and Suarez, *M. purcis* (Drury), and *M. tibialis* Stichel (Coscarón and Giacchi 1985, 1987; Giacchi and Coscarón 1986, 1989; Coscarón et al. 2003), where adults, immature stages and eggs were redescribed.

Berg in his original description characterized *M. reuteri* by the presence of: a transverse black stripe crossing the middle of chorion, the apex of the clavus, and the stripes situated on the middle of anterior and median femora and on the anterior middle of posterior femora, which are testaceous on the forelegs and red on the latter ("… la faja transversal negra que pasa por el medio del corion y el ápice del clavo, y por la cinta de los fémures, situada en el medio de los anteriores e intermedio, y algo adelante del medio en los fémures posteriores, la cual en los primeros es de color testáceo y en los últimos de un rojo vivo"). Based on the examination of the holotype, deposited in the Museo de La Plata (Universidad Nacional de La Plata, Argentina) and on additional conspecifics, we redescribe *Microtomus reuteri* (Berg) and important characters omitted in the original description.

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METHODS

We worked with specimens from the collections of the American Museum of Natural History (AMNH), New York, U.S.A; Instituto Oswaldo Cruz, Rio de Janeiro, Brazil (IOC); Fundación Miguel Lillo, Tucumán, Argentina (FML); Museo Argentino de Ciencias Naturales (MACN), Buenos Aires, Argentina, and Museo de Ciencias Naturales de La Plata (MLP), La Plata, Argentina. Morphological characters were observed with a Wild-M5 stereomicroscope. Illustrations were done with a drawing tube attachment. The measurements of body parts are given in millimeters.

Microtomus reuteri (Berg, 1879)

Figs. 1-8

Hammatocerus cinctipes: Berg, 1879 (nec Stål), Anal. Soc. Cient. Arg., 7: 159.

Hammatocerus Reuteri Berg, 1879, Hem. Arg., 9: 23; Lethierry and Severin, 1896, Cat. Gén. Hémipt., 3: 143; Berg, 1884, Anal. Soc. Cient. Argent., 17: 191.

Microtomus reuteri Stichel, 1926, Deut. Ent. Zeits., 6: 180, 184.

Microtomus fasciatus and *f. nigra* Stichel, 1926, Deut. Ent. Zeits., 6: 181, 186, 187.

Microtomus reuteri Costa Lima, 1935, Anais Acad. Bras. Cien., 7: 320; Wygodzinsky, 1949, Inst. Med. Reg. Tucumán, Monografía 1: 52; Maldonado Capriles, 1990, Carib. J. Sci., p 158; Coscarón, 1998, Rev. Mus. La Plata, 31: 6.

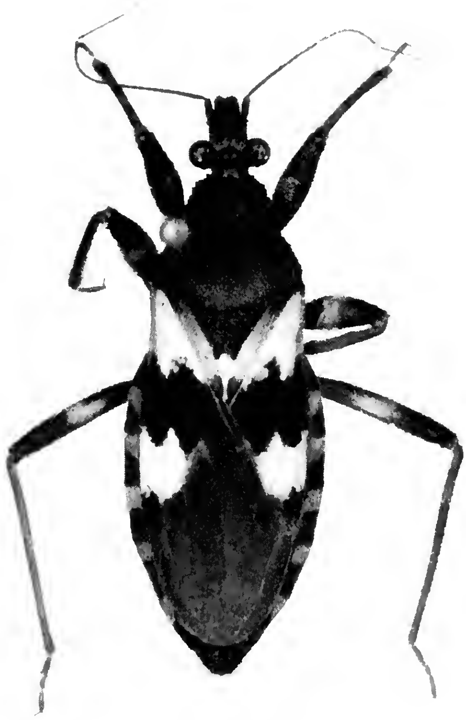


Fig. 1. *Microtomus reuteri* Berg, general aspect, dorsal.

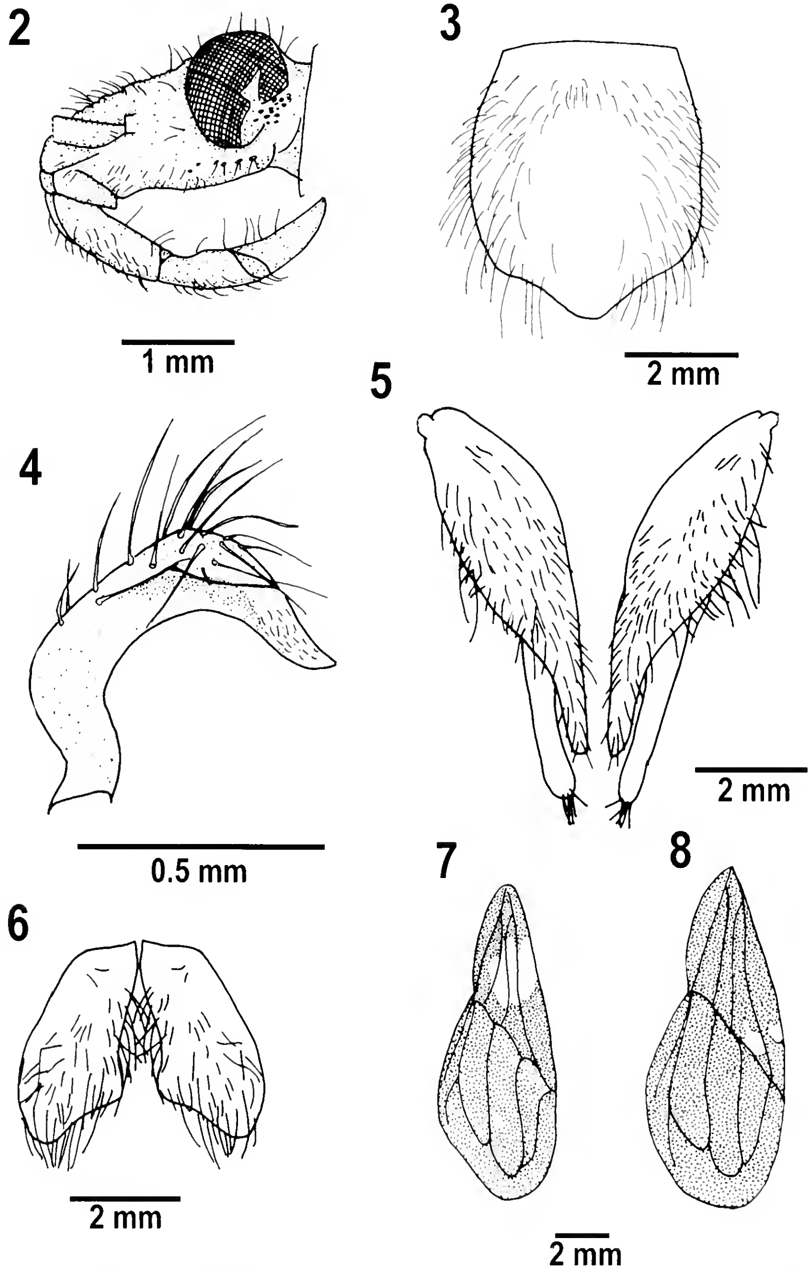
Redescription. Body compressed dorsoventrally, color dark brown (fig. 1). Total length 16.20-19.62 (mean = 17.37). Head cylindrical and elongate, with abundant granulations and setae (fig. 2). Length 2.41-2.79 (mean = 2.62), width 2.41-2.85 (mean = 2.64). Anteocular region much longer than postocular one. Eyes very prominent and lateral, with black and golden spots, reduced posteriorly. Behind them, close to the neck, light brown areas. Width of eyes 0.63-0.76 (mean = 0.70). Length of interocular space 1.01-1.20 (mean = 1.15). Ocelli present between eyes, color light brown. Before them, two triangular light brown areas are present without granulations or setae. Rostrum curved, brown, except distal portion of each segment light brown or reddish brown, with abundant setae ventrally. In some specimens, first segment with external longitudinal light brown stripe. Length 20.9-3.04 (mean = 2.70). Ratio of length of segments ca.1:0.75:0.58. Antenna inserted at middle of anteocular region. Antenna color dark brown, setose. Length 7.79. Ratio of length of segments ca. 1:9.09:3.43: 2.73. Second segment with 18-20 pseudosegments. Neck dark brown, without granulations or setae.

Thorax dark brown, with granulations and setae. Length 3.80-4.56 (mean = 4.34), width 4.43- 5.32 (mean = 4.89). Humeral angles of pronotum with short protuberances. Scutellum with granulations and setae. Legs with abundant setae and granulations, more conspicuous on fore and middle legs, color dark brown, except a pale laterally interrupted band on middle of femora. Femora I and II enlarged in middle part. Tibia brown or reddish brown, very setose. Spongy fossula present on tibia I and II. Tarsi brown, with setae. Hemelytra dark brown, except yellowish-white spots on chorion and clavus (fig. 1). In males, hemelytra reach posterior border of abdomen, being shorter in females. Length of hemelytra 10.13-12.53 (mean = 11.22). Abdomen dark brown, setose, without granulations. Males with setose area in central part of segments 3 and 4. Length 8.36-9.87 (mean = 8.94), width 5.44-6.96 (mean = 6.19). Connexivum dark brown with a colored area on every segment (fig. 1). Color varies from yellowish white to reddish light brown; with setae but without granulations.

Male: Figs. 3-4. Pygophore (fig. 3) subrounded with sparse long setae; parameres (fig. 4) curved, acute distally, with abundant long setae medially in the external surface;

Female: Figs. 5-6. Gonocoxite VIII (fig. 5) with abundant short and sparse long setae; gonapophysis VIII (fig. 5) with six setae distally; gonocoxite IX (fig. 6) with long setae.

Distribution. Argentina, Bolivia, Brazil, and Uruguay.



Figs. 2-8. *Microtomus reuteri* Berg. 2. head, lateral view; 3-4. male genitalia: 3. pygophore, lateral view, 4. paramere; 5-6. female genitalia: 5. gonocoxite and gonapophysis VIII; 6. gonocoxite IX. 7-8. Hemelytra: 7. female from Córdoba, Argentina; 8. male from Misiones, Argentina.

Material Examined: Holotype male, **ARGENTINA:** Misiones, nº 1547 (MLP). ARGENTINA: *Buenos Aires:* 1f, Escobar, V-1949, Wygodzinsky coll., IMR 802 (FML); 2m 1f, Campana, VIII-1956, (AMNH); 1f, 14-I-1909, nº 5653, Ronderos det. (MACN); 1f, Delta, INTA, 9-15-I-1978, Bachmann coll. (MACN). Córdoba: 1f, W.M. Davis coll., M. fasciatus H.G. Barber det (AMNH); 1m, Córdoba, Río Seco, II-1955, Monrós coll. (FML); 1f, Dept. Calamuchita, El Sauce, I-1941, M.J. Viana coll. (MACN); 1m, Río Ceballos, I-1951, B. Juarez Heredia coll. (FML). *Corrientes:* 1f, XII-1919, Wygodzinsky det. (AMNH); 1m, Ita Ibaté, 12-I-1949, Lieberm. Dângelo coll., Wygodzinsky det. *Misiones:* 1m 1f, P.N. Iguazú, XII-1979, Carpintero coll., Carpintero det. (MACN); *Salta:* 1m, Tartagal, 10-I-1957, Willink coll., Wygodzinsky det.(FML). *Santa Fe:* 1f, Florencia, 27-VI-1932, en poste de corral de ovejas y cabras, nº 25891, Misión de Estudios de Patología Regional, Jujuy (IOC); 1f, Lanteri, 7-I-1946 (AMNH). **BOLIVIA:** 1f, Prov. Sara, Steinbach, H.G. Barber det. (AMNH). **BRAZIL:** *Goiás:* 2f, XII- 1933, Leopoldo Bulhões, R. Spitz coll., em pau podre, nº 2198, Costa Lima det. (IOC). *São Paulo:* 1f, São Paulo, Anhemby, R. Tieté, I-10, nº 4028, Costa Lima det. (IOC); 1m, Otto One Ler?, 4-II-1922, nº 4029 (MLP); 1f 1m, Franca, O. Dreher leg.; 1f, Tiememgasap? Costa Lima det. *No certainty in procedence:* 1f, nº 2199, Costa Lima det. (IOC); 1f, Ronderos det. (MACN); 1f, nº 526 (FML).

DISCUSSION

Microtomus reuteri is easy to distinguish by the coloration pattern of hemelytra, very different to other species where the pale portion is more expanded as in *M. luctuosus, M. cinctipes, M. purcis, M. conspicillaris* or it is very reduced as in *M. lunifer, M. pintoi* and *M. tibialis.* It is closely related to *M. gayi* and *M. pessoai,* they have 5-7 setae on gonapophysis VIII in females. We agree with Berg's comments in that the diagnostic character is the coloration pattern of hemelytra; although we observed two exceptions: in one specimen from El Sauce, Dept. Calamuchita (Córdoba, Argentina) where the basal part of hemelytra is dark brown (fig. 7), and one specimen from Iguazú (Misiones, Argentina) where the pale areas are connected meddialy (fig. 8). In this species there is no variation in the pattern of the connexivum as it is in *M. conspicillaris, M. cinctipes* and *M. tibialis.*

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TAXONOMIC AND BIOLOGICAL OBSERVATIONS ON *LEISTOTROPHUS VERSICOLOR* (COLEOPTERA: STAPHYLINIDAE) FROM MEXICO[1]

Juan Márquez[2] and Julieta Asiain[2]

ABSTRACT: Taxonomic information and illustrations of habitus and aedeagus are included to identify *Leistotrophus versicolor* (Gravenhorst 1806). Geographic distribution and field observations in Mexico are included, based on specimens from six collections, fieldwork, and bibliography.

KEY WORDS: *Leistotrophus versicolor*, Staphylinidae, taxonomy, biology, geographic distribution, Mexico

The biology of the rove beetle, *Leistotrophus versicolor* (Gravenhorst 1806) has been studied in Costa Rica (Alcock and Forsyth 1988, Forsyth and Alcock 1990a, b). The previous studies report sexual dimorphism, with males having longer bodies and mandibles (Fig. 1); however, some males with small body size may be engaged in "female mimicry" to reduce aggressive behavior from larger males and as a strategy to gain access to females. The large males show resource defense, repelling aggressively other males and increasing their opportunities for access to females in search of alimentary resources. The resources defended by *L. versicolor* reported in previous studies are carcasses, dung, and decaying fruits. Furthermore, proximity to these resources permits the beetle to wait for prey, particularly adult flies (Forsyth and Alcock 1990a).

Biological knowledge of *L. versicolor* is remarkable as compared to other staphylinids, but is based only on limited studies from sites in Costa Rica (Monteverde); no additional information has been reported for other sites from their widespread distribution (tropical and subtropical forest from Mexico to Argentina).

In Mexico, the study of staphylinids has received a considerable impulse with the recent work by Navarrete-Heredia et al. (2002), where *L. versicolor* is recorded for the first time for the Mexican states of Chiapas, Hidalgo, Oaxaca, Puebla, San Luis Potosí, Tabasco, and Tamaulipas (previous records were restricted to Veracruz). New records were also reported for Belize, El Salvador, and Honduras. All records given by Navarrete-Heredia et al. (2002) are at state level for Mexico, and at country level for sites outside Mexico, thus making it difficult to know more precisely the geographic distribution of the species. Furthermore, no taxonomic information is included to identify the species.

Our goal is to contribute to the biological knowledge of *L. versicolor* in Mexico, including taxonomic information, illustrations, geographical distribution, and biological observations in the field.

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METHODS

Taxonomic information is based on Navarrete-Heredia et al. (2002) and Márquez et al. (2004). Distribution records were obtained from the literature (Sharp 1884, Blackwelder 1944, Forsyth and Alcock 1990a, b, Herman 2001, Navarrete-Heredia et al. 2002, Márquez et al. 2004) and revision of the more important staphylinid collections in Mexico (codes identify collections in the text) [Colección Nacional de Insectos, Instituto de Biología, UNAM, Silvia Santiago (CNIN); Museo de Zoología, Facultad de Ciencias, UNAM, Juan J. Morrone (MZFC); Colección de Coleoptera, Universidad Autónoma del Estado de Hidalgo, Juan Márquez (CC-UAEH); Colección Entomológica del Instituto de Ecología, A. C., Leonardo Delgado (IEXA); Colección Entomológica, Centro de Estudios en Zoología, Universidad de Guadalajara, José Luis Navarrete (CZUG); Colección José Luis Navarrete-Heredia (JLN)]. Photographs were taken with a digital camera attached to a microscope.

We took several measurements of the specimens with a scale attached to the microscope; we considered only the specimens deposited in CC-UAEH and MZFC collections because the individuals are adequately pinned. Specimens in other collections are pinned with the abdomen contracted and the head in a position that makes it difficult to measure. The specimens of the remaining collections (except CC-UAEH and MZFC) were checked during brief visits that allowed little time to perform a morphometric analysis.

Biological information is based on field observation and label data of the specimens analyzed. We observed and collected *L. versicolor* in the municipality of Tepehuacán de Guerrero, near the town of Chilijapa in the state of Hidalgo (N 21° 1.191', W 98° 51.812'). The site is located in the Sierra Madre Oriental biogeographic province, which includes tropical forest at low altitude (near 1000 m) and cloud forest at high altitude (1300 m or more), with several degrees of human perturbation. Field work lasted for three days (June 21 to 23, 2004), with visits to several sites, collecting directly and with carrion, fruit, interception flight, and light traps.

TAXONOMIC NOTES

Leistotrophus versicolor (Gravenhorst 1806) (Fig. 1)

Staphylinus versicolor Gravenhorst 1806: 119.

Generic Diagnosis: anterior angles of pronotum prominent and acute; translucent postcoxal process of pronotum a narrow flange; mesosternum with complete mid-longitudinal carina; mouthparts directed more ventrally than anteriorly (Navarrete-Heredia et al. 2002).

Species Diagnosis: total body length 15-27 mm; black, with reddish brown setae at pronotum and elytra, and yellow setae at abdomen, especially at fifth and sixth visible segments; dorsal surface rugose; antennae slender, with first five segments long and remaining segments transverse; head conspicuously wide; mandibles from twice as long as head (mainly in males) to similar length as head (mainly in females); pronotum shorter and narrower than head and elytra, with punctures at anterior angles; lateral margin of elytra carinate; legs with red and black spots; aedeagus as in figure 1c-d (Márquez et al. 2004).

Leistotrophus patriarchicus Scudder 1876 is a fossil species known from the U.S.A. No others species are known for this genus (Herman 2001).

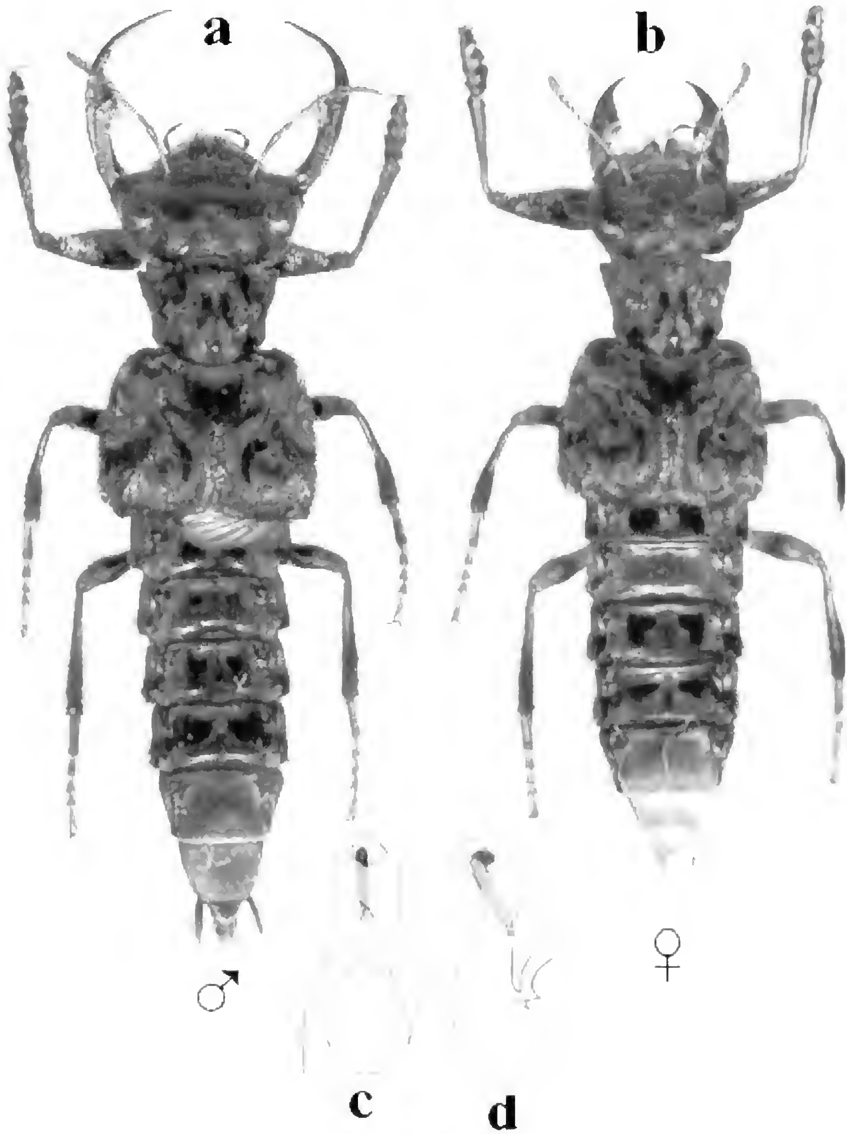

Figure 1. *Leistotrophus versicolor*, dorsal view of: a, male; b, female. Drawing of aedeagus: c, dorsal view; d, lateral view (line = 0.5 mm).

Figure 2. Geographic distribution of *Leistotrophus versicolor* in Mexico. Asterisks are state records only, without dates of precise locality. Squares are localities where the species has been collected.

Geographic Distribution. *Leistotrophus versicolor* is a Neotropical species, with Tamaulipas (Mexico) as its northern limit and Argentina as its southern limit. It may be collected in tropical and subtropical areas, with predominance of rain and cloud forests. In Mexico, the species is distributed in Chiapas, the Gulf of Mexico and the Sierra Madre Oriental provinces (Fig. 2). Records from Argentina are included in Blackwelder (1944) and Navarrete-Heredia et al. (2002), but not in Herman (2001), although the latter is the most complete and current checklist of Staphylinidae of the world. Unfortunately, records from Mexico are not included in that work.

Material Examined: MEXICO (asterisks indicate state or country records). Chiapas: Berriozabal, El Suspiro (1, MZFC); Ocosingo, Montes Azules (1, IEXA); El Chorreadero, Tuxtla Gutiérrez (7, CNIN); Finca Prusia, Jaltenango (1, CNIN); Rancho Los Compadres, Ocozocoautla (1, CNIN). Hidalgo: Tepehuacán de Guerrero, Chilijapa (5, CC-UAEH). Oaxaca: San Mateo Yetla, Valle Nacional (1, CNIN). Puebla: Xicotepec de Juárez, Hidroeléctrica "Patla" (3, MZFC); San Lorenzo (1, CNIN). San Luis Potosí: Xilitla (1, CNIN). Tabasco.* Tamaulipas.* Veracruz: Los Tuxtlas, Playa Escondida, San Andrés Tuxtla, Estación Biológica "Los Tuxtlas" (2, MZFC; 1, IEXA; 2, CNIN); Catemaco (1, CNIN); Teocelo (2, MZFC; 1 CZUG; 13, CNIN); Coatepec, Briones (1, IEXA); El Fortín de las Flores (2, CNIN); Totutla, Zacuapam (1, MZFC; 1, CC-UAEH); Sierra de Atoyac, Atoyaquillo (1, IEXA); Córdoba, Guadalupe del Barrial (1, JLN), Tajín (5, CNIN); Suchi (1, CNIN); Otatitlán (1, CNIN); Tuxpan, Misantla and Xalapa (Sharp, 1884). OTHER COUNTRIES (asterisks indicate country records only): Belize,* Guatemala (Calderas, San Jerónimo, Cubilguitz, Zapote and La Tinta; Sharp, 1884), El Salvador,* Honduras,* Nicaragua (San Carlos, Estación Biológica "Bartola"; 2, MZFC; Chontales; Sharp, 1884), Costa Rica (Cache, Irazu; Sharp; 1884; Puntarenas, Monteverde; Forsyth and Alcock, 1990a), Panama (Bugaba, David, Volcán de Chiriqui, San Lorenzo and Tolé; Sharp, 1884), Colombia,* Ecuador,* Peru,* Bolivia,* Paraguay,* Venezuela,* Guyana,* Surinam,* Brazil (type locality: Brasiliae, Para; Herman, 2001; Rio de Janeiro; Sharp, 1884) and Argentina.*

BIOLOGICAL OBSERVATIONS

In Tepehuacán de Guerrero, Hidalgo, we observed several specimens of *L. versicolor* during three days. We installed three carrion traps, an interception fight trap, a decayed fruit trap, and a light trap concurrently. The traps were unsuccessful in catching any specimens, but several individuals were oberserved near cow dung at the periphery of the forest where human perturbation is notable. It is possible that the species is diurnal, because it was not attracted to the light and was not seen at night near cow dung; however, one specimen from Veracruz (Coatepec) and another from Chiapas (Ocosingo) were collected at night with an electric light. It would be important to study activity throughout a complete day and to observe if conduct changes over time.

Some specimens observed arrived at dung, where they stood to capture prey. Other organisms stood in the vegetation near the dung. We saw one specimen move at great speed to capture a fly. These observations agree with previous studies (Alcock and Forsyth 1988, Forsyth and Alcock 1990a).

We did not observe individuals defending cow dung, but it is probable that it occurs. Also, we did not observe specimens on other previously reported substrates, namely carrion and decayed fruit. Foraging and resource defense may vary among different geographic areas, because availability of resources is different. Cow dung was abundant at the study site and was the only substrate where specimens were observed. It would be important to study the conduct of foraging and resource defense with varying abundance of resources, because it is likely that the species is able to adapt its strategy opportunistically.

The specimen collected from Sierra de Atoyac, Veracruz, probably exhibited a conduct of foraging and resource defense near commercial gravy spilled accidentally on the forest floor. Its collectors observed the beetle near the gravy and unsuccessfully tried to catch it; 10-15 minutes later the beetle returned to the same site and the collectors failed on a second occasion; 10-15 minutes later the specimen returned again and was finally collected (L. Delgado pers.com.). This can be a striking example of foraging and resource defense by *L. versicolor*, and suggests a possible study that could be performed on the preferences of this beetle to forage and defend distinct resources at different sites. Another specimen from Teocelo, Veracruz was collected near a decaying banana, yet another different substrate probably defended by the insect.

Predatory strategies of *L. versicolor* are rather uncommon compared with other staphylinids, because it is a specialized obligate predator of adult dipterans, and exhibits unusual flexibility and complexity in prey capture (Forsyth and Alcock 1990b). Due to its conduct, specimens have not been observed or collected within or underneath dung, as have other staphylinids (for example some species of *Philonthus and Platydracus* collected in the same dung visited by specimens of *L. versicolor* in Hidalgo, Mexico). Also, it is known that *L. versicolor* emits drops of anal secretions with a dung odor attractive to prey. These droplets can be deposited on the substrate or the beetle may wave its abdomen tip with its secretion devices toward flies that happen to approach it. The ability to employ different strategies allows the beetle to forage in areas without fly-attracting rotting materials (Newton 1973, Forsyth and Alcock 1990b, Dettner and Liepert 1994, Frank and Thomas 1999).

Only two or three specimens were observed near each pile of cow dung, but we were unable to identify the sex of all the specimens, and only five were collected. It is possible that the abundance of individuals in Hidalgo is not as high as reported for Costa Rica (up to 20 individuals per pile of cow dung; Forsyth and Alcock 1990a), but our collection and observation times were very reduced and not directly focused on the study of this species. Three of the five specimens are male, and two are female. Female length is 22 and 20 mm respectively, and male length is 20, 19.5, and 15 mm, respectively.

Of the ten specimens in the MZFC collection, three from Xicotepec de Juárez, Puebla, have a total body length of 18.6, 17.4 (males) and 17.0 mm (female); four specimens from three localities in Veracruz have a total body length of 17.1 (male), 21.0, 19.3, and 15.6 mm (females); two specimens from Nicaragua have a total body length of 27.4 (male) and 18.7 mm (female); and one specimen from Chiapas has a total body length of 19.0 mm (male).

Unfortunately, we have too few specimens to generalize whether these differences are or are not consistent with the previous information indicating that males are longer than females, but it could be interesting to study whether the male-female length proportion is the same at several localities where the species is distributed. The difference in male body length is noted in the three specimens collected and probably also the conduct of "female mimicry" at the site, but we were unable to study this question in more detail.

Mandibles of *L. versicolor* capture the prey, pinch the body with a pair of acute teeth, secrete digestive fluids and undertake a preoral digestion, as in the majority of predator staphylinids (Frank and Thomas 1999). Mandible length with respect to head length of the five specimens collected are 1.30, 1.19 and 1.04 times, respectively, for the three males, and 1.22 and 1.12 times, respectively, for the two females. Mandible length with respect to head length of the ten specimens of MZFC collection are 2.20, 1.75, 1.65, 1.56 and 1.33 for males, and 1.34, 1.25, 1.25, 1.13, and 1.13 for females. It is necessary to measure more specimens to obtain an appropriate sample with statistical significance, and to corroborate whether males have mandibles longer than females at different sites throughout their geographic distribution.

Our observations and records are limited, but lead us to wonder whether the remarkable biological characteristics of this species actually can vary at different sites under different conditions, and how this presumed variation relates to the evolution of the species. Also, we hope to contribute additional information to the poorly studied Mexican staphylinids.

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NEW SPECIES OF THE GENERA *STICTOPHAULA* HEBARD AND *MIROLLIA* STÅL (ORTHOPTERA: TETTIGONIIDAE: PHANEROPTERINAE) FROM CHINA[1]

A. V. Gorochov[3] and Le Kang[2]

ABSTRACT. This paper describes a new species of *Stictophaula* Hebard (*S. sinica* sp. n.) and five species of *Mirrollia* Stål, four of which are new to science (*M. bispinosa* sp. n., *M. hainani* sp. n., *M. yunnani* sp. n., *M. angusticerca* sp. n., and *M. composita* Bey-Bienko) all from southern China. Genital complex and other diagnostic characters are illustrated.

KEY WORDS: new species, *Stictophaula*, *Mirrollia*, Orthoptera, Tettigoniidae, Phaneropterinae, genitalia, China

The genus *Mirollia* was established by Stål in 1873, a subsequent designation for *Locusta (Phylloptera) carinata* de Haan. Subsequently, several authors (Hebard 1922; Karny 1925, 1926; Shiraki 1930; Bey-Bienko 1957, 1962; Ingrisch 1990, 1998; Mu, He and Wang 1998; Ingrisch and Shishodia 1998, 2000; Gorochov 1999, 2003b) have described 22 species (or 23 species and subspecies), from Philippines, Java, Borneo, southern China, Vietnam, Thailand, and India.

Hebard erected the genus *Stictophaula* in 1922 for three new species, *S. bakeri, S. micra,* and *S. quadridens* from Singapore, and three known species, *Phaula spinosolaminata* Brunner, *Locusta (Phaneroptera) trichopus* Haan (both from Java) and *Phaula chlorotica* Brunner (from Singapore). Subsequently, Ingrisch (1994) described three new species from Thailand. Gorochov (1999, 2003a) described ten new species and subspecies from Vietnam, Thailand, Java, Borneo, and Sumatra. Gorochov (1999) removed *Locusta (Phaneroptera) trichopus* De Haan and *Stictophaula ocellata* Ingrisch, 1994 from *Stictophaula* and placed them in the genus *Arnobia* Stål, 1876.

Currently, 23 species (or 24 species and subspecies) of *Mirollia* and 16 species (or 17 species and subspecies) of *Stictophaula* are known from the Oriental region. Of those, five species of *Mirollia* but no species of *Stictophaula* have been recorded from China.

In examining the collections of the Beijing Institute of Zoology, Chinese Academy of Sciences (IZCAS) and of the Beijing Agricultural University (AU), we found one new species of *Stictophaula (S. sinica)* and four new species of *Mirollia (M. bispinosa, M. hainani, M. yunnani,* and *M. angusticerca*), which are described herein. The female of *M. composita* Bey-Bienko is described for the first time (formerly this species was known only from a single male). The signif-

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icant taxonomic characters for these genera are details of the male and female abdominal apex, especially sclerites of the male genitalia, male stridulatory apparatus (Ingrisch 1994, 1998; Gorochov 1999; Ingrisch and Shishodia 2000), and the head rostrum (Gorochov 1999, 2003b).

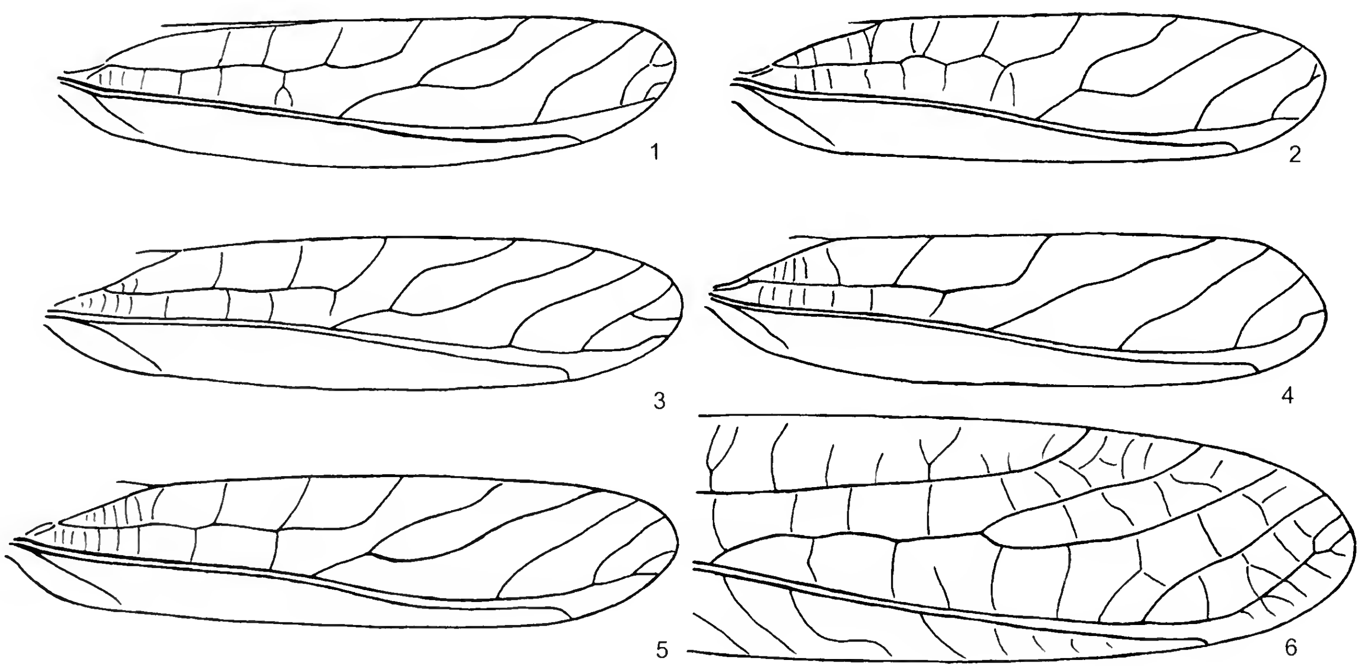
Mirollia Stål, 1873
Mirollia bispinosa, NEW SPECIES
(Figs. 1, 7-13)

Type Data: Holotype, male, CHINA: HUNAN PROVINCE: Cili, Jianya, 26.VIII.1988 (collector unknown) (IZCAS). Paratypes. CHINA: HUNAN PROVINCE: 1 male, Cili, 2.VIII.1988 (collector unknown) (IZCAS); 1 male, Changsha, 15.VII.1985, coll. Chen Naizhong (AU); GUANGXI PROVINCE: 1 male, 1 female, Guilin, Yanshan, 9.IX.1952 (male) and 5.VI.1953 (female) (collector unknown) (IZCAS).

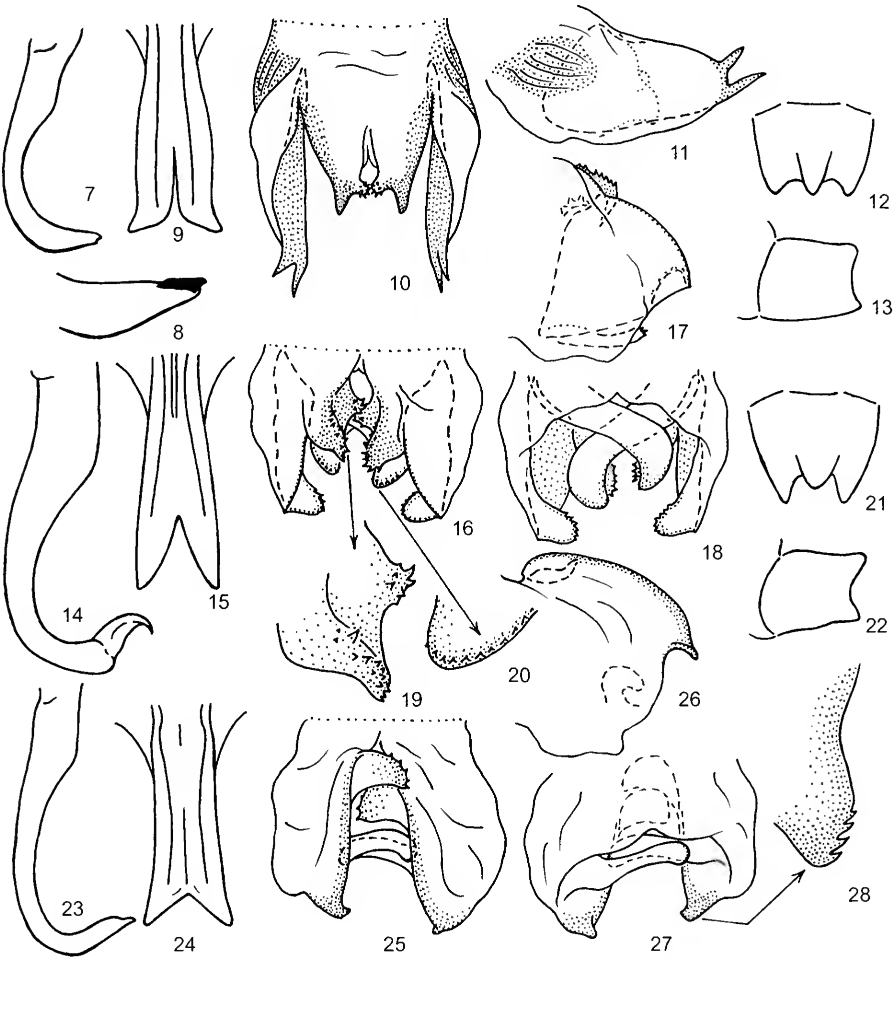
Description: Male (holotype). Body yellowish green with dark brown spots on antennae (including scape), numerous dots on upper half of pronotum and along anal edge of tegmina, and a large spot on widened part of dorsal part of upper tegmen (this spot occupies central area of this part; light brown stridulatory vein divides this spot into smaller proximal and larger distal parts; size of this spot approximately equal to size of mirror of lower tegmen); slight brownish darkenings near auditory organ of fore tibiae present also. Rostrum distinctly (but not strongly) S-shaped in profile, similar to that of *M. fallax* Bey-Bienko (Gorochov, 1999: Fig. 87), but with large lateral ocelli. Shape of tegmina as in Fig. 1; upper tegmen with 2 branches on RS and 3 more or less distinct branches on RA (Fig. 1), but lower tegmen with single RS and 4 more or less distinct branches on RA; hind wings very distinctly longer than tegmina. Cerci comparatively short, not very thin and not very strongly curved (Fig. 7); their apex with characteristic small and heavily sclerotized ridge (Fig. 8); genital plate with characteristic shape of its narrow hind part provided with deep and very narrow hind notch (Fig. 9). Genitalia with rather long lateral lobes provided with 2 apical spines directed backward (these spines almost immovable in relation to each other); a pair of medial genital lobes with small membranous upper (medial) projections (armed by distinct denticles) and larger semi-sclerotized lower (lateral) rounded additional lobes (these lobes without any denticles) (Figs. 10, 11).

Variation: Occasionally, rostrum more strongly S-shaped than in holotype [almost intermediate between those of *M. fallax* and *M. carinata* (Haan) (Gorochov, 1999: Figs. 87, 95)] and outer side of proximal part of antennae dark brown. All males with RS of both tegmina similar to RS of upper tegmen of holotype.

Female: Similar to male in general appearance and structure of lateral tegminal part, but without dark spot on dorsal part of upper tegmen. Apical part of genital plate with a pair of not deep hind notches; hind unpaired median projection of this plate not shorter than hind lateral projections (Figs. 12, 13); ovipositor typical of this genus.



Figs. 1-6. *Mirollia and Stictophaula,* lateral part of male tegmen. 1, *M. bispinosa* sp. n. (holotype); 2, *M. hainani* sp. n. (holotype); 3, *M. yunnani* sp. n.; 4, *M. angusticerca* sp. n.; 5, *M. composita* B.-Bien.; 6, *S. sinica* sp. n.



Figs. 7-28. *Mirollia*. 7-13, *M. bispinosa* sp. n. (7-11, holotype); 14-22, *M. hainani* sp. n. (14-20, holotype); 23-28, *M. yunnani* sp. n. Left male cercus (7, 14, 23) and its apical part (8) from above; distal part of male genital plate from below-behind (9, 15, 24); male genitalia from above (10, 16, 25), from side (11, 17, 26), and from below (18, 27); female genital plate from below (12, 21) and from side (13, 22); structures of male genitalia: upper medial lobe (19) and apex of lower medial lobe (20) from above, apical part of lateral lobe from below-behind (28).

Measurements (length in mm): Body: male, 14-17, female 18; body with wings: male 29-32, female 32; pronotum: male 3.8-4.2, female 4.5; tegmen: male 22-24, female 24; hind femur: male 12-13, female 13; ovipositor 6.

Differential diagnosis: *Mirollia bispinosa* is most similar to *M. quadripunctata* Ingrisch, *M. beybienkoi* Gorochov, and *M. caligata* Ingrisch, but it differs from those in the size, shape, and position of apical spines of lateral genital lobes of male. From *M. formosana* Shiraki, this new species is distinguished by the other coloration of scape (not reddish brown), the presence of numerous dark dots on pronotum, and the absence of any tubercles on inner side of male cercal base; from *M. rufonotata* Mu, He and Wang, it differs in the absence of any red spots on lateral pronotal lobes (it has only blackish brown dots on upper part of pronotum), the shorter tegmina of female, and the somewhat other shape of female genital plate.

Mirollia hainani, NEW SPECIES

(Figs. 2, 14-22)

Type Data: Holotype. Male, CHINA: HAINAN ISLAND: Jianfengling, 14.X.1983, coll. Chen Peizhen (IZCAS). Paratypes, CHINA: HAINAN ISLAND: 1 male, 1 female, Jianfengling, 27.IV.1983 (male) and 19.VI.1983 (female), coll. Gu Maobin (IZCAS); 1 male, Ledong, 26.VIII. 1984, coll. Lin Youdong (IZCAS); 1 male, Qiongzhong, 8.VII.1984, coll. Lin Youdong (IZCAS); 1 female, Tongshen, 340 m, 26.III.1960, coll. Li Changqing (IZCAS); 1 female, Yinggen, 200 m, 5.V.1960, coll. Li Changqing (IZCAS).

Description: Male (holotype). Very similar to previous species *(M. bispinosa)* in general appearance including size, shape of body, and coloration, but dark parts of antennae somewhat smaller, pronotum with only a pair of dark dots on fore half of disc, and stridulatory vein of upper tegmen almost dark brown. Rostrum slightly S-shaped, almost as in *M. foliolum* Gorochov (Gorochov, 1999, Fig. 97); lateral ocelli medium-sized. Tegmina and hind wings almost as in *M. bispinosa* (Fig. 2); R with 2 branches on RS and 3 more or less distinct branches on RA in both tegmina. Cerci rather long, but not very thin, strongly curved and with large apical hook (Fig. 14); genital plate with shape of its narrow part as in Fig. 15 (this part with deep, but not very narrow, hind notch). Genitalia (Figs. 16-18) with rather short and curved lateral lobes provided with denticles on apical part; medial genital lobes well divided into short upper additional lobes [these additional lobes with denticles on apical parts and on proximal medial projections of these lobes (Fig. 19)] and longer and rather narrow lower additional lobes [latter lobes with rounded apex denticulated along its hind edge above (Fig. 20)].

Variation: Occasionally, shape of rostrum almost as in *M. bispinosa*, and stridulatory vein of upper tegmen somewhat lighter than in holotype.

Female: General appearance and lateral part of tegmina as in male, but without dark spot on dorsal part of upper tegmen. Apical part of genital plate with a pair of somewhat deeper (than in *M. bispinosa*) hind notches; hind unpaired median projection of this plate somewhat shorter than hind lateral projections (Figs. 21, 22); ovipositor indistinguishable from that of previous species.

Measurements (length in mm): Body: male 13-17, female 16-18; body with wings: male 25-28, female 30-32; pronotum: male 4-4.4, female 4.3-4.5; tegmen: male 19-21, female 23-25; hind femur: male 11-13, female 12-13; ovipositor 5.3-5.7.

Differential diagnosis: This new species is more or less similar to *M. carinata* (Haan), *M. proxima* Gorochov, *M. javae* Gorochov, *M. ranongi* Gorochov, *M. hexapinna* Ingrisch, *M. bigemina* Ingrisch, *M. hamata* Ingrisch, and *M. rostellum* Gorochov, but *M. hainani* differs from them in the deeper apical notch of male genital plate, the shape of male cerci, and the details of male genitalia (Figs. 19, 20).

Mirollia yunnani, NEW SPECIES

(Figs. 3, 23-28)

Type Data: Holotype, male, CHINA: YUNNAN PROVINCE: Changyuan, 1010 m, 16.V.1980 (collector unknown) (IZCAS).

Description: Male (holotype). Similar to *M. hainani* in size, structure of body and wings, as well as details of coloration, but rostrum as in *M. bispinosa*, cerci with small apical hook (Fig. 23), genital plate with not deep and not narrow hind notch (Fig. 24), and genitalia as in Figs. 25-27: their lateral lobes rather short and with narrow denticulated apex (Fig. 28), their medial lobes divided into upper denticulated processes (partly fused with proximal part of lateral lobes) (Fig. 25) and longer and narrow lower additional lobes not denticulated and directed medially (Fig. 27).

Measurements of male (length in mm): Body 15; body with wings 31; pronotum 4.5; tegmen 23; hind femur 12.

Female unknown.

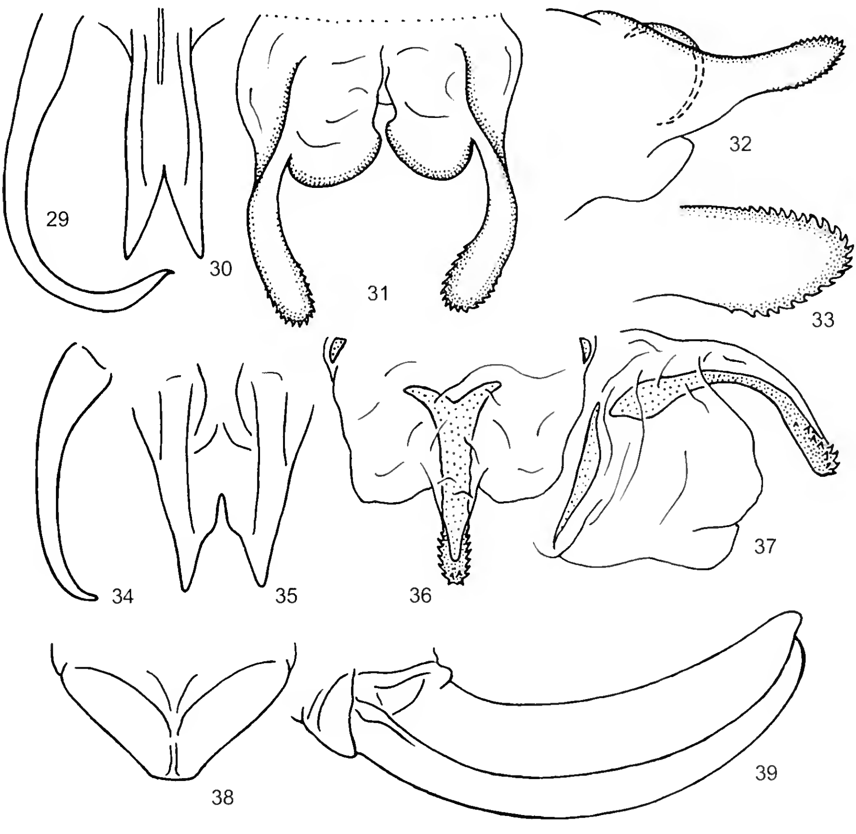
Differential diagnosis: This new species is very similar to *M. carinata* (Haan) and partly similar to *M. bigemina* Ingrisch in the shape of distal part of male genital plate, but *M. yunnani* is well distinguished from them in the other structure of male genitalia and shape of male cerci.

Mirollia angusticerca, NEW SPECIES

(Figs. 4, 29-33)

Type Data: Holotype, male, CHINA: HAINAN ISLAND: Jianfengling, 28.IV.1983, coll. Gu Maobin (IZCAS).

Description: Male (holotype). Size and general shape of body similar to previous species. Coloration light brownish (almost yellow) with a pair of small brown spots behind eyes, spotted antennae (including scape), several dark (blackish) dots on upper part of pronotum (including a pair of larger dots on fore half of disc and 6 distinct dots along its hind edge), darkish small marks near auditory organ and in place of articulation of femora with tibiae, large brown spot on dor-



Figs. 29-39. *Mirollia and Stictophaula*. 29-33, *M. angusticerca* sp. n.; 34-39, *S. sinica* sp. n. Left male cercus from above (29, 34); distal part of male genital plate from below-behind (30) and from below (35); male genitalia from above (31, 36) and from side (32, 37); apical part of lateral lobe of male genitalia from side and slightly below (33); female genital plate from below (38); ovipositor and genital plate from side (39).

sal part of upper tegmen including stridulatory vein (this spot occupies this part almost completely), and several small dark spots on different places of tegmina and lower side of hind tibiae. Tegmina with roundly angular subapical part of anal edge; R with single RS and 3 more or less distinct branches on RA in both tegmina; hind wings as in all previous species. Cerci long and thin, well curved, with small apical hook (Fig. 29); genital plate with distal part almost as in *M. hainani*, but its lateral apical lobes slightly longer and narrower (Fig. 30). Genitalia with long lateral lobes (Figs. 31, 32); their distal part rounded and denticulated (Fig. 33); medial genital lobes also rounded, not divided and not denticulated (Fig. 31).

Measurements of male (length in mm): Body 14; body with wings 29; pronotum 4.5; tegmen 22; hind femur 12.5.

Female unknown.

Differential diagnosis: *Mirollia angusticerca* is similar to *M. longipinna* Ingrisch in the long denticulated lobes of male genitalia, but it well differs from this Indian species in the shape of male genital plate and above-mentioned genital lobes.

Mirollia composita Bey-Bienko, 1962
(Fig. 5)

Material Examined: CHINA: YUNNAN PROVINCE: 1 male, 1 female, Xishuangbanna, Mengla, 620-650 m, 5.V-10.VI.1959, coll. Li Xiaofu (IZCAS); 1 male, 1 female, Xishuangbanna, Menghun, 1200-1400 m, 25.V-14.VI.1958, coll. Meng Xuwu and Zhang Yiran (IZCAS); 2 males, 1 female, Xishuangbanna, Damenglong, 650 m, 10-21.IV.1958, coll. Meng Xuwu, Pu Fuji and Hong Chunpei (IZCAS); 1 female, Xishuangbanna, Yiwu, 800-1300 m, 11.V.1959, coll. Li Xiaofu (IZCAS).

Description of female (nov.): Very similar to female of *M. bispinosa* and *M. hainani,* but coloration of pronotum as in *M. hainani,* rostrum of head and genital plate practically indistinguishable from those of *M. bispinosa.* Lateral part of tegmina in all these specimens with 2 branches on RS and 3 more or less distinct branches on RA (as in male from Fig. 5); sometimes, this part of tegmina with sparse dark dots or very small spots.

Measurements of female (length in mm): Body 16-19; body with wings 30-35; pronotum 4-4.3; tegmen 21-25; hind femur 12-13.5; ovipositor 5.5-6.

Genus Stictophaula Hebard, 1922
Stictophaula sinica, NEW SPECIES
(Figs. 6, 34-39)

Type Data: Holotype, male, CHINA: YUNNAN PROVINCE: Xishuangbanna, Xiaomengyang, 850 m, 24.X.1957, coll. Zang Lingchao (IZCAS). Paratypes. CHINA: YUNNAN PROVINCE: 3 females, same data as holotype, but 25-28.X.1957 and 6.IX.1958, coll. Zang Lingchao and Wang Shuyong (IZCAS); 1 female, Xishuangbanna, Mengla County, 620-650 m, 15.VI.1958, coll. Pu Fuji (IZCAS).

Description. Male (holotype). Structure of body and size typical of this genus. Coloration green with rather sparse small dark dots on upper part of pronotum, numerous somewhat larger blackish dots on fore femora (these dots form 4 more or less distinct spots on upper part of femora) and near auditory organ (on fore tibiae), black small lower spines of fore femora, dark brown spot on proximal half of dorsal part of both tegmina, and sparse small dark spots in different places of lateral part of tegmina. Mirror of lower tegmen developed, but small and triangular, similar to that of *S. gialaiensis* Gor., *S. daelacensis* Gor., and *S. thaiensis* Gor. (Gorochov, 1999: Figs. 1, 3, 5); R with 2 branches on RS and 2 distinct branches on RA (Fig. 6); hind wings clearly longer than tegmina. Cerci with hooked apical part; lateral apical lobes of genital plate with slight (but distinct) almost angular medial projections (Fig. 35). Median process of genitalia with curved and comparatively thin sclerite provided with rather numerous distal denticles; upper part of this process membranous (excepting its apex) (Figs. 36, 37).

Female. Similar to male, but dorsal part of tegmina with very small dark spot at base of its lateral edge only. Genital plate short, triangular, with hardy truncated apex (Fig. 38); ovipositor as in Fig. 39.

Measurements (length in mm): Body: male 22, female 21-24; body with wings: male 46, female 46-48; pronotum: male 5.5, female 5.8-6.3; tegmen: male 36, female 37-39; hind femur: male 20.5, female 21-22; ovipositor 8.5-9.5.

Differential diagnosis: *Stictophaula sinica* is similar to *S. armata* Ingrisch and *S. grigorenkoi* Gorochov in the shape of male genital plate and sclerite of male genitalia, but the hind median notch of this plate is less narrow, the hind lateral lobes of this plate with distinct or more distinct medial projections, and the above-mentioned genital sclerite is narrower than in *S. armata* (and without basal bend characteristic of this species) and distinctly wider than in *S. grigorenkoi* (Ingrisch, 1994, Figs. 1-8; Gorochov, 1999, Figs. 76-80).

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FIRST HOST RECORD FOR *PTEROMALUS CARDUI* (HYMENOPTERA: PTEROMALIDAE) ON *UROPHORA QUADRIFASCIATA* (DIPTERA: TEPHRITIDAE) IN SPOTTED KNAPWEED (*CENTAUREA BIEBERSTEINII*, ASTERACEAE) IN MICHIGAN, U.S.A.[1]

Jordan M. Marshall,[2,3] Roger A. Burks,[4] and Andrew J. Storer[2]

ABSTRACT: An association between the biological control agent *Urophora quadrifasciata* and a parasitoid, *Pteromalus cardui,* was found within seed heads of spotted knapweed *(Centaurea bieber-steinii)* in Michigan, U.S.A. There was a significant correlation between the percentage seed heads with *U. quadrifasciata* emerging and those with *P. cardui* emerging. This parasitoid might reduce the already limited effectiveness of *U. quadrifasciata* in controlling spotted knapweed.

KEY WORDS: *Pteromalus cardui,* Hymenoptera, Pteromalidae, *Urophora quadrifasciata,* Diptera, Tephritidae, spotted knapweed, *Centaurea bierberteinii,* Asteraceae, Michigan, U.S.A.

Classical biological control of exotic pestiferous organisms involves the importation and release of their natural enemies, with each release intended to reduce the population size of the targeted species (e.g. Pedigo 1999, Speight et al. 1999). Prior to release of the biological control agents, host specificity tests are carried out under quarantine conditions to minimize the likelihood of the agent having unacceptable impacts on nontarget species. During the quarantine period, biological control agents are sterilized to ensure the agents are not carrying a pathogen, parasite, or predator of their own that would result in a failure of the biological control program (APHIS-PPQ 2003). Even with such measures in place to increase the chances of a biological control agent, predators or parasites native to the release location may become problematic for the agent.

Spotted knapweed, *Centaurea biebersteinii* de Candolle (= *C. maculosa* auct. non Monnet de la Marck) (Asteraceae), is considered one of the most economically destructive weeds in rangelands of western North America (Harris and Cranston 1979). It can be found throughout the contiguous United States, Alaska, Hawaii, and in all Canadian provinces except the Northwest Territories and Nunavut. Ecological impacts imposed by spotted knapweed include increasing sedimentation and runoff, decreasing native plant diversity, and decreasing forage quality for grazers (Lacey et al. 1989, Kedzie-Webb et al. 2001, Olson and Wallander 2001).

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Urophora quadrifasciata (Meigen) (Diptera: Tephritidae) is a Palearctic seed head gall fly introduced from the Krasnodar Territory, Russia, into British Columbia, Canada, in 1972 as a biological control agent for spotted and diffuse knapweed, *C. diffusa* Monnet de la Marck (Asteraceae) (Harris 1980a). Over the past 30 years, subsequent releases in several American states and Canadian provinces have allowed *U. quadrifasciata* to spread through much of the northern range of spotted and diffuse knapweeds (Story 2002). In addition to these releases, the dissemination of *U. quadrifasciata* is aided by its ability to disperse over large distances and locate remote patches of knapweed (Harris 1986, Mays and Kok 2003). It develops within seed heads by diverting energy from the plant to larval maturation by inducing gall production in the plant (Burkhardt and Zwölfer 2002).

U. quadrifasciata has an obligate second generation that overwinters in the seed head as late-instar larvae and emerges the following May-June (Myers and Harris 1980, Harris 1980a). A high supercooling capacity (down to -35°C) enables the larvae to survive at extremely low temperatures, providing an extension of suitable habitat into areas experiencing extended periods of exceptionally cold weather (Story et al. 1993).

Larval mortality within spotted knapweed seed heads is often caused by direct predation by several bird and small mammal species, as well as indirect consumption by deer grazing on seed heads (Story et al. 1995). In April 2003, *Pteromalus cardui* (Erdös) (Hymenoptera: Pteromalidae) (Dzhanokmen and Grissell 2003), a Palearctic parasitic wasp, was reared from spotted knapweed seed heads collected at locations in Houghton County, Michigan. During this time, *U. quadrifasciata* adults were also reared from seed heads collected from the same locations.

Pteromalus cardui has been recorded from Britain, Hungary, Kazakhstan, and The Czech Republic (Graham 1969; Dzhanokmen 1987, 2001). It has been reported to parasitize the tephritids *Tephritis dilacerata* (Loew) and *Ensina sonchi* (Linnaeus) on *Sonchus arvensis* Linnaeus (Asteraceae), as well as other *Tephritis* spp. on *Ptarmica cartilaginea* Ledebour (Asteraceae) (Dzhanokmen 2001). None of these fly hosts of *P. cardui* have been recorded from northern Michigan (Foote et al. 1993).

Following initial observations of the parasitoid emerging from spotted knapweed seed heads, studies were undertaken to (1) develop evidence that the parasitoid uses *U. quadrifasciata* as its host in spotted knapweed and (2) determine whether there is a relationship between emergence of the parasitoid and emergence of the seed head fly.

METHODS

Spotted knapweed plants were collected from 12 patches in Houghton County, Michigan, from 23 August to 14 November 2002, and stored at -8°C for 6 to 8 months, depending on the collection date. In April and May 2003, 660 seed heads were randomly selected from the 12 sites and placed into vials to rear adult *U. quadrifasciata* and *P. cardui* at room temperature. Eight-dram plastic shell vials were half filled with wet sand topped with a layer of dry sand. Vials were covered with cotton fabric securing a single knapweed seed head inside, and they were monitored for insect emergence every 3 to 4 days. The identity of *U. quadrifasciata* adults was verified using White and Korneyev (1989) and voucher specimens (1 male and 1 female) of *P. cardui* have been deposited in the Insect Collection of the University of Michigan, Museum of Zoology.

The proportion of seed heads from which *P. cardui* emerged and from which *U. quadrifasciata* emerged was determined for each collection site, and relationships between these proportions were tested using correlation analysis of arcsine transformed data ($\arcsin\sqrt{p}$) (Zar 1999).

RESULTS AND DISCUSSION

One hundred seventeen *P. cardui* adults emerged from the 660 spotted knapweed seed heads placed in rearing. Wasps were reared from seed heads collected at 9 of the 12 sites (Table 1), with the first adults emerging after 17 days. Fifty-four *U. quadrifasciata* adults also emerged from the 660 seed heads, with specimens reared from 8 of the 12 sites. On 9 occasions these flies emerged from the same seed head as a wasp (Table 1).

Table 1. Percentage of spotted knapweed seed heads from which *Urophora quadrifasciata* and *Pteromalus cardui* emerged alone, and those from which both *U. quadrifasciata* and *P. cardui* emerged. Seed heads were collected in Houghton County, Michigan, and insects emerged from May through July 2002 after overwintering.

Site (UTM Zone 16N)	No. of seed heads placed in rearing	*Urophora quadrifasciata*	*Pteromalus cardui*	Both spp.
1 (382178, 5219134)	50	0.0	4.0	0.0
2 (380817, 5219287)	52	0.0	0.0	0.0
3 (380634, 5219085)	50	0.0	0.0	0.0
4 (379830, 5218685)	25	4.0	8.0	0.0
5 (379672, 5219258)	25	12.0	44.0	4.0
6 (379990, 5219550)	78	3.8	6.4	2.6
7 (380159, 5210635)	50	0.0	12.0	0.0
8 (380549, 5218850)	55	1.8	0.0	0.0
9 (380338, 5218618)	97	9.3	29.9	1.0
10 (380338, 5218618)	20	40.0	30.0	10.0
11 (379739, 5218616)	49	6.1	20.4	2.0
12 (378375, 5221202)	109	10.1	11.9	1.8
Total	660	5.9	12.7	1.4

Of seed heads that yielded at least one *P. cardui,* the mean number emerging was 1.26 (SE = 0.07). Of seed heads that yielded at least one *U. quadrifasciata,* the mean number emerging was 1.13 (SE = 0.06). Thirty-five percent of *P. cardui* adults that emerged were reared from seed heads with one or more other adult *P. cardui.* Eleven *P. cardui* adults emerged from the 9 seed heads producing both *U. quadrifasciata* and wasps. No other insects emerged from seed heads from any of the sites. The proportion of seed heads from which *P. cardui* emerged at each site was correlated with the proportion of seed heads from which *U. quadrifasciata* emerged ($r = 0.7270$; $p < 0.01$).

The fifty-four *U. quadrifasciata* adults emerged resulted in 0.08 viable galls/seed head. Though Norwierski et al. (1987) described acceptable densities of *U. quadrifasciata* larvae as 0.5 gall/seed head, Harris (1980b) observed only 0.1 galls/seed head and reported a ninety-five percent reduction in seed production by *U. quadrifasciata,* in cooperation with *U. affinis.* This reduction in seed production is based on the assumption that each spotted knapweed plant produces an average of 416 seeds (16 seed heads/plant , x 26 seeds/seed head) (Watson and Renney 1974). A large number of seeds, 1300 to 1600 seeds/m^2, are still allowed to enter the seed bank with viability of up to eight years in the soil (Harris 1980b, Davis et al. 1993). In areas where *U. affinis* and *U. quadrifasciata* co-occur, *U. quadrifasciata* rapidly becomes the dominant species in knapweed patches (Mays and Kok 2003).

Even with *U. quadrifasciata* becoming well established, including areas such as the Upper Peninsula of Michigan where no releases have been made, a large number of seeds are not being destroyed and densities of spotted knapweed are not being reduced (Lang et al. 1997). Such ineffectiveness has been considered a biological control failure (Myers 2000). The limited effectiveness of *U. quadrifasciata* in reducing spotted knapweed seed production may be decreased further through parasitism by *P. cardui.*

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TWO NEW SPECIES OF *RHOPALOPSOLE* (PLECOPTERA: LEUCTRIDAE) FROM CHINA[1]

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ABSTRACT: Two Chinese stonefly species of *Rhopalopsole*, *Rh. Xui* sp. n. and *Rh. shimentaiensis* sp. n., in the family Leuctridae are described. Their relationships with the related species are discussed. Their diagnostic characteristics are discussed with closely related congeners and their habitat and biological data are provided.

KEY WORDS: *Rhopalopsole shimentaiensis*, *R. xui*, new species, stoneflies, Plecoptera, Leuctridae, China

The genus *Rhopalopsole* is characterized by the short subgenital plate of sternite 9, sclerotized lateral process of tergite 10, and long cylindrical cerci in male adults (Zwick, 1977). It is distributed in Asia with about 30 known species. Seventeen species are known in China from the studies of Wu (1949, 1973), Yang D. and Yang J. (1991, 1993, 1995a-b), Yang J. and Yang D. (1991, 1994). In the present paper, two species of *Rhopalopsole* from China are described as new to science. The types are deposited in the Entomological Museum of China Agricultural University in Beijing. Morphological terminology generally follows that of Zwick (1977). The major references dealing with *Rhopalopsole* are as follows: Kawai, 1967; Jewett, 1975; Zhiltzova, 1975; Harper, 1977; Zwick, 1977.

Rhopalopsole shimentaiensis NEW SPECIES
(Figs. 1-5)

Male: Body length 7.1-8.7 mm; forewing length 8.7-9.2 mm, hindwing length 7.2-7.5 mm.

Head dark brown, slightly wider than prothorax; antennae brown; mouthparts dark brown. Thorax brown, pronotum dark brown; wings more or less brown; legs brown. Abdomen brown; hypopygium including cerci dark brown.

Genitalia (Figs. 1-5). Tergite 9 weakly sclerotized, distinctly wider than long, its posterior margin weakly incised, with one small sclerotized mid-posterior spine. Sternite 9 basally with tonguelike vesicle bearing dense hairs and slightly longer than wide, apically with distinct subgenital plate wider than long and rounded apically. Tergite 10 with strongly sclerotized lateral process short and fingerlike in lateral view, and somewhat acute apically in dorsal view; three separated and slightly sclerotized mid-anterior sclerites, of which two lateral ones are small and narrow and median one is large and broad; one pair of weakly sclerotized mid-posterior sclerites indistinctly separated from the hemitergites. Cercus long and cylindrical, apically with black tiny spine. Epiproct slightly curved forward, rather wide with subtruncate apical margin. Paraproct somewhat tapering apically.

Female: Unknown.

Type Date: Holotype male, **paratype** 1 male, Guangdong, Yingde, Shimentai National Forest Park, 2003. III. 28, D. Yang.

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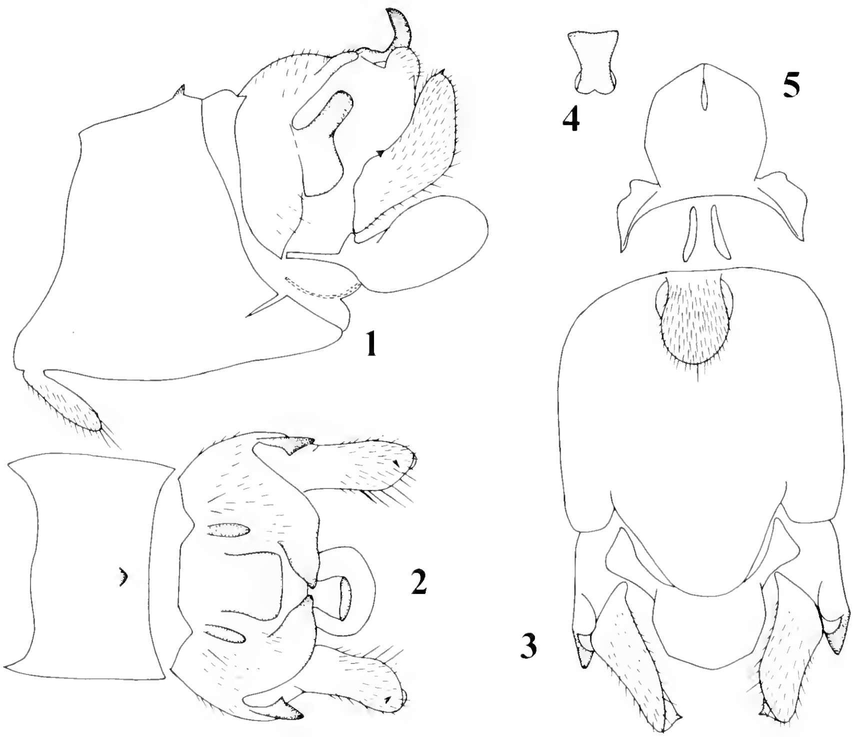
Etymology: The species is named after the type locality Shimentai.

Remarks: The new species is somewhat similar to *R. apicispina* Yang and Yang from Hubei, but can be easily distinguished from the latter by the 9th tergite with a mid-posterior spine, lateral process of the 10th tergite longer, epiproct wide with truncate tip, and cercus with tiny apical spine. In *apicispina,* the 9th tergite has no mid-posterior spine, the lateral process of the 10th tergite is rather short, the epiproct is narrow with the pointed tip, and the cercus has no apical spine (Yang, D. and Yang, J., 1991). This species is collected in the mountainous area of the Shimentai National Forest Park. Adults appear in the early spring.



Figs. 1-5 *Rhopalopsole shimentaiensis* sp. n. (male) 1, Genitalia, lateral view; 2, genitalia, dorsal view; 3, genitalia, ventral view; 4, epiproct, posterior view; 5, paraproct, ventral view.

Rhopalopsole xui NEW SPECIES

(Figs. 6-10)

Male: Body length 8.5-10.2 mm; forewing length 10.5-12.8 mm, hindwing length 9.1-11.6 mm.

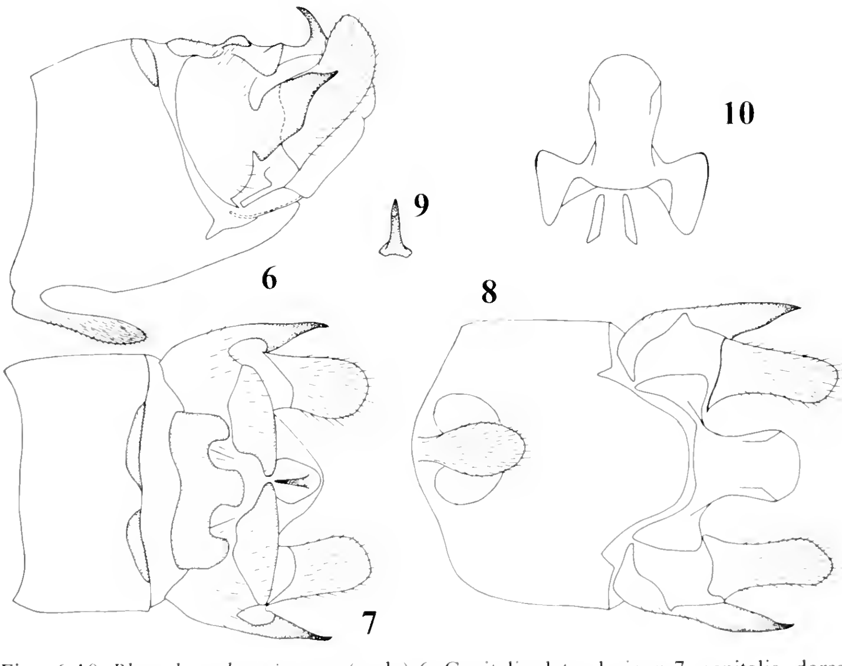
Head dark brown, slightly wider than prothorax; antennae dark brown; mouthparts dark brown. Thorax brown, pronotum dark brown; wings more or less brown; legs brown. Abdomen brown; hypopygium including cerci dark brown.

Genitalia (Figs. 6-10). Tergite 9 weakly sclerotized, distinctly wider than long, its posterior margin nearly straight, with two narrow mid-posterior transverse stripes distinctly sclerotized. Sternite 9 basally with tonguelike vesicle bearing dense hairs and much longer than wide, apically with distinct subgenital plate wider than long and rounded apically. Tergite 10 with strongly sclerotized lateral spine rather thick basally and curved backward apically in lateral view and nearly straight and slightly directed outward apically in dorsal view; weakly sclerotized mid-anterior sclerite distinctly wider than long, which has two short obtuse lateral processes and one slightly long obtuse median process posteriorly; one pair of weakly sclerotized mid-posterior sclerites. Cercus long and cylindrical, apically without tiny spine. Epiproct with thin spinelike apical portion curved forward. Paraproct wide and rounded apically.

Female. Unknown.

Holotype male, **paratype** 1 male, Guangdong, Ruyuan, Nanling National Natural Reserve, 2003. III. 25, D. Yang.

Etymology: The species is named after Preofessor Zaifu Xu.



Figs. 6-10 *Rhopalopsole xui* sp. n. (male) 6, Genitalia, lateral view; 7, genitalia, dorsal view; 8, genitalia, ventral view; 9, epiproct, posterior view; 10, papraproct, ventral view.

Remarks: The new species is similar to *R. longispina* Yang and Yang from Zhejiang and *R. aculeata* Harper from Nepal in having the 9th tergite with one pair of sclerotized mid-posterior stripes and thin spinelike epiproct, but can be easily distinguished from *longispina* by the lateral spine of the 10th tergite rather thick and curved backward apically, median process of mid-anterior sclerite of the 10th tergite obtuse posteriorly, and paraproct wide and rounded apically. In *longispina*, the lateral spine of the 10th tergite is narrower basally and curved upward apically, the median process of mid-anterior sclerite of the 10th tergite is pointed posteriorly, and the subanal lobe has the acute tip (Yang, C. and Yang, D., 1991). It can be easily separated from *aculeata* by the lateral spine of the 10th tergite rather thick and curved backward apically in lateral view and nearly straight and directed outward in dorsal view, mid-anterior sclerite of the 10th tergite divided into three processes posteriorly, and paraproct rather wide and rounded apically. In *aculeata,* the lateral spine of the 10th tergite is narrower basally and curved upward apically in lateral view and distinctly curved and directed inward in dorsal view, the mid-anterior sclerite of the 10th tergite is complete posteriorly, and the paraproct is rather narrow apically (Harper, 1977). This species is collected in the mountainous area of the Nanling National Nature Reserve. Adults appear in the early spring.

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FURTHER RECORDS OF PHLEBOTOMID SANDFLIES (DIPTERA: PHLEBOTOMIDAE) FROM CAMPECHE, MEXICO[1]

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ABSTRACT: *Leishmania mexicana* is endemic in southern Mexico, vectors of this parasite are phlebotomid sandflies. As part of entomological surveys carried out in the state of Campeche, we collected sandflies from different sites. A total of 16 species in two genera were recorded. Most of the species had been recorded previously in the state of Campeche, although in different counties. Two species; *L. longipalpis* and *L. ylephiletor* are recorded for the first time in Campeche, whilst *L. undulata* is confirmed to occur in Campeche.

KEY WORDS: Phlebotomidae, Phlebotominae, Diptera, Campeche, Mexico, leishmaniasis

Phlebotomine sandflies are the vectors of *Leishmania* parasites causing human leishmaniases (Killick-Kendrick, 1999). Cutaneous leishmaniasis (CL) in southern Mexico is endemic and it is chiefly due to *L. mexicana* (Biagi). The state of Campeche is known to be an endemic area of CL (Rebollar-Téllez et al., 1996b). Knowledge of sandfly fauna is therefore an important component for understanding parasite transmission in Campeche. Field studies on sandflies in Campeche have been conducted by several authors (e.g. Biagi and de Biagi, 1953, Rebollar-Téllez et al., 1996b, c and d). In spite of the importance of transmission of *L. mexicana* in Campeche, during the last five years no field studies nor collections of sandflies had been undertaken in this state. The present paper documents recent collections of phlebotomine sandflies in several foci of Campeche and compares them to the previous records of sandfly species in Mexico and Campeche.

METHODS

Collection of sandflies was conducted in several occasions from March 2001 to March 2002. Catches were carried out in five locations ("ejidos") of the state of Campeche. Locations were situated in La Libertad, (N 18°31.60' W 90°27.89') Escárcega, Dzibalché, (N 20°19.23' W 90°13.41') Calkini, "20 de Noviembre" (no coordinates available) Dos Naciones (N 17°58.40' W 89°20.74'), and La Guadalupe (N 18°20.24', W 89°28.49') Calakmul. Trapping methods included

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Shannon traps (for anthtropophilic species), light CDC traps, Disney traps (for rodentophilic species), funnel traps set at animal burrows, as well as manual captures on human bait and into tree holes. Unless otherwise stated, for each collection, the trapping method is indicated as Shannon, CDC, Disney, or funnel. Trapping effort was unequal in each location concerning the kind of used traps and days of collecting. Traps (except Shannon trap) were set before dusk and were collected at dawn. Sandflies were preserved in 8 ml glass vials containing 70 percent ethanol. Later in the laboratory, flies were cleared with a solution of 20 percent NaOH, then they were placed onto glass microscope slides and mounted in either Berlese fluid (Entomopraxis S. C., Barcelona, Spain) or DPX (Watkins and Doncaster, The Naturalists, Kent, England). Flies were identified under a light binocular microscope using the keys of Young (1979) and Young and Duncan (1994). Voucher specimens have been kept in the entomological collection of the Universidad Autónoma de Yucatán with some duplicates deposited at the entomological collection at the Centre for Applied Entomology and Parasitology, School of Life Sciences, Keele University (Staffordshire, England).

RESULTS AND DISCUSSION

A total of 16 species in two genera were recorded in this survey. Dos Naciones was the location with the highest number of species (n= 15) followed by La Guadalupe (n= 8), however, this figure should be taken with caution as it may be due to the more frequent catches (trapping effort) of sandflies in these two sites. The species composition for each location is listed in Table 1.

Brumptomyia hamata (Fairchild and Hertig, 1947)

Material Examined: 4 ♀, 12 ♂. Campeche, Dos Naciones, Calakmul, 18 Oct 2001 (2 ♂ CDC), 21 Nov 2001 (1 ♀ Shannon, 1 ♂ CDC), 19 Jan 2002 (2 ♂ CDC), 21 Jan 2002 (2 ♂ CDC), La Libertad, Escárcega, 02 Nov 2001 (1 ♂ CDC), 04 Nov 2001 (3 ♀ funnel trap, 4 ♂ tree hole).

This is the first record of the species for the county of Calakmul. This species had previously been reported in Escárcega, Campeche by Navarro-Correa (1995) and Rebollar-Téllez et al. (1996a).

Brumptomyia galindoi (Fairchild and Hertig, 1947)

Material Examined: 17 ♀, 81 ♂. Campeche, Dos Naciones, Calakmul, 17 Oct 2001 (3 ♀, 10 ♂ CDC), 18 Oct 2001 (4 ♀, 9 ♂ funnel, 3 ♀, 21 ♂ CDC), 21 Nov 2001 (2 ♀ CDC), 22 Nov 2001 (2 ♀, 2 ♂ CDC), 23 Nov 2001 (1 ♀, 11 CDC), 18 Jan 2002 (1 ♀, 9 ♂ CDC), 19 Jan 2002 (2 ♀, 4 ♂ CDC), 20 Jan 2002 (1 ♀, 2 ♂ CDC), 21 Jan 2002 (3 ♂ CDC), 20 de Noviembre, Calakmul, 22 Mar 2001 (2 ♂ Shannon), La Libertad, Escárcega, 02 Nov 2001 (1 ♂ CDC), 04 Nov 2001 (1 ♂ funnel, 4 ♂ tree hole).

This species had previously been reported by Navarro-Correa (1995) and Rebollar-Téllez et al. (1996a) in the county of Escárcega. This is the first report in the county of Calakmul. Ibañez-Bernal (1999) refers this species as *B. mesai* Sherlock on the basis of a shorter wing length to that which was given by Fairchild and Hertig (1947) in their original description. In addition, Ibáñez-

Table 1. Known distribution of sand fly species in five sites of the counties of Calkini, Calakmul, and Escárcega, all located in the State of Campeche, México. Site 1 = Dos Naciones, Site 2 = La Guadalupe, Site 3 = 20 de Noviembre, Site 4 = Dzibalché, and Site 5 = La Libertad.

Species	**Site 1**	**Site 2**	**Site 3**	**Site 4**	**Site 5**
Brumptomyia hamata	1♀ 7♀				3♀ 5♂
B. galindoi	17♀ 73♂		2♂		6♂
Lutzomyia cruciata	201♀ 3♂	608♂	5♂	1♂	70♂
L. longipalpis	3♀				
L. gomezi	3♀				
L. ovallesi	323♀ 3♂	14♀	71♀ 1♂		3♀
L. serrana	2♀				
L. deleoni	92♀ 2♂	6♀	2♀ 2♂		41♀ 8♂
L. permira		1♂	3♂		
L. shannoni	140♀ 37♂	43♀ 1♂	1♀	1♀	26♀ 8♂
L. undulata	3♀	1♂			
L. carpenteri	54♀ 31♂				
L. olmeca olmeca	160♀ 1♂	83♀ 3♂	6♀ 12♂	1♀	108♀
L. ylephiletor	25♀ 1♂				
L. panamensis	345♀ 92♂	55♀ 5♂	1♀ 1♂		1♀ 5♂
L. trinidadensis	31♀ 5♂				

Bernal (1999) points out that the Mexican specimens never possess seven or eight spines in the inner side of the gonocoxite. In this paper, we decided to adopt a more conservative position in regard of Ibánez-Bernal (1999) resurrection of *B. mesai*. We propose to maintain the name *B. galindoi* for the Mexican specimens until new and stronger evidence becomes available to consider *B. galindoi* and *B. mesai* as distinct species.

Lutzomyia (Lutzomyia) cruciata (Coquillett, 1907)

Material Examined: 885 ♀, 3 ♂. Campeche, Dos Naciones, Calakmul, 17 Oct 2001 (1 ♀ tree hole), 18 Oct 2001 (14 ♀ Shannon, 1 ♀ CDC), 21 Nov 2001 (56 ♀ Shannon, 2 ♀ CDC), 22 Nov 2001 (17 ♀ Shannon), 23 Nov 2001 (13 ♀ Shannon), 24 Nov 2001 (10 ♀ Shannon, 1 ♀ CDC), 18 Jan 2002 (9 ♀ Shannon), 19 Jan 2002 (3 ♀ Shannon, 2 ♀ light CDC), 20 Jan 2002 (4 ♀ Shannon), 21 Jan 2002 (5 ♀ Shannon, 2 ♂ CDC), 22 Jan 2002 (1 ♀ Shannon), 24 Jan 2002 (2 ♀ Shannon), 25 Jan 2002 (5 ♀ Shannon), 26 Jan 2002 (4 ♀ Shannon), 25 Mar 2002 (6 ♀ Shannon), 26 Mar 2002 (14 ♀ Shannon), 27 Mar 2002 (5 ♀ Shannon), 28 Mar 2002 (17 ♀ Shannon), 29 Mar 2002 (8 ♀ Shannon), 30 Mar 2002 (1 ♀, 1 ♂ Shannon). La Guadalupe, Calakmul, 21 Oct 2001 (1 ♀ CDC), 22 Oct 2001 (56 ♀ Shannon), 6 Dec 2001 (60 ♀ Shannon, 11 ♀ CDC), 7 Dec 2001 (26 ♀ Shannon), 8 Dec 2001 (51 ♀ Shannon), 9 Dec 2001 (26 ♀ Shannon), 10 Dec 2001 (22 ♀ Shannon), 11 Dec 2001 (50 ♀ Shannon), 12 Dec 2001 (136 ♀ Shannon), 13 Dec 2001 (32 ♀ Shannon), 14 Dec 2001 (104 ♀ Shannon), 17 Feb 2002 (1 ♀ Shannon), 18 Feb 2002 (3 ♀ Shannon), 19 Feb 2002 (5 ♀ Shannon), 20 Feb 2002 (5 ♀ Shannon), 21 Feb 2002 (13 ♀ Shannon), 24 Feb 2002 (5 ♀ Shannon), 25 Feb 2002 (1 ♀ Shannon). 20 Noviembre, Calakmul, 22 Mar 2001 (5 ♀ Shannon), Dzibalche, Calkini, 06 Jul 2001 (1 ♀, human bait), La Libertad, Escárcega, 01 Nov 2001 (44 ♀ Shannon), 02 Nov 2001 (13 ♀ Shannon, 1 ♀ CDC, 1 ♀ human bait), 03 Nov 2001 (1 ♀ Shannon, 1 ♀ CDC), 04 Nov 2001 (9 ♀ Shannon).

This is the first record in the counties of Calkini and Calakmul. *Lutzomyia cruciata* is also known for the states of Quintana Roo (Cruz-Ruiz et al. 1994) and Yucatán (Rebollar-Téllez and Manrique-Saide, 2001). Ibáñez-Bernal (1999) reports this species as the most widely distributed species in México, occurring in 16 states in México. Currently, *L. cruciata* continues to be one of the suspected vectors of *Le. mexicana* in the Yucatán Peninsula and probably in other areas of México.

Lutzomyia (Lutzomyia) longipalpis (Lutz and Neiva, 1912)

Material Examined: 3 ♀. Campeche, Dos Naciones, Calakmul, 28 Mar 2002 (1 ♀ Shannon), 29 Mar 2002 (1 ♀ Shannon), 30 Mar 2002 (1 ♀ Shannon).

This is the first report of *L. longipalpis* for the state of Campeche. In the Yucatán Peninsula, it has been reported in the neighboring states of Yucatán and Quintana Roo (Ibáñez-Bernal, 1999 for references). *Lutzomyia longipalpis* is the main vector of *Le. infantum* in the New World. Recent evidence shows that *L. longipalpis* is a species complex of at least three different members based on the stereochemistry of the male-sex pheromone (Hamilton et al. 1996). No Mexican specimens have hitherto been analyzed to compare the sex pheromone profiles.

Lutzomyia (Lutzomyia) gomezi (Nitzulescu, 1931)

Material Examined: 3 ♀. Campeche, Dos Naciones, Calakmul, 18 Jan 2002 (1 ♀ Shannon), 20 Jan 2002 (1 ♀ Shannon), 26 Jan 2002 (1 ♀ Shannon).

Ibáñez-Bernal (1999) reports this species from the county of Escárcega based on the works of Ramírez-Fraire (1992) and Navarro-Correa (1995). However, none of these authors seems to have deposited their specimens in an entomological collection for further comparison.

Lutzomyia ovallesi (Ortiz, 1952)

Material Examined: 411 ♀, 4 ♂. Campeche, Dos Naciones, Calakmul, 18 Oct, 2001 (118 ♀ Shannon, 1 ♀ CDC), 21 Nov 2001 (54 ♀ Shannon), 22 Nov 2001 (16 ♀ Shannon), 23 Nov 2001 (6 ♀ Shannon), 24 Nov 2001 (2 ♀ Shannon), 22 Jan 2002 (1 ♀ Shannon), 24 Jan 2002 (1 ♀ Shannon), 25 Jan 2002 (1 ♀ Shannon), 25 Mar 2002 (10 ♀ Shannon), 26 Mar 2002 (10 ♀, 1 ♂ Shannon), 27 Mar 2002 (21 ♀ Shannon), 28 Mar 2002 (46 ♀ Shannon), 29 Mar 2002 (21 ♀, 1 ♂ Shannon), 30 Mar 2002 (15 ♀, 1 ♂ Shannon). La Guadalupe, Calakmul, 29 Apr 2001 (1 ♀ CDC), 22 Oct 2001 (2 ♀ Shannon), 6 Dec 2001 (4 ♀ Shannon), 7 Dec 2001 (1 ♀ Shannon), 8 Dec 2001 (1 ♀ Shannon), 9 Dec 2001 (1 ♀ Shannon), 20 Feb 2002 (1 ♀ Shannon), 21 Feb 2002 (3 ♀ Shannon), 20 de Noviembre, Calakmul, 22 Mar 2001 (71 ♀, 1 ♂ Shannon), La Libertad, Escárcega, 01 Nov 2001 (2♀ Shannon), 02 Nov 2001 (1 ♀ Shannon).

This is the first report of *Lutzomyia ovallesi* for the county of Calakmul. This species has been reported in the states of Quintana Roo (Ibáñez-Bernal, 1999) and Campeche (Navarro-Correa, 1995). The later author reported *L. ovallesi* in the county of Escárcega (no specimens available). *Lutzomyia ovallesi* has been found infected with *Le. braziliensis* in Guatemala (Rowton et al., 1992).

Lutzomyia serrana (Damasceno and Arouck, 1949)

Material Examined: 2 ♀. Campeche, Dos Naciones, Calakmul, 18 Oct 2001 (1 ♀ CDC), La Libertad, Escárcega 02 Nov 2001(1 ♀ Shannon).

This is the first report in the county of Calakmul. This species has been previously known in Chiapas and Nayarit (Ibáñez-Bernal, 1999). Navarro-Correa (1995) also listed this species in Escárcega, however there are no specimens available.

Lutzomyia (Coromyia) deleoni (Fairchild and Hertig, 1947)

Material Examined: 141 ♀, 12 ♂. Campeche, Dos Naciones, Calakmul, 17 Oct 2001 (2 ♀ CDC), 18 Oct 2001 (5 ♀ Shannon, 30 ♀ CDC, 5 ♀ funnel), 22 Nov 2001 (1 ♀ Shannon, 7 ♀ CDC), 23 Nov 2001 (2 ♀ Shannon, 6 ♀ CDC), 24 Nov 2001 (2 ♀ Shannon, 13 ♀ CDC), 18 Jan 2002 (4 ♀ CDC), 19 Jan 2002 (2 ♂ Shannon, 6 ♀ CDC), 20 Jan 2002 (1 ♀ Shannon, 4 ♀ CDC), 21 Jan 2002 (4 ♀ CDC). La Guadalupe, Calakmul, 29 Apr 2001 (1 ♀ CDC), 6 Dec 2001 (4 ♀ CDC), 14 Dec 2001 (1 ♀ Shannon), 20 de Noviembre, Calakmul, 22 Mar 2001 (2 ♀, 1 ♂ Shannon), 28 Apr 2001 (1 ♂ funnel), La Libertad, Escárcega, 01 Nov 2001 (3 ♀ Shannon, 4 ♀ CDC), 02 Nov 01 (6 ♀ Shannon, 4 ♀ CDC), 03 Nov 2001 (5 ♀, 1 ♂ CDC), 04 Nov 2001 (2 ♀ Shannon, 4 ♀, 3 ♂ funnel, 13 ♀, 4 ♂ tree hole).

This is the first report of *L. deleoni* for the county of Calakmul. This species had previously been reported in the county of Escárcega by Ramírez-Fraire (1992) and by Navarro-Correa (1995) with no specimens available from either of their reports. Rebollar-Téllez et al. (1996a) also reported this species in Escárcega and the studied material remains at the Entomological Collection of the Universidad Autónoma de Yucatán

Lutzomyia (Dampfomyia) permira (Fairchild and Hertig, 1956)

Material Examined: 4 ♀. Campeche, 20 de Noviembre, 28 Oct 2001 (3 ♂ funnel), La Guadalupe, Calakmul, 21 Feb 2002 (1 ♂, CDC).

This is the first report of *L. permira* in the county of Calakmul. The specimen collected in La Guadalupe has been deposited at the School of Life Sciences, Keele University.

Lutzomyia (Psathyromyia) shannoni (Dyar, 1929)

Material Examined: 211 ♀, 46 ♂. Campeche, Dos Naciones, Calakmul, 17 Oct 2001 (3 ♀, 1 ♂ Shannon, 1 ♀ 1 ♂ CDC), 18 Oct 2001 (7 ♀, 3 ♂ Shannon), 21 Nov 2001 (42 ♀, 2 ♂ Shannon), 22 Nov 2001 (6 ♀, 1 ♂ Shannon, 1 ♂ CDC), 23 Nov 2001 (3 ♀ Shannon), 24 Nov 2001 (2 ♀ Shannon), 18 Jan 2002 (1 ♀ CDC), 19 Jan 2002 (1 ♀ CDC), 21 Jan 2002 (1 ♀ Shannon), 25 Mar 2002 (3 ♀, 1 ♂ Shannon), 26 Mar 2002 (21 ♀, 3 ♂ Shannon), 27 Mar 2002 (9 ♀, 3 ♂ Shannon), 28 Mar 2002 (30 ♀, 17 ♂ Shannon), 29 Mar 2002 (2 ♀, 3 ♂ Shannon), 30 Mar 2002 (8 ♀, 1 ♂ Shannon). La Guadalupe, Calakmul, 22 Oct 2001 (2 ♀ Shannon), 6 Dec 2001 (1 ♀ Shannon, 1 ♀ CDC), 7 Dec 2001

(7 ♀ Shannon), 8 Dec 2001 (5 ♀, 1 ♂ Shannon), 9 Dec 2001 (1 ♀ Shannon), 10 Dec 2001 (3 ♀ Shannon), 11 Dec 2001 (4 ♀ Shannon), 12 Dec 2001 (5 ♀ Shannon), 13 Dec 2001 (1 ♀ Shannon), 14 Dec 2001 (2 ♀ Shannon), 17 Feb 2002 (1 ♀ Shannon), 18 Feb 2002 (1 ♀ Shannon), 19 Feb 2002 (2 ♀ Shannon), 21 Feb 2002 (2 ♀ Shannon), 23 Feb 02 (1 ♀ Shannon), 24 Feb 2002 (1 ♀ Shannon), 25 Feb 2002 (3 ♀ Shannon), 20 de Noviembre, Calakmul, 22 Mar 2001 (1 ♀ Shannon), Dzibalche, Calkini 06 Jul 2001 (1 ♀ human bait), La Libertad, Escárcega, 01 Nov 2001 (8 ♀, 5 ♂ Shannon), 02 Nov 2001 (7 ♀, 1 ♂ Shannon), 03 Nov 2001 (7 ♀ Shannon, 2 ♀, 1 ♂ CDC), 04 Nov 2001 (2 ♀, 1 ♂ Shannon).

This is the first report of *Lutzomyia (Dampfomyia) permira* for the counties of Calkini and Calakmul. This species had previously been reported in the county of Escárcega by Ramírez-Fraire (1992), Navarro-Correa (1995) and Rebollar-Téllez et al. (1996a). According to Ibáñez-Bernal (2000) the actual distribution of *L. shannoni* may be much greater than that which is known at present. Female *L. shannoni* are antropophilic and may act as secondary vector of *Le. mexicana* in certain areas.

Lutzomyia (Psathyromyia) undulata **(Fairchild and Hertig, 1953)**

Material Examined: 4 ♀. Campeche, Dos Naciones, Calakmul, 28 Mar 2002 (3 ♀ Shannon), La Guadalupe, Calakmul, 21 Feb 2002 (1 ♀ Shannon).

This is the first report *L. undulata* for the county of Calakmul. *L. undulata* had been reported in the county of Escárcega by Navarro-Correa (1995), although to the best of our knowledge there are no specimens available.

Lutzomyia carpenteri **(Fairchild and Hertig, 1959)**

Material Examined: 54 ♀, 31 ♂. Campeche, Dos Naciones, Calakmul, 17 Oct 2001 (4 ♀ CDC), 18 Oct 2001 (2 ♀, 3 ♂ CDC), 22 Nov 2001 (1 ♀ CDC), 24 Nov 2001 (1 ♀ CDC), 18 Jan 2002 (11 ♀ 10 ♂ CDC), 19 Jan 2002 (21 ♀, 5 ♂ CDC), 20 Jan 2002 (9 ♀, 7 ♂ CDC), 21 Jan 2002 (4 ♀, 6 ♂ CDC), 29 Mar 2002 (1 ♀ Shannon).

According to Ibañez-Bernal (2000) *L. carpenteri* is at present known to occur in the states of Campeche, and Quintana Roo, but he does not quote the records of Ramírez-Fraire (1992), Navarro-Correa (1995) and Rebollar-Téllez et al. (1996a) from Escárcega.

Lutzomyia (Nyssomyia) olmeca olmeca **(Vargas and Diáz-Nájera, 1959)**

Material Examined: 358 ♀, 16 ♂. Campeche, Dos Naciones, Calakmul, 17 Oct 2001 (4 ♀ Shannon), 18 Oct 2001 (8 ♀ Shannon, 3 ♀ CDC), 21 Nov 2001 (23 ♀ Shannon, 1 ♀ CDC), 22 Nov 2001 (11 ♀, Shannon, 13 ♀ CDC), 23 Nov 2001 (9 ♀ Shannon, 10 ♀ CDC), 24 Nov 2001 (17 ♀ Shannon, 4 ♀, 1 ♂ CDC), 18 Jan 2002 (5 ♀ Shannon), 19 Jan 2002 (1 ♀ Shannon), 20 Jan 2002 (6 ♀ Shannon, 2 ♀ CDC), 21 Jan 2002 (7 ♀ Shannon, 1 ♀ CDC), 23 Jan 2002 (3 ♀ Shannon), 24 Jan 2002 (7 ♀ Shannon), 25 Jan 2002 (6 ♀ Shannon), 26 Jan 2002 (6 ♀ Shannon), 25 Mar 2002 (3 ♀ Shannon), 26 Mar 2002 (1 ♀ Shannon), 27 Mar 2002 (4 ♀ Shannon), 28 Mar 2002 (4 ♀ Shannon), 29 Mar 2002 (1 ♀ Shannon). La Guadalupe, Calakmul, 21 Oct 2001 (4 ♀ Shannon), 22 Oct 2001 (1 ♀ CDC), 06 Dec 2001 (4 ♀ Shannon, 2 ♀, 2 ♂ CDC), 07 Dec 2001 (6 ♀ Shannon), 08 Dec 2001 (4 ♀ Shannon), 09 Dec 2001 (4 ♀ Shannon), 11 Dec 2001 (6 ♀ Shannon), 12 Dec 2001 (1 ♀ Shannon), 13 Dec 2001 (5 ♀ Shannon), 14 Dec 2001 (5 ♀ Shannon), 17 Feb 2002 (3 ♀ Shannon), 18 Feb 2002 (3 ♀ Shannon), 19 Feb 2002 (8 ♀ Shannon), 20 Feb 2002 (5 ♀ Shannon), 21 Feb 2002 (7 ♀ Shannon), 22 Feb 2002 (4 ♀ Shannon), 23 Feb 2002 (1 ♀ Shannon), 25 Feb 2002 (10 ♀, 1 ♂ Shannon). 20 de Noviembre, Calakmul, 22 Mar 2002 (6 ♀, 12 ♂ Shannon). Dzibalche, Calkini 06 Jul 2001 (1 ♀

human bait). La Libertad, Escárcega, 01 Nov 2001 (19 ♀ Shannon), 02 Nov 2001 (42 ♀ Shannon), 03 Nov 2001 (9 ♀ Shannon, 10 ♀ CDC), 04 Nov 2001 (28 ♀ Shannon).

In this paper, we report for the first time *L. olmeca olmeca* for the counties of Calkini and Calakmul. *Lutzomyia (Nyssomyia) olmeca olmeca* is currently the proven vector of *L. mexicana* in the Yucatán Peninsula, México (Biagi et al., 1965). In Ibáñez-Bernal (2000), *L. olmeca olmeca* is listed for the Mexican states of Chiapas, Oaxaca, Quintana Roo, Veracruz, and Tabasco. However, in Ibañez-Bernal (2000b) *L. olmeca olmeca* is listed also for the state of Campeche. In addition, *L. olmeca olmeca* had been reported in the county of Escárcega, Campeche by Ramírez-Fraire (1992), Navarro-Correa (1995) and Rebollar-Téllez et al. (1996a).

Lutzomyia (Nyssomyia) ylephiletor (Fairlchild and Hertig, 1952)

Material Examined: 25 ♀, 1 ♂. Campeche, Dos Naciones, Calakmul, 26 Mar 2002 (14 ♀, 1 ♂ Shannon), 27 Mar 2002 (4 ♀ Shannon), 28 Mar 2002 (7 ♀ Shannon).

This is the first report of *L. ylephiletor* for the state of Campeche. This species is also known in the states of Chiapas and Tabasco (Ibáñez-Bernal, 2002). Female *L. ylephiletor* have been associated with transmission of *Le. braziliensis* in the neighboring country of Guatemala (Porter et al., 1987; Rowton, et al., 1991).

Lutzomyia (Psychodopygus) panamensis (Shannon, 1926)

Material Examined: 402 ♀, 103 ♂. Campeche, Dos Naciones, Calakmul, 17 Oct 2001 (21 ♀, 2 ♂, Shannon, 2 ♀, 1 ♂ CDC), 18 Oct 2001 (25 ♀, 13 ♂ Shannon, 12 ♀, 13 ♂ CDC), 21 Nov 2001 (101 ♀, 1 ♂ Shannon, 1 ♀, 1 ♂ CDC), 22 Nov 2001 (17 ♀, 6 ♂ Shannon, 5 ♀, 4 ♂ CDC), 23 Nov 2001 (53 ♀, 16 ♂ Shannon, 2 ♀, 10 ♂ CDC), 24 Nov 2001 (6 ♀, 4 ♂ Shannon), 18 Jan 2002 (4 ♀, 3 ♂ Shannon, 1 ♀ CDC), 19 Jan 2002 (6 ♀, 7 ♂ Shannon, 1 ♀ CDC), 20 Jan 2002 (12 ♀, 2 ♂ Shannon), 21 Jan 2002 (10 ♀, 4 ♂ Shannon, 1 ♀ CDC), 22 Jan 2002 (5 ♀, 1 ♂ Shannon), 23 Jan 2002 (4 ♀ Shannon), 24 Jan 2002 (1 ♀ Shannon), 25 Jan 2002 (1 ♀ Shannon), 26 Jan 2002 (16 ♀, 1 ♀ Shannon), 25 Mar 2002 (1 ♀ Shannon), 26 Mar 2002 (6 ♀, 1 ♂ Shannon), 27 Mar 2002 (4 ♀ Shannon), 28 Mar 2002 (3 ♀, 1 ♂ Shannon), 29 Mar 2002 (3 ♀ Shannon), 30 Mar 02 (1 ♀ Shannon), La Guadalupe, Calakmul, 22 Oct 2001 (23 ♀, 5 ♂ Shannon), 6 Dec 2001 (2 ♀ Shannon, 1 ♂ CDC), 7 Dec 2001 (6 ♀ Shannon), 8 Dec 2001 (6 ♀ Shannon), 9 Dec 2001 (2 ♀ Shannon), 10 Dec 2001 (3 ♀ Shannon), 11 Dec 2001 (2 ♀ Shannon), 12 Dec 2001 (4 ♀ Shannon), 13 Dec 2001 (3 ♀ Shannon), 14 Dec 2001 (1 ♀ Shannon), 19 Feb 2002 (1 ♀ Shannon), 21 Feb 2002 (1 ♀ Shannon), 20 de Noviembre, Calakmul, 22 Mar 2001 (1 ♀, 1 ♂ Shannon), La Libertad, Escárcega, 01 Nov 2001 (1 ♀, 1 ♂ Shannon, 1 ♂ CDC), 02 Nov 2001 (2 ♂ Shannon, 1 ♂ CDC).

This is the first record of *L. panamensis* in the county of Calakmul. This species had also been reported in the county of Escárcega and in the state of Quintana Roo (Ibáñez-Bernal, 2000b). Female *L. panamensis* have been found naturally infected with flagellates (probably *L. braziliensis*) in Tikal, Guatemala (Rowton et al., 1991).

Lutzomyia trinidadensis (Newstead, 1922)

Material Examined: 31 ♀, 5 ♂. Campeche, Dos Naciones, Calakmul, 18 Oct 2001, (1 ♀ Shannon, 3 ♀, 1 ♂ CDC), 21 Nov 2001 (4 ♀ Shannon), 23 Nov 2001 (9 ♀ CDC), 24 Nov 2001 (1 ♀ Shannon, 1 ♀ CDC), 18 Jan 2002 (1 ♀, 2 ♂ CDC), 19 Jan 2002 (3 ♀ CDC), 20 Jan 2002 (1 ♀ CDC), 21 Jan 2002 (6 ♀, 1 ♂ CDC), 26 Mar 2002 (1 ♀ Shannon), 28 Mar 2002 (1 ♂ Shannon).

In this study *L. trinidadensis* is reported for the first time to the county of Calakmul. *L. trinidadensis* had previously been found in the county of Escárcega by Navarro-Correa (1992 This species is also known in the states of Chiapas and Yucatán (Ibañez-Bernal, 2000b), Guerrero and Morelos (Ortega-Gutierrez, 1966).

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BOOK REVIEW

WHEN BUGS WERE BIG, PLANTS WERE STRANGE, AND TETRAPODS STALKED THE EARTH: A Cartoon Prehistory of Life before Dinosaurs. Hannah Bonner. 2003. National Geographic. 48 pp. ISBN 0-7922-6326-X. US$16.95.

Although 94 percent of the history of life occurred before the Age of Dinosaurs, few picture books for kids tackle any portion of that unfamiliar span of earth's long story. Bonner's genuinely funny "cartoon prehistory" is the perfect format for sharing the adventure. A timeline makes clear just what's meant by "before the dinosaurs"—the book opens in the Carboniferous Period (about 355 million years ago) and ends at the close of the Permian (250 million years ago).

Maps for each period show the supercontinents Gondwana and Pangaea, with today's world for comparison. In comical sidebars, TV weather reptiles announce climate change. Several panels illustrate how lush Carboniferous vegetation became the coal burned today in power plants. That the electricity in some of our homes "is really solar energy captured by plants hundreds of million of years ago," is information to astound young *and* old readers.

Bonner's detailed drawings set the Carboniferous scene of lycopods, horsetails, and ferns as the arthropods make their appearance: scorpions, land snails, early daddy longlegs, mayflies, springtails, millipedes, spider ancestors, and *palaeodictyopterans*. Immense *Arthropleura* provide a starting point for conjecture on why "XXL model" arthropods became so big. Alongside an amusing depiction of modern and Carboniferous "attitudes" to cockroaches, she explains possible reasons for roach evolutionary success.

As Bonner shows rather than tells where possible, her introduction to amniotes (animals that lay eggs on dry land) includes a cartoon answer to the old question—which came first, the chicken or the egg? Kids will get the picture. Comic want ads for bug-eaters and restaurant ads displaying tasty bug dishes allow young readers to quickly grasp one reason why tetrapods moved onto land, though insects aren't featured in detail in the Permian half of the book. The text is straightforward when it needs to be; excellent spreads compare the precursors of dinosaurs to today's turtles, birds, and reptiles, and explore the mammal-like reptiles. All of course affected by the ultimate setback on the last pages—the Permian Extinction ending the Paleozoic Era.

An illustrated timeline, chart of vertebrate evolution, pronouncing glossary, and index complete this playful romp through 100 million years. Guaranteed to be enjoyed by all ages, but especially 6-12.

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Jorge A. Santiago-Blay, Editor *Entomological News*

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1	Jan. & Feb. 2004	1-60	November 12, 2004
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Jorge A. Santiago-Blay[1] and Sarah E. Pivo[2]

We are profoundly grateful to colleagues from around the world who have generously donated their time and energy to review numerous articles. In addition to those reviewers who helped with contributions published on volume 115, we have added the names of a few colleagues overlooked in the Acknowledgements of volume 114, with the parenthetical notation "volume 114." The names of all reviewers are arranged alphabetically by last name; affiliations, or addresses, follow.

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and
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SOCIETY MEETING OF NOVEMBER 10, 2004

Biomonitoring Pinelands Rivers using Snag-dwelling Insects

Dr. William J. Cromartie
Richard Stockton College
Pomona, New Jersey, U.S.A.

Dr. Cromartie discussed his biological monitoring research program to improve methods for ascertaining water quality using aquatic macroinvertebrates, mostly insects. Faculty and students of the Environmental Studies Program (ENVL) at Richard Stockton College (Pomona, New Jersey) are working with the New Jersey Department of Environmental Protection, the Pinelands Commission, and the Great Egg Harbor Watershed Association to develop better invertebrate bioassays for the acidic, blackwater, sandy-bottomed streams in the New Jersey Pinelands.

In spring 2002, the ENVL team devised a conceptual model of water quality in the Great Egg Harbor River based on chemical and biological data as well as percent developed land in each sub-watershed. In summer 2002, they collected macroinvertebrates from diverse substrates and measured pH as well as specific conductance. Macroinvertebrates were identified in the laboratory, and multivariate analysis was performed on the data. This preliminary research showed that percent of developed land seemed to be the best predictor of water quality and biological impairment. Based on this preliminary analysis, the ENVL team focused on woody debris, which is known to be a key habitat for blackwater macroinvertebrates. In 2003 and 2004, they collected chemical data and additional replicated samples of 1-2 meters of woody debris (5-35 mm diameter). There was a clear relationship among stream chemistry, land use, and the fauna on woody debris, indicating that this assemblage is a reasonable target for monitoring. This monitoring method clearly indicates the sites with fairly pristine conditions and those that are very disturbed, but it has difficulty accurately discriminating among sites showing less severe and more diverse types of impairment. More information on this research can be found on the web at: http://www.stockton.edu/~cromartw/GEHR/GEHR%20homepage.htm.

About 30 members and visitors attended the meeting.

Jon Gelhaus, Corresponding Sec. of the American Entomological Society (2004)
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Mailed on March 15, 2005